

**MODERATING EFFECT OF FINANCIAL INNOVATIONS ON THE
RELATIONSHIP BETWEEN MACROECONOMIC FACTORS AND
FINANCIAL PERFORMANCE OF COMMERCIAL BANKS IN KENYA**

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**A Thesis Submitted to the Institute of Postgraduate Studies of Kabarak University
in Partial Fulfillment of the Requirement for the Award of Doctor of Philosophy in
Business Administration (Finance)**

KABARAK UNIVERSITY

NOVEMBER, 2023

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This thesis entitled “**Moderating effect of Financial innovations on the relationship between macroeconomic factors and financial performance of commercial banks in Kenya**” and written by **Nelly Chelangat Mutai** is presented to the Institute of Postgraduate Studies of Kabarak University. We have reviewed the thesis and recommend it be accepted in partial fulfillment of the requirement for award of the degree of Doctor of Philosophy in Business Administration.

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DEDICATION

This thesis is dedicated to my father Dr. Joseph Mutai for his love, support and encouragement during the entire duration of the course. Further dedication is to my mother Mrs. Ann Mutai and my late grandfather Mr. Jeremiah Murgor for teaching me the discipline and value of hard work when I least knew the world. I also wish to my children Tamarah Wamaitha and Tarrel Rogumi. This thesis will be a source of motivation to them for hard work when they become of age.

ABSTRACT

Performance of commercial banks in Kenya have been declining since 2010 which was largely attributed to macro-economic factors, fiscal policies introduced by central bank of Kenya and market activities such as issuance of bonds and capping of interest rates, CBK 2018. However, whereas there is some theoretical literature on the effects of Macroeconomic factors on financial performance, little empirical evidence exists on these relationships particularly in Kenya. In addition, there has been increased integration due to embracement of financial innovations in the banking sector however the moderating effects of financial innovations on the relationship between macroeconomic factors and financial performance is still uncertain. The general objective of this study was to investigate the moderating effect of financial innovation on the effect of macroeconomic factors on financial performance of commercial banks in Kenya. Specific objectives of the study were; to investigate the effect of gross domestic product per capita, interest rates, inflation on financial performance of commercial banks and to access the moderating effect of financial innovations on the relationship. The study was anchored on four theories: Keynesian theory, Deflation theory, Interest rate parity theory and Constraint Induced Financial Innovation Theory. The study utilized secondary data for 10-year period as from 2011 to 2020. The target population of the study was 42 commercial banks that are licensed and supervised by the Central Bank of Kenya. Secondary panel data on financial performance of Commercial Banks was obtained from the individual institutions' financial reports while data on macroeconomic factors was obtained from both Central Bank of Kenya and Kenya National Bureau of Statistics. The study found a significant and positive relationship ($b=0.594$, $t=2.939$, $p=0.022$) between GDP per capita and ROA but a significant and negative relationship ($b= -0.430$, $t= -2.247$, $p=0.05$) between inflation rate and ROA. The study found a moderating effect of interest rates on financial performance of commercial banks in Kenya ($b= -5.292$, $t= -2,202$, $p=0.028$). However, no moderating effect of financial innovations was found between either gross domestic product per capita or inflation on financial performance of the banks. This study concludes that when a bank's innovations are at the highest, it can achieve a very high return on assets even when it keeps its interest rates very low. The study recommends that banks should implement the highest degree of financial innovations, which will enable them achieve very high return on assets even when they keep their interest rates very low.

Keywords: *Financial Innovations, Macroeconomic factors, Financial Performance, Commercial Banks.*

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LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---------|---|
| ADF | Augmented Dickey-Fuller |
| ACF | Autocorrelation Functions |
| ATM | Automated Teller Machine |
| APT | Arbitral Price Theory |
| CAMEL | Capital Adequacy, Asset Quality, Management Efficiency, Earnings Ability and Liquidity. |
| CBA | Commercial bank of Africa |
| CBK | Central Bank of Kenya |
| CBR | Central Bank Rate |
| CI | Confidence Interval |
| CIFIT | Constraint Induced Financial Innovation Theory |
| CPI | Consumer Price Index |
| EMH | Efficient Market Hypothesis |
| GDP | Gross Domestic Product |
| ICT | Information and Communications Technology |
| IMF | International Monetary Fund |
| KEPSS | Kenya Electronic Payment and Settlement Systems |
| KNBS | Kenya National Bureau of Statistics |
| KUREC | Kabarak University Ethical Consideration |
| LN | Natural logarithm |
| MLR | Multi Linear Regression |
| MPC | Monetary Policy Committee |
| MPMS | Mobile phone money services |
| NACOSTI | National Commission for Science, Technology and Innovation |
| NL | Natural Logarithms |
| NPL | Non-Performing Loans |
| NSE | Nairobi Stock Exchange |
| OLS | Ordinary Least Square |
| PCF | Partial Correlation Functions |
| POS | Point of sale terminal |
| ROA | Return on Assets |
| ROE | Return on Equity |

| | |
|------|-----------------------------------|
| RTGS | Real Time Gross Settlement |
| SAP | Structural Adjustment Programmes. |
| SMEs | Small and Medium Enterprises |
| SSA | Sub Saharan Africa |
| VAR | Vector Autoregression |
| VECM | Vector Error Correction Model |
| VIF | Variance Inflation Factor |

CONCEPTUAL AND OPERATIONAL DEFINITION OF TERMS

ATM Banking - Refers to the use of an automated teller machine in provision of banking services. An automated teller machine (ATM) is an electronic banking outlet that allows customers to complete basic transactions without the aid of a branch representative or teller. (Arumugarajan & Ponnudurai 2019). This study adopted the same definition of an ATM machine and its functions.

Banking Institution – It refers to a financial institution that is dedicated to provide financial services, for instance, giving business loans, accepting deposits and loans, mortgage lending, and basic investment products like certificates of deposit and savings accounts (CBK, 2015). This study adopted the same definition and viewed banks as a main player in the Country's economy.

Consumer Price Index (CPI) - Refers to a measure that examines the weighted average of prices of a basket of consumer goods and services to rate inflation rates in the economy Boskin, M. J. (2010). In the study CPI is used as the main tool to measure inflation and adopted the same definition.

Electronic Payment and Settlement Systems – Relates to the entirety (integrity) of payment instruments, of common rules, procedures and supportive technical and program facilities for implementation of clearing, transfer of funds and execution of final settlement, which is used to provide a payment to a beneficiary CBK, (2019). The study adopted the same definition and used KEPSS in the setup to mean Kenya electronic payment and settlement system.

Financial Innovation - Refers to a strategic tool used by a financial institution to reduce costs and increase efficiency. The study adopted and analysed financial innovations as a process in which organizations come up with new products or new production processes to make their operations better, in which case the new products could be based on the new processes Tufano, (2002).

Financial Performance - Refers to a complete evaluation of a company's overall standing in categories such as assets, liabilities, equity, expenses. Return of assets is used to measure financial performance. The study adopted this definition of financial performance as a subjective measure of how well a firm can use Assets from its primary mode of business and generate revenues. Novak, (2008).

Gross Domestic Product – It refers to a measurement that seeks to capture a country's economic output. Countries with larger GDPs will have a greater amount of goods and services generated within them, and will generally have a higher standard of living. The study adopted this definition of GDP as the total market value (the amount that a product would trade for in the open market) of all goods and services produced within a specific a location over a particular time period. Callen, (2008).

GDP per Capita - Refers to country's economic output divided by its population. It's a good representation of a country's standard of living. GDP Per capita is a metric that breaks down a country's economic output per person and is calculated by dividing the GDP of a country by its population Thomas B, (2020).

Inflation - It is the measure of the rate of rising prices of goods and services in an economy. Inflation can occur when prices rise due to increases in production costs, such as raw materials and wages. It is a sustained or persistent increase in the general prices of goods and services in the long run. Ademola & Badiru (2016). The definition was adopted by this study.

Interest Rates - Refers to the amount charged by a banking institution to a borrower for any form of loan. The interest rate is the amount a lender charges for the use of assets expressed as a percentage of the principal. Cox *et.al* (2005). The definition was adopted by this study.

Macro-Economic Factors – Relates to sector wide factors that affect performance of Commercial Banks and are beyond the control of the management. This study described Macroeconomic variables as the elements that typify the national economy and business environment Brueggeman & Fisher, (2011).

Mobile Phone Money Transfers - Mobile money is a technology that allows people to receive, store and spend money using a mobile phone. This study adopted this definition of MPMS as a 'mobile wallet' or by the name of a specific service such as mPesa, Eco Cash, GCash, Tigo Pesa and many more Susan Johnson (2012).

Payment Cards – Refers to a payment system issued by financial institutions, such as a bank, to a customer that enables its owner (the cardholder) to access the funds in the customer's designated bank accounts, or through a credit account and make payments by electronic funds transfer and access to ATMs Bounie, D *et.al* (2016). The study adopted this definition.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Commercial Banks are an important feature in every stable economy in the World. Financial intermediation is the greatest role played by Commercial Banks. It includes, the movement of funds from lenders to borrowers and matching sellers and buyers indirectly through the process of financial asset transformation thus acting as vehicles of investment of savings, extension of credit and risk management. Banks help in diversification of risks and reduce substantially transaction cost due to their developed expertise and economies of scale. They also play financial role by providing payment services and financial products that enable households and firms to participate in the broader economy (P. Ngumi 2013). According to Adam Hayes (2020), virtually everyone living in a developed economy has an ongoing or at least periodic need for the services of a financial institutions. Beyond the intermediation function, the financial performance of Commercial Banks has critical implications for economic growth of countries.

Globally, Performance of commercial banks is affected by internal and external factors (Ongere, 2013), which can be classified into financial innovations and macroeconomic factors. Financial innovations are internal factors specific to individual banks which affect the bank performance. Macroeconomic factors are sector wide factors or country wide factors which are beyond the control of the company and affect the performance of Commercial Banks. In order to survive in the long run, it is important for a banking institution to find out what are the determinants of performance so that it can take

initiatives to increase its profitability by managing the dominant determinants (Podder, 2012).

According to IMF (2018), the year 2019 marked a decade since the peak of the global financial crisis in 2009. Since then, the global banking system has been significantly strengthened through global regulatory reform measures. These measures have resulted in stronger capital and liquidity buffers which was informed by the continued influence of technology in the banking sector. Commercial Banks scaled up partnerships with Fintechs and Bigtechs to leverage their agility in the new age of technology. On the risk frontier, technology presented new opportunities for banks to leverage on to identify and mitigate emerging risks, particularly cyber-security, Albani *et al* 2019.

According to European Commercial Bank 2003, the definition of financial innovation is described as a factor which creates cost reduction in a product and the organization which are mainly banks or other service sector. According to Akhavein *et. al.* (2005.) there are three types of financial innovations: institutional innovation, process innovations and product innovations. Financial Innovations are much more efficient than payment systems based on paper, because it reduces the cost of collection, storage, processing, and transmission of information, increase accessibility and financial inclusion. Financial innovation aspects have been implemented by diverse commercial banks across the globe.

Macroeconomic variables are the elements that typify the NATIONAL economy and business environment. In an economy, these macroeconomic factors are not within the influence of one individual firm (Brueggeman & Fisher, 2011). However, the government often influences the macroeconomic variables through enactment of legislation and or policies. These factors include the inflation rate, GDP, interest rate,

foreign exchange rate, money supply, and so on (Simiyu & Ngile, 2015). Macroeconomic variables influence the complexity and volatility of the business setting (San & Heng, 2013). Due to increasing globalization and technological advances, economic turbulence in other (international) economies might creep into the local business environment. The government has a precarious role in enhancing stability of the macroeconomic variables. Businesses, among them commercial banks, prefer a stable macroeconomic environment; a stable environment is more predictable, risk is also lower under such stable conditions. In this era of globalization, it is important for financial institutions to be strongly integrated with the global economy. Increased integration and the growing economic fluctuations require more attention to be paid to determine the effect of macroeconomic variables and the company's development (Simiyu & Ngile, 2015).

According to World Bank report 2019, growth of the global economy is estimated to have decelerated to 2.9 percent in 2019 from 3.6 percent in 2018. The deceleration in growth was a result of a confluence of factors that include trade tensions and tariff hikes between the United States and China, a decline in business confidence, a tightening of financial conditions, and heightened policy uncertainty. Global growth contracted by 3.0 percent in 2020, a downward revision of more than 6 percentage points relative to the October 2019 World Economic Outlook (WEO) this could be attributed to the impact of the Coronavirus (COVID-19) pandemic. However, the rebound of global output activity in 2021 depends critically on the pandemic fading in the second half of 2020, allowing containment efforts to be gradually scaled back and restoring consumer and investor confidence.

Regionally, Structural Adjustment Programs (SAP) introduced in the late 1980's, led to major transformations in the banking sector operating environment. Countries eased controls on interest rates, reduced government involvement and opened their doors to international banks Kusa *et.al.* (2013). Due to this reform, firms of the developed nations have become more visible in developing countries through their subsidiaries and branches or by acquisition of foreign firms. In the last two decades' studies have shown that commercial banks in Sub-Saharan Africa (SSA) were more profitable than the rest of the world with an average Return on Assets (ROA) of 2 percent Flamini, V., McDonald, C. A., & Schumacher, L. B. (2009).

However, with the entry of international banks in the SSA Financial Performance in Sub-Saharan Africa took a dual path approach. Some countries exhibited robust growth driven by higher levels of public investment and diversity in their economies. On the other hand, resource dependent economies registered feeble growth rates on the back of weaker commodity prices (IMF, 2018). To be in a better competitive edge most banks embraced technological advancement to increase their efficiency and attract more profits.

The macroeconomic factors have had great influence on the financial performance of Commercial Banks across Africa. Recession witnessed in Nigeria, which business analysts pronounced that led to the delisting of some companies, has brought to limelight the implications of macroeconomic factors on corporate performance Zeitun, R., & Tian, G. G. (2007). Activities in Sub-Saharan Africa (SSA) have been subdued reflecting spill over effects from global economic activities, financial market conditions and alongside country specific factors IMF Report (2019). Overall, the economic growth for this region was 3.7 percent in 2019 from 4.5 percent in 2018, worsen to 1.0 percent in 2020 before picking up to 6.6 percent in 2021. The significant downward revision to the 2020 growth

projection reflects largely anticipated domestic disruptions to economic activity from COVID-19.

Locally, the activities of Kenyan Commercial Banks are associated with the achievement of Vision 2030 development goals. The financial performance of the commercial banks thus remains critically important to the country (Njue *et.al* 2020). Despite declining profitability in the last decade, the Kenyan banking sector remained stable and resilient in 2019. The sector's gross loans and advances increased by 8.80 percent from Ksh.2.488 trillion in December 2018 to Ksh.2.707 trillion in December 2019. The sector's asset base grew by 9.1 percent in 2019 a slight decline from 10.1 percent growth in 2018. The increase in total assets was mainly attributed to growth in investment in government securities and loans and advances.

The banking sector registered an increase in profitability in 2019 with profit before tax increasing by 4.2 percent to Ksh.159.1 billion in December 2019 from Ksh.152.7 billion in December 2018. The increase in profitability was attributed to a higher increase in income (Ksh.24.7 billion) compared to increase in expenses (Ksh.6.4 billion). Over the same period, strong capitalization levels were recorded as a result of retention of profits and additional capital injections. (CBK Report,2019). These figures are captured in Table 1.

Table 1*Income and Expenditure as a Percentage of Total Income/Total Expenses*

| Income | Dec-18 | | Dec-19 | |
|--|---------|-------------------|---------|--------------------------------------|
| | Kshs. M | % of Total Income | Kshs. M | % of Total Income/ total expenses |
| Interest on Advances | 266,368 | 45.39 | 265,020 | 49.32 |
| Fees and Commission for Loans and Advances | 25,324 | 4.32 | 33,946 | 6.32 |
| Other Fees and Commission Income | 48,012 | 8.18 | 52,237 | 9.72 |
| Interest on Government Securities | 118,990 | 20.28 | 122,011 | 22.71 |
| Interest on Placement | 5,341 | 0.91 | 8,515 | 1.58 |
| Other Income | 49,419 | 20.92 | 55,578 | 10.34 |
| Total Income | 513,454 | 100.00 | 537,307 | 100.00 |
| Expenses | | | | |
| Interest Expenses | 138,296 | 38.34 | 137,485 | 36.35 |
| Bad Debts Charge | 30,616 | 8.49 | 39,640 | 10.48 |
| Salaries and Wages | 91,090 | 25.25 | 96,055 | 25.40 |
| Other Expenses | 100,752 | 27.93 | 105,055 | 27.78 |
| Total Expenses | 360,754 | 100.00 | 378,236 | 100.00 |
| Profit Before Tax | 152,700 | | 159,072 | |

Source: Central Bank of Kenya (2019)

1.1.1 Financial Innovations by Commercial Banks in Kenya

Financial innovations have been used by Commercial Banks as formidable strategic variables to outstrip any form of competition thus becoming an effective means by which banks can improve their performance while simultaneously being able to maintain their effectiveness in the market Alabdullah, T. T. Y., Ahmed, E. R., & Muneerali, M. (2019). According to Noyer (2007), financial innovation has not only opened up new opportunities for the sector participants, but also increased new market players arising from new products in the financial market.

Diverse financial innovations prevalent in the Kenyan commercial banks includes mobile banking, agency banking, and ATM banking amongst others (Nkeshimana & Onsiro, 2020). The CBK (2014) notes that there has been a rise in use of electronic banking facilities due to adoption of computer technology. On June 5, 2020, the CBK went live with a new platform for the Kenya Electronic Payment and Settlement System (KEPSS). The previous KEPSS platform, implemented in 2005 had a number of capacity limitations. It could do up to 50,000 transactions per day compared to the new system's capacity of more than one million transactions per day. The new system has other advantages including elimination of manual paper-based instructions; efficient liquidity optimization; ability to configure customized alerts for exceptional transactions; unique transaction reference numbers for ease of tracking; compliance with ISO20022 SWIFT standards for messaging; Anti Money Laundering/ Combating the Financing of Terrorism (AML/CFT) capabilities. The new KEPSS platform is functionally ready for a 24/7 economy.

1.1.2 Macroeconomic Factors in Kenya

The Macroeconomic factors in Kenyan context has kept on fluctuating over the years as shown in Table 1.5. GDP per capita growth has been fluctuating from 2000 to 2020. Inflation rates has been fluctuating during this period with the highest rates recorded on 2011. Financial performance has also been declining from 2010 up to 2018 where it increased by a small margin as indicated in Table 2. Figures of GDP per capita, Inflation and Financial Performance are captured in Table 2.

