



UNIVERSITY of
RWANDA

College of Business and Economics

**MOBILE MONEY, COVID-19 AND DIGITAL PAYMENTS: EVIDENCE
FROM RWANDA**

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DECLARATION

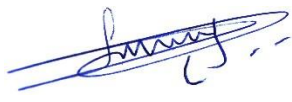
I, **Emmanuel Ntambara**, hereby declare that the work presented in this dissertation is my original work and has not been presented for any other degree at the University of Rwanda or any other University. All sources of materials that will be used for the Dissertation work will have been fully acknowledged.



Signature:

Date: **July 15, 2021**

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Signature: 

Date: **July 15, 2021**

DEDICATION

I dedicate this Masters dissertation:

To the Almighty GOD,

For your mercy, Grace and Love.

To my lovely wife, my daughter Keza and Sons; Alvin and Marvin respectively,

For your immeasurable love, tolerance and care I respect.

To my Family; brothers, sisters and cousins who deserve praise for the pain and sacrifices endured during my education journey.

To all my dear friends for your prayers and encouragement.

To you all I say thank you.

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A thesis such as this one is not written in isolation rather, it is shaped by the author's experience and interactions with other researchers and practitioners. In large part, I gained much experience while carrying out this work.

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I would like to thank the University of Rwanda staff through its College of Business and Economics (CBE) for their professional knowledge towards the smooth running of this research work. For all your academic support I am grateful.

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ABSTRACT

Mobile Money is one of the most innovative tools recently introduced to enable financial services in some developing economies, facilitating users to digitally transact without formal bank accounts. This innovation in payment systems has allowed individuals to pay for several services including utility bills, accessing government services through Irembo, buying airtime and transfer of money to and from their mobile money wallets. The study evaluates the impact of mobile money usage and Covid-19 on digital payments of economic outcomes based on rich administrative panel data on digital services from MTN Rwanda, a large Telecom company operating in the country. While mobile money has registered a wide MoMo agent's network across the country, less is still known whether the MoMo transactions could smooth business transactions during the unavoidable pandemic and lockdown times. The results indicate that MoMo has a significant impact on economic outcomes under study, including number of users and public revenues. It further reveals a shock in MoMo transactions conducted before and after the lockdown period. The interaction with MoMo agents also made the number of users and revenues generated from outcome variables significant and more statistically meaningful. The increase in MoMo transactions during the Covid-19 period is also attributed to policy measures by regulators of MoMo services where fees for individuals and merchants' transfers were slashed to zero. This shows how the government is faster in taking decisions for using online services. Based on the findings, appropriate and timely policy making helped the increase in MoMo usage and availed opportunities to overcome key challenges faced during the unprecedented times of the pandemic. Relevant recommendations are suggested to help telecom operators, policy makers and regulators to continuously expand and improve MoMo services in the country.

Key Words: MoMo, Digital Payments, MoMo Agents, Utility Bills, Lockdown, Covid-19.

LIST OF ABBREVIATIONS AND ACRONYMS

ADF: Augmented Dickey Fuller

BNR : Banque Nationale du Rwanda (Central Bank)

CBE: College of Business and Economics

COVID-19: Corona Virus Disease

E-Gov: E-Government

GSMA: Global Systems for Mobile Association

MMT: Mobile Money Transfers

MNOs: Mobile Network Operators

MoMo: Mobile Money

RURA: Rwanda Utilities Regulatory Authority

SCP: Special Cash Payment

SIM: Subscriber Identity Module

STATA: Statistical Software for Econometrical analysis Txs: Transactions

UR: University of Rwanda

USSD: Unstructured Supplementary Service Data

WHO: World Health Organization

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CHAPTER ONE: GENERAL INTRODUCTION

1.1 Background

1.1.1 Mobile Money and Digital Payments

There is strong evidence that Mobile Money is one of the innovative tools that has revolutionized both the telecom and financial sectors landscape, availing means of transfers from person-to-person and making financial services more accessible to mobile phone users. This innovation has in recent years captured the attention of researchers and scholars largely because it has revolutionized mobile money transfers in various countries where financial services infrastructure has been broadly inadequate (Jack & Suri, 2014). Since mobile money was introduced in Rwanda in 2010, it has facilitated individuals to make transfers through their mobile wallets, making utility payments such as electricity and water bills, payment of E-government services such as taxes and social benefits through Irembo, checking balances, enabling cross-border remittances, purchasing mobile phone airtime, data bundles and other services which provides convenience and reduces costs, consumes less time and has encouraged village savings and loan accounts (Nampewo, et al., 2016; Ondiege, 2015; Mawejje & Lakuma, 2019).

According to the Global Systems for Mobile Association (GSMA), the scale of mobile money grew with “866 million registered accounts in 90 countries and \$1.3 billion transacted every day uniting 750 operators with over 350 companies in the broader mobile ecosystem which has played a significant role in enhancing financial inclusion in emerging markets”. “The total value of mobile money-enabled international remittances processed was \$4.3 billion in 2018”. It is also estimated “that mobile money-enabled remittance services were available across 184 unique corridors, and there is a growing awareness among governments, regulators and the industry itself that mobile money can lower the costs of sending international remittances” (GSMA, 2018).

Riley (2018) also argue that the contribution of mobile money remittances is an important source of income especially for communities with unlimited resources in developing countries.

Arguably, the introduction of mobile money services has revolutionized the way the telecommunication industry conduct business, availing new business models and ways through

which customers access financial services in real-time. Digital payments over mobile phones have also forced telecommunication companies to integrate their systems with banks for customers to access their bank accounts and transfer money to and from their mobile money wallets and perform online transactions. This has become evident with MTN Mobile money and Airtel money.

In East Africa, Kenya's Safaricom telecom operator became the first to introduce M-PESA as its Mobile Money service in 2007. Tanzania followed in 2008 and launched both M-PESA and Z-PESA as mobile money products of Vodacom and Zantel respectively. Uganda through MTN telecom operator followed the trend and launched its MoMo service in 2009. The success of MoMo services in these countries was attributed to the fact that they were able to extend financial services through cash deposits, withdraws, sending and receiving money remittances and became platforms through which customers can make their savings.

There are two Mobile Money Transfer (MMT) services currently operating in Rwanda, Mobile Money operated by MTN Rwanda (launched in 2010), TIGO Cash (launched in 2011) and later acquired by Airtel Rwanda with Airtel Money as its MMT product.

Rwanda has also registered a significant increase of Non-Mobile Network Operators (MNOs) as providers of mobile payment services notably; M-Cash as a product of MTN and Ikofi which is operated by the Bank of Kigali. These Non-MNO institutions hold escrow accounts that mirror the mobile money deposits held. Utility service providers have also adopted mobile money usage where customers purchase electricity and pay for water bills online via MoMo USSD Code.

The Government of Rwanda also introduced the Irembo portal through which citizens were provided with a platform to request and pay for government services online including payment for taxes, passports, certificates and other local government services without traveling to respective administration offices. The introduction of this digital platform has reduced the burden of citizens traveling long distances thereby reducing transport costs and has been regarded as time-saving since it does not require their physical presence.

The National Bank's annual report of 2018-2019 estimates that active mobile financial services rose by 51% with 6 million subscribers which were due to the increase of merchant payments services and the number of mobile operator's agents increased by 8 percent in June, 2019 excluding the data for year 2020 which part of this study. These figures also indicate a rise in

the number of SIM cards registered on mobile money services who are not necessarily mobile money customers. The Volume of mobile financial transactions increased by 22 percent from 272 million to 333 million francs with the Value of mobile financial services increasing by 32 percent from 1,563 billion to 2,058 billion FRW as shown in figures 1 and 2 below (BNR, 2019).

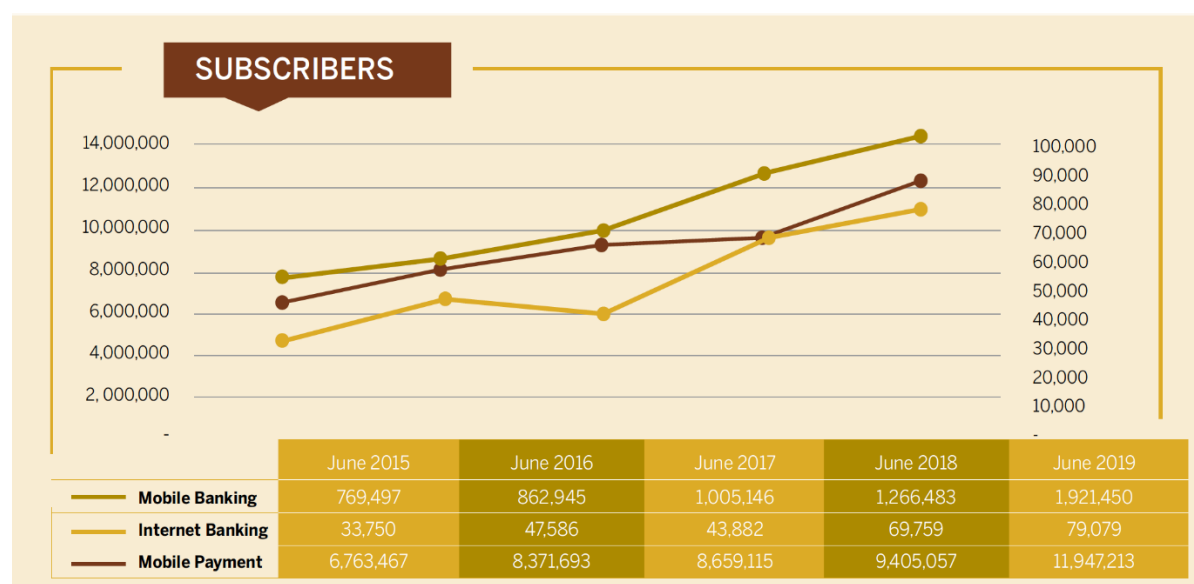


Figure 1: Mobile Financial Services

Source: BNR, Annual Report 2018-2019



Figure 2: Mobile Payment Agents

Source: BNR, Annual Report 2018-2019

The contribution of MoMo services and digital payments is also recognized towards savings and financial inclusion but argue that such inclusion may be impacted by lack of proper legal and regulatory framework. Mobile money services have also contributed to broad money where money in circulation has considerably increased (Jack, et al., 2013; Maurer, 2012; Munyegera & Matsumoto, 2015; Donovan, 2012; Lal & Sachdev, 2015).

