The Impact of e-Payments on the Economic Growth of Lesotho

Tlotliso D. Mabitle

Faculty of Commerce, Law and Management

WITS Business School

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Dr. Sylvester Horvey

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Abstract

This study examines the impact of e-payments on the economic growth of Lesotho. Time series secondary data covering quarterly range of 2017 till 2024 obtained from the Central Bank of Lesotho (CBL) was used whereby an ARDL model was employed to uncover the relationship between real GDP as a proxy for economic growth, and various types of e-payments activity as dependent variables. These independent variables constituted: ATM deposits, ATM withdrawals, Mobile money transfers, Mobile money deposits, Mobile money withdrawals, Mobile money payments, EFT Payments, and POS Payments.

In this study, ATM withdrawals volumes and EFT Payments volumes were found to be highly significant with a positive relationship to real GDP growth, and similarly value amounts for mobile money transfers, mobile money withdrawals, and Mobile money payments were also found to be highly significant with a positive relationship to the model. However, Mobile money payment values and POS Payments volumes were found to be highly significant but contribute with a negative relationship to the model. The variables exhibiting positive relationship imply those electronic payment types are crucial for economic development thus necessitating increased enhancement and maturing. On the other hand, the two variables which exhibit a negative relationship suggest that there is potential inefficiencies which may hider economic development.

A recommendation to policy makers, both in private and public organizations, is that infrastructure and technology for Mobile Money deposits and POS payments should be prioritised for improvements to uplift customer experience as an attempt to address negative impact of economic growth. Another recommendation to stakeholders such as regulators and investors is that innovation must be encouraged and incentivized towards development of more efficient electronic payments.

Key words: e-payments, economic growth, real GDP

Declaration

I, Tlotliso Mabitle, declare that this is my original work and has not been presented for a degree in any other university. Citations have been captured appropriately and listed on the references section at the end of the study.

Name: Tlotliso Mabitle – 2698897 **Sign:** …… **Date:** ……

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List of Abbreviations

ARDL	Auto-regressive Distributed Lag
ADF	Augmented Dickey-Fuller
APEC	Asia-Pacific Economic Cooperation
BRINCS	Brazil, Russia, India, China and Nigeria
ATM	Automated Teller Machine
CBL	Central Bank of Lesotho
GDP	Gross Domestic Product
EFT	Electronic Fund Transfer
E-PAYMENTS	Electronic Payments
GSMA	Global System for Mobile Communications Association
ICT	Information and Communication Technology
IMF	International Monetary Fund
MENA	Middle East and North Africa
OECD	Organisation for Economic Cooperation and Development
P2P	Person-to-person
B2B	Business-to-business
B2P	Business-to-person
A2C	Authority-to-consumer
POS	Point-of-Sale
SADC	Southern African Development Community
SSA	Sub-Saharan Africa
UNCTAD	United Nations Conference on Trade and Development
USD	United States Dollar

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Chapter 1: Introduction

1.1 Context of the study

In Lesotho, the impact of remittance and settlement transactions on economic growth is influenced by several factors. Primarily, outdated regulatory including framework barriers delayed full adoption of e-payments and digital financial offerings (Nalane et al., 2012). Over the years, the country preferred cash over e-payments owing to scarce penetration of the technology leading to limited adoption both in the rural and semi-urban areas where the masses still live (AFI, 2019). Furthermore, there has been limited interoperability between banks, mobile network operators, and emerging financial technology organizations at large resulting in heightened inertia related e-payments (Brey et al., 2022).

Given these challenges which were uncovered and documented a while ago, some before the COVID-19 pandemic and Russian-Ukraine war, a more recent study on the impact of e-payments on economic growth could contribute immensely to insights sought by policy makers as well as organizational leaders. Efforts have been made to address the challenges such as implementation of a national payment switch to reduce interoperability friction between domestic financial institutions (CBL, 2024). Another notable initiative was the authorization by the CBL to increase limits for transaction amounts on the mobile money platforms (CBL, 2020), further resolving inertia related to cash transactions.

E-payments are becoming an integral part businesses activity as well as normal livelihoods of citizens of Lesotho. The growing importance has been witnessed in the areas of financial inclusion, convenience, and security of handling payments (Sekantsi & Motelle, 2016). Examples include collaborations between tax regulators and mobile money providers where e-payments are used to facilitate agility in the economic activity and simplify processes for remote remittances (Maoeng, 2024). Another example as illustrated by Sekantsi et al., (2016) was the low-cost distribution of financial services afforded through use of e-payments between users which are often separated by huge distances as an efficient alternative to physical cash.

The e-payments landscape is regulated through bills which define and institutionalize oversight of the evolution of technology and protection of users of the systems (Generis Global Legal Services, 2024). It is through this oversight that Lesotho is able to catch-up with digital innovations around the globe, especially with standards which get enforceable on e-payment solutions offered for public and commercial use. Regulator bodies who implement policies for e-payments are: Central Bank of Lesotho (CBL) which enforces compliance with laws, Financial Intelligence Unit (FIU) which watches for money laundering including counterterrorism, and Lesotho Communications Authority (LCA) which focuses on connectivity infrastructure standards.

This chapter briefly discusses the nexus of e-payments technology and economic growth. Then the problem statement and the research gap are laid out.

1.1.1 E-Payments and Technology

Fundamentally, a payment system is an architectural capability that has been developed to facilitate financial transactions. It constitutes evolving regulatory and technology innovations embodied in rules, methods and authorities involved in ensuring efficient transfer of monetary value (Afaha, 2019). E-payments are an alternative option to overcome physical distance challenges or meet urgency needs for transfer of cash by leveraging internet connectivity and penetration of mobile technology (Ani, 2020).

For example, mobile phone penetration in the OECD countries is above 99%, thereby providing a basis for success of e-payments (Wong et al., 2020). Mobile connectivity added value of USD $170 billion to the sub-Saharan Africa, which forms 8.1% of GDP of this region, and will grow to USD $210 billion in a span of a decade for sub-Sahara (GSMA, 2023). According to the World Bank Group (2020), Lesotho's mobile penetration was already saturated above 120% by the year 2017 (World Bank Group, 2020) which is a conducive mobile penetration level for success of e-payments.

E-payments have been categorized in several ways, such as with classification through the underlying technology as in crypto currencies, blockchain currencies, Global Positioning System (GPS), Near-field communication (NFC), Short Message Service (SMS), and mobile applications on WEB3.0 (Srivastava & Rezabek, 2022). Other

classifications follow business models such as cash based systems (debit cards, mobile wallets, and prepaid cards) and account based systems (credit cards and membership cards or loyalty subscriptions), all with the underlying similarity that electronic value is transacted without the need of converting to physical money (Ani, 2020). The current advent of financial innovation and financial technology leverages platforms built upon use of cutting-edge solutions offered by use of big-data, generative pre-trained transformers (GPT), artificial intelligence (AI), augmented reality (AR), and Cloud.

There are few challenges of e-payments solutions which includes perceived issues of privacy, the inherent risks of cybercrime, and as well as tight coupling to effective foundation of ICT, however these are out-weighed by the benefits (Ehiedu, 2020).

1.1.2 The E-Payments and Economic Growth Nexus

Majority of academics converge on findings that e-payments are positively related to economic growth and economic development at large (Killian & Kabanda, 2017; Bulo, 2018; and Khiewngamdee & Yan, 2019; Rooj & Sengupta, 2020). In the past, emerging markets have been inclined to physical cash usage but are now rapidly adopting e-payments (Bulo, 2018). This high diffusion rate in the emerging markets is fueled by reduction of costs of handling cash, and improvement of operations by velocity of cash (Khiewngamdee & Yan, 2019). Since most economic activity is underpinned by movement of funds and information, further innovation and acceptance of e-payments technology exerts a transformational pull factor on other integrating ICT ecosystems, hence additional invigoration of economic productivity at scale (Bulo, 2018).

Financial exclusion was cited as one of the conditions which exert a negative drag effect on economic development, sometimes due to cultural or societal issues and lack of evangelization about benefits of the advanced options of payments provided by digital financial institutions (Rooj & Sengupta, 2020). A solution put forward by academics was that during adoption and deployment of e-payment products, consideration should be taken to heed contextual, social, and psychological norms of the societies to accommodate unique nuances that are key to adoption and diffusion of the technology

(Killian & Kabanda, 2017). Hence it was further confirmed that e-payments are positively related to economic growth and development at large (Khiewngamdee & Yan, 2019).

In this study: person-to-person (p2p), business-to-business (b2b), business-to-person (b2p) and authority-to-consumer (a2c) types of e-payments transactions will be analysed to expose their relationship as independent variables to GDP as the dependent variable.The gap being addressed is that there is limited study of the impact of e-payments on economic growth of Lesotho.

1.2 Research Problem

The IMF (2024) reports a downward trend in the economic growth of Lesotho, compounded by a slow recovery from structural changes in various industries. The real GDP growth has declines from 7.5% in the 1990s, through 6.1% in the early 2010s, to 2.8% in the 2020s (IMF, Kingdom of Lesotho, 2024). The global recession caused by COVID-19 and the Russia-Ukraine war has further impacted the economy. As a result, economic growth is considered a principal issue by Lesotho government (CBL, 2023)

Numerous feasibility studies and strategic plans about technology solutions including e-payments on national level in Lesotho as factors for economic growth, e.g., NSDP II (2018) and UNCTAD (2019), have been conducted. Only one study broadly covering financial inclusion in Lesotho for 2013 to 2015 was discovered as a working paper for CBL and published in 2016. The paper concluded that mobile money operators should work hard to increase internet and network coverage to pave way for financial inclusion (Sekantsi & Motelle, 2016). However, to the best of my knowledge no study has focused on the impact of e-payments on economic growth of Lesotho which this study seeks to address

Without adequate impact studies, the policy makers, the investors, and the public will remain in the dark and will not be informed enough to make decisions about the position to take with regards to e-payments as a priority technological innovation as was highlighted by Jumba et al. (2019) and Awinja et al. (2021). On a policy perspective, the findings of this study could have an implication of promoting wider adoption of e-payments

which could improve financial inclusion to the currently underserved populations (AFI, 2019; Brey et al., 2022; Sekantsi & Motelle, 2016). Additionally, as noted by Brey et al. (2022) in their study, the findings could help suggest areas in the regulatory framework which require robustness to ensure the security and efficiency of e-payment systems, which can build trust among users and encourage adoption. Practically, strategies which will be informed by the findings of this study include optimization of awareness campaigns partnerships between the regulators, private sector, and the public, such as witnessed by Maoeng (2024).

1.3 Purpose Statement

The purpose of this study is to contribute to the bridging of the literature gap by analyzing the impact of the e-payments on the economic growth of Lesotho through conducting ex-post facto quantitative research. In similar studies completed by Soutter et al. (2019) , and Wong et al. (2020), it was found possible to contribute meaningfully and bridge literature gap about the impact of electronic payments on the economy of a country. Specifically, the study focuses on bridging the literature gap in the niche of understanding the direct economic impact through quantification of how the e-payments highlighted in section 1.1.2 contribute to real GDP growth Lesotho.

1.4 Research Questions

The aim of the is to investigate the following questions:

- Are the volumes and values of different e-payment transactions, specifically mobile-money transaction, ATM transactions, and EFT transactions, increasing in Lesotho?
- Does use of e-payments in Lesotho impact real GDP growth?

1.5 Justification of the study

E-payments have globally become a de facto standard of payments as was highlighted by Bulo (2018), hence their impact must be interrogated and understood. Therefore, this study is timely and pertinent since it covers the periods for Lesotho's economic growth before and after global economic shocks caused by the COVID-19 pandemic, as well as the Russia-Ukraine war. It is also unique since it will form one of foundational reference on the topic for Lesotho having established the gap in literature in around this topic. The study will highlight merits or demerits of e-payments to the regulators, the financial sector, as well as the public of the as was uncovered in similar studies such as Sreenu (2020).

1.6 Delimitations of the study

The scope of this study was restricted to e-payments as sub-section within a wider payment system in Lesotho. Real GDP is used as a proxy for measurement of the economic growth, and the period covered is restricted to ten years.