Table 2*Inflation, GDP per capita and Financial Performance for Period 2010 to 2019*

| Description | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|------------------------|--------|--------|--------|--------|--------|-------|-------|--------|-------|-------|
| GDP Per Capita (US \$) | 5.14% | 2.10% | 17.01% | 6.47% | 8.71% | 1.60% | 5.51% | 11.47% | 8.63% | 6.36% |
| Inflation | 3.96% | 14.02% | 9.37% | 5.71% | 6.87% | 6.58% | 6.29% | 8.00% | 4.69% | 5.10% |
| Financial Performance | 24.40% | 20.20% | 15.30% | 15.90% | 18.50% | 9.20% | 5.8% | 8.10% | 9.10% | 9.10% |

*Source: World Bank (2020)***1.2 Statement of the Problem**

Financial performance of a firm is importantly the core mandate in venturing into business and is crucial for its sustainability and wellbeing (Ajayi & Atanda, 2012). Essentially, cash dividends and retained earnings which provides directions to investors on whether to invest or not to invest in a particular firm relies on profitability. Performance of commercial banks in Kenya have been declining since 2010. According to World Bank (2017), ROA declined from 24.4% in 2010 to 20.2% in 2011. Similarly, the downward trend extended to 2014, 2015, 2016, 2017, 2018, 2019 and 2020 with 18.5%, 9.2%, 5.8%, 8.10%, 9.10%, 9.9% and 9.6% respectively. In 2017 to 2020, most banks embarked on retrenchment activities so as to minimize their operating cost and others got into merger acquisition deals due to poor financial performance (Mbua, 2017). This was largely attributed to macro-economic factors; interest capping policy introduced by central bank of Kenya (CBK report, 2018).

Financial wellbeing of the banking sector is linked to the economic wellbeing of the country. This is because of their financial intermediation role, financial inclusion role

and financial asset transformation role. Further note that the banking sector control the money supply in circulation and act as economic stimuli through provision of capital to the SMEs as well as large corporations for entrepreneurial activities .(Mutemi & Makori, 2019). Both Micro and Macro-economic factors affect the performance of a business, microeconomics factors are controllable and the effect can easily be anticipated and controlled (Simiyu & Ngile, 2015). However, macroeconomic factors are beyond the control of an organization and its variations affect the turbulence and volatility of the business environment. In Kenya, the central bank influences macroeconomic variables not only through economic and fiscal policies but also through market activities such as issuance of bonds and capping of interest rates. Banks are then forced to adapt to the changes in order to protect and safeguard their future financial performance. It is therefore imperative for banks to predict the heterogenous effect of these macroeconomic variables on future corporate performances (Broadstock, Shu, & Xu, 2011).

Whereas there is some theoretical literature on the effects of macroeconomic factors on financial performance, little empirical evidence exists on these relationships particularly in Kenya. Previous studies have been done on the effect of macroeconomic variables on financial performance like Kanwal and Nadeem (2013); Kiganda, (2014); San & Heng, (2013); found out macroeconomic factors have no effect on financial performance of firms however, (Mueni J (2016); Mohammed & Samwel (2017); Kungu (2013), Ongeru (2013), Simiyu & Ngile (2015) and Gerlach *et.al* (2005) finds that macroeconomic variables affect financial performance by firms. The specific macroeconomic variables are also found to have differing effect on financial performance as measured by different researchers. The mixed findings witnessed in the previous studies may be attributed to the method of data analysis where most of these studies used pooled panel data which treats the entities under the study to be homogenous yet in practice they are not. To

address this problem this proposed study used fixed effect or random effect model as determined by Hausman test.

Increased integration through embracement of advanced financial innovations and the growing economic fluctuations requires more attention to be paid to. Financial innovations have been used by banks as formidable strategic variables to outstrip any form of competition thus becoming an effective means by which banks can improve their performance while simultaneously being able to maintain their effectiveness in the market (Ahmed *et.al.* 2019). However, Financial innovations' effect on the strength and direction on the relationship between macroeconomic factors and financial performance is yet to be determined. This study therefore addressed this gap by empirically examining the effect of key selected macroeconomic factors on Financial Performance of Commercial Banks in Kenya and the moderating effect of financial innovations on the relationship. The study used a more advanced technique of analysis, Panel data, and covered a 10 Years Period (2011-2020).

1.3 General Objective of the Study

The general objective of this study was to investigate the moderating effect of financial innovation on the relationship between macroeconomic factors and financial performance of commercial banks in Kenya.

1.3.1 Specific Objectives of the Study

The study was guided by the following specific research objectives;

- i. To analyse the effect of Gross Domestic Product Per Capita on Financial Performance of Commercial Banks in Kenya.

- ii. To assess the effect of Interest Rates on Financial Performance of Commercial Banks in Kenya
- iii. To determine the effect of Inflation on Financial Performance of Commercial Banks in Kenya.
- iv. To ascertain the moderating effect of Financial Innovations on the relationship between Gross Domestic Product per Capita and Financial Performance of Commercial Banks in Kenya.
- v. To analyse the moderating effect of Financial Innovations on the on the relationship between Interest Rates and Financial Performance of Commercial Banks in Kenya.
- vi. To evaluate the moderating effect of Financial Innovations on the relationship between Inflation and Financial Performance of Commercial Banks in Kenya.

1.4 Research Hypothesis

The study was guided by the following research hypotheses;

- H₀₁: There is no statistically significant effect of Gross Domestic Product per Capita on the financial performance of Commercial Banks in Kenya.
- H₀₂: There is no statistically significant effect of Interest Rates on the financial performance of Commercial Banks in Kenya.
- H₀₃: There is no statistically significant effect of Inflation on the financial performance of Commercial Banks in Kenya.
- H₀₄: There is no statistically significant moderating effect of Financial Innovations on the relationship between Gross Domestic Product per Capita and Financial Performance of Commercial Banks in Kenya.

H₀₅: There is no statistically significant moderating effect of Financial Innovations on the relationship between Interest Rates and Financial Performance of Commercial Banks in Kenya.

H₀₆: There is no statistically significant moderating effect of Financial Innovations on the relationship between Inflation and Financial Performance of Commercial Banks in Kenya.

1.5 Justification of the Study

The Financial performance of Commercial Banks is important to Kenyan economic development and achievement of diverse developmental targets such as Vision 2030. This is premised on the Commercial Banks providing credit facilities for entrepreneurship activities which is a predictor for employment opportunities and Gross Domestic Product growth. However, stiff competition and public health challenges in the last year has undermined the financial performance of Commercial Banks as evidenced by declining Return on Equity (RoE) and increase in the Non-Performing Loans amongst other financial performance challenges.

Increased integration also due to embracement of financial innovation requires more attention to be paid to find out the indirect effect it has on financial performance of commercial banks. This study thus sought to investigate the moderating effect of Financial Innovations on the effect of macroeconomic factors on Financial Performance of the Commercial Banks in Kenya.

1.6 Significance of the Study

This study will be of importance to diverse stakeholders and management of the Commercial Banks and the financial institutions in Kenya and abroad. This is premised

on the study being able to link the moderating effect of Financial Innovations on the effect of Macroeconomic factors on Financial Performance of the Commercial Banks. The generated knowledge in terms of conclusions and recommendations of this study will provide an action plan on what the managers need to undertake in order to enhance the Financial Performance of Commercial Banks. The study will thus provide knowledge on how banks can leverage on the financial innovations in order to achieve better Financial Performance as well control the adverse effects of macroeconomic factors fluctuations on financial performance. The study will also provide suggested interventions on any negative implication of Macroeconomic factors on Financial Performance of Commercial Banks.

The Central bank of Kenya as the commercial bank regulator will gain insights on the moderating effect of Financial Innovation on the relationship between Macroeconomic factors and Financial Performance of the Commercial Banks in Kenya. This information would be critical in the formulation of the regulatory policies targeting the commercial banks. This is due to the importance of the Commercial Banks' Financial Performance to the economic development of the country. The study will also be of importance to the researchers in the financial sector and other disciplines as a rich source of empirical literature, and as a source of research ideas through the documented suggestions for further studies. The study will also be used by other researchers in the examination of the formulation of various research methodology aspects for finance thesis.

1.7 Scope of the Study

This study was undertaken focusing on the Financial Performance of the 42 Commercial Banks in Kenya within a ten-year period from 2011 to 2020. The commercial banks play a significant role in the contribution of livelihoods as well as the economy allowing

money circulation the authorized medium of exchange. Banks are the backbone of every economy and can give a reflection of how the general economy of a Country is doing. 10-year duration was a moderately long duration to allow keen observations of the changes taking place between and within the banks. However, to minimise truncated data, three banks, Chase Bank (K) Ltd, Dubai Bank Ltd, and Imperial Bank were dropped from the analysis, as they were missing roughly a half of their data thus a total of 39 banks were used in the study. The study focused on moderating effect of financial innovation on the effect of macroeconomic factors on financial performance of Commercial Banks in Kenya. Macroeconomic factors included GDP per capita, Interest rate, Inflation which are the main tools used to measure macroeconomic factors according to Mwangi (2013), Ochanda (2018) and Sharma (2016). Financial innovations included KEPSS, MPMS and payment cards which are the most the significant innovations affecting the banking distribution system that influence the banks performance significantly (Lyons *et.al* 2007).

1.8 Limitations and Delimitations of the Study

Due to time and resource constraints the study only, reviewed innovations on the commercial banks only in Kenya and therefore did not include other financial sector players such as the stock exchange, insurance, micro finance institutions, Savings and Credit Cooperatives (SACCO's) and pension funds. However, this provides an opportunity for further research. The data comprised of purely time series data (macroeconomic variables) and a mixture of cross-sectional and time series (panel) data (financial innovations and ROA). However, this study's time series had only nine observations covering a period of ten years and statistics computed might not have been accurate and can be complemented by other statistical tests.

The study experienced an initial set back since some of the bank annual reports data were missing in the CBK website and had to do request of the data directly from the individual banks. This process was tedious, time consuming and increased the cost of data collection but eventually all the data was availed. It's also good to note that three banks, Chase Bank (K) Ltd, Dubai Bank Ltd, and Imperial Bank, Ltd which were placed in receivership in the 2015/2016 financial year, were dropped from the analysis, as they were missing roughly a half of their data. This is because unbalanced data sets make some statistical models to be invalid.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The chapter reviews relevant literature by various researchers on financial innovation, macroeconomic factors and financial performance of Commercial Banks. The first segment covered the theoretical review theories in the study. The second segment covered the empirical review of the past studies done by various scholars and the last section covered the conceptual framework.

2.2 Theoretical Literature

The study was guided by the following theories anchored on the specific objectives of the study

2.2.1 Keynesian Economics Theory

Keynesian economics was developed by Keynes in 1936 in an attempt to understand the Great Depression. Keynesian economics theory is a theory of total spending in the economy and its effects on output, employment, and inflation. Keynesian economics theory is considered a "demand-side" theory that focuses on changes in the economy over the short run. Keynes's theory was the first to sharply separate the study of economic behaviour and markets based on individual incentives from the study of broad national economic aggregate variables and constructs.

Based on his theory, Keynes advocated for increased government expenditures and lower taxes to stimulate demand and pull the global economy out of the depression. Subsequently, Keynesian economics was used to refer to the concept that optimal economic performance could be achieved and economic slumps prevented by

influencing aggregate demand through activist stabilization and economic intervention policies by the government.

This theory was relevant to this study since it described the total spending in the economy and its effects on output and inflation. Keynesian believes that aggregate demand is influenced by a host of economic decisions both public and private and sometimes they behave erratically. The public decisions include, most prominently, those on monetary and fiscal (i.e., spending and tax) policies.

2.2.2 Deflation Theory

The theory was developed by Fisher in 1933, the theory views the decrease in general price levels to bring about depreciation in the net value of businesses and investments, which further lowers profitability, thereby triggering bankruptcies and other forms of business collapses. Therefore, interest rates which move hand in hand with price levels are characterized by various fluctuations which bring about loss of value of money. These fluctuations and volatility of profitability determinants as regarded as forces within the external (operating) environment and internal environment which exert influence on the degree of over indebtedness between creditors and debtors which ultimately result in default in loan repayment. This default in turn hampers on bank profitability and its financial performance at large. Higher inflation leads to higher profitability when it is well anticipated as interest rate is quickly adjusted and vice versa.

In view of this study, the theory postulates that decreased inflation brings about reduced revenue of banks and ultimately reduced bank profitability which eventually led to banks running into bankruptcy. This varies with the expectation that higher inflation (that is price levels) leads to losses in the purchasing power of money and increase in operating costs and further the interest rates in the banking industry and economy at large. As a

result of this loss of purchasing power of money and reduced value of money, the growth of the country's economy is hampered and thus, hence negatively impacting on GDP growth of the country (Pandey, 2009).

2.2.3 Interest Rate Parity Theory

The theory was developed by Keynes in 1936. The theory is of the notion that the variations in the rate of interests between one nation's currency and that of its counterparts in other countries who trade across borders account for the fluctuations in the nominal rate of interest. The theory rests on the notion of the differences in interest rates of other economies and the local economy. Parity condition rests on the idea that the differences in interest rate for two different currencies is accounted by a discount or premium for the forward rate of exchanges on the foreign currency whereby there is no trading activity as regarding selling and buying of currency in the market (Bhole & Dash, 2002).

This theory was relevant to this study because it relates the existence of parity which performs a vital function in banking transactions. Banks charge interest on loans in order to make profits so as to sustain market share and perform their role of intermediation efficiently. Thus, the financial performance of banks is often affected by the rate of interest charge on loans. Increased interest rates lead to higher profitability while decreased interest rates leads to lower profitability and hence poor financial performance of banks.

2.2.4 Constraint Induced Financial Innovation Theory

The theory was developed by Silber in 1983. Silber argues that the entities have a purpose of maximizing their profits and this is the main factor contributing to

innovations. The theory stated that the main motive for embracing financial innovation in a firm is to improve its financial position. However, in the process of improving financial performance a firm faces some constraints like external handicaps such as policy and internal handicaps such as organizational management. The constraints not only give an assurance on the stability of the management they reduce the competence of any financial institution. Thus, financial institutions struggle towards removing or lessening or casting the constraints off through financial innovation (Silber, 1983).

Internal and external restrictions such as policy and organizational management and leadership style limit the procedure of profit maximization (Jaber & Al-khawaldeh, 2014). The restriction guarantees the constancy of management as well as minimize reduce the competence of monetary institution therefore the institutions, so endeavour to throw them away. Commercial banks which operate in a market with more constraints have the greatest inducement of embracing financial innovation that assist in boosting their financial performance because of reduction in operational costs (Lerner, 2006). Additionally, commercial banks that do not embrace financial innovation are deemed to fail (Johnson & Kwak, 2012). More so, banks in Kenya are strictly regulated by the central banks of Kenya and may not be free to adopt all financial innovations without the express approval of the regulator (Halima & Wepukhulu, 2020).

The theory was relevant to this study because it sheds light on the reasons that make banks venture into financial innovations (Ryabov, 2019). Financial constraints significantly reduce the probability that a firm undertakes innovative projects. According to Silber (1983), Silber, (2004) cited in Kombe & Wafula, (2015) financial innovation occurs to remove or lessen the constraints imposed on firms. Firms facing imperfections (e.g. regulation, entry barriers) have the greatest incentive to innovate and boost profits

because of the high shadow costs of such constraints (Silber 2004 cited in Kombe & Wafula, 2015).

2.3 Empirical Literature

This section analyzed the previous studies that have been conducted on financial innovation, macro-economic factors and financial performance. The key argument in this study was to reveal the moderating effects of financial innovation on the relationship between macro-economic factors and financial performance and finally tested the study hypothesis with a view of agreeing or disagreeing with them.

2.3.1 Financial Performance of Commercial Banks

Financial performance is the degree to which financial objectives of a firm are being accomplished (Pandey, 2009). There are many measures of financial performance. For example, return on assets (ROA) determines an organization's efficiency in ability to make use of its assets and return on equity (ROE) reveals the return investors expect to earn for their investments and return on sales (ROS) reveals how much a company earns in relation to its sales. Traditionally, the success of a company has been evaluated by the use of financial measures (Tangen, 2003).

The main measures of profitability are the rate of return on assets (ROA), the rate of return on equity (ROE), operating profit margin and net income respectively (Hansen & Mowen, 2015). Liquidity measures, gauge the ability of the business to meet financial obligations as they fall due, without disrupting the normal, ongoing operations of the business. Liquidity can be analyzed both structurally and operationally. Structural liquidity refers to balance sheet measures of the relationships between assets and liabilities and operational liquidity refers to cash flow measures.

Solvency measures the amount of borrowed capital used by the business relative to the amount of owner's equity capital invested in the business. In other words, solvency measures provide an indication of the business' ability to repay all indebtedness if all its assets were sold. Solvency measures also provide an indication of the business' ability to withstand risks by providing information about the operation's ability to continue operating after a major financial adversity (Harrington & Wilson, 2019).

Profitability measures the extent to which a business generates a profit from the factors of production: labor, management and capital. Profitability analysis focuses on the relationship between revenues and expenses and also on the level of profits relative to the size of investment in the business. Repayment capacity measures the ability to repay debt from both operating and non-operating income. It evaluates the capacity of the business to service additional debt or to invest in additional capital after meeting all other cash commitments. Measures of repayment capacity are developed around an accrual net income figure. The short-term ability to generate a positive cash flow margin does not guarantee long-term survival ability (Jelic & Briston, 2011). Financial efficiency on the other hand measures the degree of efficiency in using labor, management and capital. Efficiency analysis deals with the relationships between inputs and outputs. Because inputs can be measured in both physical and financial terms, a large number of efficiency measures in addition to financial measures are usually possible (Tangen, 2013).

Rabaa and Younes (2016) surveyed the influence of the financial performance of Islamic Banks on the economic growth in terms of financial liberalization through the use of Islamic banks in all of Abu Dhabi, Saudi Arabia, Bahrain, Great Britain and Tunisia over the period 2001–2012. They used panel fixed effect and GLS regression with variables of GDP, return on assets (ROA), return on equity (ROE), a ratio of the performance of

Zakat, a ratio of Islamic earnings vs. not Islamic earnings, industrial production index (IPI), consumer price index (CPI) and money market rate. They resolved that Islamic banking performance had a significant influence on economic growth.

Tabash (2019) also came to a similar conclusion, which found that there is a constructive significant relationship between financial performance of banks and economic growth in the UAE; he used pooled ordinary least square with variables of GDP, ROA, ROE and the net revenue margin (NRM) on a sample of all full-sized active Islamic banks in the UAE covering a period from 2000 to 2014. In the same vein, Alkhazaleh (2017) demonstrated the correlation between the financial performance of commercial banks in Jordan and economic growth. He used (ROA), deposits and credit facilities as independent variables, and GDP as a dependent element. He used the pooled regression examination to test the associations between variables. He settled that commercial banks' performance contributes to the economic growth in Jordan.

In another empirical study of evaluating how profitability which is the main proxy for the financial performance in the banking sector influences Nigeria's economic growth, Adekola (2016) showed the existence of a straight connection between banks' profitability and economic growth in Nigeria. He used a pooled regression technique for all banks occupied in Nigeria under the period 2005–2014 using the GDP, ROE and return on capital employed (ROCE). In a similar study, Yazdani (2011) explored the effect of private banks' financial performance on economic growth in Iran. He adopted GDP, ROA, cash and investments as research variables. His results showed that bank performance had a positive effect on the economic growth of Iran.

Concerning studies of the financial performance of Islamic finance determinants measured by the profitability, Khan *et al.* (2014) have examined factors that affect

Islamic banking profitability which was adopted as a measure for the financial performance in Pakistan. They employed a sample of five Islamic banks in Pakistan from 2007 to 2014. They employed capital adequacy ratio, bank size, nonperforming loans (NPL) ratio, gearing ratio, asset composition, operational efficiency, asset management, deposit ratio, (GDP) and (CPI) as exogenous variables, ROE, ROA, earnings per share (EPS) as endogenous variables. Their results showed that the profitability of Islamic banking was impacted by bank-specific aspects such as asset management, NPL ratio, deposit ratio and exterior factors such as CPI.