1.1.2 Covid-19 and Regulations in Mobile Money Landscape

While analysing the “*Regulatory impact on mobile money and financial inclusion in African Countries*”, (Ondiege, 2015) identified the difference in mobile financial services in terms of their regulatory environments. There are still challenges that Mobile Network Operators are still facing in offering mobile money services which may undermine the development of Mobile money services and financial inclusion if not properly addressed.

Regulators need to enhance supportive regulatory frameworks that allow MNOs to extend the infrastructure to unserved areas and conduct financial literacy programs while ensuring trust and privacy through all their communication channels. The study emphasizes the need for a single integrated framework between MNOs and bank institutions that can lower costs of MoMo transactions that would provide affordability and convenience to consumers thereby encouraging digital payments through mobile money services.

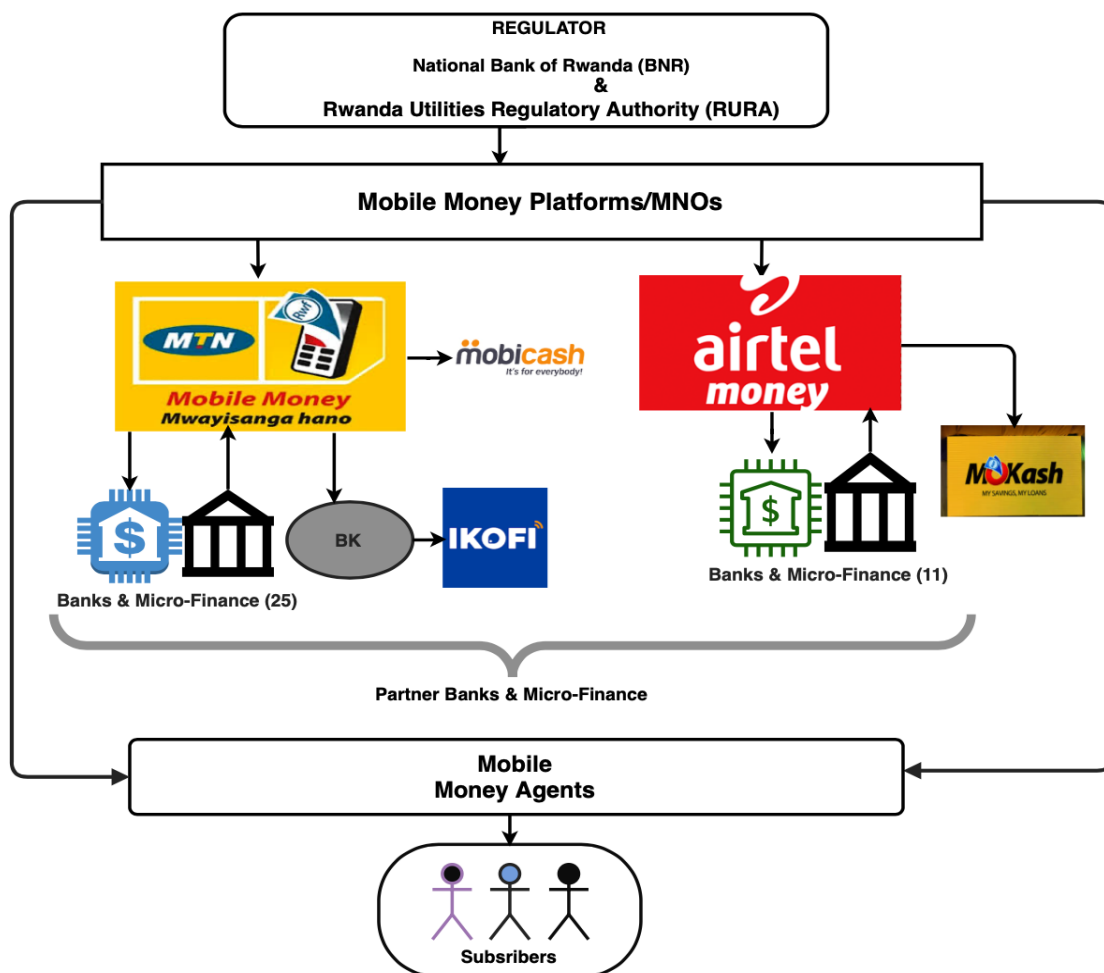


Figure 3: Mobile Money Architecture

Source: Designed by the Author using app.diagrams.net (2020)

Figure 3 shows a high-level architecture of mobile money operations in Rwanda. Mobile money is regulated by both the Central Bank (BNR) as a payment systems regulator and Rwanda Utilities Regulatory Authority (RURA) as Telecom Operators' regulator. BNR oversees mobile money operations as part of financial payments where MNOs are required to report all MoMo-related transactions regularly. RURA issues licenses to MNOs and issues technical regulatory requirements to be adhered to by telecom companies to ensure mobile money services are secure and subscribers are protected from any kind of fraud.

Over the recent years, MNOs have integrated their mobile money operations with various banks and microfinance institutions facilitating users to transfer and withdraw money from their bank accounts onto their MoMo wallets and vice-versa. MNOs have also integrated with other platforms such Mobicash and Mokash as payment gateways which helps in borrowing

and savings for MoMo users. The Bank of Kigali recently introduced IKOFI which is a scheme aimed at helping rural entrepreneurs to seek loans to boost their agricultural products.

A network of mobile money agents has also been built for all the telecom operators across the Country. These help MoMo users to deposit, transfer and withdraw their money through mobile phones. Customers are also able to purchase SIM cards and recharge their phones through MoMo agents.

Cross border transactions and money remittances also need to be regulated to address issues of applicable fees, money conversion where there is no clearing house and define clear responsibilities of the concerned parties in case of any irregularities during transactions.

The contribution of mobile money transactions has also been visible following the outbreak of the Covid-19 pandemic, most African countries turned to online payments to avoid hand-to-hand money exchanges to curb Covid-19. “Governments and startups implemented measures to shift a greater volume of payment transactions toward mobile money and to avoid cash transactions which were also flagged as a conduit for the spread of the coronavirus by the World Health Organization” (Gardner, 2020).

In the same effort to fight against the spread of Covid-19, RURA in collaboration with the Central Bank released a directive to use MoMo services and other digital payment platforms to purchase goods and services thus avoiding hand-to-hand money exchange.

The study reorganizes the efforts made by the Government of Rwanda to curb Covid-19 at the policy level. The regulatory measures taken by both telecom and financial services regulators saw an increased demand for digital payments through MoMo usage as witnessed during the lockdown where digital payments significantly increased.

From an economic perspective, the Covid-19 pandemic left a lesson due to the level of unpreparedness by both developed and developing countries, there is a need to implement long-term preventive measures and welfare programs to help the population earn a living during times of uncertainty such as Covid-19. The Government should establish adequate food reserves and raw materials to sustain local industries in their efforts to produce enough when imports and exports are affected to control the economy to an expected level.

On the other hand, mobile money would not have been possible without enough network coverage across the Country. Over time, MTN has established a network infrastructure to ensure that customers access mobile services across the Country. People in remote areas may find it difficult to perform digital payments due to limited coverage.

In this regard, Figure 4 below, the study presents the overall network coverage in the Country. It shows the distribution of MTN towers across all thirty (30) districts with the aim to show that network coverage would equally be a determinant of MoMo transactions as well as digital payments. Figure 4 below shows a distribution of sites from 2002-2010 and 2011-2020 respectively.

This shows how the sites increased over time since MTN started operations in the Country. It is visible that MTN sites are more concentrated in the City of Kigali compared to other districts in remote areas where perhaps demand for digital payments is still limited and MNOs might find it as a good adventure to expand their market.

The high demand for enough coverage in the City of Kigali could also be attributed to highly populated zones and their technology literacy to use online services. It is also possible that the sites which have been built there are enough to cover their customer size and demands.

