Effect of Mobile Money on Economic Growth within Select East African Community Countries

By

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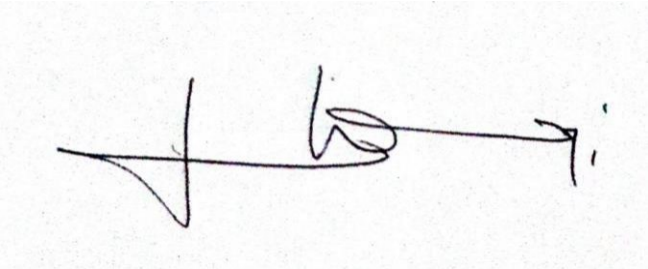
DECLARATION

This research is my original work, and has not been submitted to any other university for the purpose of examination or award of degree. I further declare that any related works referred to in this research have been properly cited, and consistently referenced.



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This research report has been submitted for grading with my approval as the University supervisor.

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DEDICATION

I dedicate this research to my family for their words of encouragement, you have taught me to believe in myself, determined and always persevere. Thank you for your love and support along this journey I have taken. I love you always and forever.

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ABSTRACT

This paper analyzes how economic growth within select countries in the East African Community (EAC) is affected by mobile money. The analysis leverages on annual panel data from Uganda, Tanzania, and Kenya from 2009 to 2021. Static panel regression techniques- random effects, fixed effects, and the pooled ordinary least squares- is employed. Economic growth significantly rises in modest inflation rate, and the real rate of interest, but significantly declines in the value of mobile money transactions. To reverse the negative effect of mobile money, it is crucial for governments within EAC to invest in human capital accumulation. To further revitalize growth, price stability must be maintained within 2-7% inflation rate whereas real rate of interest has to be maintained within the confines of the Taylor rule.

CHAPTER ONE: INTRODUCTION

1.1 Background to the Study

Mobile money is a form of cashless transactions (Ndung'u, 2019). In order to understand how economic growth is affected by mobile money, it is imperative to contextualize cashless transactions. There have been developments in financial innovations both globally, and within the East African Community (EAC) aimed at enhancing financial inclusion. These developments introduced cashless transactions within the financial ecosystem (Fabregas & Yokossi, 2022). Various forms of cashless transactions were incepted at different periods. Earlier developments included the introduction of debit and credit cards that targeted owners of accounts in banks (Cheng et al, 2021). These excluded individuals and firms without bank accounts from leveraging on cashless transactions. In order to financially include those excluded, financial innovations further introduced mobile money.

Global scholarship intertwines cashless transactions with economic growth in two respects. One, as economies grow, financial needs rise beyond what can be met using cash (Ndung'u, 2019). This in turn incentivizes financial actors to innovate. Financial innovations inevitably introduce cashless transactions alongside new financial products. The basis of financial innovations often involves raising convenience, e.g., reducing unnecessary travel to transact, and efficiency within the financial ecosystem (Islam et al, 2018). As financial innovations increase, cashless transactions rise whereas the demand for cash balances declines. This implies that cashless transactions substitute transacting in cash. Tay et al (2022) reveal cashless transactions rising during coronavirus (COVID)-19 pandemic. This was particularly true for mobile money. At the same time, cash transactions declined due to reductions in physical contact (Tay et al, 2022).

Two, cashless transactions raise financial inclusion, thereby catapulting economic growth (Islam et al, 2018). This arises from cashless transactions raising access to financial products, especially among unbanked groups (Kandpal & Mehrotra, 2019). Financial products such as cashless credit enable firms to overcome liquidity challenges (Ouyang, 2021). Furthermore, cashless transactions raise the efficiency of payment systems, thereby fueling economic activities (Ndung'u, 2019a). Whereas debit and credit cards were introduced into the EAC from outside, mobile money originated from within the region. Existing mobile money platforms within EAC include M-Pesa

in Kenya and Tanzania (Misati et al, 2022) and Pesa Choice in Uganda and Tanzania (Khayesi, 2022). The expansion of mobile money within EAC has reduced financial exclusion, and offered convenient means of transacting financially among small enterprises and households (Abdulhamid, 2020; Misati et al, 2022). Besides, mobile money transactions have facilitated credit access (Khusoko, 2022), and thereby fostered retail business and commerce (Njoroge, 2021).

Theoretically, the nexus between finance and economic growth develops from the indirect role of finance in compensating owners of factors of production while enhancing efficiency of economic systems (Cheng et al, 2021; Chu, 2020). In perfectly competitive markets, for example, labor attracts a real wage equivalent to its marginal product. Real wages are, nevertheless, monetized leading effectively to nominal wages which are financial constructs. Broadly considered, finance (whether digital or cash) is an enabler of economic growth (Sobiech, 2019; Nguyen et al, 2019). At the firm level, credit inaccessibility and financial challenges constrain productivity (Tay et al, 2022). That is, a financially-depraved firm faces hurdles in meeting its financial obligations such as servicing employee wages, debt repayment, and making purchases which subsequently affect the level of output within the firm.

1.1.1 Mobile Money and Economic Growth within Select-EAC Countries

Financial ecosystem within EAC, as elsewhere, comprises of cash and cashless transactions. Cashless transactions within the region originate from financial innovations. These innovations include the adoption of debit and credit cards in the banking sector, and the introduction of mobile money (Khayesi, 2022). Other cashless transactions that are common within EAC are point-of-sale (POS) terminals/ machines, cheques, electronic funds transfer (EFT), and real-time gross settlement (RTGS) (Ndung'u, 2019).

This subsection focuses on the trends in mobile money and economic growth in select-EAC countries. These countries are Uganda, Tanzania, and Kenya. Data on mobile money transactions for each country is retrieved from the respective central bank. That is, the Bank of Uganda, Bank of Tanzania, and the Central Bank of Kenya. Data on the value of mobile money transactions is in local currency units. This data is converted into the United States (US) dollars for easy cross-country comparisons. Data on real per capita gross domestic product (GDP) is retrieved from the World Development Indicators.

Figure 1 shows the evolution of the value of mobile money transactions, and real per capita GDP in Uganda, Tanzania, and Kenya.

The value of mobile money transactions has generally risen over the years. There are, however, observed differences in evolution of mobile money transactions among the countries. In 2009, the value of mobile money transactions in Uganda almost equaled that in Tanzania. This value was extremely low relative to Kenya. From 2010 to 2014, the value of mobile money transactions grew rapidly relative to both Uganda, and Kenya. This reduced the gap between the value of mobile money transactions in Kenya and Tanzania but tremendously widened the gap between Tanzania and Uganda's value of mobile money transactions. The latter is attributed to very sluggish growth in the value of mobile money transactions in Uganda. In 2015, Tanzania's value of mobile money transactions declined, but recovered in 2016. This was occasioned by rapid growth in the value of mobile money transactions that nearly fully closed the gap between Tanzania and Kenya in 2019. Nevertheless, the difference in the value of mobile money transactions in Kenya and Tanzania in 2021 was larger than that recorded in 2009.