Further, Djalilov and Piesse (2016) have investigated bank financial performance with profitability determinants in the early transition countries of Central and Eastern Europe; they applied GMM system, random-effects regression on a sample of 275 banks from 16 transition economies, eight are from the ex-Soviet Union, other countries are from the CEE and the States of Baltic covering the period of 2000-2013. They adopted capital, credit risk, cost, bank size, bank market share, GDP growth, inflation, government spending, fiscal freedom, monetary freedom as independent variables, and ROA as the dependent variable. They noticed that the effect of credit risk on bank profitability in the early transition countries was favorable, and government spending and well-capitalized banks in the early transition countries were more competitive.

Campanella *et al.* (2017) examine the impact of three types of information technology – which are retail Internet, home banking, and business Internet – on the bank profitability for 3692 banks across 28 European countries over the year 2013. They find out a positive relationship between all types of IT investments and the profitability of European banks. Furthermore, Tunay *et al.* (2015) look into the relationship between the Internet banking and financial performance of banks, using ROA and ROE measures for 30 European

countries during the period of 2005–2013. The authors prove a significant relationship between Internet banking and performance. Rega (2017) investigates the influence of digital investments as well as the effect of the number of physical branches on the bank profitability in a sample of 38 European banks throughout the period of 2013–2015. The author gives proof of a positive relationship between the digital investment and profitability. What is more, Wang et al. (2021) denote that fintech can boost the productivity factors of commercial banks. This is because fintech promoted the adoption of more attractive business models, reduced operating costs, and improved service efficiency, thereby boosting competitiveness. Furthermore, Dong *et al.* (2020) provide evidence that Chinese commercial banks have benefited from the development of Internet finance, promoting diversification, profitability, and security of commercial banks but decreasing the bank liquidity. In addition, Cho and Chen (2021) argue that fintech in China is regarded as a strategy for improving the banking performance. Kou *et al.* (2021) evince that fintech improves the financial performance of European banks through its ability to enhance the bank's competitive advantage. Dadoukis *et al.* (2021) analyze the effect of the information technology adoption in the course of the COVID-19 pandemic on the bank performance. They draw the inference that the IT adoption improves the bank soundness in times of this crisis.

Cicea and Hincu (2009) state that commercial banks represent the core of the credit for any national economy. In turn, the credit is the engine that put in motion the financial flows that determine growth and economic development of a nation. As a result, any efficiency in the activities of commercial banks has special implications on the entire economy. The management of every commercial bank must establish a system for assessing investment performance which suits its circumstances and needs and this evaluation must be done at consecutive intervals to ensure the achievement of the Bank's

investment objectives and to know the general direction of the behavior of investment activity in the past and therefore predict the future. Profitability offers clues about the ability of the bank to undertake risks and to expand its activity. The main indicators used in the appreciation of the bank profitability are: Return on equity, ROE ($\text{Net income} / \text{Average Equity}$), Return on Asset, ROA ($\text{Net income} / \text{Total assets}$) and the indicator of financial leverage or ($\text{Equity} / \text{Total Assets}$) A commonly used measure of bank performance is the level of bank profits. According to Ceylan *et.al.* (2008), bank profitability can be measured by the return on a bank's assets (ROA), a ratio of a bank's profits to its total assets and has proved to be the most effective measure. The income statements of commercial banks report profits before and after taxes.

Narwal *et.al.* (2014) studied the performance variables of banking sector and microfinance institutions in India over a study period of six years 2006 to 2012. The findings of the study established that performance of microfinance institutions mainly rotate around two variables, which include size and spread to total assets. The study concentrated on Micro finance institutions only and didn't reflect the banking sector as a whole. Muriu (2011) explored the impact of financing choice on microfinance profitability using an unbalanced panel dataset comprising of 210 MFIs across 31 countries operating from 1997 to 2008. The study found a proportionally higher deposit as a ratio of total assets was associated with improved profitability. Further, the study revealed that MFIs with a higher portfolio-assets ratio are more profitable but the impact depends on MFI age. The study however concentrated on Micro finance institutions only.

2.3.2 Macro-economic Factors and Financial Performance of Commercial Banks

Osamwonji and Chijuka (2014) investigated the effect of macroeconomic variables on profitability of commercial banks. The study was based on 1990 to 2013 secondary data obtained in Nigeria. The secondary data was obtained from central bank as well as firm's annual reports and financials. Macroeconomic variables studied are GDP, inflation rate, and interest rate; the proxy for profitability being return on equity. Data analysis was by 17 way of ordinary regression. The study finds a significant positive relationship between GDP and return on equity, a significant negative relationship between return on equity and interest rate, and an insignificant negative relation involving inflation rate. This study however fails to indicate neither the population of the study nor the sample used.

Zhang and Daly (2013) examined how macroeconomic and bank specific factors affect the performance of banks in China. The study period covered was 2004 to 2010. The population of the study comprised all the banks in China; a sample of 124 banks with complete data set was studied. Secondary data was collected and used by the study. Return on assets was used as a proxy for profitability. Data collected was analysed using regression analysis. The research study indicates that banks with lower credit risk, and well capitalized are more profitable; banks with higher expense preference exert negative effect on performance. Banks also grow along with growth in the economy; greater economic amalgamation increases bank profitability. The study focused on only Chinese banking sector and failed to statistically show the impact of government policies on performance of Chinese banks.

San and Heng (2013) investigated how macroeconomic conditions and bank specific characteristics affect the performance of Malaysian commercial banks. Period of study

covered 2003 to 2009. Secondary data in this study was obtained and used by the study. 23 banks comprised the population; 20 banks were sampled (three banks had missing data, thus excluded). Data analysis was made via regression analysis and descriptive statistics. The study finds that return on assets ratio is the best measure for profitability. Macroeconomic variables such as gross domestic growth and inflation are found not affecting profitability. Bank specific determinants however affect bank performance. However, no evidence is found in support of the macro-economic variables have an impact on profitability.

Kanwal and Nadeem (2013) also in a research study sought to establish the relationship that exists between macroeconomic variables (GDP, inflation rate, interest rate) and profitability (measured by return on assets, return on equity, and equity multiplier) of public commercial banks in Pakistan. The study covered a period 2001-2011 (ten years). Population comprised thirty-eight banks; a sample of twenty-three listed banks was studied. Data was sourced from secondary sources and analyzed using correlation analysis, descriptive statistics as well as pooled ordinary least squares regression analysis. The researchers find a strong positive relationship between profitability and interest rate, an insignificant positive relationship between GDP and profitability and a weak negative relationship between inflation rate and bank profitability. In summary the study concludes that the selected macroeconomic variables have negligible impact on performance commercial banks earning.

Issah and Antwi (2017) investigated the role of macroeconomic variables on firm's performance in the UK. Multiple regression was used to analyze the data. They studied a total of 59 macroeconomic variables, subjected to principal component analysis for variable reduction. The full sample model showed adjusted R^2 value of 0.91, and the

following variables were significant: lagged ROA; adjusted unemployment rate; benchmarked unit labor costs; real GDP and exchange rate. And five out of the six studied industries had significant F -values.

Owolabi (2017) examined the relationship between economic characteristics and financial performance in Nigeria. The economic characteristics were: government expenditure, inflation, interest rate and exchange rate. The sample comprised 31 manufacturing firms listed on the Nigeria Stock Exchange. The duration of the study was from 2010 to 2014. The effect of government expenditure, inflation, interest rate and exchange rate on EPS and ROA was not significant. Interest rate was significant for only ROE, while all the variables (government expenditure, inflation, interest rate and exchange rate) were significant for Tobin's Q .

Mwangi and Wekesa (2017) examined the influence of economic factors on firm performance in Kenya. They study used a descriptive research design, and the sample comprised 74 staff working in Kenya Airways Finance Department. The economic factors were interest rate and taxation; the dependent variables of the study were efficiency and growth. The study used primary data. They used multiple regression technique in testing the hypotheses. They found that economic factors had significant effect on performance. Rao (2016) examined the relationship between macroeconomic factors and financial performance in Nairobi. The sample comprised five firms listed under the energy and petroleum sector of the Nairobi Stock Exchange. The study was from 2004 to 2015. The study found a significant negative effect of interest rate and oil price on financial performance. However, GDP growth, exchange rate and inflation rate were not significant.

Otambo (2016) examined the effect of macroeconomic variables on financial performance of banks in Kenya. The duration of the study was from 2006 to 2015. ROA was used to measure financial performance while quarterly interest rates, quarterly exchange rates (USD/KSH), quarterly GDP and quarterly inflation rates were used to measure interest rates, exchange rates, GDP and inflation rates. The study found that interest rates and exchange rates affect financial performance negatively while GDP affects financial performance positively. Inflation rates were not significant.

Udu (2015) examined the influence of environmental factors on business operations in Nigeria. The duration of the study was from 1981 to 2013. The variables studied were inflation rate, interest rate, unemployment rate, and exchange rate, and business operations proxied as real GDP was the dependent variable. Ordinary least squares method of analysis was employed to test the hypothesis. The study found that interest rate and unemployment rate were positive and significant. Gado (2015) examined the impact of macro environment on performance in Nigeria. The sample comprised 20 most capitalized companies. The study used ordinary least squares and correlation. The results showed that collectively the macro-environmental variables have significant and positive impact on performance. Specifically, government expenditure and inflation have a positive impact while exchange and interest rate have a negative impact.

Murungi (2014) examined the relationship between macroeconomic variables and financial performance in Kenya. The sample comprised 46 Insurance firms listed on Kenya Stock Exchange. The study duration was from 2009 to 2013. The data were analyzed using multiple regression. The study found that interest rate and GDP were statistically significant. Others such as inflation rate, exchange rate, money supply and size of assets were not statistically significant.

Kiganda (2014) examined the effect of macroeconomic factors on profitability of banks in Kenya. The study focused on Equity Bank. The studied macroeconomic factors were: real GDP, inflation and exchange rate. The study used the Cobb–Douglas production function transformed into natural logarithm and used annual data from 2008 to 2012. The results showed that the macroeconomic factors (real GDP, inflation and exchange rate) have insignificant effect on profitability of Equity Bank at 5 percent level of significance. The study focused on a single bank which limits the generalizability of the findings.

Ogunbiyi and Ihejirika (2014) examined the effect of interest rates on profitability of Deposit Money Banks in Nigeria. They used country-level aggregate annual data over a period of 13 years from 1999 to 2012. They employed multivariate regression analysis. The results showed that maximum lending rate, real interest rate and savings deposit rate have negative and significant effect on profitability of banks as measured by ROA at 5 percent level of significance. However, no significant relationship was found between interest rate and net interest margin of banks.

Osamwonyi and Michael (2014) investigated the impact of macroeconomic variables on profitability of banks in Nigeria from 1990 to 2013. They used pooled ordinary least squares (POLS) regression. The macroeconomic variables were: GDP, interest and inflation rate; profitability was proxied using ROE. The study reported a positive effect of GDP on ROE. Interest rate had a significant negative effect on ROE, while inflation was not significant at all levels of significance. Enyioko (2012) examined the effect of interest rate policies on performance of banks in Nigeria. The sample comprised 20 banks that emerged from the consolidation exercise of 2004. They applied regression and

error correction models to analyze the relationship. The study reported that interest rate policies have not affected the performance of banks significantly.

Izedonmi and Abdullahi (2011) studied the effect of three macroeconomic variables, i.e. inflation, exchange rate and market capitalization on the performance of 20 sectors of the Nigerian Stock Exchange (NSE) for the period 2000–2004. The study reported that the extent to which a factor affected the various sectors varied from one sector to another. Jointly the study found no significant influence of macroeconomic factors on the NSE.

Kandir (2008) investigated the effect of macroeconomic factors on stock returns in Turkey. The sample comprised all non-financial firms listed on the Istanbul Stock Exchange for the period 1997–2005. Macroeconomic variables in the study were: growth rate of industrial production index, change in CPI, growth rate of narrowly defined money supply, change in exchange rate, interest rate, growth rate of international crude oil price and return on the MSCI World Equity Index. Multiple regression was employed in data analysis. The study finds that exchange rate, interest rate and world market return affect all of the portfolio returns, while inflation rate is significant for only 3 of the 12 portfolios. On the other hand, industrial production, money supply and oil prices do not have any significant effect on stock returns.

Mueni Juliana (2016) studied the effect of macroeconomic variables on the financial performance of commercial banks in Kenya. The measure of financial performance used was return on assets (ROA) measured against the macroeconomic variables like inflation rate, foreign exchange rate gross domestic product (GDP), and lending rate while controlling for effect of asset quality, management efficiency and capital adequacy. The research design used was the descriptive research design. The research study population comprised all the forty-two commercial banks in Kenya that are licensed by the Central

Bank of Kenya (CBK). The findings of the study indicate financial performance (measured using return on assets ratio) of commercial banks in Kenya has a strong positive correlation with changes in macroeconomic variables as inferred from the correlation coefficient of 0.768. The study however covered a short study period, five years.

Simiyu and Ngile (2015) undertook a research study to analyse how macroeconomic variables effect on the profitability of listed commercial banks in Kenya. The census study used a population of ten commercial banks and obtained secondary data covering the period 2001 to 2012. Data obtained was analysed using fixed effects panel data analysis. The macroeconomic variables studied were GDP, exchange rate, and interest rate; profitability was measured using return on assets. In this study, the researchers find an insignificant positive effect by GDP on profitability; also, the study finds a significant negative relationship between interest rate and profitability and a positive significant effect between exchange rate and profitability.

Kiganda (2014) also undertook a study to investigate how macroeconomic variables affect the performance of commercial bank profitability in Kenya. The case study of Equity bank limited used a correlation research design and obtained secondary data covering the five-year period, 2008 to 2012. Data analysis was undertaken via ordinary least squares regression. The study finds macroeconomic variables (GDP, inflation rate and exchange rate) have insignificant effect on profitability and concludes that the factors do not affect bank performance in Kenya. The case study might have resulted in skewed findings; generalization of findings to the over forty banks in Kenya might not be hold.

Ongeri (2014) also in a research study investigated how macroeconomic variables affect the financial performance of non-banking financial institutions in Kenya. The study employed a descriptive research design and obtained secondary data on the one hundred 20 and twelve firms that formed the population. The census study covered the period 2004 to 2013. The study variables were GDP, exchange rate, interest rate, return on assets and inflation rate. Data analysis was undertaken using descriptive, regression and correlation analyses. The study finds a strong positive relationship between the return on assets and the exchange rate and weak positive relationship between GDP and interest rate, and return on assets; and concludes that there is a positive effect of macroeconomic variables on profitability of the said studied firms. The study however fails to indicate the effect of inflation rate on profitability, yet it was part of the intended analysis.

Tora J. (2018) studied the effect of macro-economic variables on financial performance of commercial banking sector in Kenya. The researcher ran a descriptive as well as a correlational study on all the commercial banks in Kenya between January 2008 and December 2017. Return on assets was used to measure financial performance while quarterly interest rates, quarterly exchange rates, quarterly GDP growth rate, and quarterly inflation rates were used to measure interest rates, exchange rates, economic growth and inflation rates respectively. The results of the study indicated that there is a strong relationship ($R=0.656$) between macro-economic variables and financial performance of commercial banks. The study further established that interest rates affect financial performance of the commercial banking sector positively and to a significant extent while the rest of the selected macro-economic variables have no significant effect on financial performance of the banking sector. The study recorded an R-squared value of 0.43. This implies 43% of the total variance in financial performance of the commercial banking sector in Kenya can be attributed to macro-economic variables. This

implies that there are other key macro-economic variables that impact the banking sector's financial performance

Kungu (2013) in a research study to establish how financial performance (return on investment) of private equity firms in Kenya is affected by macroeconomic variables (GDP, interest rate, inflation rate, foreign exchange rate), used a descriptive and correlation research designs. The population covered 28 firms and utilized secondary data, which was analysed using multiple regression analysis. The study concludes that financial performance of private equity firms is affected by macroeconomic factors. The exchange rate was found to have a weak negative

Njau (2013) did a study on relationship between macroeconomic variables and financial performance of private equity (PE) firms in Kenya and had the objective of establishing the effect of macroeconomic variables: inflation, lending interest rates, GDP growth, non-diversifiable risk and currency exchange rate and financial performance, between the periods January 2011 to March 2012. Regression analysis and time series were applied to examine the causal relationship between selected macroeconomic variables and financial performance. This study made use of various analysis software such as STATA version 11.0, advanced Microsoft Excel and SPSS version 16. The study findings indicated that the selected variables which. GDP growth rate, inflation rate, foreign exchange rates and banking lending rates had the highest impact on financial performance of PE firms. The research recommended that future plans should consider inflation rate and GDP in particular since they have the highest effect on PE firm's earnings.

Barasa (2014) undertook a study on the relationship between economic performance indicators and stock returns amongst listed firms at NSE and used exploratory research design. All the companies listed from 2008 to 2012 were chosen for study using Census

survey. The study applied multi linear regression analysis to investigate the relationship and correlation analysis to ascertain the strength of the relationship between stock returns and economic performance indicators. His findings established a significant positive relationship between inflation, economic growth, interest lending rate and stock returns and to the contrary, an inverse relationship existed with exchange rate and stock returns. Multi linear regression analysis was not suitable for a time series data.

According to Njuguna (2013) who undertook a study on the relationship between macroeconomic factors and financial performance of MFIs in Kenya measured with ROA as the dependent variable. The study concluded that ROA is highly a function of 19 macroeconomic factors and more specifically GDP, Interest rates and Inflation and the three variables can be credibly used to predict MFIs expected ROA. This revelation offers regulators and those responsible over macroeconomic variables, vital information that if MFIs are to operate profitably and encourage growth in the sector, then; they have to offer favorable economic variables. That is, they should ensure high economic growth (GDP) and have low inflation and interest rates in the economy which will instead boost MFIs performance and therefore creating room for higher economic growth.

Francis (2013) identified determinants of commercial bank profitability in Sub-Saharan Africa. Using the cost efficiency model, bank profitability was estimated using panel random effects method in static framework. The explanatory variables are growth in bank assets, growth in bank deposits, capital adequacy, operational efficiency (inefficiency), and liquidity ratio as well as the macroeconomic variables of growth in GDP and inflation. The findings clearly show that both bank-specific as well as macroeconomic factors explain the variation in commercial bank profitability. Decline in GDP growth will negatively affect the demand for products at the market and credit

services from financial institutions. And as interest earnings is one of the key sources of income to financial institutions then with such a case the profitability will be low.

Imoughele & Ismaila (2014) looked at the impact of commercial bank credit on the growth of small and medium scale enterprises econometric evidence from Nigeria (1986-2012) obtained mainly by secondary sources. Econometric model was specified and estimated via the Ordinary Least Square (OLS) techniques to ascertain the relationship between dependent SMEs output and the explanatory variables. The variables were tested for stationarity, co-integration analysis was also carried out and also error correction test was performed. The findings revealed that commercial banks credit to SMEs and the saving and time deposit of commercial banks exert a positive and significant influence on SMEs development proxy by wholesale and retail trade output as a component of GDP, while exchange rate and interest rate exhibit adversative effect on SMEs development.