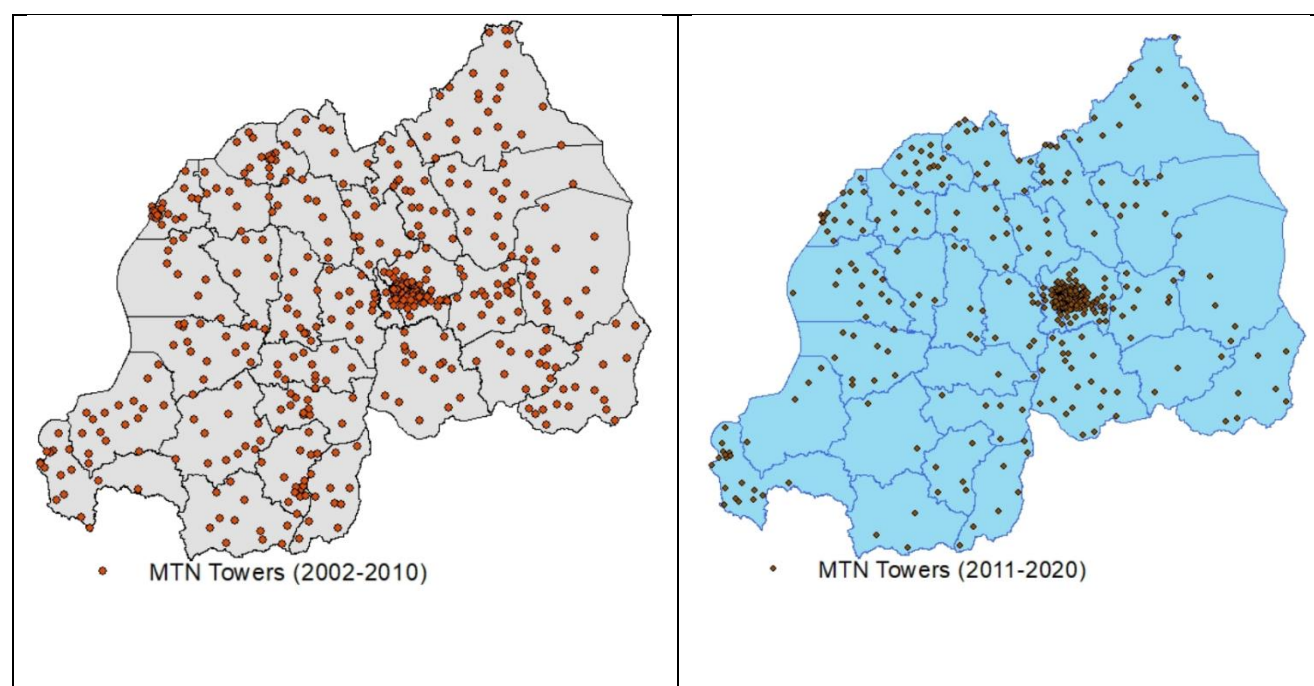


Figure 4: Distribution of MTN Towers across the Country

Source: Rwanda Utilities Regulatory Authority (2020)

1.1.3 Key Challenges in the Mobile Money Landscape

There are various challenges affecting mobile money services and digital payments which range from lack of infrastructure, awareness, digital literacy and privacy concerns;

Interoperability; the interconnection between telecom operators remains a barrier to customers when sending money from one operator to another therefore payment systems must be interoperable with banks and MoMo platforms across all telecom operators.

Security and privacy concerns; there have been several money fraud cases where unauthorized people try to trick people to channel their money to their MoMo accounts, this reduces trust and confidence for people using digital payments.

Sustainability of operations; For more services to remain sustainable, the telecom industry and regulators must address issues of privacy and implement preventive measures to combat fraud and organize awareness programs on how customers can secure their MoMo transactions.

SIM card registration and management of MoMo agents; there have been registered cases of MoMo fraud mainly due to lack of how SIM cards are registered, poor management and registration of agents. Customers use SIM cards registered under the names of other people to conduct MoMo transactions which lead to fraudulent activities and loss of money. There is also no clear management of agents to help regulators and law enforcement agencies to track records of agents in case a fraudulent activity occurs.

Proper SIM card registration process must be streamlined using advanced identification standards such as facial recognition and using biometric data capture for authentication of users as well as ensuring proper management of MoMo agents is equally paramount. It was noticed during the Covid-19 period that a limitation on the daily number of transfers for individuals and merchants was a measure to curb fraud.

Transfer Fees; regulators do not set charges for MoMo transfers and an increase in these charges might affect the growth of MoMo transactions and consequently affect the increase in digital payments.

Considering that MoMo provides only SMS as a proof of payment, customers who are used to receipts still find it a challenge and opt for physical payments which customary issues a

physical receipt as a proof of payment. This calls for awareness as Rwanda anticipate building a cashless economy.

There is also a fear of change that Telecom operators who operate MoMo services have started operating as banks and if not properly regulated, this would cause a shift in the financial payments landscape as MNOs to become competitors of financial institutions.

1.2 Statement of the Problem

The empirical literature suggests that mobile money services have evolved, and does not only include person-to-person (P2P) transfers but also enable money transfers between mobile phone subscribers and businesses under a network of cash-in/cash-out agents thereby allowing digital payments of various goods and services without the exchange of cash at most stores, gas stations and other mobile-enabled services (MINECOFIN, 2012; Mawejje & Lakuma, 2019; Jack & Suri, 2014).

However, there is limited knowledge on the impact of mobile money services on digital payments in Rwanda. The relationship between mobile money users and digital payments and the extent to which mobile money transfer agents have contributed to the growth of MoMo services also remains unrevealed.

Further, while there are several regulatory instruments and preventive measures implemented by both RURA and BNR as telecom and financial payments regulators respectively especially during the Covid-19 period, there is no clear evidence to show how these policy measures have impacted the mobile money landscape which calls for the need of this research work.

Therefore, the study identifies trends in regulatory measures taken by policy makers especially during Covid-19 to track response from MoMo users on how government policy and regulatory measures impacted online payments thereby helping in making informed decisions towards promotion of a cashless economy.

1.3 Objectives of the Study

1.3.1 General Objective

The study evaluates the potential impact of mobile money services and Covid-19 on digital payments in Rwanda.

1.3.2 Specific Objectives

Particularly, the study aimed to achieve the following specific objectives;

- i. To identify the relationship between mobile money users and online services paid through IREMBO platform;
- ii. To examine the association between MoMo agents and utility bills payments;
- iii. To investigate the impact of Covid-19 on online services.

1.4 Scope of the Study

The study focuses on analyzing the impact of mobile money and Covid-19 on economic outcomes in Rwanda. Administrative data collected from MTN Rwanda was considered for this study and regression analysis was carried out using STATA tool (Version 13). Transactions performed through Airtel Money were out of the scope of this study. The selection of MTN Rwanda Limited was based on its market share with the mobile-cellular telephone subscriptions market shares of up to 61.8% as of December, 2020 which is a good representation of the overall mobile telephone users in the Country (Anon, 2020). In addition, most Airtel users are also subscribers of MTN where users possess two (2) SIM cards from both telecommunication service providers.

1.5 Expected Outcomes and Significance of the Study

1.5.1 Expected Outcomes

To effectively conduct this study and satisfy the above objectives, the study sought to evaluate how Mobile money services and Covid-19 have affected the development of online services in Rwanda. In this study, it is expected that the increase in the number of MoMo users would induce an increase in digital payments. It is also anticipated that any additional unit in the number of MoMo agents would have a significant and positive effect on users of outcome variables and consequently increase corresponding revenues generated through MoMo services.

Further, the regression analysis would reveal a positive impact of MoMo usage during the Covid-19 period using MoMo agents. The interaction of the number of agents with the treatment variable as well as Covid-19 would also produce positive and more significant results on all economic outcomes under study.

1.5.2 Significance of the Study

The study is an addition and a great contribution to the existing literature and reveals how MoMo services have impacted digital payments.

Based on the findings, relevant recommendations were suggested to help mobile money operators, decision-makers, policy makers and regulators of the telecom industry to continuously expand and improve MoMo services in the Country.

The study also identifies trends in regulatory measures taken by policy makers especially during Covid-19 and track response from MoMo users on how they were implemented and the impact such measures had on online payments in a bid to help them in making informed decisions in their future efforts to promote a cashless economy.

Furthermore, the study examines the impact of MoMo on online services by controlling district effects which provides an indication of how MoMo users conduct online payments and provides a picture for both regulators and MoMo service providers of where to invest to expand and improve their services Country wide.

1.6 Organization of the Study

The rest of the study is organized into 5 chapters; Chapter 1 introduces the topic under study; Chapter 2 presents both theoretical and empirical literature related to the study. Chapter 3 presents data and methods used during data collection and analysis. Results of the key findings are presented and discussed in Chapter 4 and finally, Chapter 5 concludes the work and suggests policy recommendations and future studies. Chapter 2 is discussed next.

CHAPTER TWO: REVIEW OF RELATED LITERATURE

2.1 Introduction

This section contains both theoretical and empirical literature of related work by different researchers and practitioners. It critically analyses various research studies that were conducted by other researchers, academicians and scholars around the Globe. It further identifies the gaps in relation to the research topic under study. In view of the above, the section of this study evaluates and analyzes previous research findings by reviewing the literature on Mobile Money usage, and Covid-19 with the aim to identify its contribution and implications on digital payments.

2.2 Mobile Money Services and Digital Payments

In a study conducted by (Jack, et al., 2013) to understand “money management by households and firms in Kenya”, noted that mobile money arrangements such as M-PESA have changed how resources are transferred and received amongst households and individuals in Kenya. Their OLS results conducted on panel data indicated that M-PESA users transact financially to make transfers over long distances. It further argues that the transaction activity of M-PESA users exhibits more reciprocity in their transactions than nonusers.

The distinction between users and nonusers was not only remarkable in terms of transfers but also in terms of frequency at which they are engaged in such transfers where “households with at least one M-PESA user were 37.4 and 34.3 % more likely to receive and send remittances”.

The development of mobile money services has also been driven by mobile money agent networks that are licensed and distributed across the Country. Donovan (2012) observed that without agents’ power, M-PESA could find it difficult to reach a critical mass of customers across the Country who remain unserved by financial providers. It is imperative to properly manage licensed agents to meet the demand of customers while ensuring the increase of agent numbers and safeguarding their profitability.