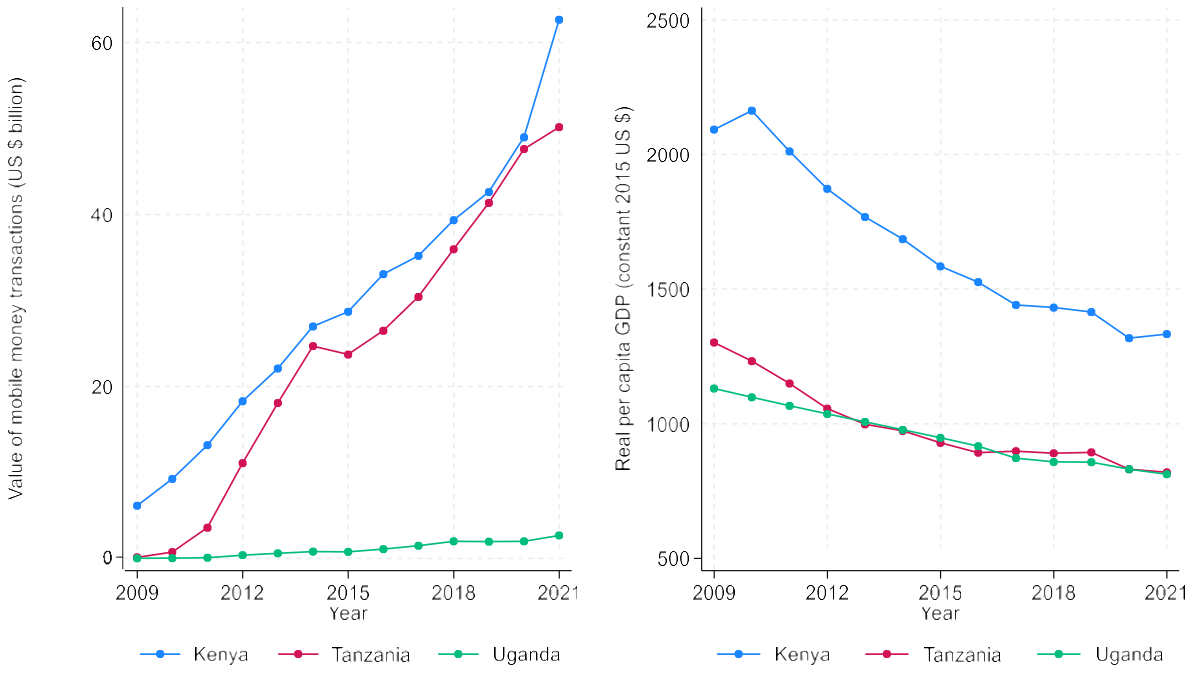

Figure 1: Historical patterns of mobile money and economic growth in select-EAC countries

There has been a general decline in real per capita GDP within the region from 2010 to 2021. Even then, Kenya's real per capita GDP remains high relative to Uganda and Tanzania. Tanzania's real per capita GDP declined faster compared to Uganda in the 2009-2013 period. This culminated into convergence of real per capita GDP between the two economies in 2013. This was followed by minor divergence in 2015 although the difference in per capita real GDP between Uganda and Tanzania has been very small.

1.2 Statement of the Problem

Historical data from select- EAC countries- Uganda, Tanzania, and Kenya- reveals a general increase in the value of mobile money transactions. This has been the case from 2007 when mobile money was incepted in Kenya, and 2009 when it was introduced in Tanzania, and Uganda (Khayesi, 2022). This reflects increase in financial innovations that led to the development of mobile money. Mobile money, just like other cashless transactions, is argued to raise the efficiency of payment systems (Islam et al, 2018; Misati et al, 2022). Efficient payment systems have been shown to raise economic growth (Ndung'u, 2019a; Cheng et al, 2021).

This suggests that economic growth rises in mobile money transactions. However, historical data suggests that real per capita GDP has maintained a downward trajectory from 2010 to 2021. This decline in real per capita GDP do not reflect general increase in the value of mobile money transactions. Besides, real per capita GDP in Uganda and Tanzania have almost converged yet the difference in the value of mobile money transactions within these two economies has tremendously widened. Whereas the difference in real per capita GDP in Tanzania and Kenya has not narrowed, the difference in the value of mobile money transactions in the two countries significantly narrowed. This then necessitated an analysis of the extent to which economic growth within EAC is affected by mobile money.

1.3 Research Questions

This research sought answers to the following questions:

i. To what extent does mobile money uptake affect growth of GDP in the EAC?
ii. To what extent do other factors, e.g., size of the labor force, affect growth of GDP in the EAC?

1.4 Objectives of the Research

This research's main purpose was to analyze how mobile money affects economic growth in the EAC. This goal's realization was anchored on the following particular objectives:

i. To analyze how GDP growth in Kenya, Uganda, and Tanzania is affected by mobile money uptake.
ii. To analyze how GDP growth is affected by other factors, e.g., size of the labor force in Kenya, Uganda, and Tanzania.

1.5 Significance of the Research

In addition to contributing to the existing body of knowledge on mobile money and economic growth, this research offers insights to policymakers on promoting economic resilience within the EAC.

1.6 Organization of the Research

The current section presented an introduction and captured this research's background, stated the problem, and identified key objectives. The remainder of this paper reviews and discusses the literature in the next chapter which is then followed up a presentation of the approach and methodology that was employed. Lastly, results are presented alongside a discussion before wrapping up with a presentation of the summary, conclusions drawn, and suggestions for policy action.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

Relevant literature is reviewed in this chapter from theoretical perspectives and evidence documented in previous researches. In reviewing the theories, attention is shifted away from stand-alone theories such as Swan (1956), Solow (1956), and Romer (1990) to the factors underlying those theories. This is informed by the understanding that empirical literature considered in this study missed the opportunity to test the validity/ applicability of stand-alone theories. Lastly, an overview of the literature is presented; the overview identifies the gap in the literature.