2.3.3 Gross Domestic Product per Capita and Financial Performance of Commercial Banks

GDP Per capita is a metric that breaks down a country's economic output per person and is calculated by dividing the GDP of a country by its population. Per capita GDP is a global measure for gauging the prosperity of nations and is used by economists, along with GDP, to analyse the prosperity of a country based on its economic growth. Small, rich countries and more developed industrial countries tend to have the highest per capita GDP (Thomas Brock;2020). GDP is the total market value of goods and services produced by a country's economy during a specified period of time. It includes all final goods and services, that is, those that are produced by the economic agents located in that country regardless of their ownership and that are not resold in any form. According

to Mwangi (2013), GDP is a most commonly used macroeconomic indicator to measure total economic activity within an economy; its growth rate reflects the state of the economic cycle. It is used throughout the world as the main measure of output and economic activity.

According to KNBS (2016), there has not been a specific study on the financial performance of Kenyan banks based on its GDP. The trend of GDP per capita affects the demand for banks asset. Decline in GDP per capita growth rate leads to fall in credit demand which in turn negatively affect the profitability of banks. On the contrary, in a growing economy as expressed by positive GDP per capita growth, the demand for credit is high due to the nature of business cycle. During boom the demand for credit is high compared to recession Athanasoglou *et al.* (2005). GDP per capita growth has been fluctuating over the years. The Gross Domestic Product per capita in Kenya was recorded at 1237.50 US dollars in 2019. The GDP per Capita in Kenya is equivalent to 10 percent of the world's average. According to World Bank., (2020a), Kenya's GDP per capita growth stood at 983, 1000.8,1032.3,1060.1093.1,1129.7, 1157.4, 1201.5 and 1237.5 for the financial years 2011,2012,2013,2014,2015,2016,2017,2018,and 2019 respectively. Within a ten-year period between 2000 to 2020, World Bank., (2020c) noted a highest growth of 0.441% in the year 2018 and a low of 0.17% in the year 2012.

Hong & Razak (2015) conducted a study on the impact of nominal GDP and inflation on the financial performance of Islamic banks in Malaysia. The aim of this paper was to analyse the financial performance of Islamic banks in Malaysia measured using ratio analysis of profitability, liquidity, credit risk and impaired financing performance. The study also includes determining the impact of nominal Gross Domestic Product (GDP) and inflation rates on the variables of profitability, liquidity, credit risk and impaired

financing performance during the period spanning from year 2007 to year 2011. In order to analyse the performance growth of the Islamic banks, the financial data was generated from Bank scope for the duration of year 2007 until 2011. The period chosen include the U.S. financial crisis as the results should portray the resilience of the Islamic Banks. The study concluded that the log linear regression between nominal GDP and inflation rate as the dependent variables show that nominal GDP has significant and positive impact on ROAA (return on average asset) and liquidity ratio and EQL (equity to total liquidity).

Wabita (2013) researched on the correlation between macroeconomic variables and financial performance of aviation industry in Kenya and had the objective of establishing the relationship between macroeconomic variables: real exchange rate, GDP growth, money supply, interest rate and inflation on financial performance. The period of study was between 2008 to 2012. The study employed descriptive, correlation and multiple regression analysis tools and established that the companies ROA in the aviation industry had a weak positive significant correlation with GDP and annual changes in money supply. The study only focused on the aviation industry which doesn't give a clear picture on performance of the sectors.

Kiptoo (2012) sought to investigate the factors that influenced commercial bank rate adjustment disparity with what the Central Bank of Kenya would expect after variation of the Central Bank Rate and Cash Reserve Ratio. The study used secondary data which was collected from the Central Bank of Kenya and the Kenya National Bureau of Statistics, and on whose basis, comparisons were made with reference to the Non-Performing Loans, Operating Costs, industry Return on investment, and overall Gross Domestic Product. The study revealed that gross domestic product had little and negative influence on commercial bank profitability and that an increase in gross domestic

product did not significantly trigger commercial banks' adjustment of interest rate, and if it did it was to the opposite direction. An adjustment in interest rates often renders the effect of GDP on productivity useless. The study recommended to test the impact of GDP on profitability alone and interest rates separately too taking into considerations their indirect effects.

Ongore and Kusa (2013) conducted a study on determinants of financial performance of Commercial Banks in Kenya. The study adopted a liners multiple regression and generalized least square on panel data to estimate the parameters. The findings showed that bank specific factors significantly affect the performance of commercial banks in Kenya, except for liquidity variable. During the declining of GDP growth, the demand for credit falls which in turn negatively affect the profitability of International. On the contrary, in a growing economy as expressed by positive GDP growth, the demand for credit is high due to the nature of business cycle.

Kenya's economy is being hit hard through supply and demand shocks on external and domestic fronts, interrupting its recent broad-based growth path. Apart from the COVID-19 (coronavirus) pandemic, the locust attack which started early 2020, has affected many parts of Kenya especially the North East. It has had a negative impact on the food security and growth of the agriculture sector in the country. This study will seek to ascertain the current effect of GDP on the Financial performance of Commercial Banks considering the impact of supply and demand shocks on external and domestic fronts.

2.3.4 Interest Rates and Financial Performance of Commercial Banks

Interest rate is main tool of monetary policy and an important macroeconomic variable, which is positively linked with country's economic growth. Commonly, interest rate is said to be the cost of capital, means the price paid for money used over a certain time

period. (Investopedia.com). Where the interest rates spreads are very high, the banks often lend to individual who are perceived as low risk, while low interest rate spreads lead to crossing out of individual borrowers who are perceived as high risk. In cases where the interest rate spread is regulated by regulators and the crowding out effect by governments it leads to low levels of profitability due to low levels of lending in the market (Ochanda, 2018). In Kenya, all interest rates generally declined in 2019, partly reflecting the reduction in the Central Bank Rate (CBR) during the last quarter of 2019. The Monetary Policy Committee (MPC) lowered the CBR from 9.0 percent in October 2019 to 8.50 percent in November 2019, noting that inflation expectations were well anchored within the Government target range and that economic output was below its potential level.

The average 91-day Treasury bill rate declined to 6.92 percent in 2019 from 7.76 percent in 2018, while the average 182- day Treasury bill rate declined to 7.87 percent from 9.56 percent. The average commercial banks' lending rate declined to 12.44 in 2019 from 13.06 percent in 2018. The interest rate spread increased to an average of 5.38 percent in 2019 from 5.15 percent in 2018. The average interbank rate declined to 4.32 percent in 2019 from 5.22 percent in 2018, largely reflecting improved liquidity conditions in the money market. However, the interbank rate was relatively volatile during the year; ranging from an average of 2.51 percent in February to a peak of 6.86 percent in October 2019, partly reflecting market segmentation.

Irungu (2013) sought to determine the effect of interest rate spread on the performance of commercial banks in Kenya. The study sought to determine the effect of interest spread on Kenya commercial banks financial performance. The target population in this study is all 43 commercial banks in Kenya. Data is collected from central banks supervision

report. The data collected was analysed using SPSS (Statistical Package for Social Scientists). Regression analysis was used to analyse the data and find out whether exists a relationship between interest rate spread and the performance of commercial banks in Kenya. The study found that there is strong positive relationship between financial performance of Commercial Banks with interest rate spread. Study found variables are significance to influencing financial performance of Kenya banks. The study found that interest rate spread affect performance assets in banks as it increases the cost of loans charged on the borrowers, regulation on interest rates have far reaching effects on assets non-performance. The study recommends there is need for government to regulate interest rates as this would help to safeguard borrowers from exploitation by commercial banks.

Ngure (2014) investigated the effect of interest rates volatility on the performance of commercial banks in Kenya. The study used descriptive research design using secondary data obtained from Central Bank of Kenya for the period of five years from 2009 to 2013. Data obtained was analysed using SPSS version 21 and results obtained tested for significance using ANOVA. The study found that interest rates have significant positive effect on financial performance of Commercial Banks in Kenya at 95% confidence level. The relationship between interest rates and financial performance was also found to be linear with increase in interest rates leading to higher profitability. The study also concluded that bank size and interest rate volatility had effect on profitability of commercial banks. The study also found that the model containing interest rates and size of commercial bank can explain 64% of the changes in commercial banks profitability. The study recommended that policies to be put in place to shield bank lending rates and ensure monitoring the same. Further, so as to cushion consumers from exploitation by commercial banks, the Central Bank need exercise their monitoring roles strictly and

discipline any commercial banks that may be increasing the interest rates arbitrary to boost their profitability. The study also recommends that in times of poor performance of commercial banks and the need to boost their profitability may be necessary for their role in economy, Central Bank of Kenya should come up with monetary policy that will lead to rise in interest rates and hence improving banks profitability.

Okech (2013) undertook a study on the effect of lending rates on the performance of commercial banks in Kenya. The research sought to determine the effect of lending interest rates on the financial performance of the commercial banks in Kenya. The study involved a census survey of all the 43 commercial banks registered and in operation as at 31st December 2012. ROE was regressed against the Lending interest rate, Operating cost efficiency and Management Efficiency. The study found out that a weak but positive relationship ($R= 0.378$) exists between lending interest rates and financial performance of Commercial Banks. The study also revealed that 14.3% of financial performance in commercial banks can be explained by lending interest rates. The study recommended income source diversification for better performance.

Kipngetich (2011) examined the effect on interest rates on the performance of commercial banks in Kenya. The study set out with an objective of establishing the relationship between interest rates and financial performance of Commercial Banks in Kenya. To achieve the objective of the study regression models were developed using financial performance as the independent variable and interest rates as dependent variables. In the model ROE was defined as the profitability indicator. Secondary data was collected from published reports for a period of five years between 2006 and 2010. The findings and analysis reveal that interest rates have an effect on financial performance of Commercial Banks in Kenya. The study used regression analysis to

establish the relationship between interest rates and ROE. The results obtained from the regression model shows that there is a positive relationship between interest rates and financial performance of Commercial Banks in Kenya. The study recommended the application of diversification strategies to enhance performance of commercial banks

The studies above provide valuable insights on interest rates and financial performance; however, they do so only partially. Given the volatile macroeconomic environment in Kenya, there is need for up-to-date research on the complex relationship between interest rates and financial performance. Basing on the foregoing, it is imperative to study the relationship between interest rates and financial performance in Kenya. This study therefore seeks to answer the question: what is the effect of interest rates on the financial performance of Commercial Banks in Kenya?

2.3.5 Inflation and Financial Performance of Commercial Banks

The Consumer Price Index (CPI) is a measure that examines the weighted average of prices of a basket of consumer goods and services. It is calculated by taking price changes for each item in the predetermined basket of goods and averaging them. The CPI is one of the most frequently used statistics for identifying periods of inflation or deflation. CPI measures the average change in prices over time that consumers pay for a basket of goods and services. Essentially it attempts to quantify the aggregate price level in an economy and thus measure the purchasing power of a country's unit of currency (Jason & Peter; 2020)

Sharma (2016) indicated that, CPI is one of the most important inflation indicators and one of the most closely watched national economic statistic in general. This is because the annual percentage change in the CPI is used as a measure of inflation and as a means for indexation for example, Social Security benefits are tied to the CPI to keep them in

line with changing prices. An upsurge in the rate of increase in the CPI will prompt government or policy formulators to lean toward raising interest rates in its policy deliberations. And a decrease in the CPI will lead to decrease of interest rates in the banking sector. Movements in the CPI also have a direct impact on the pocketbooks of many Kenyans. For instance, the annual increase in the CPI determines the rate at which the nominal payments to Social Security recipients will rise each year. The tax brackets that determine the income tax liability of most workers are indexed to the CPI as well.

Increase in Inflation has both positive and negative effects on an economy. Negative effects of Inflation include loss in stability in the real value of money and other monetary items over time; uncertainty about future returns and may discourage investment and saving, it leads to shortages of goods if consumers begin hoarding out of concern that prices will increase in the future. Positive effects include a mitigation of economic recessions, and debt relief by reducing the real level of debt. Overall inflation in Kenya has remained well anchored within the Government target band. As measured by the Consumer Price Index (CPI), it increased to 5.2 percent in 2019 from 4.7 percent in 2018 mainly on account of significant increases in the prices of selected key food items. Non-Food-Non-Fuel (NFNF) inflation remained low in 2019, reflecting muted demand pressures in the economy supported by prudent monetary policy. Consumer price index in May to December 2020 was stood at 108.6, 108.27, 108.35, 108.57, 108.57, 109.6, 110.7 and 111.87 respectively.

Vena (2012) analysed the impact of inflation on the yields of companies listed in Kenya. She observed that inflation was a major problem in Kenyan and with a rise in inflation there was a corresponding rise in the Consumer Price Index due to the rising interest rates resulting to a fall in price of shares for the listed companies. Since the overall goal

of a company is wealth maximization, with the fall in the share price there was a fall in the returns for the companies. The study was conducted between 1998 and 2013 and the researcher used the GARCH model that highlighted the effect of inflation on firms' yields. The findings indicated that inflation has an adverse effect on profitability and it was concluded that stock returns are low when there is high inflation since investments are moved from stock exchange into business ventures that are not influenced by inflation. The study did not show a clear effect of inflation on the stock market return and volatility, which ultimately influence the profitability of the firms.

Wamucii (2010) analysed the ten (10) year relationship between inflation and the financial performance of Commercial Banks. The analysis of the data was done through regression of inflation against the commercial banks' economic performance for the period under analysis. The findings indicated that there was an inverse relationship between inflation and financial performance and therefore, he concluded that as inflation decreased, the profits for the same period increased. This study did not clearly identify the relationship between inflation rates and how they influence profitability since there are other factors such as the negative impact of inflation that discourages investment and saving influences growth and performance. Kobia (2018), examined effect of inflation rate on Profitability of Commercial Banks in Kenya. The study covered the period between 2000 and 2009 while this study will cover the period between 2013 and 2017. Different periods produce different results since inflation is calculated from the weighted average of selected price changes that are modified over time and therefore, the current period will provide the calculation of a more accurate inflation rate. Consequently, this period will give a conclusive comparison between inflation and profitability. In addition, there was a limitation to only three variables used, which were assets, profits and cash

flows and this study will focus on more control variables to give an extensive comparison of this relationship.

The study on the effect of interest and inflation on exchange rates was done for the period between 2007 and 2012 by Okoth (2013). The analysis was meant to determine the significance levels based on the two variables and ascertain their correlation. The study established that a great impact caused by a rise in inflation and interest on the exchange rate. It indicated that there was a likelihood of increase of the exchange rate due to the corresponding increase of the two variables. The study did not show how inflation rate affected the profitability despite having an effect on the exchange rate, currency values and revenues from foreign exchange trading.

Wanjohi (2003) examined internal and external factors of commercial banks' profits in Kenya. The study was done to determine why some commercial banks are more successful than others since profitability was one of the measures of a firm's success. Inflation was also noted as a determinant of profitability since it affects the costs and revenues of the business. Inflation was associated with higher realized interest margin and profitability since there was a positive connection between inflation and profits. The period analysed was between 1993 and 2002 for banks listed in the NSE. Regression was conducted and thus findings indicated that despite the banks being different in characteristics and experience it was evident that the internal factors contributed to the profitability. The study was only limited to listed banks in Kenya and therefore all banks were not considered. The study did not extensively show how inflation affected profitability since the focus was on the loan component as an internal factor.

Mulwa, (2011) examined the influence of exchange rate on inflation rates since many countries experience this and it translates to high uncertainty in their economies. The

study covered the period between 2003 and 2013 and used the Auto Regressive Integrated Moving Average model to describe the behaviour of the variables against each other. The conclusions indicated that there existed a weak connection between exchange rates and inflation since the variations in the model were small and therefore a moderate relationship of the variables. The study did not indicate how the relationship between the exchange rates and inflation rate affect the firms' profitability as an economic variable for performance.

2.3.6 Financial Innovations and Financial Performance of Commercial Banks

2.3.6.1 Kenya Electronic Payment and Settlement System (KEPSS)

According to the Bank of International Settlements (BIS), a payment system “consists of a set of instruments, banking procedures and, typically, interbank funds transfer systems that ensure the circulation of money.” They are a major channel by which shocks can be transmitted across domestic and international financial systems and markets.

The Kenya Electronic Payment and Settlement System (KEPSS) is Kenya's Real Time Gross Settlement System (RTGS). It was set up in 2005 as part of CBK's efforts to modernize payments in Kenya. KEPSS settles Kenya's high-value and time-critical payments. KEPSS implementation facilitated the mitigation of risks associated with the previous paper-based inter-bank settlement system, transformed the management of liquidity in the banking industry, reduced the systemic importance of the Automated Clearing House (ACH) and enhanced financial stability while providing an efficient mechanism for monetary policy transmission. KEPSS has continued to register remarkable growth in both volume and value of transactions. In 2019/20, KEPSS processed 4.97 million transaction messages valued at Kshs 33.23 trillion compared to 4.75 million transaction messages worth Kshs 30.04 trillion in 2018/19. KEPSS is

classified as a Systemically Important Payment Systems (SIPS) due to the value of transactions it processes and its impact in the economy. The system was implemented on July 29, 2005 and is wholly owned and managed by the Central Bank of Kenya (CBK)

RTGS payments has shown a steady increase from inception in 2005 at 2 trillion, 9 trillion in 2007 rising to 17 trillion in 2010, 19 trillion in 2012 and to 23 trillion in 2014 as per the central bank data. In general, the overall payment system in Kenya has shown steady increase in the value of the transactions that has been conducted during the years from the year 2007 to date. The increase in the value of payment may mean an increase in the factors of production that may be associated with the real or nominal GDP. All of payment systems are aimed at mitigating various risks and enhancing the efficiency and effectiveness of our payments system (Kiptepkut, 2007). Although the introduction of the Real Time Gross Settlement System was expected to reduce the systemic importance of the Automated Clearing House (ACH) and increase the stability and soundness of the payment systems, CBK report 2019 reveals that there has been no significant change in the volumes and values of payment instruments going through the ACH.

2.3.6.2 Payment Cards

According to CBK (2019), Payment cards include credit, debit and prepaid cards, which hold a strong foothold not only in Kenya but globally, offering everyone better access to their money. The banking sector continues to adopt more secure, convenient and safe technology at their cash points to curb insecurity and at the same time enlighten their customers. In 2013, the industry, through the ‘Great Migration to EMV Chip’ project, initiated shifting from magnetic strip-based cards to chip enabled cards. This process improved the security of cards and ensured they are globally interoperable, thus further

increasing their uptake. These cards are normally transacted through the ATMs or Point of sale terminals.

The ATMs functions in Kenyan context include cash deposit and withdrawals, balance enquires, mini statement processing, and funds transfers (Melubo & Musau, 2020). Most of the customers prefer ATM to other forms of banking in accessing bank products and services (Mwatsika, 2016). ATMs provides services for 24 hours and therefore customers are able to access them any time when they have a need. They are faster as compared to human teller and easy to use them (Jegede, 2014). Even though ATM systems have a high fixed cost, they have contributed a lot in improving the efficiency of banking to customers (Danlami & Mayowa, 2014). According to Central Bank of Kenya (2015), the number of ATMs increased from 2,205 in 2011 to 2,718 in 2015 even though the increases per year were a bit low. In addition, the bank's annual banking industry reports indicate that there has been a decreasing trend in ratio of ATM to the number of branches from 1.899 in 2011 to 1.785 in 2015. According to Supervisory Bank Report 2020, the number of Automated Teller Machines (ATMs) decreased by 70 (2.77 percent) to 2,459 in December 2019 from 2,529 in December 2018 as indicated in Table 3.