1.7 Assumptions

The study harbored the assumption that adoption of e-payments, related complementary technologies such as e-commerce, as well as basic supporting technologies including highspeed internet connectivity, cybersecurity, and smart devices will continue at an increasing rate. Also, the study assumed the economic conditions of Lesotho will remain relatively stable, allowing for the assessment of e-payments' impact without significant external economic shocks. Over and above, the assumption was that principal stakeholders such as the investors in private sector, the regulators, and the government will continue to support the expansion of e-payment systems through favorable policies and regulation. Lastly, as was the case in Bulo (2018), the study assumed that each specific type of e-payment activity being observed and measured was likely to influence the wider systems policies and strategies, hence in turn impact economic growth.

Chapter 2: Literature review

2.1 Theoretical Review

Economic theories provide frameworks for understanding how economies function, grow, and interact. This section briefly highlights the theoretical principles as a background of the hypothesis and models which were developed for this study. These theories are relevant in the fields of study covering macroeconomics, technology, and engineering hence necessary as a prelude to the hypothesis.

2.1.1 Classical Economics

Scholars widely attribute foundation of Classical economics to Adam Smith in the 18th century, who advanced the theory that free markets are self-regulating and that individuals acting in their own self-interest unintentionally benefit society as a whole (Boldeanu & Constatinescu, 2015). This theory emphasizes the efficiency of free markets and minimal government intervention. Researchers agree that the dominant notion from Smith's Classical economic theory is that the rate of capital formation and capital accumulation (Piętak, 2014) is the fundamental determinant of economic growth (Ucak, 2015).

Classical Economics lay emphasis on the efficiency of free markets with minimal intervention from government which can lead to optimal and self-regulating resource allocation as a positive attribute. However, the potential weakness of classical economics is that it assumes perfect competition of the suppliers and rational behavior of consumers, which is not always realistic, and are often the cause of market failures and inequalities. While classical economic theory lay foundation to understanding economic growth, its applicability to modern economies undergoing technological transformations like Lesotho, is limited since the determinants of economic growth evolves with passage of time (Boldeanu & Constatinescu, 2015).

2.1.2 Neo-Classical Economics: the Solow Growth Model

In their review of international literature, Chirwa et al., (2016) studied macroeconomic determinants of economic growth covering neoclassical growth theories amongst others. In their study, accumulation of physical capital as a determinant of economic growth in the short run was acknowledged, however, technological advancement is put forward as the key determinant in the long run as first proposed by Robert Solow (Chirwa & Odhiambo, 2016). For example, it was demonstrated that the share of land, labour, and capital were less significant in the economic growth of the United States of America (USA) when compared to the technological progress as a source of economic growth of the USA (Piętak, 2014).

The neoclassical form of the Solow Growth Model of economic growth expressed by the aggregate productivity function can be captured in terms of capital $K_{(t)}$, and labour $L_{(t)}$, as depicted in the equation below (Dykas et al., 2023):

$$Y_{(t)} = f(K_{(t)}, L_{(t)})$$

$$(\ldots equation\ 1)$$

However, foregoing from Thomas et al., (2016), the contemporary measurement of productivity in an economy includes technology or the state of knowledge of how to optimally configure ideas and information for an uplift in output. In the contemporary form, the model highlights iron logic of diminishing returns which bring productivity to a steady state, which can be resuscitated by technology $A_{(t)}$ as depicted below:

$$Y_{(t)} = f(K_{(t)}, L_{(t)}, A_{(t)})$$

$$(\ldots equation\ 2)$$

Ideas and technology thrust productivity into cutting edge economic growth (Marginal Revolution University, 2016). As mentioned by Piętak (2014), the Solow Growth Model narrows the measurement of economic growth to a technological development problem, and as such this study bases itself on this theory as it closely aligns to the concept of e-payments which is a technological advancement.

With a strong emphasis, The Solow Growth Model highlights the importance of technological advancement in long-term economic growth, providing a framework for understanding how use of information and ideas innovatively drives productivity, however the postulation of diminishing returns to capital and labor, may not fully capture the complexities of economic growth in developing countries such as Lesotho. Having considered the potential relevance, this theory highly aligns with the concept of e-payments as a technological advancement that can drive economic growth in Lesotho.

2.1.3 The Endogeneity Growth Theory

Another noteworthy theory is the endogeneity growth theory postulates that the level of performance of an economy is related to the level of financial systems development, technology, innovation, and income sharing (Bulo, 2018). With this theory, the implied investment into technology, research, and development, results in reduced cost and improved efficiencies in the output of goods and services (Wong et al., 2020).

The mention of this theory in this study was to bolster the relevance of technology advancements in the pursuit of improved and efficient payment mechanisms within financial institutions offered by way of e-payments. The Endogeneity Growth Theory integrates technology, innovation, and financial systems development as key drivers of economic growth, emphasizing the role of endogenous factors. The downside of this theory might be that challenging to measure and quantify the impact of these endogenous factors to overall economic growth. Having considered both arguments for relevance, theory supports the assertion that investment in technology and innovation, such as e-payments, can lead to improved efficiencies and economic growth, making it appropriate to build a framework for this study upon.

2.1.4 Unified Theory of Acceptance and Use of Technology

Lastly, the Unified Theory of Acceptance and Use of Technology (UTAUT) was also found as complementary and providing insight into the social side of how technology becomes a key determinant of economic growth. This theory posited that the acceptance and use of a technology is dependent on the perceived usefulness of the technology, the advantage that is gained by performance, the learning curve, the prevailing cultural or demographic influences, and prerequisite conditions such as experience or education level. (Killian & Kabanda, 2017). UTAUT also encompasses the Diffusion of Innovation Theory (DOI) which states that the acceptance of new ideas is driven by push and pull interactions amongst individuals as they perform their productive duties (Bulo, 2018). As was uncovered, advances in technology define the lag between developed countries and poor countries in terms of economic growth (Boldeanu & Constatinescu, 2015).

The strength of UTAUT is that it provides a comprehensive framework for understanding the social and psychological factors influencing technology adoption, which is crucial for assessing the acceptance of e-payments. On the other hand, the perceived weakness might be that require extensive qualitative data on user perceptions and behaviors, which can be difficult to collect. UTAUT is relevant to this study as it helps explain how e-payments can be adopted and used by the population, influencing economic growth through increased financial inclusion and efficiency much pertinent to developing countries such as Lesotho.

In consolidation, while the assessed theories of economic growth and development have notable relevance in formulation of a framework on which to base this study on, the neo-classical theory depicted by The Solow Growth Model is the most relevant, hence upon which the conceptual framework was constructed, with strong support from principles of the Endogeneity Theory and UTAUT.

2.2 Empirical Review

This section reviews studies that were conducted in other geographical areas to uncover the impact of e-payments on economic growth. It has been divided into geographical subsections, beginning with global view and zooming in to Africa, and ultimately Lesotho.

2.2.1 Outside Africa

Featured in Moody's Analytics in 2013, it was highlighted that usage of e-payments contributed 0.8% increase in GDP to emerging markets (Zandi et al., 2013). In their later study in 2021, Moody's Analytics revealed the contribution of payment cards to the global GDP has been 0.3% (Zandi & Singh, 2021). The OECD also continually grapple with implementing advance real-time economy growth targets underpinned by digitalization and integration of ecosystems (Verohallinto, 2022), and improvement of cashless payments which reduce friction in the economy (Deloitte LLP, 2019). To this effect, studies, emphasize that investments must include improvement of skills, income, infrastructure, and integration of technology capabilities (Gherghina et al., 2021).

Khiewngamdee et, al. (2019) conducted a study on the role of Fintech e-payment on APEC countries to uncover countries whether e-payments affects economic development. The finding was that economic development impact significant within the developing member countries than those already classified as developed. For example, impact was significant on income growth, productivity, and price volatility amongst others.

Sreenu (2020) undertook an exploratory study on cashless payment policy and its effects on economic growth of India, which concluded that there was impact of e-payments on economic development: e-payment product promotion, increase user experience, and continued performance of the information technology employed have a significant positive correlation with cashless payments. Wong et. al, (2020) undertook similar research about cashless payments and its association to economic growth in selected OECD countries. The revelation was that debit cards do stimulate economic growth and relate positively to each other. In another account, Rooj et. al, (2020) performed an analysis of digital payment systems and the economic growth of India. In

that study as well, it was exposed that real time gross settlements and economic activity dynamically influence each other in a bidirectional relationship.

More recently, Srivastava et al., (2022) conducted an impact analysis of digital payments on the economic growth of the Czech Republic. In this case there was existent evidence that a positive relationship between digital payments and economic growth, however the margin was not enough to persuade full investment into payment infrastructure. The quoted possible reason was that potentially the data used was not adequate enough to run the validation tests (Srivastava & Rezabek, 2022).

In a study conducted in Ukraine about the impact of digitalization on ensuring economic growth whereby the aim in this case was to intterogate other studies and theory to come up with a model and methodoly to track the economic impact of ICT on any other industry. The conclusion derived a model that confirms that higher digitalization is an enabler for a sustainable economic growth (Novikova et al., 2022).

Other contributions of noteworthy study covering BRINCS, MENA, SSA also converge on the conclusion that there is a positive relationship between e-payments and increase in economic growth in the incumbent countries, those in Africa as well as their partners in economic trade communities. Bulo (2018) further assets that the impact of the e-payments is influenced by country specific policies and strategies regarding the payments systems where entrepreneurial individuals and authorities archive superior efficiencies.

2.2.2 Africa and Sub-Saharan Africa

Killian, et. al (2017) undertook research about middle income population's understanding and adoption of the mobile payments in South Africa. Though this study is indirectly related to economic growth, it is directly related to economic development as a larger set to indicators of economic welfare and livelihood of the communities. Factor affecting adoption of mobile payments were examined and explained using theoretical frameworks such as the Technology Acceptance Model (TAM) and Diffusion of Innovation

(DOI) framework which explain models that induce and increase economic activity in a geographical area and time dispensation.

A good footprint of academic research about the impact of digital payments on economic growth has been conducted in Nigeria, converging on the outcome that there exists a significant positive relationship between e-payments and economic growth (Afaha, 2019; Ehiedu, 2020; and Andrea, Udeh, & Allison, 2022). The discoveries were consistent with those concluded half a century ago about the positive relationship cashless economy on Nigeria's economic development (Mieseigha & Ogbodo, 2013).

Observation is that determined jurisdictions achieve greater results in their fintech and e-payment adoption by leveraging ICT (Andrea et al., 2022). Catalysis on adoption of e-payment solutions in African countries hinges on the proliferation of fast, reliable internet connectivity (Bahrini & Qaffas, 2019). Evolving policy and technology frameworks also play a major role for countries that lead in the adoption of advanced implementation of e-payment solutions (Soutter et al., 2019).

2.2.3 Review of Studies in Lesotho

A recent macroeconomic report for Lesotho states the real GDP growth of Lesotho as 2.3% and projected to increase to 2.5% by 2025. (IMF, Kingdom of Lesotho, 2024).The country is part of the sub-Saharan countries, and a member of Southern African Development Community (SADC) which is categorized among the least developed countries. Just before the grip of COVID-19, Lesotho undertook an assessment which revealed that deliberate policy efforts should be undertaken to develop e-payments systems in an attempt to ignite economic growth (UNCTAD, 2019).

Reported in Lesotho's National Strategic Development Plan II (NSDP II) of 2018/19 to 2022/23, the number of mobile network operators remained level at two, while there was a steady growth of mobile money agents as well as a steady growth in registered mobile money accounts (Government of Lesotho, 2018). With commercial banks, the number of ATMS and POS terminals grew steadily. On average, growth observed on adoption of financial services offered by mobile network operators was faster than that of

commercial banks. Lesotho has named technology and innovation as key priority on the NSDP.

In a closely related study about financial inclusion focusing on the penetration of mobile money in Lesotho, Sekantsi et al., (2016) found a strong evidence of long run steady state relationship between financial inclusion and mobile money. Additionally, it was found that mobile money Granger causes financial inclusion in both the short run and long run in Lesotho. The recommendation urged policy makers in Lesotho to promote investments in mobile phone technology and its related financial services.