While it is important to have a dense network of agents across the country, it is equally paramount for operators to provide sufficient physical and electronic money (e-float) to agents such that mobile money users can cash-in and cash-out whenever they wish to conduct such transactions and ensure liquidity management (Lal & Sachdev, 2015).

To investigate mobile money consumption and how it is changing payment space, (Maurer, 2012) explores economic narratives behind mobile money opportunities for profit making and financial inclusion in digital payment systems. The author's analysis identified that users were using mobile money for other purposes than what it was originally designed for where users could opt to use airtime as a currency.

While trying to understand the effect of various macroeconomic factors on mobile money transfers, the stationarity tests (unit root) performed using Augmented Dickey Fuller (ADF) method found that all dependent and independent variables under study were stationary at level (Agong & Oketch, 2015). The analysis also indicated that there was existence of co-integration confirming that the variables had a long-run relationship. The regression analysis also confirmed that unemployment was one of the determinants of MoMo transfers at 10% significant level implying that a unit increase in unemployment variable translates into an increase in MMT which implies therefore that, the proportion number of individuals who are not already absorbed in the labour force may affect MoMo transfers.

Lal and Sachdev (2015); Ondiege (2015) investigated the contribution of mobile money to financial inclusion. Indeed, the Pearson correlation results presented by Bongomin, et al. (2015) identified “that there was a significant and positive relationship between mobile money usage and financial inclusion which implies that indeed, mobile money has transformed the lives of people especially the poor households who have been provided with access to basic financial services through phone-based money transfer and storage services”. However, the researchers did not provide enough evidence on how mobile money services have contributed to digital payments.

2.3 COVID-19 in Context

The outbreak of the Covid-19 pandemic has affected the global community because of an increase in infections and death rates as well as posing economic implications to the well-being of people around the Globe because of increased health demands. Like any other country, the implications of this global pandemic have affected Rwanda mainly because it brought businesses across various sectors to a standstill resulting in low liquidity ratios and impacting the global market supplies.

While examining how Covid-19 pandemic may affect electronic payments in Africa, reorganizes the shift from cash transactions to contactless payments and wallet forms of

payments by most African countries during the times of crisis where most countries have imposed lockdown and businesses seeking continuity of their services which forces them to establish their presence through online transactions which has accelerated the need to use digital payments (McKinsey & Company, 2020)). The study also noted the change in consumer behavior noting a significant change on where and how consumers spend their money where many have adopted digital payments to exercise social distancing and a conduit for the spread of the pandemic noting that it would not only be safer but a long-term shift towards financial inclusion.

Kubota, et al. (2021) examined the Special Cash Payment (SCP) program cash payment a scheme implemented by Japanese government in response to the COVID-19 pandemic. Their results indicated a continuous distribution of payments between May and the end of August 2020. The study employed difference-in-difference model to differentiate the impact of the program of SCP payments from the effects of pandemic shocks, measures during lockdown and various policies imposed by the government of Japan. Their findings identified substantial variations in payments through cash deposits/transfers by households during the period of three months and there was an immediate increase in spending during that period.

Rwanda being a land-locked country relies on imports and exports from overseas to sustain its economic growth where over 20 percent of the country's imports originate from China and with the outbreak of Covid-19, capital and consumer goods were contracted including materials that help local industries to operate. As a result, food security was impacted and local industries run short of supplies and cannot meet the GDP providence ration quotient (ICPAR, 2020).

Rwanda also relies hugely on tourism, after the outbreak of Covid-19, the number of visits by foreign tourists became impossible. Touristic attractions including mountain Gorillas, Genocide memorial sites were all shut limiting domestic tourism as well. Shipping of goods being an integral part of trade across the globe was equally affected as airlines were brought to a complete stop. The outbreak of Covid-19 also necessitated local tech companies operating in the transport sector to distribute free-of-charge meters to help passengers using motorbikes to pay for transport charges using mobile money.

However, despite the availability of such cashless infrastructure, the uptake of digital payments is still low mainly because of the cultural mindset where people still prefer using paper money coupled with low levels of education and access. In the next chapter, I discuss various datasets used and methods applied in this study.

CHAPTER THREE: DATA AND METHODOLOGY

3.1 Conceptual Framework

Data collection sources were justified by the fact that, data on individual variables under study were consistent and available in making such statistics and estimation. The study uses all MoMo users on outcome variables to estimate the effect of MoMo access on economic outcomes. Both dependent and independent variables are indicated in Figure 5.

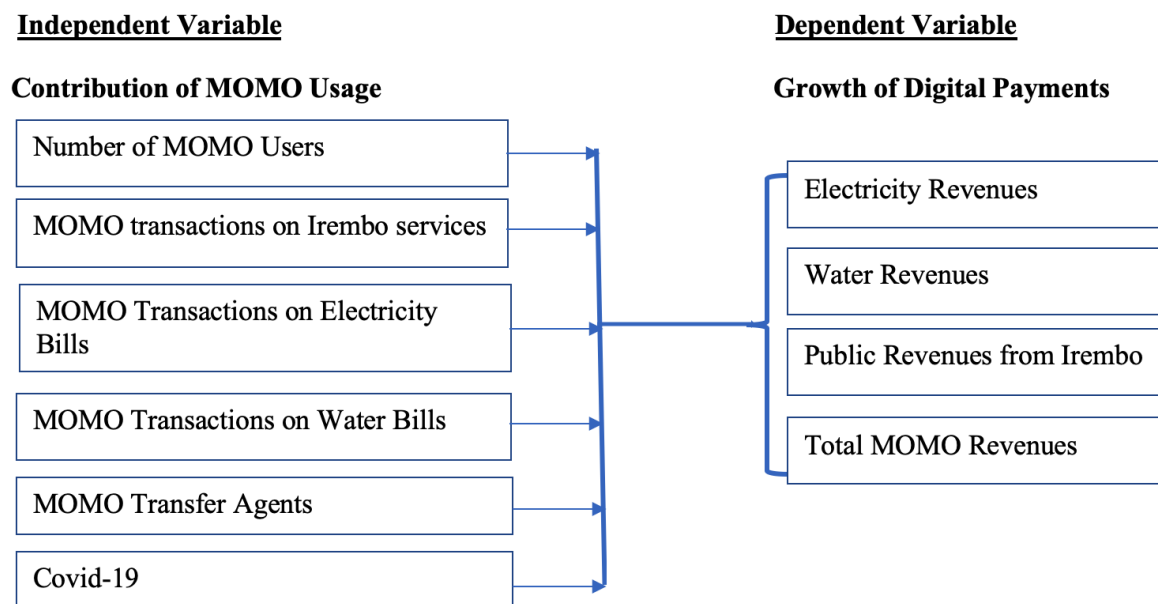


Figure 5: The Variables of Interest under Study

Source: Author (2020)

The study establishes the contribution of mobile money services and Covid-19 on various digital payments. In Figure 5, mobile money users on both the Irembo platform and on utility bills were considered as independent variables. Covid-19, especially during the time of lockdown and mobile money transfer agents, are also considered as drivers of these transactions as shown in Figure 5. Digital revenues from utility payments and public revenues generated from Irembo were treated as outcomes because of various transactions performed through MoMo. The study assesses if the dependent variables affect the increase in the number of MoMo transactions and consequently increase outcome revenues on digital payments.

It is evident that several mobile money users do not necessarily conduct digital payments, such variations are of great importance to discover. Both dependent and independent variables are

related in a sense that any increase in the number of mobile money users would also increase revenues of outcome variables hence the growth of digital payments across the country.

3.2 The Data

The study relies on administrative data on various economic outcomes under study which was collected from MTN Rwanda as the central stage for all MoMo transactions. The data were accessed across all the key variables of interest. It was composed of monthly data for the Year 2020 indicating transactions conducted from all districts. Location and period of such transactions were important for this study to determine district and time fixed effects while making it easier to construct panel data with enough observations for better regression analysis. The data were composed of datasets of all variables under study which indicates both users and total revenues corresponding to each variable to obtain a picture that shows the correlation between various economic outcomes over a certain period.

Depending on data availability especially with regards to the location of transactions, the data was limited to the Year 2020 with standard errors clustered at the district level on all variables.

3.3 Data Description for Analysis

After a successful data collection exercise, the empirical analysis of the study was conducted on the data obtained from all economic outcomes under study, verified and modelled into a panel data format for completeness and consistency.

Data was used for running the regression analysis using STATA (version 13) as a statistical tool. Various linear regressions were deployed to establish the “causal effect, significance and influence of the independent variables on the dependent variable” (Nampewo, et al., 2016).

Table 1: Summary statistics for explanatory variables

Variables	N	Mean	Sd	Min	Max
Water Users	248	1290	2436	1	14392
Irembo Users	248	3968	4362	3	29162
Electricity users	248	53826	62535	379	349370
agents	248	1254	1198	10	6797
Txs Users	248	1590641	2214498	13543	13800000
Water Values	248	17100000	40600000	1207	258000000
Irembo Values	248	36000000	49000000	28500	315000000
Electricity values	248	89100000	151000000	271183	852000000
Txs Values	248	16500000000	28000000000	70100000	172000000000

Source: Computed by the Author using STATA-13 (2020)

Table 1 shows summary statistics of outcome variables used for analysis. It presents the mean and standard deviations (Sd) of users for various outcome variables such as water, electricity, Irembo and MoMo agents as well as the total number of transactions conducted on all outcome variables. It also presents the values in terms of expenditure performed on individual variables indicating their minimum and maximum values for both users and expenditures.