2.1 Theory

Understanding technological advancement and innovations is vital towards analyzing the nexus between economic growth and mobile money for three reasons. Firstly, the origin and evolution of mobile money, and cashless transactions in general, globally and in Kenya is a development anchored on technological advancements and innovation (Ahmad et al, 2020; Iqbaal et al, 2020). Following Romer (1990), these advancements are indicative of better ideas replacing existing ones. Digital credit such as M-shwari loan in Kenya enable households to access loan facilities at relatively low administrative costs (Suri et al, 2021). Secondly, the continued utilization of mobile money has ramifications on the accumulation and distribution of financial resources which are arguably necessary facilitators of economic activities, and subsequent economic growth. That is, mobile money can be thought of as augmenting production or entering the production function multiplicatively in Solow (1956) and Swan (1956). Thirdly, technology and its evolution affect the pace of growth of output in an economy as well as the extent to which finance mobilization takes place (Romer, 1990; Scholtens & Wensveen 2003). The idea behind financial mobilization is that mobile money, and other forms of cashless transactions, facilitate the process of saving as well as borrowing (Scholtens & Wensveen 2003; Suri et al, 2021).

Mobile money, which is an outcome of financial innovations, raises economic growth by raising financial accessibility among unbanked communities as well as through job creation (Ahmad et al, 2020; Talom & Tengeh, 2019; Mawejje et al, 2019). By not requiring mobile money users to have a bank account, both the banked and unbanked individuals can leverage on mobile money services in channeling remittances, paying for purchases, receiving payments, saving money, andin further mobilization of financial resources (Ahmad et al, 2020; Iqbaal et al, 2020; Pelletier et al,2020). Moreover, the expansion of mobile money has meant that employment opportunities emerge since the technology-human interface requires people working as agents in retail outlets (Pelletier et al, 2020; Fabregas & Yokossi, 2022). This in turn reduces unemployment. Without capital constraints, a decline in unemployment implies an increase in output. Besides, financial innovations in developing countries tend to lower the cost of transaction which in turn increases economic exchanges (Pelletier et al, 2020).

Although financial innovations reduce the demand for cash balances, Mawejje et al (2019) hypothesized that mobile money accumulation raises money supply. As money supply rises, inflationary pressures set in, holding real output and velocity of money constant (Mawejje et al, 2019). There is, however, no reason for money supply to rise when mobile money accumulates. Ahmad et al (2020) indicated that mobile money is created when hard cash is converted into electronic money. Suggestively, depositing Kenya Shillings 152 in a person's mobile money account does not change the amount of money in circulation. Thus, inflationary pressures cannot be entirely pegged on accumulation of mobile money.

In some instances, consumption and production is shaped by credit availability. Mawejje et al (2019), Suri et al (2021), and Pelletier et al (2020) argued that mobile money contributes to the pool of loanable funds which can be utilized by individuals, households, and firms through the uptake of mobile loans to smooth consumption or as investible capital. Besides, credit cards can be utilized in consumption smoothing (Hundtofte et al, 2019; Prabheesh & Rahman, 2019). According to Hundtoften et al (2019), when negative shocks to income are transitory (such as due to temporary unemployment), affected households and individuals tend to borrow as a means of stabilizing household consumption. However, credit uptake declines when negative shocks to income are permanent (Hundtoften et al, 2019). Temporary unemployment brings with it the prospects of future employability, and hence future employment serves as a collateral for credit.

2.2. Empirical Literature

2.2.1 Mobile Telephony and Mobile Money Uptake

In 33 member countries of the Organization for Economic Cooperation and Development (OECD) and 41 Sub-Saharan African (SSA) countries, the system generalized method of moments (GMM) estimates in Myovella et al (2020) suggested that mobile phone subscriptions raised growth of per capita incomes for the 2006-2016 period. According to Myovella et al (2020), mobile phone subscriptions facilitated financial digitalization which in turn promoted economic growth. Myovella et al (2020), however, presumed that owning a mobile phone automatically led to the utilization of digital financial resources. This may not always be the case in practice. A plausible suggestion would have been for Myovella et al (2020) to use mobile money uptake instead of mobile phone subscriptions as an indicator of financial digitalization.

For the 2000-2014 period in 43 lower middle-income and low-income countries, the system GMM estimates in Das et al (2018) revealed that growth of per capita incomes rose significantly in cellular phone subscriptions although financial development insignificantly affected growth of per capita incomes. Das et al (2018), argued that failure of financial development to significantly affect growth of per capita incomes arose from depletion of human capital. As a result, these economies could not take advantage of information and computer technology (ICT)-finance. This assertion may, however, fail to be true considering that the 2000-2014 period evidenced significant financial innovations such as mobile money that arose from human capital development.

For the 1980-2015 period in 149 countries, the random effects, fixed effects, two-stages least squares (2SLS), pooled ordinary least squares (pooled OLS), and OLS estimates in Majeed & Ayub (2018) suggested that mobile phone subscriptions significantly raised economic growth. According to Majeed & Ayub (2018), mobile phone technology leveraged the mobilization of mobile money which was vital for production. It was; however, unclear how mobile finance was mobilized since Majeed & Ayub (2018) focused on ICT infrastructure instead of mobile money.

For the 2006-2015 period in 40 SSA countries, the two-step system GMM estimates in Haftu (2019) suggested that mobile phone subscriptions insignificantly raised per capita income. Haftu (2019) argued that low internet penetration within the region held back SSA from leveraging developments in mobile telephony for enhanced economic growth. However, it is doubtful that developments in mobile telephony reflect financial innovations. A suggestion is that Haftu (2019) could have controlled for financial innovations given mobile telephony.

For the 2000-2017 period in the European Union (EU), fixed effects estimates in Toader et al (2018) suggested that GDP rose significantly in mobile cellular subscriptions whereas financial development insignificantly affected GDP. Toader et al (2018) provided no explanation for the findings. It is possible that developments in mobile phone telephony are a catalyst for financial development. Perhaps, Toader et al (2018) could have interacted mobile cellular subscriptions with financial development or controlled for either.

For the 2005-2015 period, the system GMM, fixed effects, random effects, and pooled OLS estimates in Adeleye & Eboagu (2019) all suggested that mobile cellular subscriptions (measured in logarithm) significantly raised aggregate output. Adeleye & Eboagu (2019) argued that mobile cellular subscriptions had the potential to leapfrog growth of economies, with the greatest magnitude being in the North African region. Even then Adeleye & Eboagu (2019) did not elaborate on the mechanism through which mobile cellular subscriptions leapfrogged economic growth. It could be assumed that such a mechanism either involved sharing of information that is relevant to enhanced productivity or that such subscriptions availed the impetus for the mobilization of financial resources.

For the 2007-2016 in SSA and the Middle East and North Africa (MENA) regions, the GMM estimates in Bahrini & Qaffas (2019) indicated that although per capita incomes significantly rose in mobile cellular subscriptions for the full sample and for the SSA sub-sample, per capita incomes were insignificantly affected by mobile cellular subscriptions in the MENA region. According to Bahrini & Qaffas (2019), income differences in the MENA as well as varied degrees of penetration of ICT accounted for the non-significant finding. The non-significant findings in MENA could possibly have arisen from the empirical model chosen. For instance, the coefficient of previous period's per capita GDP was negative and non-significant statistically. This violates the assumption that per capita GDP is persistent; that is, the coefficient must be positive.