Table 3*ATM Networks*

| Month | No of ATMs | Monthly Increase | Percentage Growth (%) |
|--------|------------|------------------|-----------------------|
| Dec-18 | 2,529 | - | - |
| Jan-19 | 2,519 | -10 | -0.4 |
| Feb-19 | 2,515 | -4 | -0.16 |
| Mar-19 | 2,510 | -5 | -0.2 |
| Apr-19 | 2,510 | 0 | 0 |
| May-19 | 2,523 | 13 | 0.52 |
| Jun-19 | 2,522 | -1 | -0.04 |
| Jul-19 | 2,573 | 51 | 2.02 |
| Aug-19 | 2,556 | -17 | -0.66 |
| Sep-19 | 2,464 | -92 | -3.6 |
| Oct-19 | 2,463 | -1 | -0.04 |
| Nov-19 | 2,463 | 0 | 0 |
| Dec-19 | 2,459 | -4 | -0.16 |

Source: Central Bank of Kenya (2020)

2.3.6.3 Mobile Phone Money Transfers

Mobile phone money transfer operators are authorised as Payment Service Providers under the National Payment System Act 2011 and National Payment System Regulations 2014 under various categories including; Provision of Electronic Retail Transfers, Small Money Issuer, E Money Issuer and Designation of Payment Instrument. Mobile financial services industry has grown significantly over the past years since inception in 2007. The growth and viability of these services relies heavily on the existence of a payment platform that is convenient, easy to use, traceable and secure. The emergence of innovative mobile phone money transfers has put Kenya on the world's payment system map. It is notable that the mobile-based money financial services have greatly enhanced

access to financial services, which is one of the key objectives of the Government towards meeting vision 2030 objectives.

In particular, mobile phone money transfer platforms have moved from the traditional role of transferring money to provision of banking services to both banked and unbanked. Commercial banks have partnered with mobile network operators to enable customers to access their bank accounts through mobile phones. Mobile phones can be used for opening and operating virtual bank accounts and access of traditional banking services like depositing, withdrawing and credit facilities without physical representation to the bank.

Supervision Report of CBK 2019, indicate that with continued global technological advancements, the Kenyan Banking Sector has had to continuously adopt and adapt to technologically driven service delivery channels. Mobile-phone Financial Services (MFS), which spans the full spectrum of financial services, is one such delivery channel. MFS continues to propagate Kenya's digital banking ecosystem to cover not only money transfer but also credit and savings, payments for goods and services as well as e-commerce through linkages with various financial and non – financial institutions. The growth of MFS has been witnessed not only in the urban areas but also the rural areas. This is largely attributed to the convenience and affordability of financial services offered through MFS. In addition to offering financial services, MFS is now being utilized for customer relations especially in enhancing communication as well as receiving feedback from customers. This has been driven by the continued changes in customers' expectations, which come about with the advancement in technology. The challenge that the banking sector then continues to face is ensuring it remains relevant in

the market by continuously developing solutions that address the changing customer needs and preferences.

According to CBK, 2019; the number of active mobile subscriptions continues to grow. It stood at 54.5 million as at 31st December 2019, which translates to mobile penetration rate of 114.8 percent. Since inception of MFS, there are now over 224,108 agents, over 58 million customers and 942.7 million transactions valued at over Ksh.2.1 trillion as at December 2019. We continue to witness the growth in value of transactions with an increase of 4 percent from Ksh.367.77 billion in 2018 to Ksh.382.93 billion in 2019. While there was an increase in value of transactions, there was a slight decline in the number of transactions from 155.77 million in 2018 to 154.99 in 2019 million, a decline of 0.5 percent. These figures are captured in Table 4.

Table 4

Mobile Phone Money Transactions

| Digital Financial | 2011 | 2012 | 2013 | 2017 | 2018 | 2019 |
|---|--------|--------|--------|---------|----------|----------|
| Inclusion From 2011 To 2019 | | | | | | |
| Subscribers (millions) | 26.82 | 30.73 | 34.63 | 42.8 | 49.5 | 54.5 |
| Penetration (percent) | 67 | 78 | 81 | 94.3 | 106.2 | 114.8 |
| Subscriptions (million) | 17 | 21.06 | 23.42 | 30 | 31.62 | 58.36 |
| No. of Transactions (million) | 46 | 55.96 | 64.78 | 139.93 | 155.77 | 154.99 |
| Value of Transactions (Ksh.' billion) | 103.18 | 150.1 | 187.92 | 332.622 | 367.77 | 382.93 |
| Avg Value of Transactions (Ksh.' million) | 2303.6 | 5,005. | 6,004. | 11,087. | 12,666.7 | 12,764.3 |
| Active Mobile Money Agents | 54,815 | 76912 | 89,768 | 182,472 | 223,931 | 224,108 |

Source: Central Bank of Kenya (2019)

Hasan *et al.* (2012) used descriptive survey research design to track an integrated and comprehensive view of the significance of IT on the retail payments for the performance of Commercial Banks. The researchers examined the retail payment services across 27 European Union markets. They document a rich relationship in regions with better retail payment transaction systems such as ATMs and POS. Generally, technology greatly impacts the way the financial institutions conduct their business. IT facilities guarantee a broad range of alternative and options that make the market viable for business. In their study, Al-Smadi and Al-Wabel (2011) used the survey research designed to examine the impact of IT on the Jordanian banking sector. Their study entailed a survey of 15 Jordanian financial institutions between the year two thousand and two thousand and ten. The accounting data was used to gauge the performance of banks as well as regressed on relevant variables using the OLS regression. Their study reveals that the use of IT had a positive influence on the general performance of Jordanian banks.

Nyathira (2012) studied the effect of financial innovation on commercial bank's financial performance over a period of 4 years. The causal research design was used to carry out the study. The population of study was all the 43 commercial banks in Kenya as at 30th June 2012. The study used secondary data from published central banks' annual reports. Study results indicated that financial innovation indeed contributes to and is positively correlated to profitability in the banking sector particularly that of commercial banks. This is further supported by high uptake of more efficient financial systems in substitution for the less efficient traditional systems. This is evidenced by the negative correlation between Real Time Gross Settlement and Automated Clearing House

(Cheques & EFTs) throughput over time; as well as that of profitability and Automated Clearing House throughput. However, the study period was short; four years.

Okibo and Wario (2014) using the descriptive survey research methodology, examined a random group of selected banks in Kenya to examine the impacts of e-banking on growth of client base. The research used purposive sampling to select three banks and stratified random sampling approach to ensure equal representation. They focused their study on services provided by the banks, availability of services, level of education and adoption, and the issues surrounding e-banking. They concluded that e-banking has influenced the development of the client base for the Commercial Banks in Kenya, by improving the accessibility of banking services to a larger populace in the nation.

Using descriptive survey research design, Ngumi (2013) conducted a research study to determine the impacts of innovative practices on the profitability of the Kenyan Commercial banks. The study sampled all the 43 commercial banks across the region and applied various linear regression scrutinies to investigate the statistical implication of several independent variables allied to the system. The results indicated that innovations in the banking system have greater influences on profitability of the financial institutions in Kenya. According to Nofie (2011), inventions in the finance sector is the influx of a new or improved product and/or a process that depresses the cost of producing current financial services. Bank invention includes; internet banking, mobile banking, Point of Sale Terminal, electronic funds transfer, credit and debit cards, and real time gross settlement. The organization that International Academic Journal of Economics and Finance fails to influence these inventions loses its competitive benefit and market share to the participants

Diverse financial innovation exist in the commercial banks including mobile banking, agency banking, and ATM banking Chigada & Hirschfelder, (2017); Kilasi & Oluoch, (2017); Vishwakarma. *et.al*, (2019). Both viewed the mobile banking as the interaction between a customer of financial institution and that financial institution through mobile device. The mobile banking has been associated with the Financial performance of Commercial Banks Harelimana, (2018); Mugane & Njuguna, (2019).

The role of the mobile banking on the financial credit accessibility as a proxy for financial performance was examined by (Kibicho & Mungai, 2019) with a focus on the Wote Sub County, Makueni County, Kenya. The study viewed mobile banking in terms of technology allowing access to financial services offered by commercial banks through use of mobile handset or Personal Digital Assistant (PDA). In addressing the research objectives, the study utilized the descriptive study design and collected data from a sample size of 138 respondents. Using multiple linear regression analysis, the study found that perceived usefulness, perceived ease of use, perceived risk and customer's attitude towards mobile banking had a statistically significant influence on the access to financial credit services. The study found that the mobile banking enhances access to financial services and improves on the efficiency in payment options. The study recommended that the commercial banks need to increasingly create awareness on the mobile banking usage in order to improve on the mobile credit accessibility aspects and enhance the mobile banking software interfaces in order to enhance its uptake and utilization by the customers.

In Rwanda, (Harelimana, 2018) undertook a study that sought to examine the influence of mobile banking on financial performance of Unguka Microfinance Bank Ltd. The study focused on the link between the mobile banking and financial performance of

Unguka microfinance bank for the period 2012 to 2016. The study collected data using structured questionnaires from all the senior employees with mobile banking experience and further interviewed the managers of the bank to enhance on the quantitative data. The study conceptualized the mobile banking services as those financial services provided via mobile networks and executed through use of the mobile phone. The study found that the mobile banking services had improved on the revenue collection within the microfinance bank.

(Adhitya & Sembel, 2020) examined the impact of the mobile banking technology on the performance of commercial banks in Indonesia. The financial performance is measured by CAMEL ratio of banks and the value added of this research is the stock performance that included in the research. The stock performance is measured in stock return and stock risk (standard deviation) of the banks. The research will use class IV banks as samples, because Class IV Banks is already considered as Big Banks with a capital of more than 30 trillion IDR, and a successful Mobile banking tech adoption that has reached many users in Indonesia. The data of financial performance and stock performance from the seven banks in Indonesia that are collected will be tested using the F-test, T-Test and Regression method to measure on financial performance and stock performance. This result shows that the technology adoption on mobile banking have lower performance for ROE and NPL of the banks. This finding becomes important for banks to accelerate technology adoption to increase their competitiveness against competitors and adapt in a changing market. This is proving that the technology adoption is a journey that the banking industry must take and mobile banking adoption help the banks to gain more funds and more loan from the market with the very effective approach at scale.

Biwott *et al.*, 2019 examined the role of the mobile banking services on the financial performance in Kenya. The specific objectives of the study were the examination of perceived security of mobile payments technology, perceived ease of accessibility of mobile payments technology, and transaction cost of mobile payment technology on the financial performance of Commercial Banks in Kisii town. The study used the descriptive research design and collected quantitative data from 225 respondents. The study found that perceived cost, perceived access and perceived security of mobile payments technology have a statistically significant influence on the financial performance of Commercial Banks in Kisii town. These findings were attributable to the low costs of the mobile banking enabling serving of a huge number of customers and expanding of the customer base to the bank. The study further linked use of mobile banking to the ease of financial services accessibility and financial inclusion which is further associated with increase in revenue collection.

In Nigeria, (Mustapha, 2018) undertook a study that sought to examine the influence of electronic payment technology on bank performance aspects. (Mustapha, 2018) found that the ATM is one of the commonly used electronic payment technology in Nigeria. The study found that the ATM was negatively associated with the performance of the banks which was attributed to the costs associated with physical mounting of ATM machines and the costs of acquisition and operating of the ATM locations. The costs associated with the ATM operations is high compared to other channels utilized in the provision of cash services. This negatively impacts on the bank performance aspects.

Adewoye and Omoregie (2013) noted that use of ATMs and debit cards led to cost efficiency measured in terms of cost-to-income ratio and asset management rate in commercial banks in Nigeria. Their study used secondary data involving a sample of 22

commercial banks to recommend the continued deployment of ATMs and debit cards by commercial banks to improve overall efficiency. The study also recommended the continued deployment of other performance-improving ICTs in which management should be actively engaged. Given that the study was conducted in Nigeria, it would be important to conduct a similar study on ATMs and debit cards in a different context. This study was therefore conducted for comparison purposes necessitated by contradicting findings regarding the effects of ATMs and debit cards on institutional performance.

In another study on electronic banking and the performance of commercial banks, Ngango, Mbabazize, and Shukla (2015) found that electronic banking systems like ATMs, pay direct, electronic check conversion, mobile telephone banking, and electronic transactions had a great impact on bank performance due to increased profitability, reduced operation costs, and increased assets and efficiency. Their study however employed a weak descriptive research design by basing it on qualitative and quantitative approaches to data collection. This study was based on both descriptive and explanatory research designs to improve validity.

Ndung'u (2011) analysed the Impact of mobile phone money in Kenyan banking industry between 2007 and 2011. The study documents that within just four years of mobile banking services transactions have been tremendous. It notes that mobile banking services resulted in reduced transaction costs and greatly increased access to banking services in Kenya hence improved performance in the sector. A survey done by Central Bank in 2008 shows a steady increase in the consumption of e-banking techniques such the ATM, EFT, online banking, mobile bill payments and credit card utilisation in the Kenyan market (CBK, 2008)

Ngumi (2013) found that debit cards were not statistically significant towards improving the financial performance of banks due to their association with fraud incidences, causing financial institutions to incur losses. However, Jegede (2014) found that the deployment of ATM terminals had on average improved the performance of Nigerian banks despite the alarming rate of ATM fraud. Given the fraud incidences associated with the use of debit cards to perform banking transactions on ATMs, it was worth investigating the effect of these ATMs and debit cards on SACCOs' performance.

Automated Teller Machines (ATM) is a component of the financial innovation that is associated with the financial performance of Commercial Banks. According to (Manjushree, 2020) the ATM refers to the self-service vendor machines that enable the bank's customers to be able to undertake diverse banking functions including cash deposit, cash withdrawal, balance checking, statement request amongst other aspects. The ATMs has been associated with improved Financial performance of Commercial Banks through reduction of cost of service provision and increase in transactional revenues Kamau & Oluoch, (2016); Edoke & Anyanwaokoro, (2019).

The ATM banking influence on the financial inclusion has a consequent influence on the financial performance of Commercial Banks. In this context, (Kithinji, 2017) undertook a study that sought to examine digital banking on the financial inclusion amongst the commercial banks in Kenya. The descriptive research design was adopted for the study. (Kithinji, 2017) found that the investment levels in the ATM banking improves access to the banking services amongst the unbanked population. The study thus concluded that ATM banking had a positive and statistically significant influence on the financial inclusion amongst the commercial banks in the country. The financial including has been found by diverse studies to have a mediating influence on the financial performance

of Commercial Banks. Studies that have found a link between the financial inclusion and Financial performance of Commercial Banks include (Kinyua & Omagwa, 2020) in respect to listed commercial banks, and (Shankar, 2016) in respect to the commercial banks in India.

Similar to (Kithinji, 2017), (Kamande, 2018) examined the influence of electronic banking on the Financial performance of Commercial Banks in Kenya. The study used the descriptive cross-sectional research design and collected data from a sample size of 42 commercial banks. Amongst the aspects of electronic banking that was examined included the ATM banking components. While noting the role of ATMs in the improvement of the financial inclusion and Financial performance of Commercial Banks, (Kamande, 2018) however noted that the mobile and internet banking are increasingly being preferred amongst the bank customers. The ATM banking as measured using the ATM banking transactions was found to have statistically insignificant positive correlational relationship with financial performance ($r=0.075$). (Kamande, 2018) further found that ATM banking had a statistically insignificant predictive influence on the Return on Assets (ROA) within the commercial banks.

Shaikh et. al, (2020) examined the key drivers of customer experience with non-financial digital services and revealed that consumer awareness, ease of use and usefulness largely affects the experience and usage of mobile banking applications.

Niemand *et al.*, (2021)' study on digitalization in the financial industry revealed that having a clear vision on digitalization a willingness to take risks and no just a sheer level of digitalization affects the profitability of banks. Additionally, Opiyo (2021) explored the effect digital financial services on financial performance using descriptive and correlation analysis found a strong and significant positive correlation between

mobile financial services and financial performance while online financial services had a moderate and significant positive correlation between mobile financial services and financial performance.

Beloke *et al.*, (2021) analyzed the influence of digital financial services on the financial performance of banks in Cameroon. The study used the Taylor linearise variance estimation method. The study revealed that digital withdrawals, digital saving services and digital transfer services had a positive and significant influence on the profitability of banks. Interestingly, the study found a negative but significant influence of digital payments and the profitability of banks.

Wadesango & Magaya (2020) analyzed the impact of digital banking services on performance of Commercial banks in Zimbabwe. The study used multiple regression model and performance were measured using the Return on Assets (ROA) ratio. The study revealed that there was a positive relationship between Return on Assets and digital banking. An increase in online customer deposits and online banking transactions led to an increase in the Return on Assets. However, the study also found a negative relationship between Return on Assets, internet banking fees and commissions and expenditure on internet banking.

Too *et al.* (2016) and Oyomo (2018) studies revealed a significant relationship between mobile banking and the performance of Commercial banks. While Mateka & Omagwa (2016), study revealed a positive influence of internet banking on bank incomes,

operating costs, loan book and customer deposits. Tunay *et al.*, (2015) found a strong relationship between internet banking and performance of banks in the Euro area

countries and Dinh *et al.*, (2015) study revealed that internet banking had an impact on the profitability of banks. However, Giordani, *et al.*, (2013) found that using the internet.

2.4 Summary of Literature and Research Gaps

Previous studies done on the effect of macroeconomic variables on financial performance lack consensus since the results and findings indicate divergent views. Some studies have only focussed on either Financial Innovations or Macroeconomic factors independently but not the moderating effect of financial innovations on the relationship. The mixed findings witnessed in the previous studies may be attributed to the method of data analysis where most of these studies used pooled panel data which treats the entities under the study to be homogenous yet in practice they are not.

Study by James Kamau 2014, focussed on the effect of Financial Innovations on Financial Performance of Commercial Banks in Kenya from 2008-2012. The study found that some banks in Kenya had adopted some financial innovations such as credit cards, mobile, internet and agency banking. The financial innovations had great impact on the financial performance of the banks. The study used a sample of 16 Banks out of the 44 commercial banks which narrowed down the accuracy of the findings. Pooled data analysis was used where variables were held in cross section specific individual series and treated the entities under the study to be homogenous yet there are heterogeneous.

Kurgat David (2011), did a study on the effects of Financial Innovations on Financial Performance of Commercial Banks in Kenya for one-year period. The objective population for this study included 215 workers of business banks in Kenya. The sample estimate was 170 respondents. Basic random sampling method was utilized in choosing the sample for this investigation. The finding indicated that innovation significantly

affected financial performance. The research recommended further studies should be done on; mobile banking and agency banking which represent new avenues of growth in banking sector.

Otambo T (2016), did a study on Effects of Macroeconomic factors on financial performance of Commercial banks in Kenya for the period between 2006 and 2015. The study focussed on GDP, real interest rates and Inflation rates. The results of the study indicated that there is a strong ($R=0.792$) relationship between macroeconomic variables and financial performance of commercial banks. The study used pooled data unlike in this study where a more advance method; Panel data analysis will be used.