The monthly data for the Year 2020 from January to October was considered with a total of 248 observations (N). The number of observations is from all thirty (30) districts across the country (248/30). From the values, the number of water and electricity bill payments were at 1290 and 53826 respectively. Whereas, Irembo users were at 3968. The number of users transacting through MoMo platform increased thereby increasing expenditures on all outcome variables. On average, the revenues collected through MoMo are higher in electricity bills than in Irembo services and lower in water bill payments.

3.4 Modeling and Estimation Strategy

3.4.1 Mobile Money and Outcome Variables

The regression analysis in this study was twofold; first, the study confirmed if mobile money services indeed affect the number and volume of digital payments. Second, the analysis determined if the outbreak of Covid-19 had an impact on digital transactions.

Specifically, the study analyzes the results to establish if interaction with MoMo agents would impact the number of MoMo users and consequently increase revenues of digital payments made on outcome variables through MoMo transactions.

The study adopts three regression models to establish the relationship between mobile money, Covid-19 and MoMo agents on digital payments. The long-run (equilibrium) specification is given by the *equation (1)* specified below as a baseline model that evaluates the impact of MoMo on outcome variables;

$$y_{idt} = \alpha + \beta MoMo_{idt} + \sigma_d + \lambda_t + \varepsilon_{idt} \quad (1)$$

Where; α is the Intercept. β denotes coefficients in the model of regression. y_{idt} represents a vector of outcomes as a continuous dependent variable including digital revenues from electricity and water demand, Irembo public revenues and net MoMo transactions received digitally, σ is the fixed effects (FE) clustered at district level (**d**), λ is the Time fixed effects at period **T** where, time for this regression model is calculated on monthly basis. $MoMo_{idt}$ is the treatment variable expressed as a log value whereas, idt represents outcome variables which for this study include; the number of MoMo users on; IREMBO services, MoMo users on online Electricity consumption, MoMo users on water online bill payments, MoMo agents and expenditures on all outcome variables transacted from all districts at a period T. ε_{idt} is the Error term at a period **T** which is expected to be normally distributed and maintaining a zero mean and constant variance.

It is evident that since the inception of MoMo as MTN Rwanda's mobile money transfer product, a lot of services have been transacted online including payments on utility bills and accessing government services online using the Irembo platform. The number of mobile money agents' networks across the country has equally helped people to access financial services through transfers, receiving and paying of goods and services from their villages without relying on their traditional bank accounts. The interaction of MoMo agents with outcome variables is thus of great importance to investigate.

The study employs a panel structured data and includes time and district fixed effects to control for any endogeneity sources across outcome variables under study. In other words, the study

employs time and district fixed effects to control for other unobservable variables and other factors that might affect digital payments other than outcome variables under study.

Thus, in *equation (1)*, the baseline regression model investigates the impact of MoMo on individual outcome variables.

3.4.2 COVID-19 Model for Outcome Variables

However, although people were using both MoMo and traditional choices of payments, there came the outbreak of Covid-19 which obliged them to transact online especially during the lockdown period where people were not allowed to leave their homes to buy products pay for services using physical cash. The factor of Covid-19 also necessitated the Government's acceleration of cashless transactions where regulators of mobile money services implemented policies that made it mandatory for the public to use online transactions through MoMo in a bid to discourage hand to hand money exchange and to promote cashless transactions as well as minimizing the spread of the pandemic.

Therefore, it is anticipated that during this time, the number of MoMo transactions increased considerably which is why the study introduces the aspect of Covid-19 to evaluate its impact on digital payments transacted through MoMo.

In this context, I evaluated the impact of Covid-19 on online digital payments. The model specification in *equation (2)* will explicitly explain these variations. The equation is the same as the one previously defined except introducing the Covid-19 factor which has a binary response of [0] and [1] before and after the lockdown. Thus, the regression model in *equation (2)* below investigates the impact of Covid-19 on digital payments.

$$y_{idt} = \alpha + \beta covid_{it} + \sigma_d + \lambda_t + \varepsilon_{idt} \quad (2)$$

This model is a reduced form and all variables remain the same as previously specified in *equation (1)* except the introduction of the Covid-19 aspect.

The analysis is conducted on transactions performed on Irembo and utility bills payment bills (water and electricity) as well as on the overall total transactions paid through MoMo in the year 2020. The study further employs a Difference-in-Difference (DiD) design where the treatment variable varies by time (month) and District fixed effects. The difference-in-differences design is introduced to evaluate the differential effect on outcome variables before

and after the outbreak of Covid-19 (Lockdown). Although people were not allowed to make payments through cash transactions (physical cash) during the lockdown, there were essential services that were needed and many people started buying products online.

However, there existed MoMo agents' network that MTN had deployed in all districts across the country who remained operating to help people in making online payments, make transfers and buy various products in a more convenient and easy way during this period of lockdown.

The role of these agents is therefore important to investigate which is why the study introduces interaction with Covid-19 in *equation (3)* below to evaluate the impact of Covid-19 on the cashless economy through MoMo transactions but also the interaction of agents to establish the role of agents in helping people to access online digital transactions which is why the study does not treat the number of MoMo agents as a standalone variable but rather their interaction to establish their impact during the period of Lockdown.

Therefore, the following estimation model is an augmented equation to evaluate the role of lockdown and agents' transactions during the lockdown period. At the time of conducting this study, Rwanda had imposed two lockdowns, data for analysis in this study only consider the first lockdown which happened in March 2020. The specification in *equation (3)* evaluates the impact of Covid-19 during the lockdown period.

$$y_{idt} = \alpha + \beta covid_{it} + \delta covid_{it} * Agent_{dit} + \sigma_d + \lambda_t + \varepsilon_{idt} \quad (3)$$

The regression model in *equation (3)* shows interactions of Covid-19 (lockdown) with the number of MoMo agents ($Agent_{dit}$). Covid-19 is a dummy variable taking one (1) after lockdown and considered Zero (0) otherwise while δ is the coefficient of interaction between Covid-19 and mobile money agents. Other variables and coefficients in the regression model remain the same as previously specified.

The study assumes that the interaction term $Covid_{it} * Agent_{dit}$ "is exogenous and uncorrelated with the error term". The study believes that if unobservable variables does not interact with the response to the shocks, the Difference-in-Differences specification would suggest that they are correlated with the use of mobile money services (Jack & Suri, 2014).

The model in *equation (3)* also reveals policy implications by regulators of Mobile Money services for the three months during Covid-19 period where transfer fees for direct transfers to

individuals and transactions from MoMo to bank accounts were removed and made free. This followed a directive from the National Bank to discourage hand to hand money exchange while encouraging the use of online money transfers through Mobile Money platforms. This decision was effective for three (3) months from March to June, 2020 and was implemented immediately after the lockdown.

CHAPTER FOUR: DATA ANALYSIS AND INTERPRETATION

4.1 Descriptive Results

The analysis of the study starts by evaluating the impact of MoMo on individual outcome variables as contained in Tables 2-5 using the model expression specified in *equation (1)*. Next, the study then investigates the impact of Covid-19 on utility bill payment as well as Irembo services as expressed in tables 6-9 using the expression stated in *equation (2)*. Results above also indicate the impact of Covid-19 with the interaction of MoMo agents on all outcome outcomes (i.e. electricity consumption, water bills payments and Irembo services) as well as the impact of such interaction on corresponding revenues generated.

Throughout the analysis, tables indicate the number of users on respective outcome variables as presented in columns (1) and (2), while columns (3) and (4) present respective revenues generated from outcome variables.

Specifically, in tables 2-5, results show the impact of MoMo and agents on users as presented in columns (1) and (2), while column (3) and column (4) presents results on impact caused by MoMo with interaction of MoMo agents on revenues of individual variables using expression in *equation (1)*.

Results further reveal the impact of Covid-19 on respective outcome variables before and after the lockdown. Similarly, by applying expression in *equation (3)*, results in tables 6-9 show the impact of Covid-19 before and after Lockdown and their interaction with MoMo agents on users as presented in columns (1) and (2), while column (3) and column (4) presents results on impact of lockdown with interaction of MoMo agents on revenues of individual variables.

The results on the impact of Covid-19 on outcome variables before and after lockdown are further revealed in the figures 6-8 as presented under section 4.2.5.

4.2 Analytical Results

4.2.1 Econometric Analysis

The study presents result on the impact of MoMo and its interaction with transfer agents on all outcome variables under study as expressed in *equation (1)*. Particularly, I report Difference-in- Differences results to discuss the effect of Covid-19 shocks especially before and after the

lockdown period using expressions in *equation (2)* and *(3)*. Throughout the analysis robust errors are clustered at the district level.

Analysis in *Section 4.2.2* evaluates the impact of MoMo and agents on utility bills payment while *Section 4.2.3* will discuss results on the impact of MoMo and agents on Irembo services. Whereas *Section 4.2.4* presents results on how Covid-19 impacted digital payments especially during the period of lockdown.

OLS Results from tables 2 and 3 reveals that MoMo users are less likely to use water bill payments compared to electricity and Irembo services, where in table 3, any additional unit in the number of agents, water users would increase by 0.303 (Column 1) and revenues on water consumption would rise by 0.404 (Column 3). This indicates that consumption of water is relatively lower compared to electricity and Irembo users as contained in tables 2 and 4 respectively.

The results in Table 5 shows the impact of MoMo and agents on total revenues of all digital payments conducted on respective outcome variables. Overall, any unit increase in the number of MoMo agents would increase users on various outcome variables by 0.972 (Column 1) and 1.133 (Column 3) in total revenues respectively.

The coefficients of interaction from the model specification in *equation (1)* are positive and are statistically significant which verifies the applicability and explains the fitness of the model.