In summary, the literature review explored the theoretical and empirical foundations of the impact of e-payments on economic growth. Theoretical frameworks such as Classical Economics, the Solow Growth Model, Endogeneity Growth Theory, and the UTAUT were discussed to provide a basis for the study's hypothesis. Empirical studies from various regions, including global, Africa, and Lesotho, were reviewed to highlight the positive relationship between e-payments and economic growth. Research indicated that e-payments contributed significantly to GDP growth, with technological advancements playing a crucial role. The literature review concluded with a focus on Lesotho, emphasizing the need for policy efforts to develop e-payment systems to boost economic growth.

2.2.4 Hypothesis

Deriving logic from the empirical literature view above, the following two hypotheses can be made:

- *H_1 = An increase in the volumes and values of remittance transactions leads to an increase in real GDP. The Solow Growth Model, the Endogeneity Growth Theory, and the UTAUT support this hypothesis by emphasizing the role of technological advancements and financial systems development in driving economic growth.*

- *H_2 = An increase in the volumes and values of settlement transactions leads to an increase in real GDP. The Solow Growth Model, the Endogeneity Growth Theory, and the UTAUT support this hypothesis by emphasizing the role of technological advancements and financial systems development in driving economic growth.*

2.3 Conceptual Framework

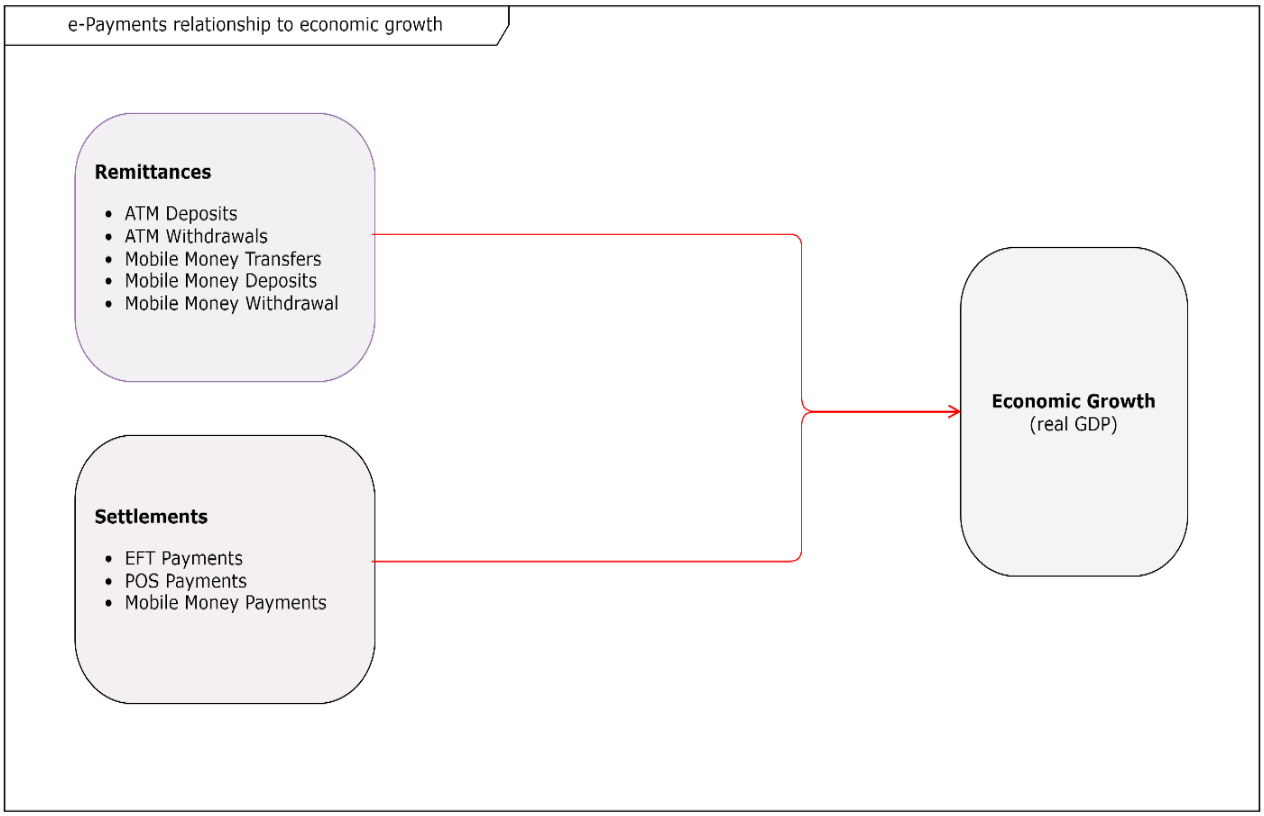

Figure 1: *Conceptual Framework of the positive relationship between e-payments and economic growth (Source: author)*

Chapter 3: Methodology

3.1 Research Design

This study adopted a quantitative research approach which involves systematic collection and analysis of numerical data to understand relationships and trends. In a quantitative approach, researchers develop hypotheses in line with theoretical and empirical literature, then use deductive reasoning upon collecting and analyzing data to confirm or reject the hypotheses (Williams, 2021). Below is the breakdown of this approach and why it was suitable for studying the impact of e-payments on the economic growth of Lesotho:

Foremost, the quantitative approach provide a framework for testing the causal relationships between independent variables and their impact on dependent variable, making predictions, and generalizing results to wider populations (Sreekumar, 2023). The structure ensures that the “ex-post-facto” data collected is consistent and can be easily compared and examined quantifiably with methods such as statical techniques for descriptive and inferential analysis (Taherdoost, 2022).

Additionally, as alluded by Taherdoost (2022), a quantitative design approach focuses on maximizing objectivity and replicability of a study. This is to an extent such that reliability of the findings can be independently validated by the audience of the research report who are typically fellow scholars or even policy and decision makers of various institutions (Harwell, n.d.).

Therefore, a quantitative design approach was followed as the most suitable for this study economic data such as real GDP growth rates, e-payment transaction volumes, and other financial indicators are typically available in numerical form, making them suitable for quantitative analysis. Also, this approach allows for the generalization of results from a sample to the larger population, for example findings from a study on a sample of e-payment users in Lesotho can be applied to the broader population and provide data-driven insights that can inform economic policies or strategies for further efficiency gains.

3.2 Research Paradigm

A positivist research paradigm has been adopted for this research. Studies rooted in positivism typically aim to identify explanatory associations or causal relationships using quantitative methods. Positivism aligns with the hypothetico-deductive model of science, which emphasizes verifying pre-established hypotheses through experimentation and the operationalization of variables and measures. Hypothesis testing in this model is used to inform and advance scientific knowledge (Park et al., 2020).

According to their study, Park et al., (2020) argued that the key definitions that must be considered when dealing with a positivism research paradigm include:

- Hypothesis which is a scientifically testable idea derived from literature
- Dependent variable as key measures of the study
- Independent variables as facts which influence the dependent variable
- Hypothetico-deductive model which based on the hypothesis and develops a way through which to confirm or reject the hypothesis

3.3 Data Source and Collection Technique

Secondary data was extracted and provided by CBL using predefined data descriptors which classify the variables as operationalized in the paradigm design above. Available data covered a range from 2017 to 2024 of electronic banking volumetric activity as well as mobile money activity data. For the same period, values for mobile money transactions were also obtained CBL, however corresponding values for electronic banking could not be obtained. The CBL, as a regulator, is a reputable and authoritative source for financial data in Lesotho, ensuring the reliability and accuracy of the data provided such the one obtained and used in this study. Expert led collection, preparation, and presentation of the CBL's data ensures its reliability for use by other stakeholders including academics for economic analysis.

Furthermore, a matching range of 2017 to 2024 for Lesotho's GDP price levels, real GDP growth rate, and Population numbers were extracted from IMF (n.d.). The IMF datasets include both historical data and projections covering 2017 to 2024. These

projections are based on economic models and expert analysis, making them a reliable source for research purposes and feed into new models for predictions. These models are used to project the dataset beyond the most recent historical data, allowing for a comprehensive analysis of trends and potential future outcomes. The actual price levels of Lesotho's real GDP were extracted from Worldometer in USD format (Worldometer, n.d.). Worldometer is known for providing up-to-date and accurate statistical data, which is essential for ensuring the validity of the research findings.

As was adopted in their research, Wong et al., (2020), and Srivastava et al., (2022), secondary data was conveniently used to analyze the impact of cashless payments on economic growth. Use of secondary data provides convenience in terms of cost and time spend to collate the data. The data was analyzed through use of a mechanical instrument on a desktop by using a statistical analysis software as was leveraged by Ehiedu et al., (2022) in a study of the effect of cashless policy model on economic growth. Similarly, using projections is justified in this study as it allows for the examination of the potential impact of e-payments on economic growth over a longer period, providing valuable insights for policymakers and stakeholders.

3.4 Variable definitions

Dependent Variable: Economic Growth

This study used real GDP as a proxy for economic growth. Real GDP is an inflation-adjusted metric that represents the value of all goods and services produced by an economy within a given year (Ganti , 2025). Researchers have concluded that changes in real GDP effectively capture shifts in economic wellbeing (Dynan & Sheiner, 2018), and that real GDP is esteemed as one of the most closely monitored aggregate economic indicators particularly in studies examining the causal relationship involving economic growth, as represented by real GDP (Nyasha & Odhiambo, 2019). The use of real GDP was favorable since it inherently controls for effects of inflation.

One of the ways of calculating real GDP growth rates is through quantification of the inputs of economic process widely accepted as: *(i) direct factors* which include labour,

physical capital, and technology; and *(ii) indirect factors* which comprise policies, regulatory frameworks, and socio-ecological sustainability plans (Georgescu et al., 2021).

The technology part which is a direct factor in the quantification process as seen above has been defined as the state of knowledge of how to optimally configure a combination of scarce resources in order to produce goods and services which are either ready for consumption, or used in the pipeline to produce for consumption (Thomas & Maurice, 2016). Studies have revealed that digital payments technology has increased in popularity in the last decade (Awinja & Fatoki, 2021), and that there is positive benefit associated to cash liquidity and cash handling costs, hence increase in economic activity and profits which directly contribute to economic growth (Jumba & Wepukhulu, 2019).

Independent Variable: E-Payment

World Bank Group (2020) pronounced that electronic payments (e-payments) are a subset within a broader range digital financial services and products which is promoted to archive efficiency and security in handling cash. Soutter et al., (2019) also confers that e-payments are at the core of success for FinTech models and innovations. Within this context, UNCTAD (2019) further acknowledges e-payments as an appropriate solution to stimulate economic growth by providing access to finance and capacity to address needs of the present-day digital economy.

As was employed by Afaha (2019), a set of independent variables were selected to be tested for correlation, significance and causality to uncover the impact their impact on the GDP as the dependent variable. Table 1 depicts the proxies for independent variables and control variables which were employed for this study whereby the variables are measured in monetary terms, Lesotho Loti (LSL), and are aggregated over the specified time periods of 2017 to 2014.

Table 1: *Expected Signs of Regression Coefficients*

Expected sign of regression as per hypotheses	
Name	**Sign**
Independent Variable	
ATM deposits	+
ATM withdrawals	+
Mobile money transfers	+
Mobile money deposits	+
Mobile money withdrawals	+
Mobile money payments	+
EFT Payments	+
POS Payments	+
Dependent Variable	
Real GDP	
Control Variables	
Population Growth	+

Source: Author

For measurement and quantification purpose, the study employs a set of independent variables to test for correlation, significance, and causality with GDP. These variables include:

- ATM Deposits: Total transactions of deposits made through ATMs.
- ATM Withdrawals: Total transactions of withdrawals made through ATMs.
- Mobile Money Transfers: Total transactions of money transferred as mobile money.
- Mobile Money Deposits: Total transactions of deposits made as mobile money.
- Mobile Money Withdrawals: Total transactions of withdrawals made as mobile money.
- Mobile Money Payments: Total transactions of payments made as mobile money.
- EFT Payments: Total transactions of electronic funds transfers.
- POS Payments: Total transactions made over point-of-sale platforms.

Control Variable: Population Growth

While the hypothesis put forward for this study was based on the Solow Growth model which acknowledges the effect both labour force and technology on sustained economic growth, the role of population growth had to be addressed and isolated for purposes of this study. Population growth is defined as the increase in population size over a given period due to more births than deaths, and net migration more immigrants than emigrants (INED, n.d.).