While there are numerous strongly held views on Financial Innovations and Macroeconomic factors in developed economies, surprisingly there is little information existing on the moderating effect of financial innovations on this relationship particularly in Kenya. The extent to which Financial Innovations and Macroeconomic factors affect financial performance needs to be quantified to allow commercial banks manage the dominant factor. Furthermore, few of these studies have captured the period before Financial Innovation and the period after embracement of advance technology to see the extent financial innovations have affected financial performance. It is therefore necessary that this study establish the effect of Financial Innovations and Macroeconomic factors on Financial Performance of Commercial Banks in Kenya for the twenty-year period (2000-2020).

Focusing on the deposit taking Sacco's, (Anyango & Mutunga, 2020) undertook a study that sought to link the role of mobile banking services on the financial performance aspects. The study used the descriptive and explanatory research designs as the methodological research approaches aspects. The study found that mobile deposits

services, mobile bill payments services and mobile statements services had statistically significant influence on the financial performance of deposit taking Sacco's. On the other hand, mobile money transfer services and mobile balance enquires services didn't have statistically significant influence on the financial performance of deposit taking Sacco's. The study recommended that the deposit taking Sacco's should formulate strategies on increasing the utilization of mobile banking services particularly mobile deposits services, mobile bill payments services and mobile statement services.

O. E. Olalere *et.al* (2021) studied the moderating role of financial innovations on financial risks, business risk and firm value nexus. The study applies the balanced panel data to analyse the 16 commercial banks in Nigeria over the period 2009 to 2017 making up to 144 observations. The empirical results reveal that credit risk is significantly positive with firm value while liquidity risk, operational risk, market risk and solvency risk have a significant negative effect on firm value. Further results revealed that business risk is significantly negative with firm value. The financial innovation significantly moderates the relationship between financial risks, business risk and firm value of the banks. Other factors that significantly affects the firm value in the model of the study are bank size, GDP growth, diversification, profitability and Herfindahl-Hirschman Index. The study was conducted in Nigeria which doesn't clearly reflects Kenyan setup, more so observations of the study was limited.

Ivon Yossy, (2017) conducted a study on the moderating Effect of Innovation on Strategy-Financial Performance Relationship: Experience of "Batik" SMEs. Mixed method was used in the study for the reason that it can reveal more in-depth explanation about the phenomena. 71 managers of batik SMEs in Solo city participated and the result of the study showed that innovation significantly moderates strategy-financial

performance relationship. Innovation is a pure moderating variable. The study focused on relationship between strategy and financial performance. The scope of the study was also shallow and not explorative.

Financial innovations have been also used by banks as strategic tool to help increase their service delivery, efficiency and as a cost reduction measure while simultaneously being able to maintain their competitiveness in the market (Ahmed *et.al.* 2019). However, Financial innovations' effect on the strength and direction on the relationship between macroeconomic factors and financial performance is yet to be determined. This study therefore addressed this gap by empirically examining the effect of key selected macroeconomic factors on Financial Performance of Commercial Banks in Kenya and the moderating effect of financial innovations on the relationship for a 10 Year Period (2011-2020).

2.5 Conceptual Framework

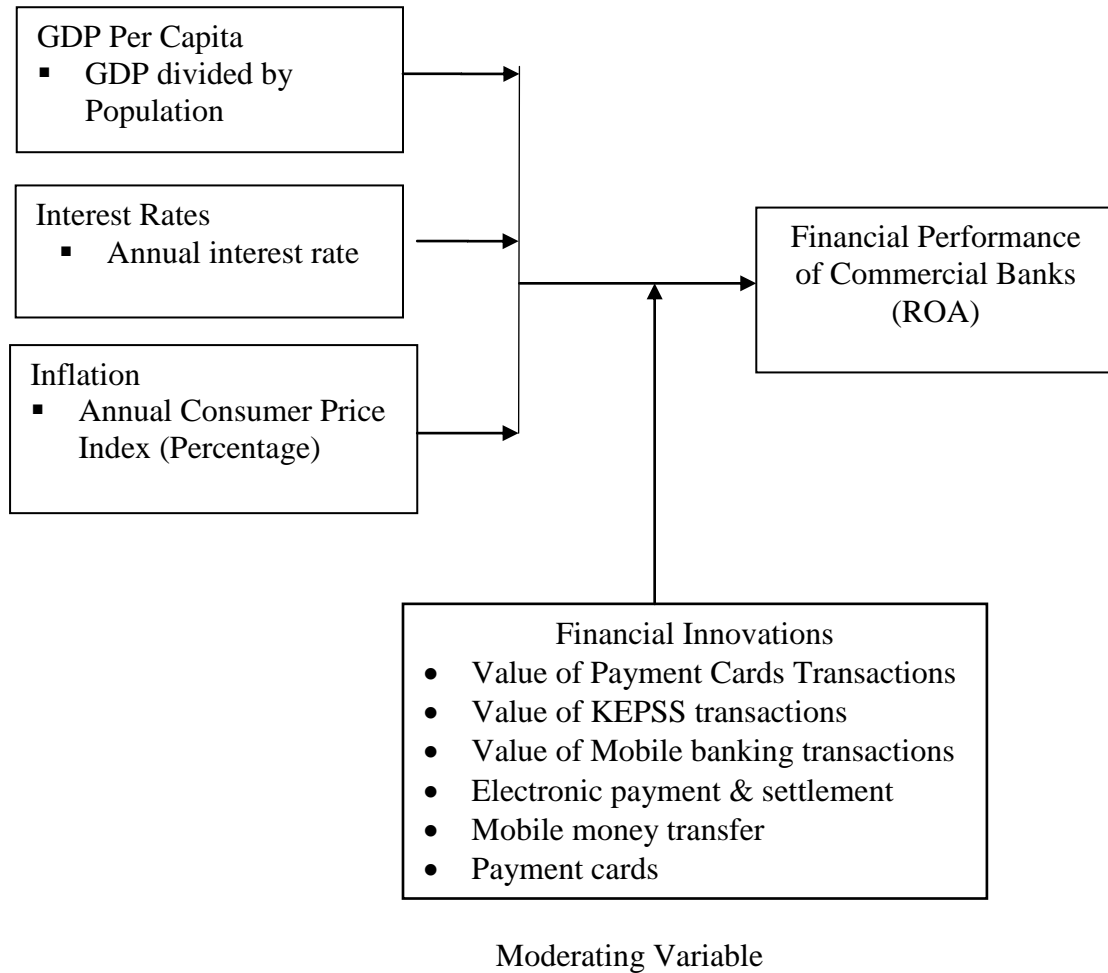
A conceptual framework is a collection of inter related group of ideas that are broad based on theories and forms the basis for developing the method for data collection for this research. It is the basis for developing the necessary econometric and financial mathematical models to be employed in this study consistent with the theoretical and empirical literature of the study. The study expects financial innovations to have significant moderating effects on the relationship between macroeconomic factors and financial performance of commercial banks. Figure 1 presents the conceptual framework of the study

Figure 1

Conceptual Framework

Independent Variables

Dependent Variable



Source: Author (2023)

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter describe the research methods that were followed while carrying out the research. It discusses the research philosophy, research design, population, methods used to collect secondary data and finally data analysis techniques.

3.2 Research Philosophy

A research philosophy relates to the development of knowledge and the nature of that knowledge (Saunders *et.al.* 2009). According to Holden and Lynch (2004), a review of philosophy is a vital aspect of the research process as it opens researchers' minds to other possibilities, which can lead to both an enrichment of their research skills and an enhancement in their confidence that they are using the appropriate methodology. The study adopted a positivism philosophical approach towards arriving at the conclusions on the research problem. A positivist approach embraces certain assumptions about truth and reality. Positivism suits the study as it comprises of the objectivity assumption which views the researcher as an objective observer and reporter of data through sample selection procedures, measurement of variables and statistical analysis (Vanderstoep & Johnston, 2009).

The study was a cause-effect nature and sought to explain the moderating effect of financial innovations and Macroeconomic factors on financial performance, justifying the philosophical choice as argued by Holden and Lynch (2004), that the aim of social science in a positivist perspective should be to identify causal explanations and fundamental laws that explain regularities in the economic domain. A choice of what to study, and how to study it in a positivist approach can be determined by an objective

criterion rather than by human beliefs and interests. The study will also suit positivism since the concepts will be operationalized in a way which enables facts to be measured quantitatively and generalizations made about regularities in prevailing economic conditions, which was made based on samples of sufficient size with the aim of generalizations being to lead to prediction, explanation and understanding (Holden & Lynch, 2004). Secondary data of Commercial Banks was obtained from the CBK and KNBS and measured using triangulation approach, analysed statistically for trends and eventually the hypotheses tested.

3.3 Research Design

According to Kumar (2011), a research design is a plan, structure and strategy of investigation so conceived as to obtain answers to research questions or problems. The study adopted explanatory research design. This is because it aims to define the reason behind a certain phenomenon. It used reasoning and connects different ideas to define a cause and effect-based relationships that highlights the factors or reasons behind the happening of a certain event. This relationship-based understanding helps in identifying main points to solving specific issues. It is a latter phase study that is usually carried out when a certain phenomenon has been discovered and defined. Explanatory research uses secondary resources to formulate the reasoning behind the occurrence of an event. Explanatory Research is conducted for a problem that was not well researched before, demands priorities, generates operational definitions and provides a better-researched model, Hyun (2021).

3.4 Population of the Study

According to Zikmund *et al.* (2010) and Kothari (2004), a population refers to all items in any field of inquiry and is also known as the 'universe'. Polit & Beck (2003) refer to

population as the aggregate or totality of those conforming to a set of specifications. The target population of this study comprised of 42 commercial banks licensed by the Central bank of Kenya from 2011 to 2020. Banks are the backbone of every economy and can give a true reflection of how the general economy of a Country is doing. 10-year duration was a moderately long duration to allow keen observations of the changes taking place between and within the banks.

3.5 Sampling Technique and Sample Size

According to Creswell (2014) and VanderStoep and Johnston (2009), sampling refers to the use of specific and defined procedure(s) in the selecting a subset from the total population, for purposes of using the subset to describe, analyse or estimate properties and characteristics of the whole. The objective of sampling is to get a representative sample from a much larger population, study the sample and make generalizations about the population from the sample (Neuman, 2006).

The study targeted 42 commercial banks registered with CBK as at 2020, with each firm being studied for a period of ten years (from 2011 to 2020). However, to minimise truncated data, three banks, Chase Bank (K) Ltd, Dubai Bank Ltd, and Imperial Bank, Ltd which were placed in receivership in the 2015/2016 financial year, were dropped from the analysis, as they were missing roughly a half of their data. Unbalanced data sets make some statistical models to be invalid (Maddala, 2001). However, CBA (Commercial Bank of Africa) and Giro Bank were included in the study as they only missed data for two and three years, respectively. CBA became defunct in 2019, having merged with the NIC Group (Mohammed, 2019). On the other hand, Giro Bank was acquired and absorbed by I & M Holdings in 2017 (CBK, 2018)

Consequently, the sample size of this study was 39 banks, which constituted 92.86% of the target companies. Each firm was studied for a period of ten years (from 2011 to 2020), except CBA and Giro Bank, giving a time series data of 385. The number of companies studied reflected the view of Mugenda and Mugenda (2003) who indicated that 70% of data collected and over is very good as it gives a representative sample for meaningful generalization and minimizes errors. Appendix iii presents the banks analysed in this study.

Since the sample size was just 39 banks, census was appropriate for this study. Creswell (2014) argued that one advantage of census was it allows the researcher to target all of the population and get specific answers to the research objectives. In addition, since the sample size was small, it could be studied at minimal cost and this also helped to eliminate any sampling error.

3.6 Data Collection Procedure

Secondary data on annual Commercial Banks' performance were obtained from the 42 banks' annual financial reports while data on macroeconomic factors was obtained from both CBK annual reports and KNBS annual reports for ten years' time period from 2011 to 2020. Table 5 shows the data collection form used in this study.

Table 5*Analyzed Data*

BANK'S NAME:

Independent Variables

| Macro-Economic Factors | Unit | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|------------------------|--------------------------------------|------|------|------|------|------|------|------|------|------|------|
| GDP per Capita | GDP divided by Population | | | | | | | | | | |
| Interest Rates | Annual interest rate | | | | | | | | | | |
| Inflation | Annual Consumer Price Index(%) | | | | | | | | | | |
| Moderating Variables | | | | | | | | | | | |
| Payment Cards | Value of Payment Cards Transactions | | | | | | | | | | |
| EPSS | Value of EPSS transactions | | | | | | | | | | |
| Mobile Banking | Value of Mobile banking transactions | | | | | | | | | | |
| Dependent Variable | | | | | | | | | | | |
| Financial Performance | Return on Assets | | | | | | | | | | |

Secondary data was useful for improving, understanding and explaining the research problem in addition to providing more information to solve a problem (Ghauri & Gronhaug, 2005). The advantages of using secondary data sources are; savings in the time and cost of acquiring information, fewer resource requirements, the provision of comparative and contextual data, unforeseen discoveries resulting from using suitable methods, and relative ease of access (Sekaran & Bougi, 2010; Saunders, Thornhill &

Lewis, 2009). Fraser *et al.*, (2006) argue that companies' annual reports are more accurate than other secondary data sources. In addition, they report that information and data based on annual reports show a high level of reliability and quality.

Before the data was subjected through any statistical analysis, it was checked for missing values, extreme values, errors and inconsistency as part of data cleaning using MS Excel. This involved the use of Histograms and Box plots to aid in data visualization with aim of detecting abnormalities.

3.7 Operationalization of Variables

The variables of this study are operationalized as presented in Table 6.

Table 6

Operationalization of the Variables

| Variable | Type | Measurements | Justification |
|---|----------------------|---|---|
| Financial Performance of Commercial Banks | Dependent Variable | Return on Assets (Annual netcome/Total assest) | Akhisar. <i>et al.</i> (2015) |
| Financial Innovations | Independent variable | EPSS -Annual Value of RTGS transactions Mobile Phone MS -Annual Value of MPMS transactions Payment Cards -Annual Value of payment cards transactions | Bech, M. L., & Hobijn, B. (2006). Johnson, S., & Kwak, J. (2012). Tam, L. <i>et al</i> (2020) |
| GDP Per Capita | Independent variable | GDP divided by population. | Tang, Y.M., <i>et al.</i> (2021). |
| Interest Rates | Independent variable | Annual real interest rate | Anbar <i>et al.</i> (2011). |
| Inflation | Independent variable | Annual CPI (%) | Kobia, (2018). |

3.8 Model Specification

The study consisted of six null hypotheses. Hypotheses 1 to 3 comprised of direct effects in the study: the effect of GDP per capita, Interest rates and Inflation on financial performance of commercial banks in Kenya. These are direct effects because they study hypothesizes that they affect firm performance in a straight-forward manner, without any intervening variables (Baron & Kenny, 1986). Hypotheses 4 to 6, make up indirect effects of the study: the moderating effect of financial innovations on the relationship between GDP per capita, Interest rates and Inflation on financial performance of commercial banks in Kenya.

Regression models were used to test both the direct and indirect effects in the study and was carried out following the procedures suggested by Dawson (2014). The regression models estimated was as follows:

Objective One: To analyze the effect of Gross domestic product per capita on Financial Performance of Commercial Banks in Kenya. The following multiple linear regression equation was used to analyze the effect of Gross domestic product per capita on Financial Performance of Commercial Banks

$$Y_{it} = \beta_0 + \beta_1 GDPC_{it} + \varepsilon_{it} \quad (3.1)$$

Y_{it} = Financial performance of Commercial Banks (Measured by ROA) i ($i=1, 2, \dots, 39$) in time t ($t=1, 2, \dots, 10$)

$GDPC_{it}$ = Gross Domestic Product per Capita

β_0 = Beta; Constant

ε_{it} = error term

β_1, \dots, β_7 = Regression Coefficients

Objective Two: To assess the effect of Interest rates on Financial Performance of Commercial Banks in Kenya. The following multiple linear regression equation was used to access the effect of Interest rates on financial performance of Commercial Banks.

$$Y_{it} = \beta_0 + \beta_1 IR_{it} + \varepsilon_{it} \quad (3.2)$$

Y_{it} = Financial performance of Commercial Banks (Measured by ROA) i ($i=1, 2, \dots, 39$) in time t ($t=1, 2, \dots, 10$)

IR_{it} = Interest Rates

β_0 = Beta; Constant

ε_{it} = error term

β_1, \dots, β_7 = Regression Coefficients

Objective Three: To determine the effect of Inflation on Financial Performance of Commercial Banks in Kenya. The following multiple linear regression equation was used to investigate the effect of Inflation using Consumer Price Index (CPI) on financial performance of Commercial Banks.

$$Y_{it} = \beta_0 + \beta_1 IN_{it} + \varepsilon_{it}$$

(3.3)

Y_{it} = Financial performance of Commercial Banks (Measured by ROA) i ($i=1, 2, \dots, 39$) in time t ($t=1, 2, \dots, 10$)

IN_{it} = Inflation

β_0 = Beta; Constant

ε_{it} = error term

β_1, \dots, β_7 = Regression Coefficients

Objective Four: To ascertain the moderating effect of Financial Innovations on the relationship between Gross domestic product per capita and Financial Performance of Commercial Banks in Kenya. The following multiple linear regression equation was used to investigate the moderating effect of Financial Innovations on the effect of Gross domestic product per capita on Financial Performance of Commercial Banks.

$$Y_{it} = \beta_0 + \beta_1 GDP_{,it} + \beta_2 FI_{,it} + \beta_3 FI \times GDP_{,it} + \epsilon_{it} \quad (3.4)$$

Y_{it} = Financial performance of Commercial Banks (Measured by ROA) i ($i=1, 2, \dots, 39$) in time t ($t=1, 2, \dots, 10$)

FI = Financial innovations

GDP_{it} = Gross Domestic Product per Capita

β_0 = Beta; Constant

ϵ_{it} = error term

β_1, \dots, β_7 = Regression Coefficients

Objective Five: To analyse the moderating effect of Financial Innovations on the relationship between interest rates and Financial Performance of Commercial Banks in Kenya. The following multiple linear regression equation was used to analyse the moderating effect of Financial Innovations on the effect of interest rates on Financial Performance of Commercial Banks.

$$Y_{it} = \beta_0 + \beta_1 IR_{it} + \beta_2 FI_{,it} + \beta_3 FI \times IR_{it} + \epsilon_{it} \quad (3.5)$$

Y_{it} = Financial performance of Commercial Banks (Measured by ROA) i ($i=1, 2, \dots, 39$) in time t ($t=1, 2, \dots, 10$)

FI = Financial innovations

IR_{it} = Interest rates

β_0 = Beta; Constant

ε_{it} = error term

β_1, \dots, β_7 = Regression Coefficients

Objective Six: To evaluate the moderating effect of Financial Innovations on the relationship between Inflation and Financial Performance of Commercial Banks in Kenya. The following multiple linear regression equation was used to investigate the moderating effect of Financial Innovations on the relationship between Inflation and Financial Performance of Commercial Banks

$$Y_{it} = \beta_0 + \beta_1 IN_{it} + \beta_2 FI_{it} + \beta_3 FI \times IN_{it} + \varepsilon_{it}$$

(3.6)

Where:

Y_{it} = Financial performance of Commercial Banks (Measured by ROA) i ($i=1, 2, \dots, 39$) in time t ($t=1, 2, \dots, 10$)

FI = Financial innovations

IN_{it} = Inflation

β_0 = Beta; Constant

ε_{it} = error term

β_1, \dots, β_7 = Regression Coefficients

The research hypothesis was tested at a significance level of 0.05, where results with p -value of less than 0.05 rejects the null hypothesis meaning the effect is statistically significant, whereas a p -value greater than 0.05 means effects between the study variables was insignificant.