4.2.2 MoMo on Utility Bills Payment

In tables 2 and 3, the analysis evaluates the impact of MoMo on utility bill payment as well interaction with agents with water and electricity consumption putting into consideration district fixed effects and alternating with or without monthly fixed effects. The results indicate a positive impact on utility bill payments meaning that MoMo and transfer agents have a statistically significant impact on electricity as well as on water consumption.

Table 2: Impact of MoMo Agents on digital electricity payment in Rwanda

Variables	(1)	(2)	(3)	(4)
Number of MoMo Agents	0.985*** (0.029)	0.987*** (0.029)	1.143*** (0.043)	1.152*** (0.043)
Constant	3.743*** (0.197)	3.730*** (0.198)	9.803*** (0.292)	9.740*** (0.291)
Observations	248	248	248	248
R-squared	0.978	0.981	0.976	0.979
District FE	YES	YES	YES	YES
Month FE	NO	YES	NO	YES

Notes: Dependent variables are standardized users and total electricity revenues collected through MoMo transactions. Standard errors are clustered at the district level. OLS estimations: *Significant at 10 percent level **Significant at 5 percent level ***Significant at 1 percent level.

The results further reveal that with an increase in the number of MoMo agents, the number of electricity users would increase by 2.9% (column 1) and revenues would by 4.3% (columns 3 & 4). The coefficients of interaction are positive and statistically significant for the explanatory variable which is a clear indication of an amplifying effect of MoMo agents on digital electricity payment.

Results also illustrate a positive and statistically significant impact of MoMo agents on digital electricity payment. Specifically, the results in Table 2 indicate that an additional unit increase in the number of agents would also increase the number of electricity users by approximately 0.98 standard deviations (column 1) and revenues would rise by 1.143 (column 3).

Table 3: Impact of MoMo agents on digital water payment in Rwanda

VARIABLES	(1)	(2)	(3)	(4)
Number of MoMo Agents	0.303 (0.219)	0.271 (0.192)	0.404 (0.288)	0.350 (0.246)
Constant	3.946** (1.488)	4.164*** (1.306)	12.351*** (1.952)	12.718*** (1.673)
Observations	248	248	248	248
R-squared	0.844	0.862	0.806	0.834
District FE	YES	YES	YES	YES
Month FE	NO	YES	NO	YES

Notes: Dependent variables are standardized users and total water revenues collected through MoMo transactions. Standard errors are clustered at the district level. OLS estimations: *Significant at 10 percent level **Significant at 5 percent level ***Significant at 1 percent level.

Results in Table 3 indicate that water users and corresponding revenues increased by 0.303 and 0.404 as shown under column (1) and column (3) respectively. Whereas, with interaction of MoMo agents, the number of users would increase by 21.9% (column 1) and revenues increases by 28.8% (column 3).

Overall, the results suggest existence of a positive association between MoMo agents and utility bill payments as values remain statistically significant when I control for district and time fixed effects.

From a consumer perspective, this means that the more users can buy and pay for utility bills online through MoMo transactions, there is a reduction in the cost burden and time saving since customers would not be required to visit agents to purchase power or pay for water bills physically. While talking about the cost, paying for utility bills would also help customers to continuously monitor their energy consumption and may as result help them to control their expenditures and make proper savings arrangements. In addition, there is no extra cost caused by penalties imposed by utility companies in a situation where customers are not able to pay their bills on time.

On the other hand, the use of MoMo services to pay for utility bills is not only beneficial to consumers but also to service providers, where it would be no longer necessary to connect and disconnect customers and printing of paper bills would be discouraged as well as their

distribution. This would also minimize costs incurred while transporting their engineers to people's homes not disregarding proper management of their cash flow.

4.2.3 Impact of MoMo on Irembo Services

IREMBO is a government portal that serves as a single landing point for government services. People use mobile money to access government services such as village certificates, passports and paying for tax among other things. This has made it easier for government to provide services to people without requiring them to travel long distances.

Table 4: Impact of MoMo agents on digital IREMBO services in Rwanda

Variables	(1)	(2)	(3)	(4)
Number of MoMo Agents	1.048*** (0.064)	0.939*** (0.079)	1.116*** (0.072)	0.996*** (0.042)
Constant	0.572 (0.435)	1.315** (0.536)	9.045*** (0.492)	9.861*** (0.289)
Observations	248	248	248	248
R-squared	0.545	0.965	0.621	0.960
District FE	YES	YES	YES	YES
Month FE	NO	YES	NO	YES

Notes: Dependent variables are standardized users and total Irembo revenues collected through MoMo transactions. Standard errors are clustered at the district level. OLS estimations: *Significant at 10 percent level **Significant at 5 percent level ***Significant at 1 percent level.

The results in Table 4 indicate that the output coefficient of interaction is positive with 1.048 (column 1) and is statistically significant at 1% level of significance which means that additional unit increase in the number of agents, would increase Irembo users and corresponding revenues by approximately 1.05 and 1.12 as shown under column (1) and column (3) respectively. Results also indicate that MoMo agents increase the number of users by 6.4% (column 1) and total revenues transacted through MoMo would increase by 7.2 % (column 3).

Table 5: Impact of MoMo agents on digital total transactions revenues in Rwanda

Variables	(1)	(2)	(3)	(4)
Number of MoMo Agents	0.972*** (0.054)	0.947*** (0.044)	1.133*** (0.106)	1.094*** (0.074)
Constant	7.138*** (0.366)	7.309*** (0.302)	15.123*** (0.721)	15.386*** (0.499)
Observations	248	248	248	248
R-squared	0.957	0.987	0.923	0.979
District FE	YES	YES	YES	YES
Month FE	NO	YES	NO	YES

Notes: Dependent variables are standardized users and total transactions collected through MoMo transactions. Standard errors are clustered at the district level. OLS estimations: *Significant at 10 percent level **Significant at 5 percent level ***Significant at 1 percent level.

In Table 5, it is evident that MoMo agents increase the number of all MoMo users by 5.4% (column 1) and total revenues transacted through MoMo platform would increase by 7.4% (column 3). Such increase in the number of transactions was mainly because people could not move from their homes and the only alternative was to transact online, transfer and withdraw money to and from their mobile wallets.

This reveals that if MTN users were able to transfer and withdraw money across all other competitor operators (Airtel), transactions would even increase considerably. Therefore, interoperability remains a challenge for customers who wish to transact across various operators without switching their service providers. Telecommunication service providers and banks must therefore ensure that payment systems are interoperable to clear this burden.

4.2.4 Covid-19 and Outcome Variables

Next, the study analyses the impact of Covid-19 on economic outcomes under study as contained in the subsequent tables 6-9 using model expressions in *equations (2) and (3)*.

Table 6: Impact of COVID-19 and Online Electricity purchases in Rwanda

Variables	(1)	(2)	(3)	(4)
Lock-down period	-0.075 (0.196)	-4.581*** (0.892)	-0.091 (0.217)	-5.289*** (0.928)
Lock-down x Agent		0.671*** (0.133)		0.774*** (0.141)
Constant	10.451*** (0.049)	10.452*** (0.036)	17.584*** (0.054)	17.585*** (0.041)
Observations	248	248	248	248
R-squared	0.646	0.725	0.656	0.731
District FE	YES	YES	YES	YES

Notes: Dependent variables are standardized users and total electricity revenues collected through MoMo. Standard errors are clustered at the district level. Covid-19 is a dummy variable equal to 1 and 0 if otherwise. OLS estimations: *Significant at 10 percent level **Significant at 5 percent level ***Significant at 1 percent level.

Table 7: Impact of COVID-19 on Online Water bill payments

Variables	(1)	(2)	(3)	(4)
Lock-down period	-0.342*** (0.028)	-1.966*** (0.531)	-0.462*** (0.037)	-2.702*** (0.729)
Lock-down x Agent		0.242** (0.088)		0.334*** (0.120)
Constant	6.088*** (0.007)	6.088*** (0.016)	15.211*** (0.009)	15.211*** (0.022)
Observations	248	248	248	248
R-squared	0.839	0.843	0.799	0.805
District FE	YES	YES	YES	YES

Notes: Dependent variables are standardized users and total water revenues collected through MoMo. Standard errors are clustered at the district level. Covid-19 is a dummy variable equal to 1 and 0 if otherwise. OLS estimations: *Significant at 10 percent level **Significant at 5 percent level ***Significant at 1 percent level.

Although it is clear in Tables 6 & 7 that during lockdown the number of both utility online consumption (electricity & water) users reduced by approximately 4.56 on electricity (column 2), 1.97 on water (column 2) respectively, Interestingly, the results presented in Table 6-7 show that with the interaction of the term $Lockdown_{it} * Agent_{dit}$ (MoMo agents before and after lockdown period), the number of users on both electricity and water online consumption both

increased by 67.1% during the lockdown period and the revenues increased by approximately 77.4% (column 2) respectively while keeping the number of transactions stable. While in Table 7, users on water online consumption increased by 24.2% (column 2) and revenues increased by 33.4% column (4).

The decrease in the number of users on utility online consumption and Irembo services (Table 8) is caused by other unobservable and/or variables beyond the scope of this study but could also be the fact that the study could not control either the number of utility users as well as those using Irembo services. However, I would argue that this could have been caused largely by the fact that many people were locked in their homes during this period, offices were shut, industries were not functioning properly which consumes a lot of energy as well as unavailability of government services through Irembo services.