Research has uncovered that population growth significantly influences economic growth through effects of labor supply and consumer demand (Brida et al., 2024) hence the necessitation to control for its influence economic studies because it helps isolate the effects of on other variables on economic growth, ensuring more accurate and reliable results

3.5 Sampling, Sample Size , and Limitations

The aim was to analyze all the data in the collected population set covering 2013 to 2024. The duration of ten years covered in the sample size is assumed to be sufficient and pose no data incompleteness bias during statistical analysis using Autoregressive Distributive Lag (ARDL) modeling since the number of observations would be greater than required minimum of 28 (Nkoro & Uko, 2016). The selected sample size aligns to sample sizes used by Andrea et al., (2022) in a study of the effect of e-payments on GDP.

3.6 Quality Assurance and Ethical Considerations

The external and internal validity measures for research quality assurance pertaining to the sample being studied are catered for in the econometric model and tests in the following section which details the instrument. As for the reliability of the data, complete normalization will be pivoted on the operational variables, then complete record of the metadata will be taken and used to validate the data throughout the testing and analysis stages. Since data sample are a national aggregate level, issues of personally identifiable data are not present.

3.7 Measurement Model and Operationalization of Variables

Since the phenomena being studied was continuous in time between the periods selected for the sample size, a time series model was appropriate for testing the relationship between the independent variables and the dependent variable. This was consistent with the models derived by Afaha (2019). Below equation depicts the time series model for this study:

$$Y_t = \beta_0 + \beta_1 ATMD_t + \beta_2 ATMW_t + \beta_3 MMT_t + \beta_4 MMD_t + \beta_5 MMW_t + \beta_6 MMP_t + \beta_7 EFTP_t + \beta_8 POSP_t + PG_t + \varepsilon_t \quad (\ldots equation\ 3)$$

The variables in the linear model in equation 3 operationalize as shown in table 2 below:

***Table 2**: Independent variables considered as part of the model*

Operationalization of Variables	
$ATMD_t$:	Aggregate ATM Deposits at time *t,*
$ATMW_t$:	Aggregate ATM Withdrawals at time *t,*
MMT_t:	Aggregate Mobile Money Transfers at time *t,*
MMD_t:	Aggregate Mobile Money Deposit at time *t,*
MMW_t:	Aggregate Mobile Money Withdrawal at time *t,*
MMP_t:	Aggregate Mobile Money Payment at time *t,*
$EFTP_t$:	Aggregate EFT Payments at time *t,*
$POSP_t$:	Aggregate POS Payment at time *t,*
PG_t:	Population Growth at time *t held constant at begging of time t,*
ε_t:	Error term at time *t*, and
β_0 to β_8:	Regression coefficients.

Source: Author

The control variable, *PG*, is held constant at the begging of each period *t* to control endogeneity influences. Two tests are performed to determine the influence of PG, one with it in the model and the other without it.

3.8 Data Analysis Strategies and Interpretation

During pre-testing, stationarity was determined first by using Augmented Dickey-Fuller (ADF) test. The ADF model equation is depicted below, which shows a differencing of the lagged values of the dependent variable Y_t as was shown earlier in *equation 3*:

$$Y_t - Y_{t-1} = \rho Y_{t-1} - Y_{t-1} - \varepsilon_t$$
$$= (\rho - 1)Y_{t-1} - \varepsilon_t$$

$$\Rightarrow \quad \Delta Y_t = \delta Y_{t-1} - \varepsilon_t$$

$$(\ldots equation\ 4)$$

Whereby $\delta = (\rho - 1)$. This means if $\rho = 1, then\ \delta = 0$, and in this case the time series under consideration is non-stationary or has a unit zero according to ADF test and would result in spurious correlation which cannot be further interpreted for cointegration (Nkoro & Uko, 2016).

Once stationarity was determined ARDL test was used to determine cointegration; the choice of test model depends on the order level at which stationarity was established. Afaha (2019) and Andrea et al., (2022) also employed ARDL model in a similar study. Each independent variables was tested for statistical significance relationship to GDP individually first by holding the other coefficients at $\beta_n = 0$ at a time, then the total relationship was also tested. *P-values* were employed to ascertain the significance of the relationship in all cases as a measure to validate the hypotheses, and the model fit was tested using R^2. Additionally, stability of the long run relationship model was tested using CUSUM of squares, and data was confirmed to be normally distributed.

Chapter 4: Interpretation of Results

4.1 Descriptive Statistics

Raw data was used for computing descriptive statistics for the datasets. As captured in Table 3 below, the number of observations from available electronic banking data is 30 per dataset, and the rest is 31 observations per dataset. The data covers the range of 2017 to 2024.

Table 3: *Mean, Min, Max, Std. Dev, and number of Observations used in the model*

Dependent Variable	**Mean**	**Min**	**Max**	**Std. Dev**	**Obs***
Real GDP	41 664 193 548,39	37 656 000 000,00	44 496 000 000,00	2 166 080 411,63	31
Control Variable					
Population Growth	2 080 645	2 021 000	2 164 000	46 380	31
Independent Variables					
Volumes (Activity)					
Bank ATM Withdrawals	2 072 058	1 634 637	2 419 560	207 943	30
Bank EFTs	737 718	140 559	1 323 318	338 465	30
Bank POS Payments	1 088 963	310 405	2 312 996	583 884	30
Mobile Money Deposits	3 793 519	1 393 047	6 487 071	1 456 349	31
Mobile Money Payments	5 278 567	3 786 755	6 547 396	583 547	31
Mobile Money Transfers	3 156 300	935 785	5 587 725	1 491 846	31
Mobile Money Withdrawals	3 391 360	899 492	6 391 665	1 615 388	31
Values (Amounts)					
Mobile Money Deposits	1 097 743 270,98	331 740 641,93	2 337 370 411,30	548 826 520,87	31
Mobile Money Payments	301 227 502,74	90 555 395,04	585 280 134,46	140 275 282,22	31
Mobile Money Transfers	1 120 078 567,83	261 344 122,76	2 651 053 025,94	732 347 842,58	31
Mobile Money Withdrawals	970 481 870,02	202 714 060,20	2 175 670 626,03	532 790 545,61	31

Note: Obs denotes the number of observations*, Source: CBL

4.1.1Trend Analysis

As illustrated in Figure 2 and Figure 3 below, Lesotho's population is around 2,2 million people, with growth that was almost stable at 0,7% from year 2017 and jumped to around 1,5% after year 2020. The population growth jump from 2020 to 2021 was attributed to several factors. One significant cause was a higher birth rate, with 23.3 births per 1,000 population in 2021. Additionally, improvements in healthcare and a reduction in the death rate, which was 11.41 deaths per 1,000 population in 2021, contributed to the natural increase in population. Net migration remained negative, but the overall natural increase was sufficient to drive population growth (Index Mundi, 2021).

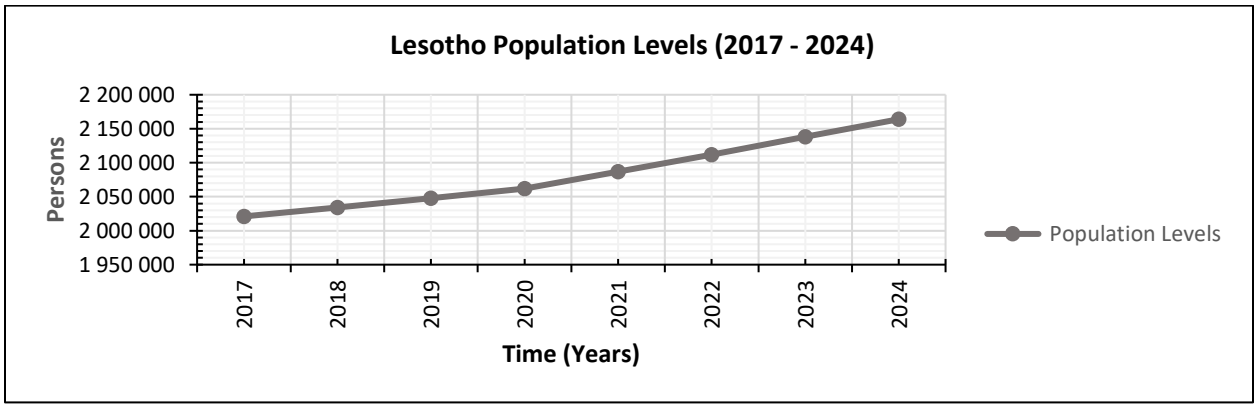

Figure 2: *Lesotho Population. Source: IMF, 2024*

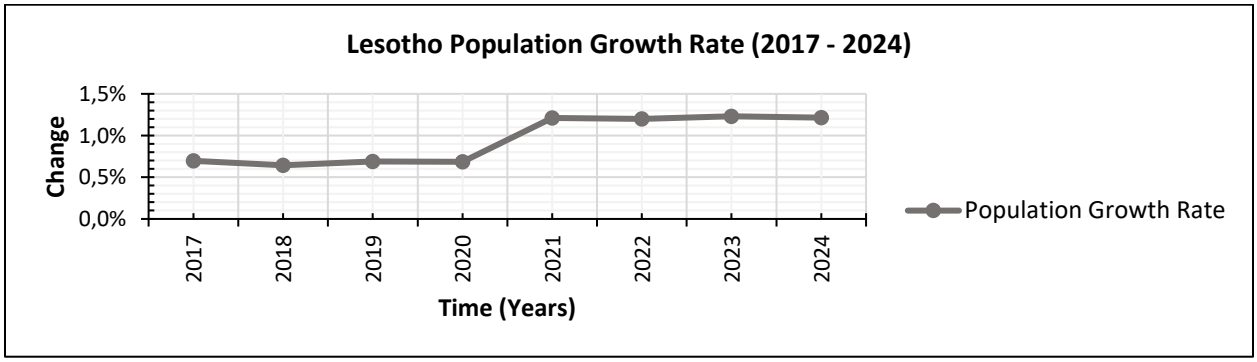

Figure 3*: Derived from Populations levels data in Figure 2*

As seen in Figure 4, GDP levels were on a sharp decline from 2018, with real GDP growth rate at the lowest measure of -5,3% in 2020 depicted in Figure 5 where the cause has been attributed to the COVID-19 pandemic (CBL, 2023). The recovery of the economy observed in 2021 was fueled by increased government spending in construction projects according to CBL (2023).

According to the Bureau of Statics (2021) in Lesotho decline in Lesotho's real GDP from 2017 to 2020 was primarily due to poor performance in several key sectors. For example, the Accommodation and Food Services, Construction, Wholesale and Retail Trade, and Mining and Quarrying sectors experienced significant declines (Bureau of Statistics, 2021).