Utilizing the Consumer Pyramids Household Survey in 500 Indian districts over the 2014-2022 period, the difference-in-difference (DiD) estimates in Dubey & Purnanandam (2023) revealed that households' business incomes significantly rose in the intensity of cashless transactions in the aftermath of the introduction of a unified payment interface. Similar results were established in the post-COVID-19 pandemic period with the latter's magnitude being greater than the former. intensity of cashless transactions was measured by digital payments made at the household level using a mobile phone. Cashless transactions using the mobile phone improved the financial accessibility among borrowers who in turn invested borrowed finances in their business establishments (Dubey & Purnanandam, 2023).

Employing analysis of covariance (ANCOVA) and instrumental variable (IV) estimation in Bangladesh, Lee et al (2021) indicated that mobile banking enhanced both household consumption in the rural areas and economic growth. According to Lee et al (2021), mobile banking enabled urban residents to channel money to the rural residents who either consumed immediately or saved as mobile money. In Kenya, the dynamic differences-in-differences (DiD) estimates in Fabregas & Yokossi (2022) showed that economic growth significantly rose in mobile money. Fabregas & Yokossi (2022) used night light density as an indicator for economic activities while MPesa agents' accessibility proxied mobile money. Fabregas & Yokossi (2022) argued that economic activities were complemented by mobile money. Although Fabregas & Yokossi (2022) controlled for sub-location fixed effects, the study ignored the possibility of night lights being an outcome of deliberate investment through public-private partnerships (PPP). Such initiatives include the development of efficient street lighting systems (Ndirangu & Elias, 2020). For instance, the World Bank initiated the Kenya Solar Lighting Program in 2018 (World Bank, 2018).

In 21 SSA countries, the difference-in-difference estimates in Nan (2019) suggested that per capita income growth was significantly higher in countries that had successfully deployed mobile money by the year 2015 compared to those that had not. Similar results were observed in the first three years following the successful deployment. Nan (2019) argued that mobile money increased efficiency while simultaneously enhancing 'affordance' which meant that households could tap into financial resources easily for purposes of raising production and consumption. However, the uptake of mobile money in the post-deployment period may have been driven by an increasing number of households being aware of this innovation Nan (2019). Perhaps, Nan (2019) could have included a variable on knowledge of the potential benefits of mobile money. Besides, mobile money deployment need not necessarily imply its effective usage (Ahmad et al, 2020).

In Kenya, among individuals that opened M-shwari accounts in the first quarter of 2015, the fuzzy regression discontinuity (RD) estimates in Suri et al (2021) revealed that households' consumption pattern steadied during negative income shock episodes among those that took up M-shwari loans. Despite M-shwari uptake at the time being only 34%, it strengthened household shock resilience among the vulnerable and the poor, enabling them to borrow for investment in education and healthcare (Suri et al, 2021); these two are vital components of human capital accumulation which

fosters economic growth. Even then, Suri et al (2021) indicated that M-shwari loan (uptake and size) insignificantly affected household's saving behavior such that households did not borrow in order to save. Nevertheless, it was unclear whether households that borrowed from M-shwari had depleted their savings.

In a related RD, Bharadwaj & Suri (2020) revealed significant increments in loan uptake as well as loan size during and in the post 'Stawisha na M-shwari' promotional campaign although the campaign insignificantly affected the inclination to save and the amount saved. According to Bharadwaj & Suri (2020), promotional campaigns incentivized people to take up M-shwari loans. The anticipated rewards (prizes of up to Kenya Shilling 5million) were, however, noisy in the individuals' saving behavior. Nevertheless, it is possible that such campaigns failed to significantly raise savings due to individuals' failure to understand the reasons behind saving.

In Siaya and Bomet counties, the intent-to-treat estimates in Banerjee et al (2020) indicated that MPesa cash transfer recipients worked more and were out of the house more often during COVID-19 pandemic compared to non-recipient counterparts. In addition, cash transfers significantly raised income source diversification such that some recipients established non-agricultural enterprises with the enterprises withstanding negative shocks. However, it is possible that some enterprises would ultimately be established or shut down with/ without the MPesa cash transfer. Besides targeted programs within the context of randomized control trials yield kinky/ skewed development (Pritchett, 2015).

Nan (2019) documented that per capita income growth insignificantly rose in the number of mobile phones per head when mobile money deployment is considered. In Nigeria, Isamade et al (2022) documented significant GDP increments as the usage of mobile payment apps rose. This was largely attributed to revolutions in technology that enabled individuals to leverage on financial innovations for productive courses. Utilizing enterprise surveys for Uganda, Tanzania, and Kenya, and employing probit regression, Islam et al (2018) indicated that although cellular phone usage did not affect investment in firms, firms that used mobile money in transactions had significantly higher inclination to invest in fixed assets compared to their counterparts that did not. Similarly, firms that used mobile money to either receive customer payments, pay suppliers, or pay

employees were likelier investors in fixed assets compared to counterparts that did not. According to Islam et al (2018) mobile money uptake within the formal sector increased firm's credit worthiness and liquidity while simultaneously reducing transaction costs significantly.

2.2.2 Other Factors

The discussion of relevant literature on mobile money and economic growth focused on the value of mobile money transactions, mobile money usage, and the number of mobile money transactions, alongside the usage of mobile phones that facilitate mobile money. Within the ecosystem of cashless transactions, however, it is not mobile money alone that affects economic growth. Other forms of cashless transactions that have been utilized in the literature include: debit and credit cards (Wong et al, 2020; Aastveit et al, 2020; Fatmasari et al, 2019; Bachas et al, 2021; Liu et al, 2022; Nneamaka, 2020; Prabheesh & Rahman, 2019; Mashabi & Wasiaturrahma, 2021; Eftimovska & Laurent, 2022; Grzelczak & Pastusiak, 2020), e-money and point-of-sale terminal (Wong et al, 2021; Grzelczak & Pastusiak, 2020; Mashabi & Wasiaturrahma, 2021; Isamade et al, 2022), and cheques (Das, 2021; Sreenu, 2020).

Empirically, in explaining economic growth using mobile money and other cashless transactions, various researches have incorporated other variables. These include price level/ inflation (Nan, 2019; Mashabi & Wasiaturrahma, 2021), lagged GDP/ lagged GDP per capita (Nan, 2019), trade openness (Nan, 2019), money supply (Mashabi & Wasiaturrahma, 2021), regulation (Ahmad et al, 2020; Mawejje et al, 2019), and institutional quality (Pelletier et al, 2020). This incorporation was anchored on the realization that no single economic phenomenon (such as economic growth) could be exhaustively explained by a handful of factors.