3.9 Data Analysis and Presentation

Several analytical tools, described in the following section, were used in data analysis. This included descriptive statistics, correlation analysis, Co-integration Tests, Regression Analysis, tests for assessing assumptions, and post estimation diagnostic tests for assessing model structure. Analysed data was presented in form frequency tables, charts and graphs.

3.9.1 Descriptive Statistics

Descriptive statistical techniques were used to describe the basic features of data used in the study by providing simple conclusions on samples and measures. They included measures of central tendency like mean, mode and median to give details of a set of data by finding the central position within that set of data and to reveal any hidden pattern in the data. They also revealed the magnitude of the differences which were presented in graphs, such as histograms and bar graphs. Measures of dispersion were used to show the extent to which a distribution was stretched. Common examples of measures of statistical dispersion are the variance, standard deviation, and interquartile range.

Since normal distribution is a key assumption behind most statistical techniques, skew and kurtosis, were calculated to determine how far the data departed from normality. Skew indicates the degree of asymmetry in the data (how concentrated data points are at the high or low end of the scale of measurement) (Norusis, 2010). A negative value indicated skew to the left; a positive, skew to the right. Kurtosis describes how concentrated data are around the mean (that is, it assesses how peaked or flat is the data distribution). A negative value indicated platykurtosis (fewer items at the mean and at tails but more in intermediate regions) while a positive value indicated leptokurtosis (more items near the mean and at the tails but fewer in the intermediate regions)

(Norusis, 2010). Significant departures from normality were indicated if the skew or kurtosis value were outside the benchmark ± 2.0 (Norusis, 2010).

3.9.2 Correlation Analysis

Pearson's Correlation Coefficient, r , was used to establish the degree of relationships between dependent and independent variables. The correlation coefficient could take any value between -1.00 and +1.00. A value of +1.00 represents perfect positive correlation while a value of -1.00 is a perfect negative correlation. Correlation coefficients (in absolute value) which are ≤ 0.35 are generally considered to represent low or weak correlations, 0.36 to 0.67 moderate correlations, and 0.68 to 1.0 strong or high correlations with r coefficients > 0.90 very high correlations (Field, 2013).

3.9.3 Stationarity Tests/Unit Root Tests

A time series is stationary if its mean and variance do not vary systematically over time. Stationarity therefore was checked for time series types of data. Stationarity of a time series is crucial for the application of various econometric techniques, and most empirical work based on time series data assumes that the underlying time series is stationary (Gujarati, 2003).

Descriptive statistics, autocorrelation functions (ACF) and partial correlation functions (PCF) were computed to visualize if variables were serially dependent on previous years' data. More explicit tests for stationarity were also conducted. For time series data, Augmented Dickey-Fuller (ADF) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests were conducted. The ADF computes probabilities and critical values using 20 observations. However, this study's time series had only 9 observations (ten years' study

period) and statistics computed might not have been accurate. Thus, it was important to complement the ADF test with the KPSS test.

For panel data, the study used a set of four tests to assess stationarity of the study variables: Levin, Lin & Chu, Im, Pesaran and Shi, ADF-Fisher) and PP-Fisher Tests. These tests were chosen because they could work with both balanced and unbalanced data (Pesaran, Shin, & Smith, 2001; Choi, 2001). The null hypothesis (Ho) for all tests states that all panels have a unit root and the alternative hypotheses (Ha) stating that all panels are stationary.

The panel unit root tests allowed investigating mean-reversion (stationarity) in the group (panel) of series. Most time series data are mostly characterized by stochastic trend which can be removed by differencing (Greene, 2012), because the variables should be integrated of the same order for valid conclusion of the results. The Augmented Dickey-Fuller (ADF) uses the following regression, to determine the presence of a unit root as:

$$\Delta y_t = \alpha_0 + \sum \alpha_j (\Delta y_{t-j}) + \beta t + \gamma (y_{t-j}) + \mu_t$$

(3.5)

Where μ is a pure white noise error term. The Model proposition is defined as:

$$Y_t = \mu + \varepsilon_t$$

(3.6)

and the trend stationary is defined as:

$$y_t = \mu + \beta_{(t)} + \varepsilon_t$$

(3.7)

3.9.4 Cointegration Test

When variables were found to be non-stationary, they were tested to determine whether a co-integration relationship and therefore, a long-run equilibrium relationship was extant between them. The co-integration test is used to test the hypothesis that linear combinations of the variables are stationary (Pedironi, 2004). Two tests were conducted to assess cointegration: Panel Pedironi Cointegration and Kao (Engle-Granger based) cointegration tests. The Pedironi cointegration test is based on an examination of the residuals of a spurious regression performed using $I(1)$ variables. If the variables are cointegrated then the residuals should be $I(0)$. On the other hand, if the variables are not cointegrated then the residuals will be $I(1)$. Pedironi (1999, 2004) and Kao (1991) extend the Engle-Granger framework to tests involving panel data.

The cointegration examination according to (Pedironi, 2004) has seven test statistics and tests the null of no cointegration. The panel tests are founded on the within dimension form, which comprises four statistics, respectively panel v , panel rho, panel PP, and panel ADF that pool the autoregressive coefficients across dissimilar states for the unit root checks on the estimated residuals. The group tests are established on the between dimension form which cover three statistics: group rho, group PP, and group ADF, that are set on means of the individual autoregressive coefficients related with the unit root checks of the residuals for each state in the panel. Moreover, a further test, Kao (Engle-Granger based) cointegration test, was conducted to supplement the results from the Pedironi cointegration tests. The null hypothesis of the test, like the Pedironi test, is that there is no cointegration.

When results from the two tests in the study (Pedironi and Kao Cointegration tests) offered strong support for the existence of a cointegrating relationship, a VECM was

conducted to model the long run relationships (Pesaran *et al.*, 2001; M'Amanja, Lloyd, & Morrissey, 2005). To estimate short-run causality among financial innovations, a joint significance test of the lagged explanatory variables was conducted using Wald test (Salazar-Núñez *et al.*, 2020).

3.9.5 Vector Autoregression (VAR) and Vector Error Correction Model (VECM)

To model the dynamic and long run relationships among study variables, two tools were used: vector autoregression (VAR) to model stationary variable and vector error correction model (VECM) to model non-stationary variables. The VAR was used when the variables were found to have no unit roots. The vector autoregressive (VAR) model is a multivariate time series model that relates current observations of a variable with past observations of itself and past observations of other variables in the system (Salazar-Núñez, Venegas-Martínez & Tinoco-Zermeño, 2020). The VAR model was assessed for stability and for autocorrelation of the residuals. If all the eigen values were less than one (that is, they all lied inside the unit circle), it indicated that the VAR was stable. A Lagrange multiplier test was conducted to test the joint null hypothesis of no auto-correlation of the residuals.

3.9.6 Tests for Assessing Model Structure

The following tests were conducted to assess the underlying structure of the models built in the study.

3.9.6.1 Hausman Test

This study used the Hausman test to determine the appropriate estimation model whether fixed effect or random effect model, for panel data. According to Greene (2008), in order to decide between random effects and fixed effects models, researchers often rely

on the Hausman specification test. Previous studies have used different types of regression approaches using either fixed or random effects models. The fixed effects model and the random effects model have different assumptions on the error term. The fixed effect model assumes that the individual effect term is constant while the random effect assumes that the individual effects are random disturbances got from probability distribution. With random effects model, the individual behaviour of firms is supposed to be unknown and is treated as random. Nevertheless, in fixed effects, individual effects are treated as fixed through time. Thus, fixed effect model is more appropriate for complete samples in a population. The Hausman test is meant to detect desecration of the random effects model assumption that the explanatory variables are statistically independent to the unit effects. If there is no correlation between the independent variable(s) and the unit effects, then estimates of β in the fixed effects model (β_{fe}) should be similar to estimates in the random effects model (β_{re}).

The general form of Hausman test statistic is:

$$H = (\beta_1 - \beta_{11})' [Var \beta_1 - Var \beta_{11}]^{-1} (\beta_1 - \beta_{11})$$

(3.5)

Under the null hypothesis, orthogonality is distributed chi-square with degrees of freedom equal to the number of regressors in the model. If $p < 0.05$, at conventional levels of significance, then the two models are different so reject the null hypothesis. Which means random effects model will be favourable and not fixed effects model. If the Hausman test fail to indicate a significant difference ($p > 0.05$), we don't rule out that random effect's estimator is from bias and thus free to use, but instead fixed effects estimator will be preferred. Hausman test is also useful for in panel data, when comparing the estimates of the fixed and random effects models.

3.9.6.2 Wald's Chi-square Test

The test was conducted to determine whether the panel regression model adequately fitted the data. If the p value of the test was less than 0.05, it was concluded that the model fitted the data.

3.9.7 Post estimation diagnostic tests

The data collected in this study was panel time series. The macroeconomic variables (GDP per capita, interest rates, and inflation), were panel (bank) non-specific while financial innovations (value of RTGS/EPSS transactions, value of mobile phone money services, and value of payment cards transactions) and ROA, were bank specific. The data, therefore, comprised of purely time series data (macroeconomic variables) and a mixture of cross-sectional and time series (panel) data (financial innovations and ROA).

Three types of regressions were conducted in the study: a MLR between detrended ROA and detrended \ln GDP per capita, \ln Inflation rates and \ln interest rates; a Random Effects Regression Analysis for ROA and financial innovation; and regressions of the moderating effect of financial innovation on the effect of GDP per capita, interest rates and inflation rates on ROA. A regression model is a mathematical representation of what and how independent variables are related to the dependent variables. All regression models have assumptions, and violation of these assumptions can lead to unreliable results. The estimation results can be biased and inconsistent if econometric problems such as heteroscedasticity, serial correlation and correlation of error term occur in the model. Therefore, diagnostic checking will be essential to ensure the model is free from econometric limitations. Diagnostic test was carried out to measure Stationarity, multi-collinearity, heteroscedasticity, autocorrelation and normality.

3.9.7.1 Auto-Correlation

Autocorrelation refers to the degree of similarity between a given time series in two different time intervals. It measures how the lagged version of the value of a variable is related to the original version of it in a time series. It is mostly used with the autoregressive-moving-average model (ARMA) and autoregressive-integrated-moving-average model (ARIMA). The analysis of autocorrelation helps to find repeating periodic patterns, which is often used as a tool of technical analysis in the Financial markets. In its simplest terms a time series Y_t is said to be stationary if:

(a) $E(Y_t) = \text{Constant}$ for all t ;

(b) $\text{Var}(Y_t) = \text{Constant}$ for all t and

(c) $\text{Cov}(Y_t, Y_{t+k}) = \text{Constant}$ for all t and all $k \neq 0$ or if, its mean, its variance and its covariance's remain constant over time.

Although less serious in micro panels (those with very few years) than in macro panels with long time series, serial correlation (autocorrelation) can cause standard errors of the coefficients to be smaller than they actually are and higher R-squared values (Park, 2011; Maddala, 2001). A Lagrangian-Multiplier test was conducted to assess the presence of serial correlation (autocorrelation) in the data. The null hypothesis of the test is that the data has no serial correlation (Park, 2011). In addition, the Durbin Watson (DW) statistic test was also used to test for autocorrelation.

3.9.7.2 Multicollinearity

A multicollinearity test was used to see whether two or more variables were strongly correlated (i.e., not independent of one another), which might influence the regression parameter estimation (Hair *et.al* 2014). The presence of multicollinearity makes it

difficult to determine and evaluate hypotheses regarding regression coefficients, which frustrates model coefficient interpretations resulting in incorrect regression results (Palaniappan, 2017). Multi-collinearity was assessed by means of tolerance and Variance Inflation Factor (VIF) values. For each independent variable, tolerance is the proportion of variability of that variable that is not explained by its linear relationships with the other independent variables in the model. Tolerance ranges from 0 to 1. When tolerance is zero, there is high multicollinearity of that variable with other independents and the beta coefficients become unstable. Normally, a tolerance value of below 0.10 or a VIF value greater than 10 reveals serious multi-collinearity problem (Maddala, 2001). VIF is the inverse of tolerance statistic.

If multicollinearity is found in the data, centering the data (that is deducting the mean of the variable from each score) might help to solve the problem. However, the simplest way to address the problem was to remove independent variables with high VIF values.

3.9.7.3 Heteroscedasticity Test

Heteroscedasticity refers to the circumstance in which the variability of a variable is unequal across the range of values of a second variable that predicts it. If the errors have constant variance, the errors are called homoscedastic. Standard estimation methods are inefficient when the errors are heteroscedastic or have non-constant variance. Homoscedasticity was assessed by analysis of residual or errors, obtained by plotting standardized residuals against standardized predicted values. If the residuals are randomly scattered around the centre line of zero, with no discernible pattern, it showed that the residuals had a constant variance (homoscedasticity), were approximately normally distributed, and independent of another (non-autocorrelated).

For panel data, an additional test, a modified Wald test was used to test for GroupWise heteroskedasticity in the residuals. The test's null hypothesis is the presence of a constant variance (homoscedasticity). If Heteroscedasticity is present, Weighted Least Squares WLS method is used to deal with the non-equal variance.

3.9.7.4 Normality Test

Regression assumes that variables have normal distributions. The study used several measures to test normality of the variables. First, normality of distribution was assessed by the Kolmogorov-Smirnov and Shapiro-Wilk tests. A p value less than or equal to 0.05 indicated non-normality in the data while $p > 0.05$ showed that the data was normal. This is because the null hypothesis of the tests is that the data is non-normal (Norusis, 2010). Secondly, skewness and kurtosis allowed an assessment on how the data departed from normality, as previously explained.

Thirdly, normality was also assessed by results from *JB* (Jarque-Bera) tests. The null hypothesis of the test is that the data is normally distributed. Therefore, p value less than or equal to 0.05 indicated non-normality in the data while $p > 0.05$ showed that the data was normal. All these tests examined normality of the raw, transformed variables. It was also pertinent to examine the normality of the residuals (errors) after conducting regression analysis. This was done by inspection of normal Q-Q plot of residuals for the variables. If all or most points fell on the straight line, it indicated that the residuals were normal.

3.9.8 Summary of the Models Used in the Study

Table 7 presents a summary of the models and statistical tests used in this study.

Table 7*Summary of Models and Statistical Tests*

| Reason | Model/Statistical tool | Objective |
|--|--|------------------|
| 1. Determine relationships between variables. Flag possible instances of multicollinearity. | Pearson's Correlation Analysis | Objectives 1 – 6 |
| 2. Model (describe) long run relationship among stationary variables | VAR | Objectives 1 – 6 |
| 3. Model (describe) long run relationship among non-stationary variables/Cointegration | VECM | Objectives 1 – 6 |
| 4. Test for presence of cointegrating relationship | Panel Pedroni & Kao cointegration tests | Objectives 1 – 6 |
| 5. Test the effects of GDP per capita, interest rates & inflation rate on financial performance of banks. More realistic and efficient to test all of them at once | Multiple Linear Regression (MLR) | Objectives 1 – 3 |
| 6. To test the effect of financial innovations (panel data) on financial performance. | Random effects Regression analysis | Objectives 3 – 6 |
| 7. To determine the moderating effect of financial innovation on the effect of GDP per capita, interest rates & inflation rate on financial performance of banks. | Moderated regression (where an interaction term is included in equation) | Objectives 3 – 6 |
| 8. Find out if variables have unit roots/are stationary | ACF, PCF, ADF, KPSS, LLC, IPS, & PP | Objectives 1 – 6 |
| 9. To test whether variables were autocorrelated | ACF, PCF, Lagram-Multiplier Test, Durbin Watson Test | Objectives 1 – 6 |
| 10. Test for multicollinearity | Tolerance, Variance Inflation Factor (VIF) | Objectives 1 – 6 |
| 11. Test for heteroscedasticity | Residuals analysis, modified Wald test (for panel data) | Objectives 1 – 6 |
| 12. Test for normality | KS, SW, skewness & kurtosis, Jarque-Bera Test, residual analysis | Objectives 1 – 6 |
| 13. Is random or fixed effects better for panel data? | Hausman Test | Objectives 3 – 6 |

Source: Author's Own Conceptualization (2023)

The statistical tests were conducted with the aid of STATA; EViews; and SPSS (Statistical Package for Social Sciences).

3.10 Ethical Consideration

According to Gathii *et al.* (2019) the ethical considerations relate to the values, norms and institutional arrangements that govern research activities. The study focussed on Commercial Banks licensed and supervised by CBK. These firms publish their financial reports publicly for investor analysis from where the researcher will source the data, an

indication that the information is already open for the public. All Information sources were cited in the document and later referenced by the researcher. Consent was also sought through a research permit from the National Commission for Science, Technology and Innovation (NACOSTI) in liaison with the approval from Kabarak University Ethics and Review Committee (KUREC).

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND DISCUSSION

4.1 Introduction

The chapter presents the research findings and discussions analysed data indicating response rate, reliability of research instruments, descriptive statistics, correlation analysis, co-integration tests, regression analysis, tests for assessing assumptions and post estimation diagnostic tests

4.2 Descriptive Statistics

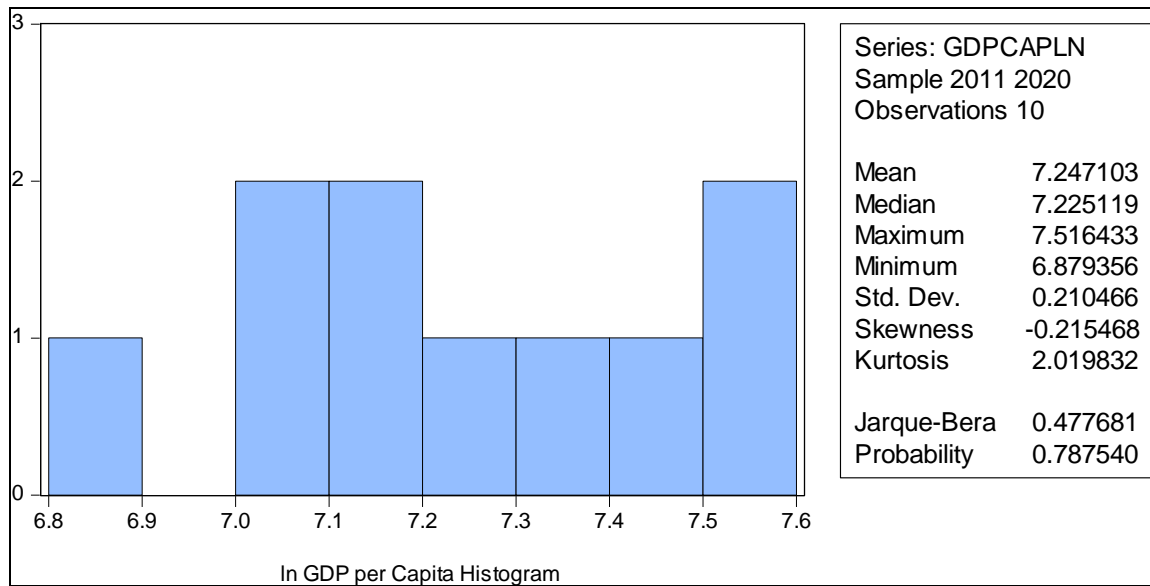
This section presents the descriptive analyses of the variables in the study. These consisted of the macroeconomic variables namely GDP per capita, interest rates, and Inflation, financial innovations (value of RTGS/EPSS transactions, value of mobile phone money services, and value of payment cards transactions) and ROA.