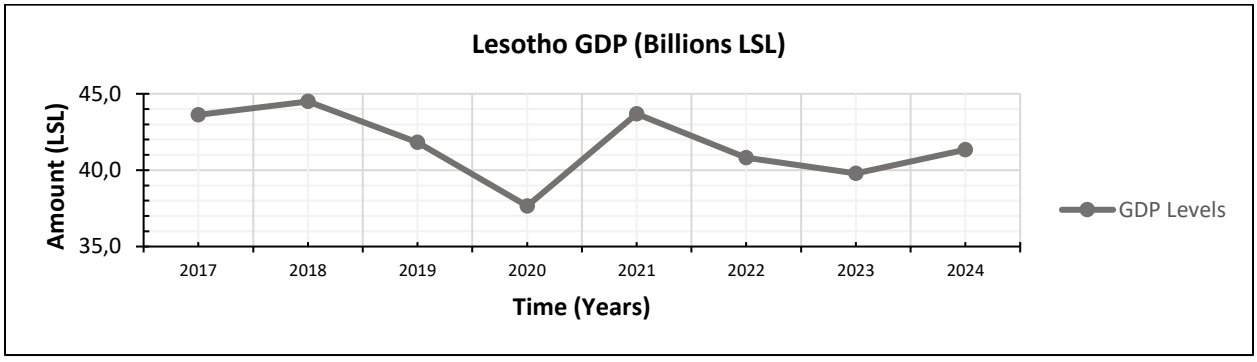

Figure 4: *Lesotho GDP. Source: IMF, 2024*

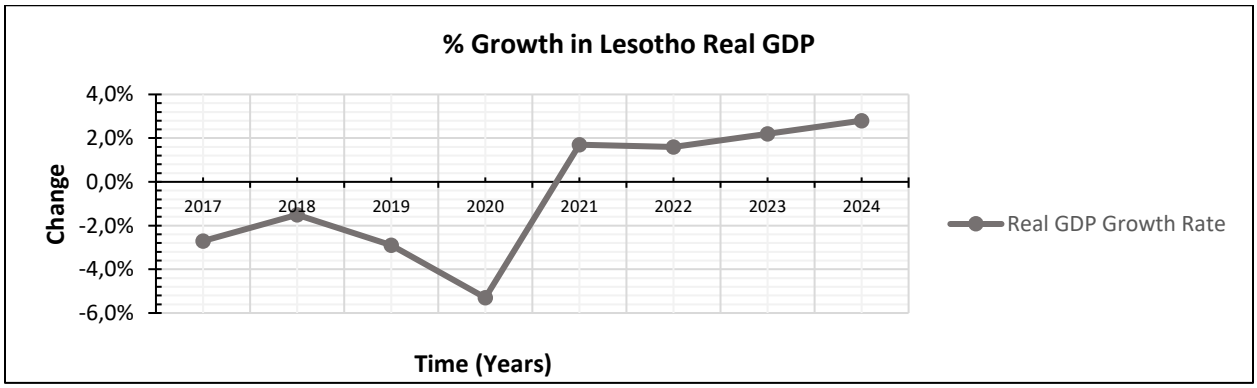

Figure 5: *Lesotho Real GDP Growth Rate. IMF, 2024*

The graphs for e-payments activity depict a positive upward trend at levels, and their growth rates converge around a certain mean ranging from -11% to 30% mean growth for the various variables as observed in Figures 6-11.

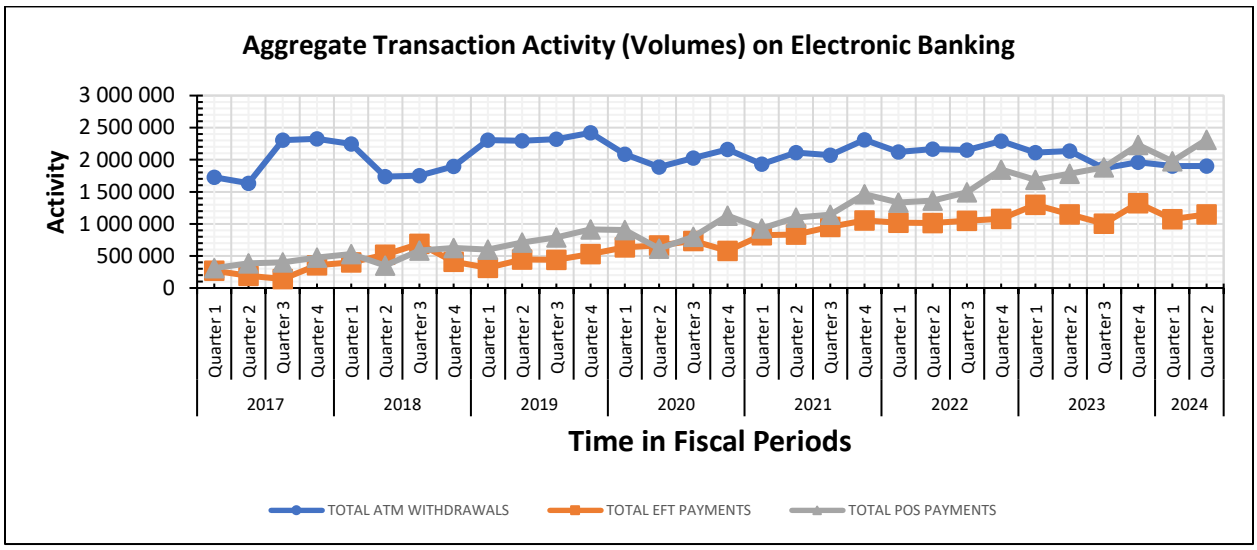

Figure 6: *Banking Activity Data (ATM Withdrawals, EFT Payments, POS Payments). Source: CBL, 2024*

Figure 6 show overall decline of ATM withdrawals from quarter 4 of 2019, but a ramp up in EFT payments and POS payments at the same time. These changes coincide with the period when COVID-19 lockdown was enacted in Lesotho and around the world which led people to adopt full electronic payments as opposed to handling cash. The trends seemingly persists and is explainable through the lens of the UTAUT theory (Killian & Kabanda, 2017) and the DOI framework (Bulo, 2018).

Figure 7 conveys that the volatile growth behavior of the activity in electronic banking has subsided over the past four years, suggesting maturity and market saturation of the products and services being rendered in this area according to the TAM framework (Killian & Kabanda, 2017).

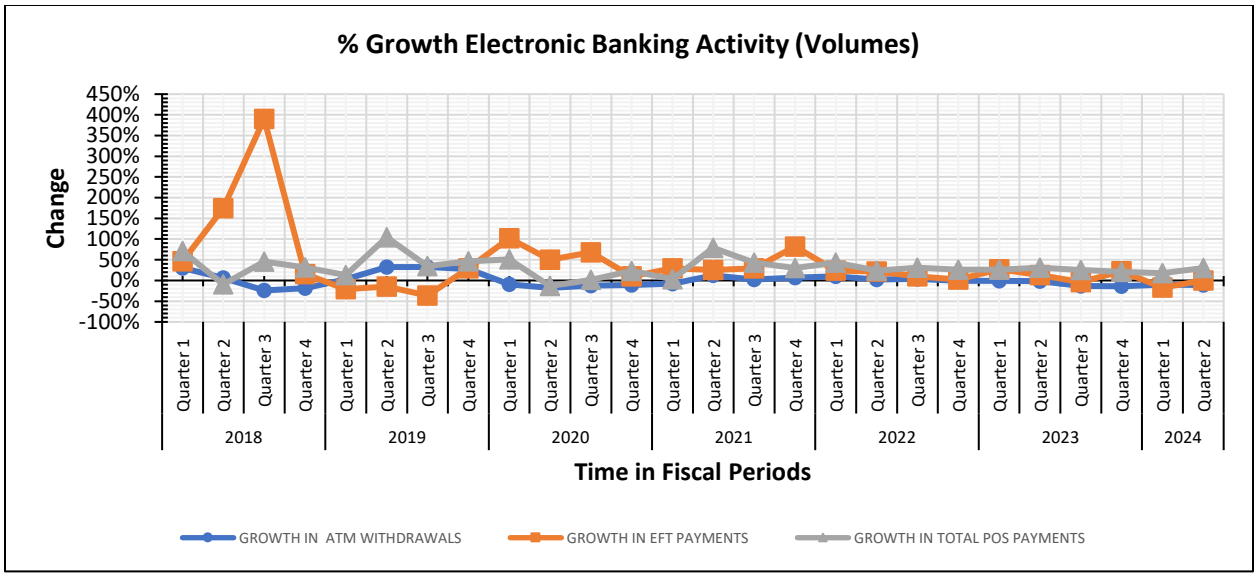

Figure 7: *Growth in Banking Activity, Derived from Figure 6*

The exponential growth in the activity or volumes being transacted on the mobile money medium are attributable to the authorization from the CBL to increase transaction limits (Nkoro & Uko, 2016) in the second quarter of 2020 (CBL, Authorisation for Increase of Mobile Money Transaction Limits, 2020).

Figure 8 shows the volumetric behaviour of mobile deposits, mobile transfers, and mobile withdrawals as tightly coupled and tailing each other, which is typical of remittance activity rather and trade suggesting a positive uptake of mobile money as preferred mode of remitting funds which is also explainable through the lens of UTAUT theory. As acknowledged in the report for NSDP II of 2018/19 to 2022/23, the payment systems have contributed to the efficiency of inbound remittances in Lesotho which relies heavily on migrant labourers working in South Africa (Government of Lesotho, 2018).

The behaviour of mobile payments in terms of activity volumes remains largely flat in overall as it is normally impacted by limited availability of solutions owing to scarce penetration of the technology leading to limited adoption both in the rural and semi-urban areas where the masses still live (AFI, 2019).

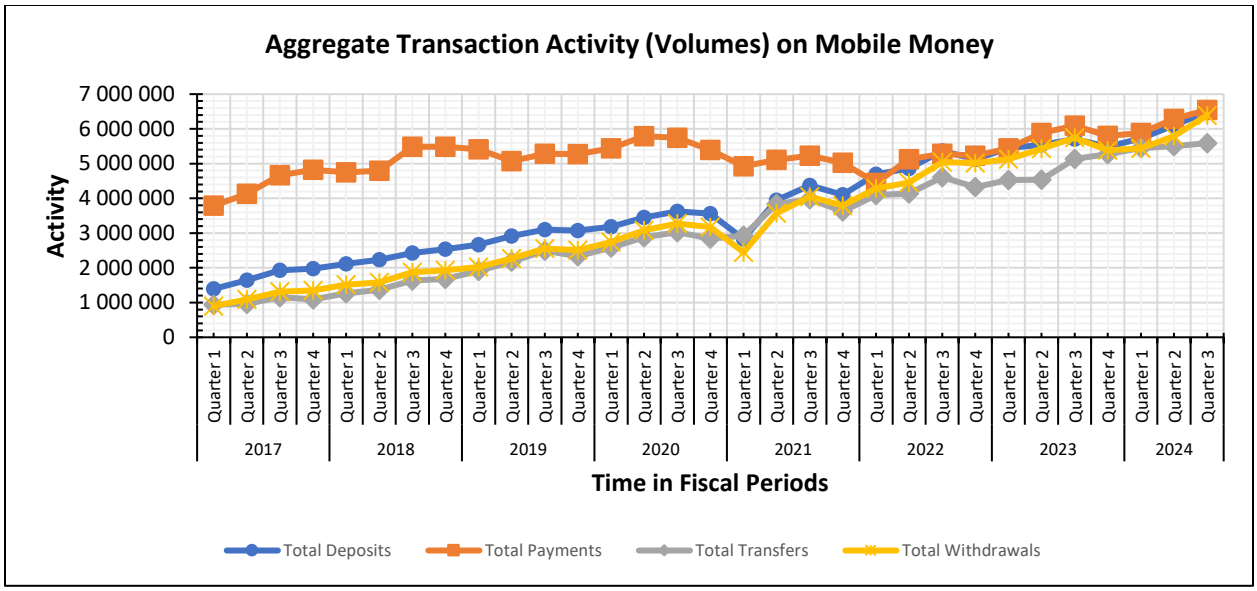

***Figure 8**: Mobile Money Activity Data (Deposits, Payments, Transfers, Withdrawals)*
Source: CBL, 2024

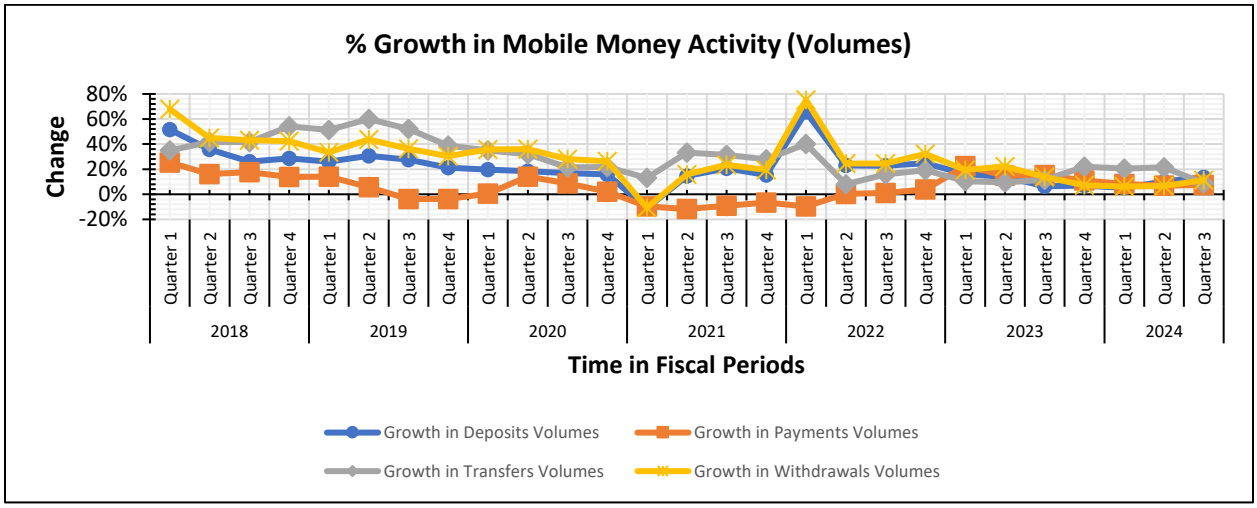

***Figure 9:** Growth in Mobile Money Activity. Derived from Figure 8*

Similar to volumes in mobile money activity (seen in Figure 8 and Figure 9), the exponential growth in the value levels or amounts being transacted on the mobile money are largely attributable to the authorization from the CBL to increase transaction limits