2.3. Overview of the Literature

The review of literature revealed that theoretical debate revolves around finance as an enabler of economic growth. Thus, transactions (cash or non-cash) are understood on the basis of the channel through which they affect production, saving, investment, and consumption at the household and firm level. Empirically, an agreement was absent on how economic growth is affected by mobile money. It is important to note that in all reviewed studies that used mobile money itself, the effect of mobile money on economic growth was statistically significant and positive. However, in studies that used mobile cellular subscriptions as an indicator for mobile money, the results'

statistical significance and direction of effect differed from one study to another. A major methodological issue in the literature is that some studies used mobile money transactions (measured in currency units) to explain nominal GDP per capita (measured in currency units). Using currency units to explain currency units is problematic, as indicated by Prof. Germano Mwabu. This research, therefore, solved this problem by using real GDP per capita which is a quantity.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

A presentation of the theoretical framework alongside the analytical model is captured here. This is followed by a presentation of the definition and measurement of variables that was utilized in the analytical model. Lastly, a discussion of econometric approaches is made before concluding with the data that was used alongside the sources.

3.2 Theoretical Framework

The theoretical basis of this research is Mankiw (2012). According to Mankiw (2012), how well an economy grows depends on the stability of its financial system. When the financial system is faring badly such as during accumulation of massive credit and delinquent loans by households and firms, economic growth declines. In particular, loan delinquency pushes interest rates up which subsequently increases the cost of credit, and thus renders it difficult for firms and households to access loans. As interest rates rise, the real user cost of capital rises which coerces firms to reduce the stock of capital, and subsequently reduce the level of output. Firms then do notfind it profitable keeping more workers, and; hence, some employees are laid off or lose jobs. Thisraises general unemployment which further leads to reductions in per capita GDP. Besides, creditunavailability renders it difficult for liquidity-depraved firms to finance their day-to-day operationswhereas new liquidity-strapped startups may close down completely (Tay et al, 2022).

Recent studies including Suri et al (2021), Cheng et al (2021), and Chu (2020) indicate that mobile money, just like any other cashless transaction, facilitates financial mobilization while simultaneously enhancing efficiency in production. Besides, mobile money not only allows for greater flexibility in firm-financing but also enable firms to overcome financial constraints in production through enhanced credit accessibility (Tay et al, 2022).

Now, economic growth depends on economic activities carried out, namely; the production of services and goods. In practice, these activities are carried out by human beings who deploy certain equipment and machinery [which can be thought of as capital]. Thus, modelling the nexus between economic growth and cashless transactions cannot be devoid of labor and capital input. Economic growth is, therefore, explained by cashless transactions via the theoretical functional form given by:

$$Y_{i,} = f(T_{i,t}, N_{i,t}, K_{i,t}) \quad (1)$$

Where f(.), t, Y, N, T, and K denote function of, time, economic growth, labor force, mobile money transactions, and capital, respectively, for economy i. Theory predicts that mobile money transactions smooth production and consumption processes (Tay et al, 2022; Suri et al, 2021; Cheng et al, 2021; Chu, 2020), and hence economic growth rises in mobile money transactions (Sobiech, 2019; Nguyen et al, 2019), and; in the absence of capital constraints, an increase in labor force raises economic growth. However, extant literature on economic growth points out that labor force, capital, and mobile money transactions do not exhaustively explain economic growth. For instance, Romer (1990) argues that growth of an economy depends on the pace at which new ideas are generated. Mankiw (2012) indicates places the stability of the financial system at the heart of economic growth in arguing that financial turmoil almost always offsets reductions in economic growth. The Taylor rule, on the other hand, suggests that when the distaste for inflation among Central Bankers is high or the Central Bank considers the cost of fighting inflation as low, the interest rate is raised above the baseline. This effectively tapers aggregate spending and raises unemployment while depressing GDP growth. Thus, other factors incorporated in models of economic growth include crises on the financial market, interest rates, and inflation.

3.3 Empirical Model

Analytically, this research explains economic growth using mobile money transactions, labor force, capital, inflation rate, and real interest rate. The estimable panel regression equation is thus:

$$Y_{i,} = \alpha_0 + +\alpha_1 M_{i,t} + \alpha_2 N_{i,t} + \alpha_3 K_{i,t} + \alpha_4 \pi_{i,t} + \alpha_5 r_{i,t} + \epsilon_{i,t} \quad (2)$$

Where Y is the economic growth for country i at year t. Countries are Uganda, Kenya, and Tanzania.

M is value of mobile money transactions,

K is capital stock,

N is labour force,

R is real rate of interest,

π is inflation rate, and

ε is panel regression error.

Labor force and capital are included in the model because they are part of standard models of economic growth, e.g., Solow (1956) and Swan (1956). Other variables included in growth regressions are: real rate of interest, and inflation rate (Mishkin, 1982; Mundell, 1963; Blanchard et al, 1984; Khan et al, 2005; Kiley, 2015).

3.4 Variable Definition and Measurement

Table 1: Operationalization of the Research		
Variable	Description	Measurement/ proxy
Y	log of real GDP per capita as an indicator of economic growth	Real GDP per capita is computed as annual GDP in 2017 PPP US dollars divided by the total population
M	Mobile money	Log of the value of mobile money transactions in US Dollars
N	Size of the labor force	log of the population aged 15-64 years
K	Capital	log of gross fixed capital formation in 2017 PPP US dollars
I	Inflation rate	Annual average of monthly inflation rates based on the consumer price index, and expressed as a percentage
R	Real interest rate	Real rate of interest, expressed as a percentage

3.5 Econometric Approach

The estimable model is a panel data model. In the financial economics literature, panel data models are estimated using either static techniques (e.g., fixed effects (FE), pooled ordinary least squares (POLS), and random effects (RE) estimators) or dynamic techniques (e.g., system generalized method of moments (system GMM)). This research spans the period from 2009 to 2021, and hence the sample size is small; i.e., 13 time periods. The performance of System GMM is limited by small sample[1] hence necessitating the employment of fixed effects regression with robust standard errors (Van et al, 2021). Robust standard errors correct for heteroscedasticity which is a common problem facing the fixed effects estimator (Van et al, 2021).