Table 8: Impact of COVID-19 on IREMBO services in Rwanda

Variables	(1)	(2)	(3)	(4)
Lock-down period	0.163 (0.181)	-4.342*** (0.796)	-0.085 (0.186)	-5.224*** (0.587)
Lock-down x Agent		0.671*** (0.119)		0.765*** (0.090)
Constant	7.650*** (0.045)	7.651*** (0.035)	16.643*** (0.046)	16.644*** (0.034)
Observations	248	248	248	248
R-squared	0.302	0.353	0.380	0.438
District FE	YES	YES	YES	YES

Notes: Dependent variables are standardized MoMo users and total IREMBO revenues collected through MoMo. Standard errors are clustered at the district level. Covid-19 is a dummy variable equal to 1 and 0 if otherwise. OLS estimations: *Significant at 10 percent level **Significant at 5 percent level ***Significant at 1 percent level.

The results in Table 8, suggest that Irembo users and revenues generated through MoMo transactions were 4.342 and 5.224 lower respectively during the lockdown period (column 2) and (column 4). This is true because, during this period, all government services were closed, travels were banned which reduced the number of users requesting Irembo services. However, results further suggest that with the interaction of the term $Lockdown_{it} * Agent_{dit}$, Irembo users and revenues would increase by 67.1% (column 2) and 76.5% (column 4) respectively.

Results further show a decrease of MoMo users on water bills and Irembo services after lockdown, as illustrated in Figure 7 and Figure 8.

The shock during the lockdown on Irembo services may be attributed to the fact that most of the government offices were closed, the number of people paying for taxes reduced because of the closure of businesses, requests for travel documents such as passports were limited since airlines closed their flight operations. A shock on water bill payments after lockdown is likely to have been caused by a return of people to their routine work where they started using other channels of payments as opposed to digital payments.

This further reveal that in long run, this percentage change of people transacting online performed through Irembo would relieve the burden from the government in terms of expenditure spent on printing notes by the Central Bank. The Central Bank would print less notes and make savings on expenditure that goes on printing and distribution of physical money (notes) and would help in promoting a cashless economy.

In the same context, although these measures implemented were aimed at containing the outbreak, they also helped people to start adopting the use of technology, mobile money specifically through buying and selling products online.

It is also worth noting that digital payments on the Irembo portal through MoMo has ensured accountability and promoted efficiency in the use of Government funds because with Irembo services online, money safety is ensured because money lands in the hands of government treasury directly and instantly which minimizes risks of embezzlement of public funds and corruption as it was the case when services were rendered by public servants from their workplaces.

Across the panel data analysis, it is clear from the coefficients of determinations that the value of R^2 is greater than 50% ($R^2 > 50\%$) which explains that the regression result is not a spurious one (Ruzima & Veerachamy, 2015). It is also an indication that generally, MoMo services contribute to the growth of digital payments in the Country.

Table 9: Impact of COVID-19 on Online total transactions

Variables	(1)	(2)	(3)	(4)
Lock-down period	-0.429** (0.176)	-4.591*** (0.757)	-0.612*** (0.204)	-5.437*** (0.771)
Lock-down x Agent		0.620*** (0.115)		0.718*** (0.116)
Constant	13.846*** (0.044)	13.847*** (0.034)	22.965*** (0.051)	22.966*** (0.039)
Observations	248	248	248	248
R-squared	0.663	0.730	0.630	0.700
District FE	YES	YES	YES	YES

Notes: Dependent variables are standardized MoMo users and total revenues collected through MoMo. Standard errors are clustered at the district level. Covid-19 is a dummy variable equal to 1 and 0 if otherwise. OLS estimations: *Significant at 10 percent level **Significant at 5 percent level ***Significant at 1 percent level.

Results further revealed an increase in MoMo total transactions during the period of lockdown, this is attributed to the fact that transactions were conducted with a zero charge and people were not allowed to make movements which were one of the drivers of a huge number of MoMo transactions and revenues generated during this period. Results during this period suggest that the use of technology especially through MoMo transactions could be a useful tool for the country to respond to an economic shock.

The introduction of MomoPay which is MTN's product to help merchants and customers to make payments through MoMo also contributed to the uptake of digital payments during the lockdown. This is evidenced by the high buying values during lockdown where merchants were buying items in big volumes. Although overall, most transactions reduced to a certain extent with a negative impact on outcome variables, Results in Table 9 further confirm with the interaction between lockdown period and MoMo agents, the number of transactions increased by 62% (Column 2) and total revenues generated using MoMo increased by 71.8% (Column 4).

Also, the reason behind this increase is attributed to regulatory measures that introduced Zero charges on all MoMo to Bank transactions as well as Zero charges on individual transfers as instructed jointly by RURA and BNR in attempt to promote a cashless economy and their joint efforts to achieve financial inclusion. Results provide evidence that elimination of transfer fees

was very important during the lockdown, mobile money operators need to ensure that MoMo services are as cheap as cash to encourage users to adopt digital financial services. The government must ensure that all services are available online, it is evident that Irembo services have not been integrated with all services to meet the demand from the public.

In the panel data analysis, although the shocks during the outbreak of Covid-19 reduced the user consumption on most services, I report robustness checks supporting these results where the interaction with MoMo agents especially during lockdown increased the number of digital payments and total revenues which verifies the previous findings by (Jack & Suri, 2014) where he asserted that despite shocks in user consumption, transactions for M-PESA remained stable.

4.2.5 Impact of MoMo on Outcome Variables: Graphical Illustration

The figures below illustrate the impact of Covid-19 on outcome variables especially before and after the lockdown.

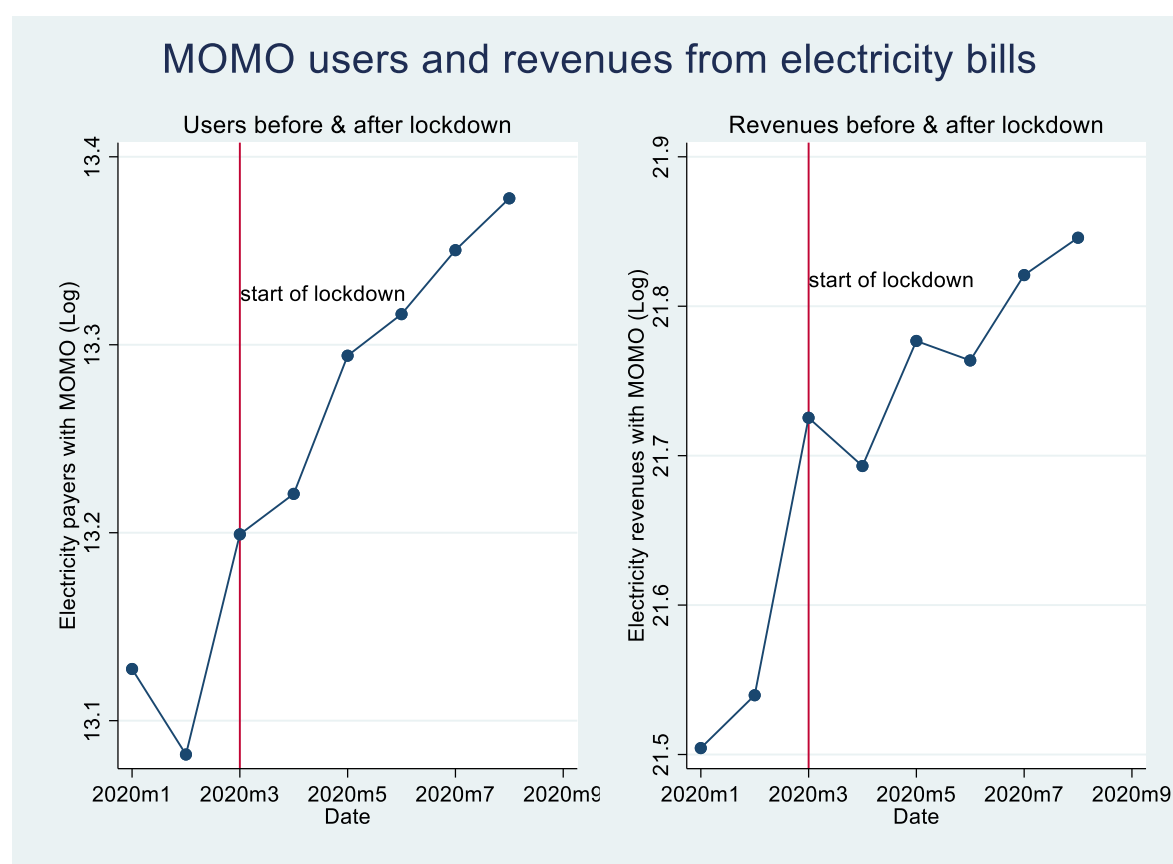


Figure 6: MoMo Users and Electricity Revenues before and after Lockdown

Overall, there was a shock before and after the lockdown on water and Irembo revenues as presented in figures 6-8.

The results indicate a shock on variable outcomes caused by Covid-19 when the government imposed a lockdown on people in the month of March 2020. There was a significant increase in both transactions and revenues during the lockdown mainly because people could not move from their homes and consequently, the use of MoMo service to perform digital payments was the only option where users and revenues on electricity online consumption increased exponentially after the lockdown as shown in

Figure 6.