(Nkoro & Uko, 2016) in the second quarter of 2020 (CBL, Authorisation for Increase of Mobile Money Transaction Limits, 2020). The argument about a flatter growth of mobile money values transacted vs deposits, transfers and withdrawals also holds as in the explanation for volumes which is deducible through the lens of UTAT theory. Figure 10 depicts the trends in levels for mobile money transactions while Figure 11 captures the growth which depicts a stabilizing growth of the transacted mobile money values

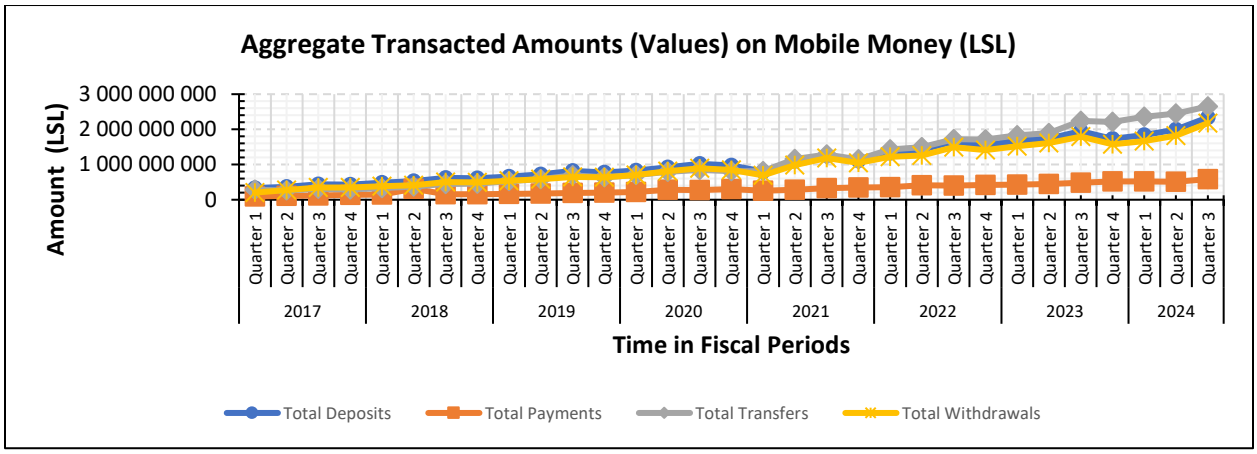

Figure 10: *Mobile Money Amounts (Deposits, Payments, Transfers, Withdrawals) Source: CBL, 2024*

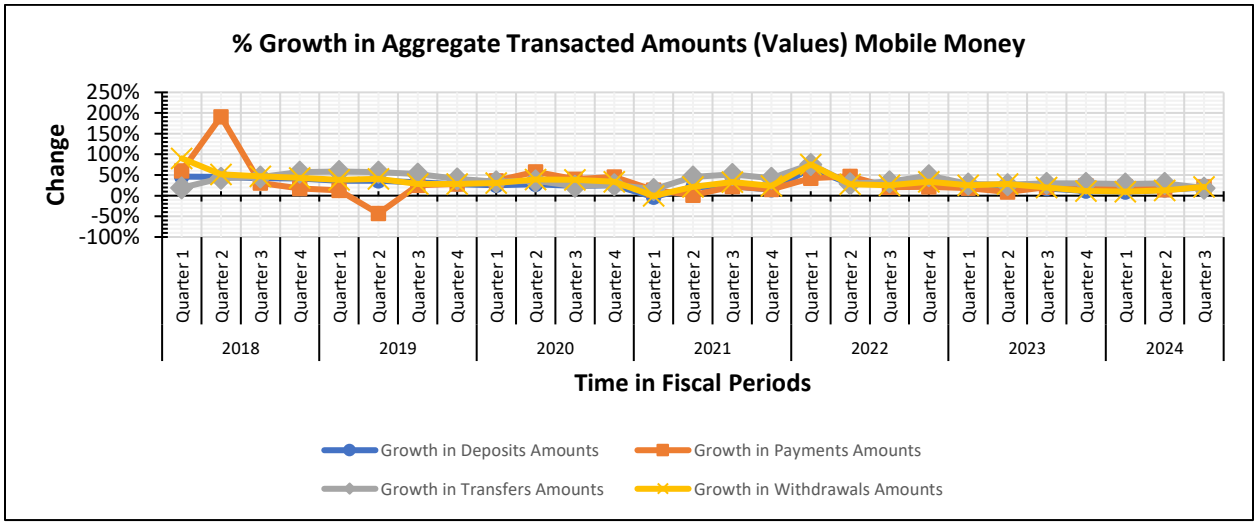

Figure 11: *Growth in Mobile Money Amounts. Derived from Figure 10*

4.2 Unit Root Test (ADF Test)

Using the ADF test, the significant variables and regressors were found to be stationary at a combination of both orders, meaning they are integrated of I(1) and I(2). As adopted by Afaha (2019), this condition was sufficient to establish that the different time series being used in this study are not random walks. The confidence level which was employed in this test is 5%.

Table 4: *Stationarity test for Volume and Value Series of the Independent Variables*

	At Levels (5% Confidence)		**At 1st Difference (5% Confidence)**		
ADF test critical values	*t-stat > -3,5806*	*p-Value < 0,05*	*t-stat > -3,5875*	*p-Value < 0,05*	**Conclusion on Order of Integration**
Control Variable *{natural log}*	**t-Stat**	**p-Value**	**t-Stat**	**p-Value**	
Population Growth	-2,954	0,162	*-6,887*	*0,000*	I(1)
Independent Variables *{natural log}*					
Volumes (Activity)					
Bank ATM Withdrawals	*-4,561*	*0,006*	*-4,353*	*0,010*	I(0)
Bank EFTs	-3,308	0,086	*-6,091*	*0,000*	I(1)
Bank POS Payments	*-5,065*	*0,002*	*-6,912*	*0,000*	I(0)
Mobile Money Deposits	-3,571	0,050	*-6,318*	*0,000*	I(1)
Mobile Money Payments	-2,819	0,202	*-5,106*	*0,002*	I(1)
Mobile Money Transfers	-1,425	0,832	*-5,623*	*0,001*	I(1)
Mobile Money Withdrawals	-2,959	0,160	*-6,490*	*0,000*	I(1)
Values (Amounts)					
Mobile Money Deposits	*-3,844*	*0,028*	*-6,417*	*0,000*	I(0)
Mobile Money Payments	*-3,837*	*0,029*	*-5,105*	*0,002*	I(0)
Mobile Money Transfers	-2,828	0,199	*-5,582*	*0,001*	I(1)
Mobile Money Withdrawals	*-4,110*	*0,016*	*-6,432*	*0,000*	I(0)

Source: output EViews 12, Student Version Lite

As shown in Table 4, the time series of volumes of bank ATM deposits, and volumes of bank POS payments are stationary at order I(0). Also, time series of value amounts of

mobile money deposits, mobile money payments, and mobile money withdrawals are stationary at order I(0). The rest of the other time series in this study stationary at order I(1), including the series of population which has been introduced for control purposes.

As was concluded in their study, Nkoro et.al., (2016), ADF test is superior and reliable because of ease of applicability and its capability to consider possible autocorrelation in the error term by incorporating lagged difference of the dependent variable.

4.3 Optimal Lag Determination – VAR Estimate

To optimise time spent on the tests, become precise, and consistent in the application of the tests and diagnostics of the time series being studied, predetermination of the optimal lag to be used in the ARDL model estimation was conducted for both scenarios which includes or excludes population as the control variable. In both cases the Schwarz Criterion (SC) was automatically picked as optimal selection method at lag(1) by use of Vector Auto Regressive (VAR) model.

Table 5. below shows the selection method criterion in comparison to the Akaike information criterion (AIC) and the Hannan–Quinn information criterion (HQ) when population growth is included for control.

Table 5: *Optimal Lag(1) selection for model with control variable included*

Optimal Lag Determination with Control Variable Included

Lag	AIC	*SC*	HQ
0	-40,99701	*-40,38408*	-40,80505
1	-54,27047*	*-45,68951**	-51,58302*

Source: output EViews 12, Student Version Lite

Table 6. shows the selection method criterion in comparison to the AIC and the HQ when population growth is excluded for control.

Table 6: *Optimal Lag(1) selection for model with control variable excluded*

Optimal Lag Determination with Control Variable Excluded

Lag	AIC	*SC*	HQ
0	-32,05167	*-31,48590*	-31,87448
1	-43,15094*	*-35,79583**	-40,84741

Source: output EViews 12, Student Version Lite

Therefore, lag(1) was used for the ARDL analysis, and SC was preferred and chosen where possible throughout the inferential statistics computation.

In comparison to AIC and HQ, SC was preferred and chosen for several characteristics. Firstly, SC imposes a heavier penalty for additional parameters, which helps prevent overfitting. This ensures that the selected model remains parsimonious and robust, avoiding the inclusion of unnecessary variables that could complicate the model without adding significant explanatory power. Secondly, SC is known for its consistency in model selection. As the sample size increases, SC is more likely to select the correct model, providing reliable and stable results. This consistency makes SC a suitable choice for the time series analysis in this study, ensuring that the findings are both accurate and dependable. In practice, researchers apply these characteristics and choose the model where either of AIC, SC, or HQ are smallest, and follows for this study that SC was the smallest (Nkoro & Uko, 2016).

4.4 ARDL Model Estimate

For the data to best fit a regression analysis, the raw level values were converted to their natural log form levels for better trend smoothing. Then Auto Regressive

Distributive Lag (ARDL) was employed. As depicted in Table 7, the model selected inclusive of population growth as a control variable is ARDL(1,0,1,1,0,0,1,1,0,1,0,1,0) whereas selected exclusive of population growth as control variable is ARDL(1,1,1,0,1,1,1,1,1,1,1,0).

In the scenario inclusive of population growth, the significance of the total model estimate captured as probability(F-statistic) is 0,000044 and for the scenario exclusive of population growth, the probability(F-statistic) is 0,000575 which are both less than the p-value of 0,05. The value of adjusted R^2 is 93% and 91% respectively, hence the models sufficiently describes the data in the data sets.