Alternatively, both FE and RE could be estimated with the Hausman test being executed thereafter to determine the appropriate model. Suppose A and B are the regression parameters associated with the covariate matrix of explanatory variables under the fixed effects and random effects

[1] When time series units > cross-sectional units, and time periods are fewer than 20, system GMM estimates are inefficient.

models, respectively. Bell et al (2019) reveal that the Hausman test investigates the claim of equality, i.e., H0: A=B. If H0 is not invalidated, then random effects model gives more precise estimates (Bell et al, 2019). However, invalidation of H0 implies that endogeneity is better addressed in a fixed effects model (Bell et al, 2019). An additional advantage with the RE and FE models is that they are easy and simple to estimate and interpret the results. This research will accordingly employ the random effects and the fixed effects estimation with the appropriate technique being informed by the results from the Hausman test. Lastly, panel unit root tests require at least 20 time periods, i.e., T≥20. Since this research covers only 13 time periods, T is small, and hence panel unit root tests are infeasible.

3.6 Data

This research utilizes annual panel data for Kenya, Uganda, and Tanzania from 2009 to 2021. 2009 is the earliest year in which complete annual data on value of mobile money transactions is available for all the three countries. The datasets are retrieved from the Bank of Tanzania, Central Bank of Kenya, and the Bank of Uganda. Links to these datasets are attached in the footnote[2]. Data on real GDP per capita, labor force, gross fixed capital formation, inflation rate, and real interest rate[3] is retrieved from the World Development Indicators' website maintained by the World Bank.

[2] Payment statistics in Tanzania are available on the Bank of Tanzania's website, and are accessible via Bank of Tanzania (bot.go.tz).

Data on mobile money and card transactions in Uganda is accessible on the Bank of Uganda's website, and is accessible via Bank of Uganda | Data and Statistics (bou.or.ug). Data on Uganda's lending rate from 2019 to 2022 is retrieved from annual statistical abstracts.

Data on mobile money transactions and card transactions in Kenya is accessible on the Central Bank of Kenya's website, and is accessible via Central Bank of Kenya.

[3] Real interest rate is computed using inflation rate [given by the GDP deflator], and the nominal lending rate of interest.

CHAPTER FOUR

EMPIRICAL FINDINGS

4.1 Introduction

Empirical findings are presented in this section alongside a discussion of key results. These findings are descriptive statistics, and the estimated model. Descriptive statistics are summarized under the cross-country analysis subsection.

4.2 Descriptive Statistics

Country-level summary statistics from 2009 to 2021 are captured in Table 2. These statistics are: the mean, standard deviation, and range. The range is given by the minimum and maximum values whereas the standard deviation captures volatility. The findings suggest that the value of mobile money transactions in Kenya were slightly higher compared to Tanzania, on average. Tanzania's value of mobile money transactions in turn exceeded Uganda's. However, Tanzania's value of mobile money transactions was more volatile compared to Kenya's. This could be attributed to rapid growth in the value of mobile money transactions in Tanzania that exceeded Kenya's growth in the value of mobile money transactions in some years. In other years, growth in the value of mobile money transactions in Tanzania slowed down slightly whereas Kenya maintained steady growth in the value of mobile money transactions.

A comparison of per capita real GDP suggests that average real incomes per capita were highest in Kenya, and lowest in Uganda. Kenya also recorded the highest volatility in real per capita GDP. This finding suggests that Kenya has a larger economy, based on per capita real GDP, compared to Tanzania, on average. Tanzania's economy is larger relative to Uganda. This finding also suggests that the average Kenyan had a higher standard of living compared to a Tanzanian counterpart. The average Tanzanian had a higher standard of living compared to a Ugandan counterpart.

The results indicate Kenya's and Tanzania's annual inflation rate averaging 7.040%. This is slightly higher compared to Uganda that evidenced 6.287% inflation rate on average. Consumer prices were more volatile in Tanzania compared to Kenya. Although Uganda's average inflation was the lowest, the country also recorded the highest inflation rate at some point. This suggests

that if the Fisher effect is true, and nominal lending rate of interest across the three economies is equal, then real interest rates in Uganda would be higher compared to Tanzania and Kenya.

At some point, Uganda experienced the lowest real rate of interest within the EAC (-34.74%), and some other point one of the highest real rates of interest (21.49%). Even then, real rate of interest in Uganda was much higher compared to Tanzania and Kenya, on average. This finding presents a dilemma. On one hand, averagely high real rate of interest in Uganda suggests high nominal user cost of capital in Uganda relative to Tanzania and Kenya. The high interest cost of holding capital in Uganda then implies low levels of investment, and hence relatively low capital formation. On the other hand, high real rate of interest in Uganda could offset massive capital inflow into the country from Tanzania and Kenya, thereby catapulting high levels of investment. However, there is no evidence on such massive capital inflows into Uganda that come from Tanzania and Kenya.

Investment levels in Tanzania are generally high relative to Kenya which in turn has high capital formation relative to Uganda. Investments in Tanzania are the most volatile whereas Uganda records the least volatility. This suggests that, if the three countries had an equal size of the labor force, then an average worker in Tanzania would have more capital to work with compared to a counterpart in Kenya or Uganda. High volatility in Tanzania relative to Uganda and Kenya suggests that the investment environment in Tanzania is more uncertain compared to Uganda and Kenya.

Tanzania's labor force towers that for Uganda and Kenya. This suggests that if the three economies had the same level of capital stock, then a unit of capital in Tanzania has more individuals to work with compared to Kenya or Uganda. This also suggests that the average per worker capital in Tanzania may be lower in comparison to Kenya. This would imply that per worker output in Tanzania could be lower than in Kenya, and hence lower per capita real GDP in Tanzania relative to Kenya.

Table 1: Descriptive statistics

Countries	Variables	Years covered	Period average	Standard error	Range	
Kenya						
	Inflation rate (%)	13	7.040	2.650	3.961	14.02
	Real interest rate (%)	13	6.640	5.436	-10.10	12.53
	Ln mobile money	13	23.94	0.677	22.53	24.86
	Ln labor	13	16.82	0.116	16.64	17.00
	Ln capital	13	23.40	0.209	22.99	23.71
	Ln real per capita GDP	13	7.403	0.172	7.183	7.679
Tanzania						
	Inflation rate (%)	13	7.004	4.079	3.290	16.00

	Real interest rate (%)	13	8.611	4.037	2.464	14.76
	Ln mobile money	13	23.21	1.824	18.60	24.64
	Ln labor	13	17.02	0.112	16.86	17.19
	Ln capital	13	23.47	0.329	22.95	23.92
	Ln real per capita GDP	13	6.887	0.147	6.709	7.171
Uganda						
	Inflation rate (%)	13	6.287	4.673	2.205	16.56
	Real interest rate (%)	13	12.19	14.32	-34.74	21.49
	Ln mobile money	13	19.83	2.201	14.21	21.70
	Ln labor	13	16.43	0.153	16.21	16.68
	Ln capital	13	22.83	0.209	22.47	23.13
	Ln real per capita GDP	13	6.856	0.111	6.700	7.030

Note: capital and per capita real GDP are measured in constant 2015 US $. Value of mobile money transactions is given in US $.