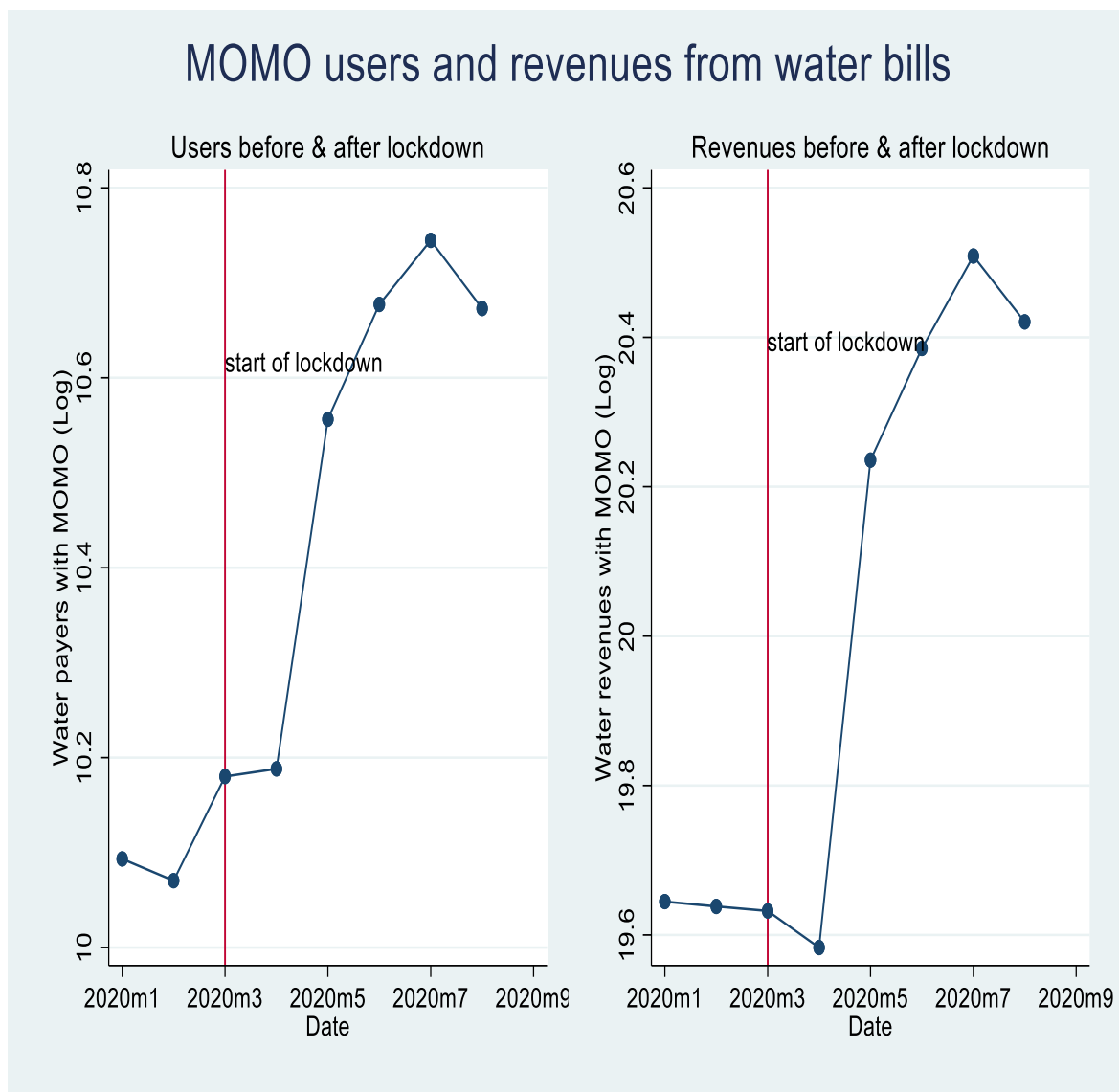


Figure 7: MoMo Users and Water Revenues before and after Lockdown

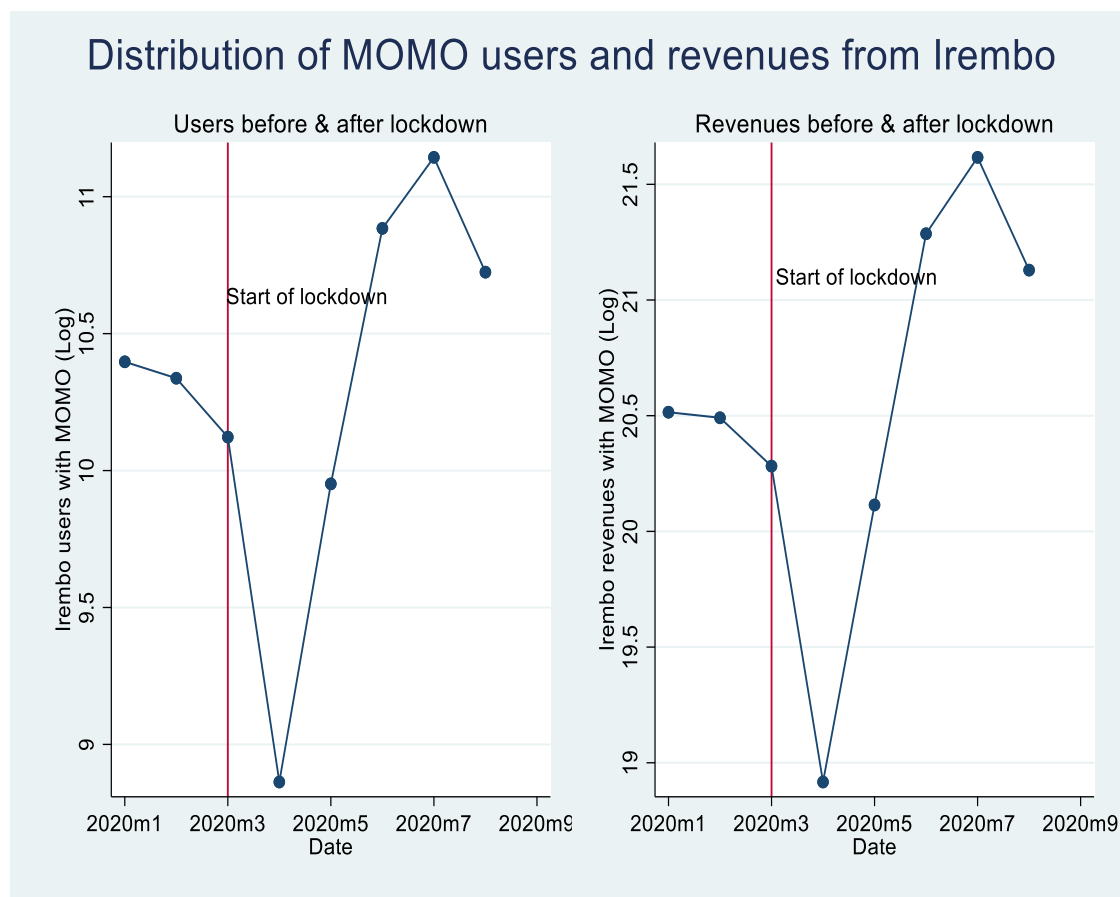


Figure 8: Distribution of MoMo users and Irembo revenues before and after lockdown

4.2.6 Introduction of free MoMo Transfers

The results in figures 6-8 also provides an indication of how mobile money transactions across outcome variables were impacted in the period of three months from March to June, 2020 when the government implemented a free of charge MoMo transfers. There was a significant increase in the number of transactions from March to June, 2020 which provides a clear indication of how government decisions impacted the use of online payments through MoMo transactions during the first months of Covid-19 pandemic.

Therefore, it is evident that in an evident where MTN would reduce transfer charges on all MoMo transactions including MoMo to bank accounts, MoMo users would increase significantly which would also drive the journey of a cashless economy initiated by the government of Rwanda.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

The study aimed at evaluating the potential impact of mobile money uses on digital payments of economic outcomes during the Covid-19 pandemic period (Lockdown) based on rich administrative panel data on digital services from MTN Rwanda, a large Telecommunication company operating in the country. It was composed of monthly data for the Year 2020 from January to October indicating transactions conducted from all thirty (30) districts. Location and period of such transactions were important for this study to determine district and time fixed effects while making it easier to construct panel data with enough observations for better regression analysis.

In this study, I report substantial evidence that overall, MoMo services have a significant impact on economic outcomes under study and together with interaction of MoMo agents, the coefficients of interaction were significantly positive, hence revealing evidence of a statistically significant association between mobile money and outcome variables. It is also evident that increase in the MoMo agents' network would increase the number of digital payments in the country which would be a source of more job opportunities. The interaction with Covid-19 was aimed at giving a picture of how reliance on MoMo service – “a phone-based money transfer product that has been adopted” by many subscribers across the country has changed during Covid-19 pandemic periods and its overall contribution to the adaption of a cashless economy. The interaction of Covid-19 with MoMo agents also indicated how MoMo agents across the districts contributed to helping people to access and conduct online digital transactions especially during lockdown when people could not leave their homes to access other channels of payments.

While investigating the impact of Covid-19 on outcome variables, results further revealed that indeed, there was a significant increase in the number of transactions and corresponding revenues, especially during a lockdown. The increase of MoMo transactions during the Covid-19 period is also attributed to policy measures where fees for individuals and merchants' transfers were slashed to zero. This shows how the government is faster in taking decisions for using online services.

The result from this study are a clear indication that policy makers and regulators can use MoMo transactions data to track the progress and impact of their regulatory measures in real-

time to reveal economic impact based on geographic distribution and serve as evidence to take timely decisions and amend policies accordingly.

For mobile money services to continuously grow, the policy makers, regulators, telecom operators are encouraged to mitigate the underlying issues affecting MoMo services including availability and reliability of the service and issues of fraud and privacy. Regulators and payment service providers must ensure that the service is reliable, secure and always available always for customers. Network coverage issues may slow down the uptake of digital payments when MoMo service is unavailable.

Finally, while the study revealed a significant increase in the number of MoMo transactions and net revenues of outcome variables during the lockdown period, there is a need to determine if this trend will remain consistent Post-Covid-19 period which calls for further research.

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