Table 7: *ARDL Model Selection Results*

	Model with Control Variable Included			**Model with Control Variable Excluded**		
	ARDL(1,0,1,1,0,0,1,1,0,1,0,1,0)			ARDL(1,1,1,0,1,1,1,1,1,1,1,0)		
	Prob(F-statistic): 0,000044			Prob(F-statistic): 0,000575		
	Schwarz Criterion: -5,804329			Schwarz Criterion: -5,690602		
	Adjusted R-squared: 0.925152			Adjusted R-squared: 0.914520		
ARDL (Short Run Causality) critical values:		*|t-Stat| > 2,4*	*p-Value < 0,1*		*|t-stat| > 2,4*	*p-Value < 0,1*
Variable	***Coefficient***	***t-Stat***	***p-Value***	***Coefficient***	***t-Stat***	***p-Value***
LnRealGDP(-1)	0,719	2,476	0,035	0,792	2,687	0,031
LnTotAtmWithdrawals(Volumes)	0,095	2,473	0,035			
LnTotAtmWithdrawals(Volumes)(-1)	0,206	3,674	0,005	0,170	2,890	0,023
LnTotEftPayments(Volumes)(-1)	0,038	3,227	0,010	0,034	2,679	0,032
LnTotPosPayments(Volumes)	-0,137	-3,242	0,010	-0,158	-3,555	0,009
LnTotMMDeposits(Values)				0,339	2,641	0,033
LnTotMMDeposits(Volumes)(-1)	-0,617	-3,891	0,004	-0,513	-2,712	0,030
LnTotMMPayments(Values)	-0,063	-3,257	0,010	-0,072	-3,297	0,013
LnTotMMPayments(Values)(-1)	0,110	3,366	0,008	0,103	2,947	0,022
LnTotMMTransfers(Values)(-1)	0,212	3,877	0,004			
LnTotMMWithdrawals(Values)(-1)	0,350	3,415	0,008	0,398	3,099	0,017

Source: output EViews 12, Student Version Lite

With population growth included for control, the *current levels of three* variables: ATM withdrawals volumes, POS payment volumes, and mobile money payment values depict a significant relationship to the real GDP growth. This implies that increase in these three variables lead to an increase in real GDP. For example, 1% increase in ATM withdrawal volumes contributes a fractional increase of 0.095% in real GDP in the short run. On the other hand, at levels, both POS payments volumes and mobile money payment values contributes a negative effect to total model. In this instance, the implication is that 1% increase in POS Payments leads to a fractional decrease of 0.137% in real GDP. However, the net effect represented by coefficients of the level variables including the regressors has a positive coefficient of 0,913.

Without population growth included, the *current levels of four* variables: ATM withdrawals volumes, POS payment volumes, mobile money deposit values, and mobile money payment values depict a significant relationship to the real GDP growth. Here, 1% increase in Mobile Money deposits leads to a fractional increase of 0.339% in real GDP. While both POS payments volumes and mobile money payment values contribute a negative effect to total model. For example, 1% increase of POS payments in this scenario contributes to a fractional decrease of 0.158% in real GDP. In the same way, the net effect represented by coefficients of the level variables including the regressors has a positive coefficient of 1,093.

From the results above, it was deduced that the performance of the model which excludes effect of population growth and population numbers performed better than that which includes the population numbers in the short run at 10% confidence.

4.4.1 Short Run Significant Variables and Regressors

As a way of confirming that the significant variables identified by the selected ARDL models in Table 7 have short run influence, the Wald test was conducted.

Table 8: *Wald Test for significant variables inclusive of population growth*

Wald Test with Control Variable Included (Short Run Causal Effect)

Test Statistic	Variable	Notation	*Value*	Probability
Chi-square	LnRealGDP(-1)	C(1)	6,129	0,013
	LnTotAtmWithdrawals(Volumes)	C(3)	6,120	0,013
	LnTotAtmWithdrawals(Volumes)(-1)	C(4)	13,501	0,000
	LnTotEftPayments(Volumes)(-1)	C(6)	10,412	0,001
	LnTotPosPayments(Volumes)	C(7)	10,512	0,001
	LnTotMMDeposits(Volumes)(-1)	C(10)	15,137	0,000
	LnTotMMPayments(Values)	C(11)	10,611	0,001
	LnTotMMPayments(Values)(-1)	C(12)	11,330	0,001
	LnTotMMTransfers(Values)(-1)	C(15)	15,034	0,000
	LnTotMMWithdrawals(Values)(-1)	C(18)	11,662	0,001

Source: output EViews 12, Student Version Lite

The results confirmed that indeed the selected variables had a significant relationship and influence on the overall model in the short run given that all the p-values are less than 5% confidence level. Table 8 shows the results of the model inclusive of population growth, while Table 9 shows results exclusive of population growth.

Table 9*: Wald Test for significant variables exclusive of population growth*

Wald Test with Control Variable Excluded (Short Run Causal Effect)

Test Statistic	Variable	Notation	*Value*	Probability
Chi-square	LnRealGDP(-1)	C(1)	7,220	0,007
	LnTotAtmWithdrawals(Volumes)(-1)	C(3)	8,351	0,004
	LnTotEftPayments(Volumes)(-1)	C(5)	7,177	0,007
	LnTotPosPayments(Volumes)	C(21)	12,635	0,000
	LnTotMMDeposits(Values)	C(6)	6,974	0,008
	LnTotMMDeposits(Volumes)(-1)	C(8)	7,354	0,007
	LnTotMMPayments(Values)	C(9)	10,870	0,001
	LnTotMMPayments(Values)(-1)	C(10)	8,687	0,003
	LnTotMMWithdrawals(Values)(-1)	C(18)	9,601	0,002

Source: output EViews 12, Student Version Lite

4.4.2 Long Run Bounds Test

On the other hand, to confirm long run influence of the selected significant variables in the ARDL model in Table 6, the Long Run Form and Bounds Test was performed whereby the F-statistic value is compared to both the lower bound at I(0) and upper bound at I(1). This test is normally conducted to confirm cointegration of the model variables for a period longer than one period assumed in the time series data, which was four months in duration for this study, however typical long run cointegration is assumed for a period of a year to three years.

Table 10: *Long Run Form and Bounds test the ARDL model inclusive of population growth*

F-Bounds Test with Control Variable Included (Long Run Causal Effect)				
Test Statistic	**Value**	**Significance**	**I(0)**	**I(1)**
F-statistic	6,057776	5%	2,06	3,24

Source: output EViews 12, Student Version Lite

Table 10 above captures the results depicting the F-statistic as greater than the upper bound of the model with population growth control variable included. These results of the bounds tests infers that there is long run relationship of the ADRL model's significant variables at confidence level of 5%. As per Nkoro et al., (2016), if the relevant computed F-statistic for the joint significance of the level variables is greater than the upper bound critical value, a conclusive decision about presence of long run relationship can be made, without the need to know whether the underlying variables are I(0) or I(1), or fractionally integrated.

The error correction equation, *EC*, for the long run bounds test with population included as control variable is:

$$EC = -(-4{,}2580 * lnpopulation + 1{,}0711 * lntotatmwithdrawals(volumes) - 0.0122 * lntoteftpayments(volumes) + 0{,}7279 * lntotmmdeposits(values) - 1{,}5205 * lntotmmdeposits(volumes) + 0{,}1658 * lntotmmpayments(values) + 0{,}2146 * lntotmmpayments(volumes) + 1{,}2207 * lntotmmtransfers(values) - 0{,}3966 * lntotmmtransfers(volumes) + 0{,}7547 * lntotmmwithdrawals(values) - 1{,}1971 * lntotmmwithdrawals(volumes) - 0{,}4897 * lntotpospayments(volumes))$$

$$(\ldots equation\ 5)$$

The results in Table 11 depict that the F-statistic is greater than the upper bound value of the model without the control variable of population growth being included. This statistic infer existence of a long run relationship between the dependent variable and significant independent variables which were identified in the selected ARDL model in Table 6 which exclude population as the control variable. The presence of both negative and positive coefficients in the error corrected model confirm that the relationship between the dependent (real GDP) and independent variables (e-payments) is stable over time despite short run fluctuations.

Table 11: *Long Run Form and Bounds test the ARDL model exclusive of population growth*

F-Bounds Test with Control Variable Excluded (Long Run Causal Effect)				
Test Statistic	**Value**	**Significance**	**I(0)**	**I(1)**
F-statistic	3,524625	5%	2,06	3,24

Source: output EViews 12, Student Version Lite

The error correction equation for the long run bounds test with population excluded as control variable is as follows:

$$EC = lnrealgdp - (1{,}2867 * lntotatmwithdrawals(volumes) - 0.0161 * lntoteftpayments(volumes) + 1{,}6244 * lntotmmdeposits(values) - 2{,}4226 * lntotmmdeposits(volumes) + 0{,}1480 * lntotmmpayments(values) - 0{,}2976 * lntotmmpayments(volumes) + 1{,}2085 * lntotmmtransfers(values) - 0{,}3966 * lntotmmtransfers(volumes) + 0{,}8208 * lntotmmwithdrawals(values) - 1{,}4339 * lntotmmwithdrawals(volumes) - 0{,}7586 * lntotpospayments(volumes))$$

$$(\ldots equation\ 6)$$

4.5 Model Diagnostic Tests

Eventually, the study conducted diagnostic tests for normality, heteroskedasticity, and stability. As shown in Figure 12 and Figure 13 in the Appendix, both the models are normally distributed since the significance of p-values sre both above 5%. The Jarque-Bera p-value for the model which excludes population growth is not highly significant at 0,67 probability while the Jarque-Bera p-value for the model which includes population growth is also not highly significant at 0,64 probability.

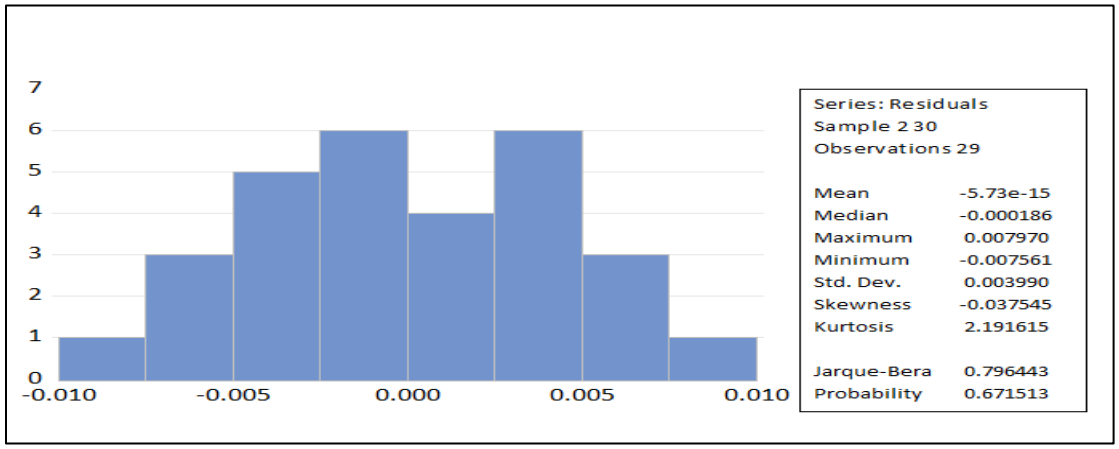

Figure 12: *Data distribution for the ARDL model exclusive of Population Growth (Diagram source: EViews 12, Student Version Lite)*

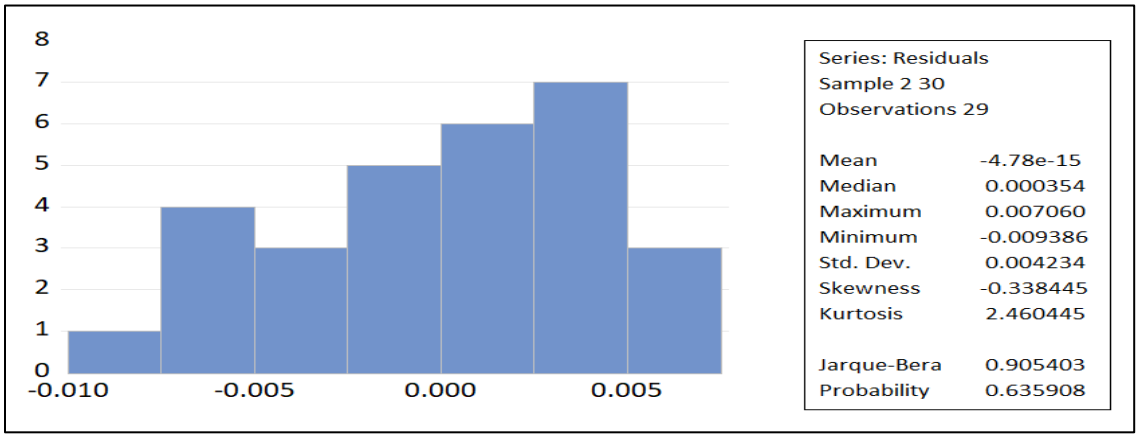

Figure 13: *Data distribution for the ARDL model inclusive of Population Growth (Diagram source: EViews 12, Student Version Lite)*

The Breusch-Pagan-Godfrey test was used on the model which excludes population growth, with a founding that the model is homoskedastistic since the F-statistic value is not highly significant at 0,28 probability. In the similar way, the same test was used on the model which includes population growth as control variable and the result was that the F-statistic was not highly significant at 0,24 probability, rendering the second model as homoskedastistic as well.