The descriptive statistics in Table 2 are further corroborated upon via a graphical examination of the observed trends. Figure 2 captures these dynamics, and offers additional insights. The pattern of the value of mobile money transactions in Tanzania was similar to Uganda's but at different levels. Rapid growth in the value of mobile money transactions in Uganda and Tanzania was recorded from 2009 to 2014; thereafter, the value increased but at a decreasing rate. Faster growth in the value of mobile money transactions in Tanzania relative to Kenya le to a near convergence of the two economies in 2014. Tanzania's per capita real GDP was higher than Uganda's in 2009. Real per capita GDP in Tanzania, however, declined faster compared to Uganda from 2009 to 2013, thereby leading to per capita income convergence in 2013. Although per capita GDP across the three economies has declined from 2009 to 2021, Kenya's per capita GDP has been high relative to Tanzania and Uganda. This is paralleled by a general increase in the level of investment. Initially, in 2009, Tanzania's gross fixed capital formation was slightly lower than Kenya's. In subsequent years, the rate of capital accumulation in Tanzania surpassed in Kenya leading to high level of investments in Tanzania relative to Kenya from 2016 to 2021.

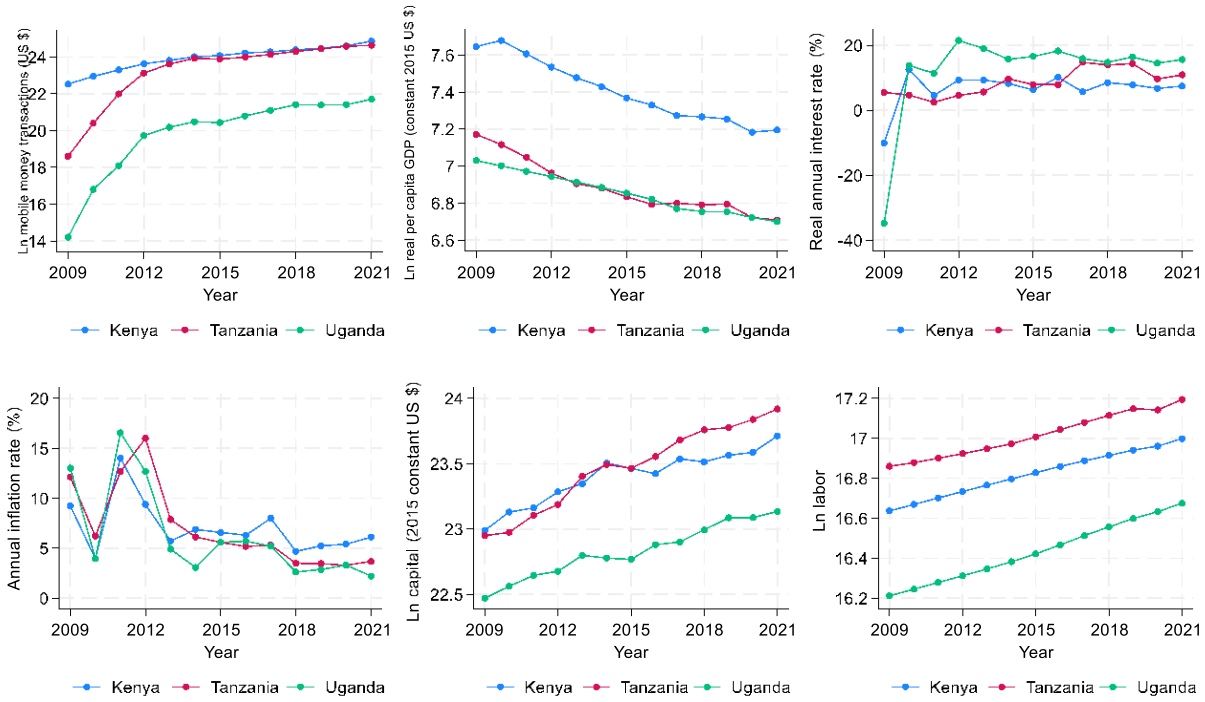

Figure 2: Evolution of variables over time

4.2 Model Estimation

This paper estimated static panel data model via stepwise approach such that real per capita GDP was first regressed on the value of mobile money transactions. This was followed by incorporation of real rate of interest and inflation rate. In the third regression, real per capita GDP was regressed on the value of mobile money transactions, labor, and capital. The last regression incorporates a full set of co-variates. Across all the four regressions, Hausman test was executed. In regressions 1, and 2, the Hausman test suggested that the random effects, and fixed effects model, respectively, was appropriate. In regressions 3, and 4, the Hausman matrix was not positive definite. An examination of the F-test that appears at the bottom of the fixed effects model suggested the presence of panel-level effects. Non-absence of panel-level effects suggests that the model must be estimated using pooled OLS (POLS), and not FE or RE. These results are organized in Table 3.

In order to interpret the results, consider a model of the form:

$$\hat{ny}_{i,t} = a_0 + a_1 \hat{nx}_{i,t}$$

Differentiating this equation with respect to time yields:

$$\frac{y_{i,t}}{y_{i,t}} = a_1 \frac{x_{i,t}}{x_{i,t}}$$

Where the dot on top of a variable indicates the time derivative of the variable. The above equation indicates that the growth of y is given by a_1 times the growth of x. This research uses 10% significance level although 5% and 1% significance levels are also reported. With this in mind, the results in table 3 are interpreted as follows:

As the value of mobile money transactions goes up, real per capita GDP significantly falls. Per capita real GDP declines further when controlling for inflation, and the real rate of interest. That is, a 1% increase in the value of mobile money transactions reduces real per capita GDP by 0.0751%. This is in sharp contrast to an initial reduction of 0.0658%. This effect dissipates when controlling further for labor, and capital such that mobile money transactions' value insignificantly raises real per capita GDP.

When controlled for inflation rate and mobile money, real per capita GDP significantly rises in the real rate of interest. As the real rate of interest goes up 1point, real per capita GDP increases by 0.00520%. Real interest rate, however, significantly reduces per capita GDP when controlling further for labor and capital.

Inflation significantly raises real per capita GDP when controlled for the real interest rate, and mobile money. As consumer commodity prices rise 1%point, real per capita GDP rises by 0.0081%. This effect withers away when controlling for labor, capital, and the value of mobile money transactions.

Lastly, statistically insignificant results are obtained for labor and capital. Growth of capital does offset changes in real per capita GDP. Similarly, growth of labor force insignificantly affects real per capita GDP.