Eventually, the stability tests were conducted on both models using CUSUM of Squares test and the results captured in Figure 14 and Figure 15. Both the models remain inside the lower bound and upper bound of the 5% confidence level. Thus, with the three diagnostic tests performed on the models, the study was justified to use ARDL.

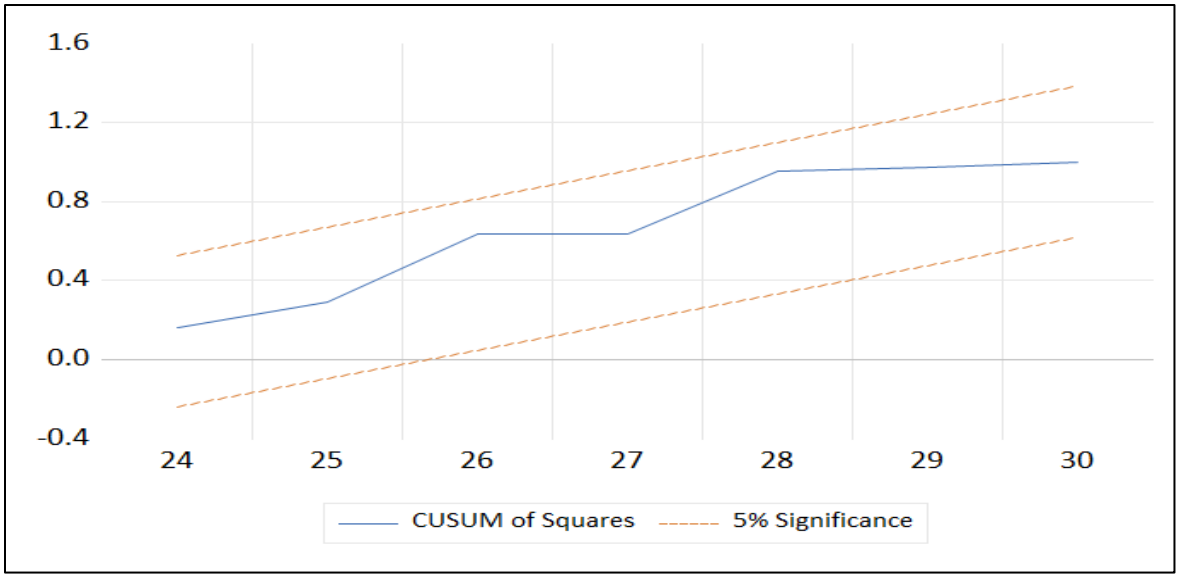

Figure 14: *ARDL Model Stability Test (Exclusive of Population Growth as Control)*
(Diagram source: EViews 12, Student Edition Software)

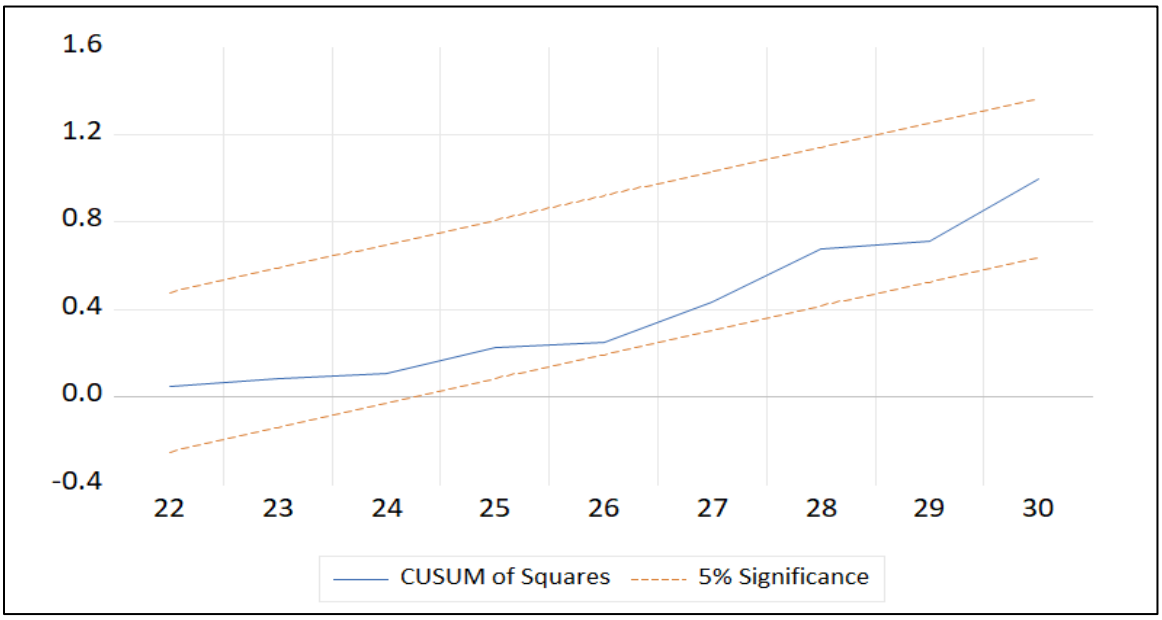

Figure 15: *ARDL Model Stability Test (Inclusive of Population Growth as Control)*
(Diagram source: EViews 12, Student Edition Software)

4.6 Implications for Lesotho Economy: short-run and long-run relationship of the variables to real GDP growth

4.6.1 ATM Withdrawals:

- Significance: The significant relationship between ATM withdrawals and real GDP indicates that these transactions play a crucial role in the short-run economic activity in Lesotho.
- Implications: Policies aimed at improving ATM infrastructure and accessibility could enhance economic transactions and stimulate growth.

4.6.2 Electronic Funds Transfers (EFT) and Point-of-Sale (POS) Payments:

- Significance: EFT and POS payments are significant in the short run, suggesting that electronic payment systems are vital for economic transactions.
- Implications: Encouraging the use of electronic payment systems could increase efficiency and reduce transaction costs, contributing to economic growth.

4.6.3 Mobile Money Transactions:

- Significance: Mobile money deposits, payments, transfers, and withdrawals show significant short-run effects on real GDP.
- Implications: Expanding mobile money services and improving network coverage could enhance financial inclusion and economic activity, particularly in rural areas.

4.6.4 Population Growth:

- Significance: The inclusion of population growth as a control variable helps isolate its effects, confirming that other variables independently influence economic growth.
- Implications: Understanding the impact of population growth on economic variables could help in designing policies that address demographic changes and their economic implications.

In alignment with Georgescu et al., (2021), real GDP is a crucial indicator of economic growth and wellbeing, and the long-run relationship between e-payment activities and real GDP suggests that enhancing e-payment systems can positively impact economic growth by increasing efficiency, reducing transaction costs, and promoting financial inclusion. The significant long-run influence of e-payment activities, such as ATM withdrawals, mobile money transactions, and electronic funds transfers, indicates that expanding e-payment services and improving infrastructure can stimulate economic activity Lesotho, particularly in rural areas, and support overall economic growth.

Chapter 5: Conclusion and Recommendations

5.1 Introduction

The study was crucial in examining the critical issue of the declining economic growth in Lesotho, which has dropped from 7.5% in the 1990s to 2.8% in the 2020s, compounded by global shocks such as the COVID-19 pandemic and the Russia-Ukraine war. By focusing on the impact of e-payments on economic growth, the study aimed to fill a significant gap in the literature and provide valuable insights for policymakers, investors, and stakeholders to make informed decisions about adopting and promoting e-payment technologies.

To achieve its objectives, the study employed an ex-post facto quantitative research design, which involved systematically collecting and analyzing numerical data to test causal relationships between e-payment variables and real GDP growth. The study utilized secondary data from reliable sources such as the Central Bank of Lesotho (CBL) and the International Monetary Fund (IMF) for the period from 2017 to 2024, and the data was analyzed using statistical techniques, including the Autoregressive Distributed Lag (ARDL) model, to determine long-run and short-run relationships. This method ensures objectivity, replicability, and the ability to generalize findings, providing robust evidence on the economic impact of e-payments in Lesotho.

5.2 Summary and Conclusions

The study utilized the Augmented Dickey-Fuller (ADF) test to ensure the stationarity of the variables, confirming that they are integrated of orders I(1) and I(2), which is sufficient to establish that the time series are not random walks. The optimal lag for the ARDL model was determined using the Schwarz Criterion, resulting in lag(1) being selected for both scenarios, with and without population growth as a control variable. The ARDL model estimates showed significant relationships between various e-payment variables and real GDP growth. Specifically, ATM withdrawals volumes, POS payment volumes, and mobile money payment values were found to have significant impacts on real GDP growth. The models demonstrated high adjusted R-squared values, indicating a good fit.

Hence in conclusion, the results indicate that e-payment variables such as ATM withdrawals, POS payments, and mobile money transactions have significant relationships with real GDP growth in Lesotho. The ARDL model, both with and without population growth as a control variable, confirmed the presence of long-run relationships between these variables and economic growth. The diagnostic tests for normality, heteroskedasticity, and stability further validated the robustness of the models used in the study.

5.3 Policy Recommendations

Consistent with research conducted by Afaha (2019), policymakers should promote e-payments adoption by providing incentives such as tax benefits, subsidies for digital infrastructure, and public awareness campaigns. Additionally, the government should establish a regulatory framework to support e-payment systems, ensuring security and consumer protection through standards for interoperability and data privacy.

Stakeholders, including regulators and investors, should encourage and incentivize innovation in electronic payments. Prioritizing improvements in infrastructure and technology for Mobile Money deposits and POS payments can enhance customer experience and mitigate negative economic impacts. Regulators like CBL can further contribute by maintaining accurate records of e-payment activity to improve studies on economic growth and development. In this regard, Georgescu et al., (2021) pointed out that life offline is gradually becoming impossible as services digitally transform.

5.4 Limitations of the Study

While data that was sought to perform the study was of the range covering 2014 to 2024, the CBL could only provide for the range covering 2017 to 2024. The impact is such that the number of observations were reduced. However, the obtained range still covered the requirement for ARDL where small datasets of 28 observations are adequate for reliable results as was found in a similar study which examined the impact of cashless payments on economic growth for G7 countries (Noman et al., 2023).

5.5 Future Research Recommendations

While studies by Sekantsi et al., (2016) and Mieseigha et al., (2013) have evidenced that adoption of e-payments improve financial inclusion, more research is needed to fully comprehend the mechanisms and long-term effects in the context of Lesotho. As an example, the topic of the first future study could be *"The Impact of Mobile Money Payments on Informal Economy"* thus effectively narrowing the focus to mobile money component of e-payments on informal economy and investigating how the adoption of positively influences informal sector activities in Lesotho, including changes in employment patterns and tax revenues.

In the midst of academic debate such as advance by Killian et al., (2017), another potential sustainable future topic could be *"Role of Government Policies in Adoption of e-payment Systems"*, whereby researchers could dig deeper into analyzing the role of government policies in promoting e-payment adoption and their effectiveness in enhancing economic growth in Lesotho. Issues such as exploring efficient means towards ubiquitous internet access as an enabler for e-payments for Lesotho citizens in rural areas could be delved into as a matter talking to National Strategic Development plans.

The third recommended topic could be *"Technological Adoption Barriers Against e-payment Systems in Lesotho"* whereby efforts could be made to understand the cause of the negative relationship between real GDP growth and POS payment volumes and mobile money payment values since it could signal inefficiencies or negative user sentiments. As future study could stem from this perspective through undertaking of a comprehensive analysis of the barriers to both mobile money and traditional bank-based e-payment adoption in Lesotho as a developing country, including technological, regulatory, and socio-cultural factors. This area could be given highest priority to understand the adoption impact within various demographic groups in Lesotho, such as rural vs. urban populations, and different income levels within those groups.

As an action plan, socio-cultural and regulatory issue should be addressed first as enablers of smooth adoption of technology offerings usured by e-payment systems. Then, understanding of the role of government policy and its intervention could be targeted as the next action area to unlock resource allocation and development acceleration.

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