Table 3: Estimating economic growth

	(1)	(2)	(3)	(4)
Variables	Random effects	Fixed effects	POLS	
Ln mobile money	-0.0658***	-0.0751***	0.109	0.156
	(0.00922)	(0.0124)	(0.118)	(0.0784)
Real interest rate		0.00520**		-0.0164*
		(0.00209)		(0.00503)
Inflation rate		0.00807*		0.0157
		(0.00447)		(0.00864)

Ln labor			-0.0934	-0.561
			(0.509)	(0.481)
Ln capital			-0.562	-0.424
			(0.516)	(0.167)
Constant	8.518***	8.622***	19.22	22.84*
	(0.279)	(0.281)	(15.06)	(7.712)
Observations	39	39	39	39
R-squared		0.691	0.160	0.487
Number of Country IDs	3	3		

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
The explained variable is ln per capita real GDP. Mobile money refers to the value of respective transactions in US $. The dataset covers Uganda, Tanzania, and Kenya from 2009 to 2021.

4.3 Model Diagnosis

4.3.1 Normal Data Test

Violation of normality assumption in panel data analysis renders the estimates unreliable. This research tested for panel normality using xtsktest proposed by Alejo et al (2013). Table 4 indicates that country-specific errors (u) and errors arising from the remainder component (e) are symmetric[4].

Table 4: Linear panel kurtosis and skewness tests

	Observed coefficient	Bootstrap standard error	Z	p-value
Skewness _ e	1.477091	1.012927	1.46	0.145
Kurtosis _ e	3.361836	2.592382	1.30	0.195
Skewness _ u	.8415703	1.15012	0.73	0.464
Kurtosis _ u	-2.19924	1.921846	-1.14	0.252
Observations=39, bootstrap replications=500				
Joint test for normality on e: chi-test p-value=0.1490 Joint test for normality on u: chi-test p-value=0.3975				

Note: u- country-specific error, e- error from the remainder component

[4] In the xtsk test, kurtosis or/ and skewness in e suggest that large levels of per capita GDP arise from country-level shocks.

4.4 Discussions

This paper sought to analyze how economic growth is affected by mobile money. Control variables incorporated in the analyses were: real interest rate, inflation rate, capital, and labor. Under certain specifications, economic growth was significantly affected by mobile money, real interest rate, and inflation rate. However, economic growth was insignificantly affected by labor and capital.

Although cashless transactions enhance efficiency of payment systems (Ndung'u, 2019a), mobile money transactions is not sufficient to offset production efficiency. This is due to low levels of human capital that leave beneficial aspects of mobile money untapped (Das et al, 2018). Besides, it is probable that mobile money was channeled towards social protection that need not necessarily imply productive activities. This then meant that growth-enhancing aspects of mobile money could not be realized (Mawejje et al, 2019). Thus, proliferation of mobile money fails to complement economic activities, contrary to Fabregas & Yokossi (2022). Countries within the EAC have evidenced proliferation of gambling activities that largely rely on mobile money. These activities are unproductive. Thus, real per capita incomes did not rise when the value of mobile money transactions went up.

The EAC has experienced moderate inflation on average. Modest increments in consumer commodity prices signal rising demand. This in turn incentivizes firms to raise output. This is in line with the theoretical predictions of the quantity theory of money. However, inflation insignificantly affects real per capita GDP when controlled for capital, and labor.

Lastly, this paper supports Pill (1997). The author reveals that as real interest rate rises from -25% to 5%, real per capita GDP rises by about 2%. Financial activities are prompted by modestly high real interest rates. This in turn catapult economic growth.

CHAPTER FIVE

CONCLUSION

5.1 Introduction

In this section, a summary of the key findings is presented alongside suggestions for policy action, conclusion, and areas for further studies.

5.2 Summary of Key Findings

This research analyzed how economic growth among select countries within the East African Community is affected by mobile money. Control variables considered in the analyses were inflation rate, real interest rate, size of the labor force, and capital. In the static panel models, the following were evident:

Economic growth significantly declines in the value of mobile money transactions. Growth deteriorates further when controlled for the real rate of interest, and inflation. Increasing the real rate of interest significantly raises economic growth when controlled for inflation rate, and the value of mobile money transactions. Lastly, economic growth rises modestly when commodity prices rise given the real rate of interest, and the value of mobile money transactions.

5.3 Policy Recommendations

The negative effect of mobile money on economic growth implies that economic growth declines as the value of mobile money transactions rise. This is due to low levels of human capital that leave beneficial aspects of mobile money untapped (Das et al, 2018). In order to reverse the negative effect, national governments of Uganda, Tanzania, and Kenya ought to invest in human capital through increasing funding for education and healthcare- the two basic aspects of human capital. Given financial challenges facing these economies, respective governments could realize this via public-private partnerships that offer risk-sharing as well as mobilizing development financing.

The positive effect of inflation on economic growth implies that economic growth increases as commodity prices rise modestly. Central banks within the region ought to streamline price stability to ensure that commodity prices rise modestly between 2-7%.

The positive effect of real interest rate on economic growth implies that economic growth rises as the real rate of interest rises. However, the real rate of interest should not be left to rise indefinitely. Instead, Central banks within the region should strictly follow the Taylor rule whenever they intend to influence real rate of interest. That is, changes on the real rate of interest ought to be aligned with inflation targeting.

5.4 Conclusion

Economic growth within select-EAC countries is undermined by mobile money but enhanced by modest rates of inflation, and the real rate of interest. Fostering economic growth within EAC will require investments in human capital accumulation in order for the economies to leverage on mobile money for enhanced growth. Equally important, governments within the region, through their respective central banks, ought to stabilize price in ensuring that commodity prices rise modestly between 2-7%. Lastly, as an imperative for growth, real rates should be allowed to rise modestly.

5.5 Areas for Further Research

This research focused on how economic growth is affected by mobile money. The analysis masked important within- and between-country effects. Within a country, for instance, mobile money transactions in urban areas may differ materially from transactions within the rural areas. This research therefore identifies a disaggregated analysis of how mobile money affects economic growth within the EAC by focusing on rural and urban areas. Countries within the EAC have different regulatory environments that affect the utilization of mobile money. This research, therefore, identifies analysis of how economic growth within EAC is affected by mobile money, and mobile money regulations.

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APPENDIX

Table 5: Matrix of correlations

	(1)	(2)	(3)	(4)	(5)
(1) Inflation rate	1.00				
(2) Real interest rate	-0.45**	1.00			
(3) Ln mobile money	-0.32*	0.25	1.00		
(4) Ln labor	-0.22	0.01	0.82***	1.00	
(5) Ln capital	-0.35*	0.11	0.90***	0.93***	1.00
Observations	39				

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$