4.2.1 Gross Domestic Product Per Capita

The study sought to find out the effect of Gross Domestic Product Per Capita on performance of Commercial Banks in Kenya. The summary statistics and histogram of natural log (ln) of GDP per capita is displayed in Figure 2.

Figure 2

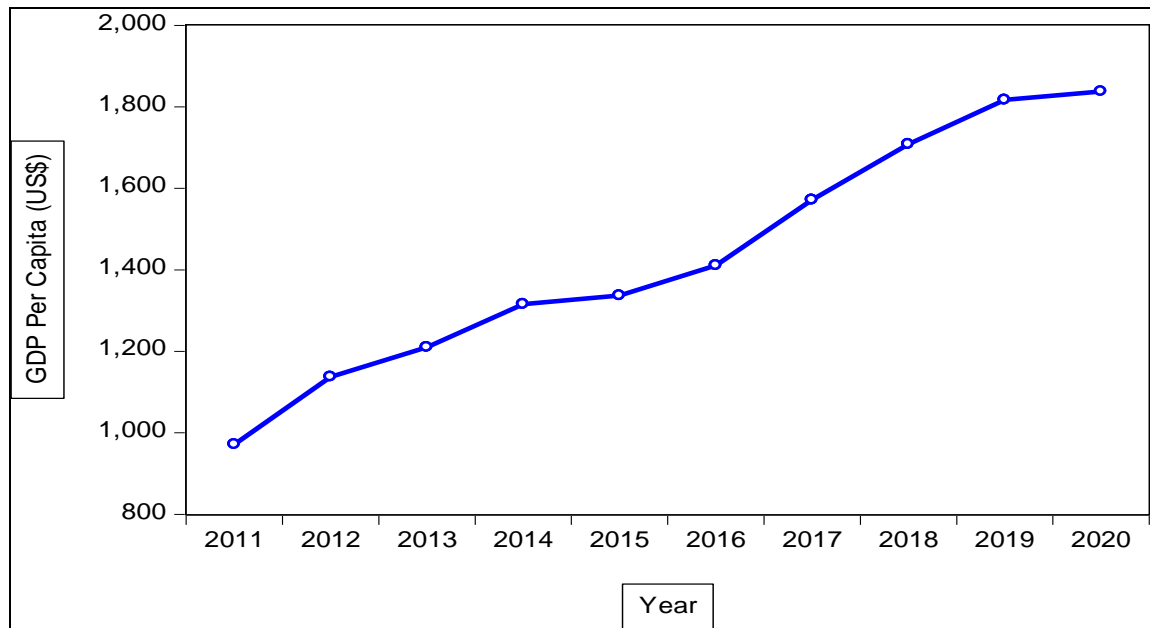
Summary Statistics and Histogram of Natural Log of GDP per Capita



GDP per capita (ln) ranged from a minimum 6.879 to a maximum 7.516, with a mean of 7.247. The median (7.225) was very close to the mean, suggesting the series could be normal. The standard deviation was 0.210, suggesting most values fell between 7.037 and 7.457. The skewness (-0.215) and kurtosis (2.019) were roughly within the benchmark ± 2 (Field, 2013), suggesting that the distribution of GDP per capita was normal. These conclusions were buttressed by results of the more explicit test for normality, JB (Jarque-Bera) = 0.478, $p=0.787$ (p value less than or equal to 0.05 indicated non-normality in the data while $p>0.05$ showed that the data was normal. The null hypothesis of the test is that the data is normally distributed. The results showed that transformation of the original data into natural logarithms ensured normality in the data. Figure 3 presents the GDP per capita for the country between 2011 and 2020.

Figure 3

GDP per Capita (2011 – 2020)



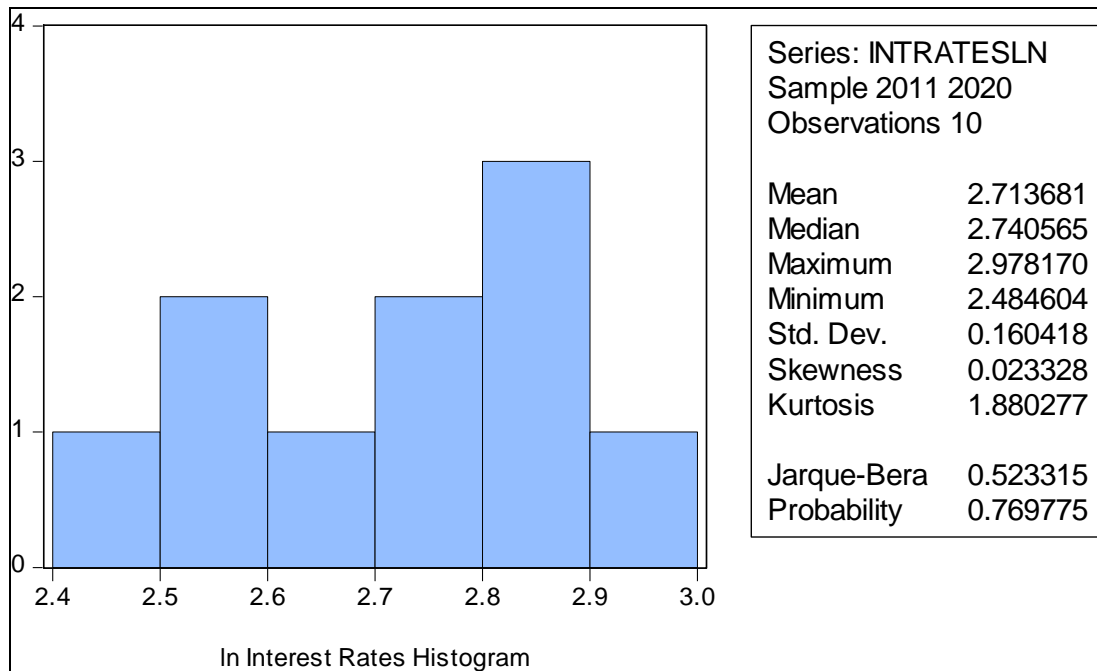
From Figure 3, the findings of GDP per capita in 2011 was US\$ 972 while it was US\$ 1838 in 2020, which showed that the per capita GDP has roughly doubled over the study period. The results also indicated that the GDP per capita increased every year in the study period, with the highest increase exhibited between 2011/12 (0.17%) and 2016/17 (0.11%). The smallest annual increase in GDP per capita between 2019/20 (0.01%) and between 2014/15, while the average annual growth rate in per capita GDP growth rate was 0.069%.

4.2.2 Interest Rates

The study sought to find out the effect of Interest Rates on performance of commercial banks in Kenya. The study used the Commercial Banks Weighted Average Interest Rates. The descriptive statistics for the natural log of this variable is presented in Figure 4.

Figure 4

Summary Statistics and Histogram of Natural Log of Interest Rates

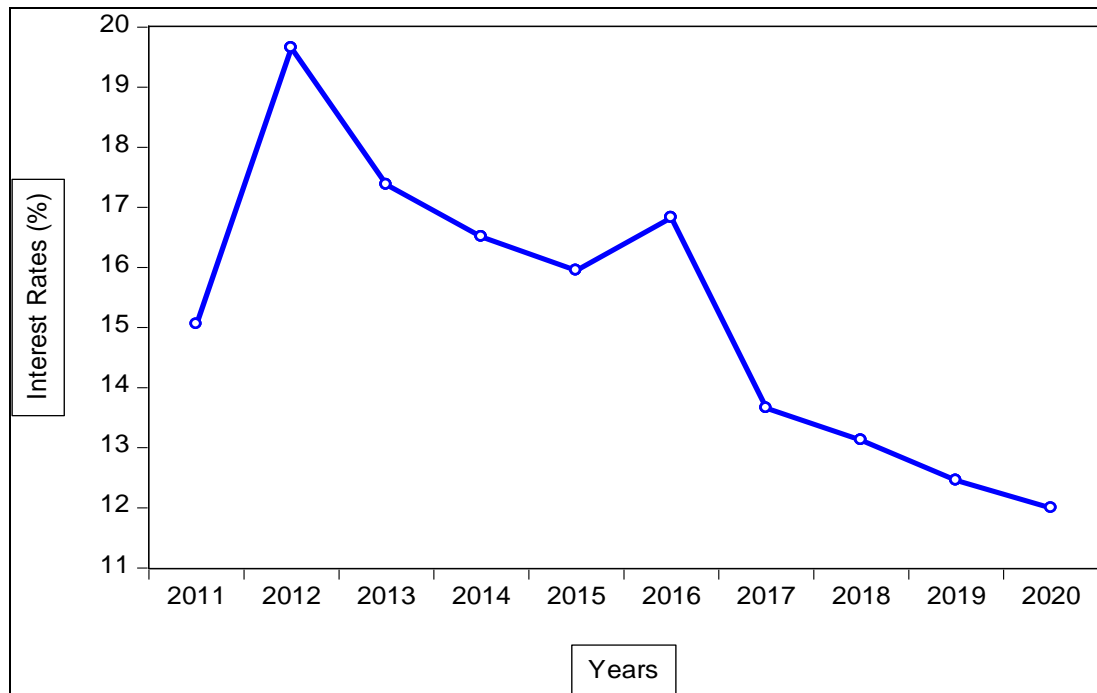


Interest rates (ln) ranged from a minimum 2.485 to a maximum 2.978, with an average value of 2.714. The standard deviation was small (0.160), showing that most values fell between 2.553 and 2.873. The skewness (0.023) and kurtosis (1.880) were all within the benchmark ± 2 (Field, 2013), suggesting that the distribution of interest rates was normal. This conclusion was validated by results of *JB* (Jarque-Bera) test = 0.523, $p=0.769$, where the null hypothesis that the data is normally distributed was accepted.

Figure 5 presents results of Interest Rates for the country between 2011 and 2020.

Figure 5

Interest Rates (2011 and 2020)



From Figure 5, the Interest rates rose from 15.05% in 2011 to the highest level of 19.65% in 2012 during the study period. The rate dropped to 17.38% in 2013 and continued to decrease between 2013 and 2015. In 2016, the interest rates increased to 16.83%. Nevertheless, in the following year, the rate dropped by 19% to a low of 13.66%. Since 2017, interest rates continued to decrease to a low of 11.99% in 2020. Findings showed that after 2017, interest rates have remained below 14%.

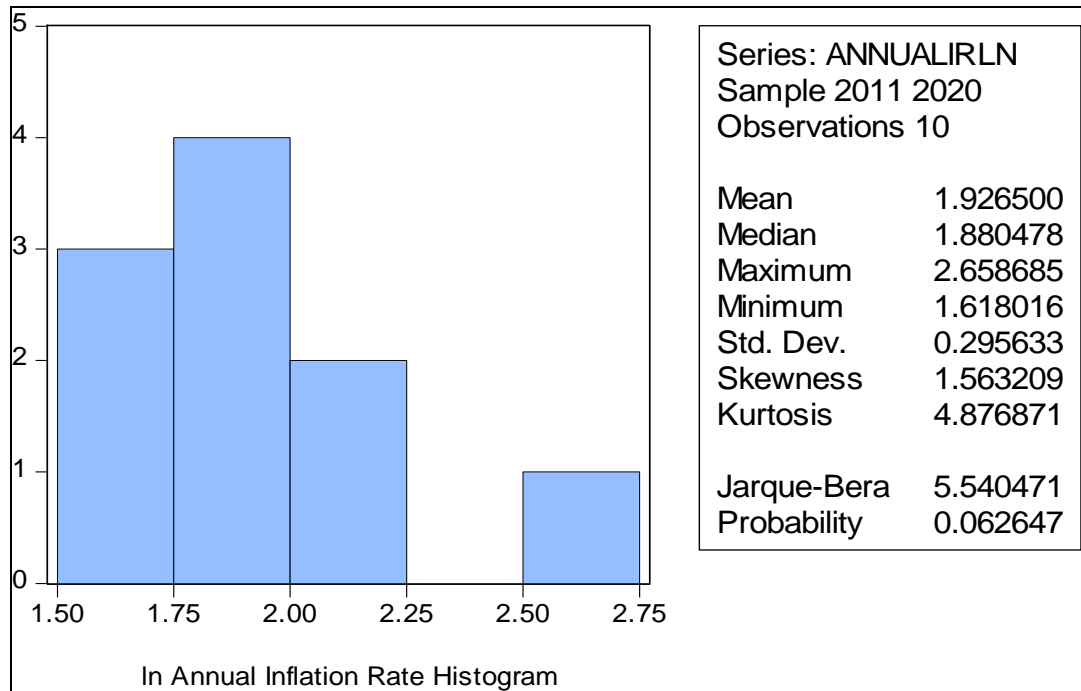
4.2.3 Inflation

The study sought to find out the effect of inflation using CPI which is a measure of inflation rates on financial performance of commercial banks in Kenya. The study used both an average of 12-month inflation, the percentage change in the monthly inflation and the annual average inflation, the percentage change in the annual average consumer

price index of the corresponding months (CBK, 2018). Figure 6 presents summary statistics and histogram of the natural log of annual inflation rates.

Figure 6

Summary Statistics and Histogram of Natural Log of Annual Inflation Rate

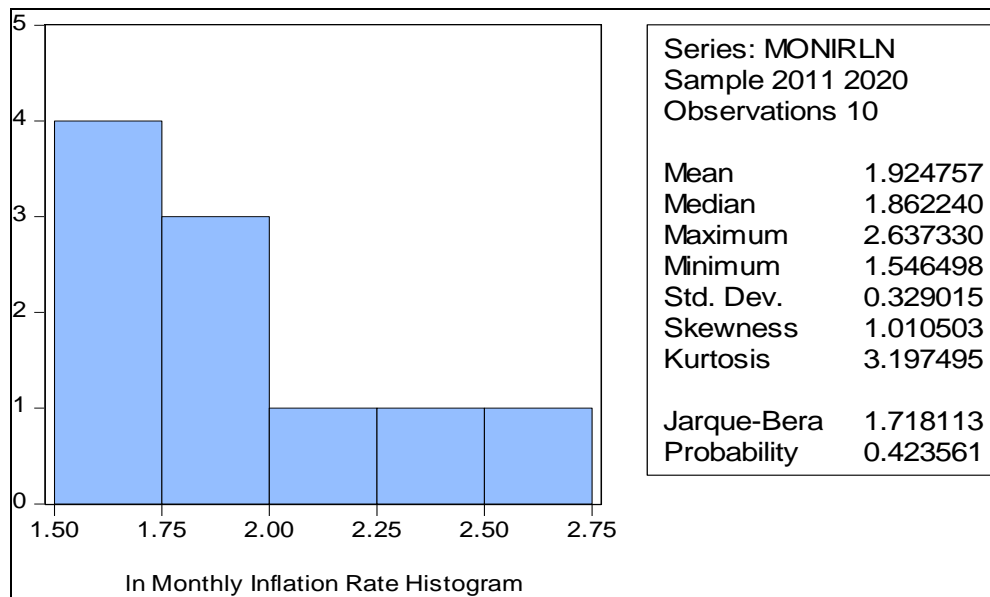


The ln of annual inflation rate had a mean of 1.926 and ranged from a minimum 1.618 to a maximum of 2.659. The standard deviation was 0.295, suggesting most values were found between 1.631 and 2.221. The skewness was small (1.563) but kurtosis was relatively large and positive (4.877), suggesting a leptokurtic distribution, that is, more items near the mean and at the tails but fewer in the intermediate regions. However, since JB test = 5.54, $p=0.062$ was not statistically significant, it indicated that the distribution of ln annual IR was roughly normal after transformation.

Figure 7 presents the summary statistics of natural log of monthly inflation rate (IR) closely mirrored those of annual inflation rates.

Figure 7

Summary Statistics and Histogram of Natural Log of Monthly Inflation Rate

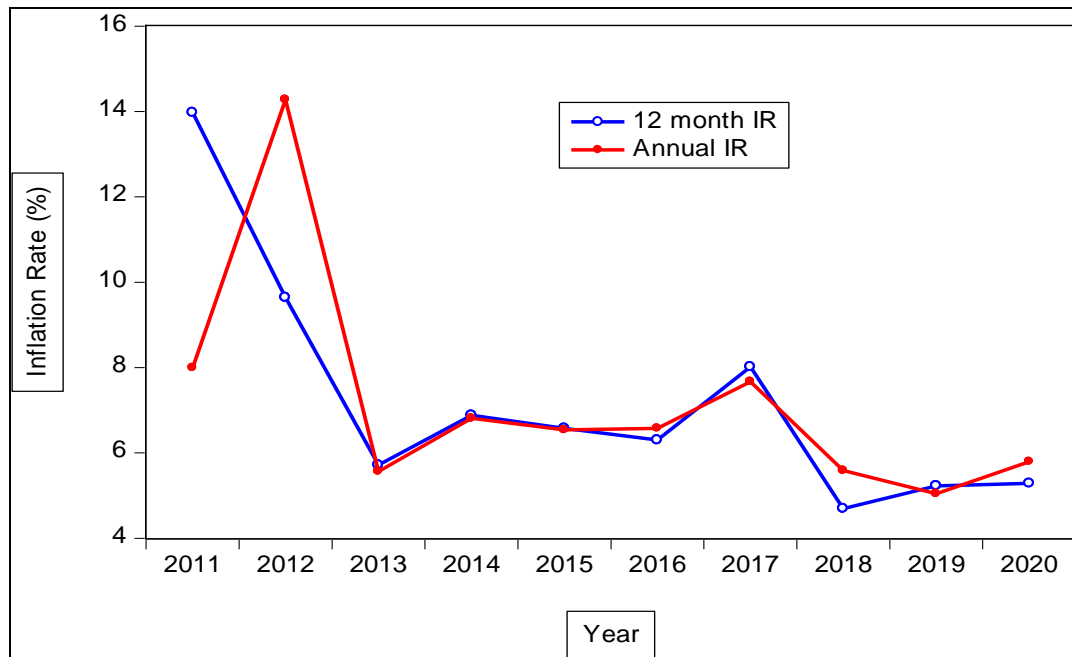


Findings from Figure 7 indicates that the average of \ln of monthly inflation rate was 1.924, ranging from 1.546 to 2.637. The standard deviation was small (0.329), which showed that most values fell between 1.596 and 2.254. The distribution, similarly, had a small skew (1.01) and was leptokurtic (3.197). However, since JB test = 1.718, $p=0.423$ was not statistically significant, it indicated that the distribution of \ln monthly IR was also roughly normal after transformation.

Figure 8 presents changes in annual and monthly inflation rates between 2011 and 2020.

Figure 8

Inflation (2011-2020)



Findings in Figure 8 showed that except in 2011 and 2012, there was a high degree of congruence between the 12-month and the annual inflation rates. In 2011, the 12-month IR was a high of 13.98% which dropped to 9.64% in 2012. On the other hand, the annual inflation rate was 7.99% in 2011 and increased to 14.28% in 2012. The results showed that the highest 12-month inflation rate experienced was in 2011 (13.98%), which dropped to 9.64% in 2012, before further dropping to 5.72% in 2013. This year (2013) was one of the years in the study period in which the inflation rate was lowest.

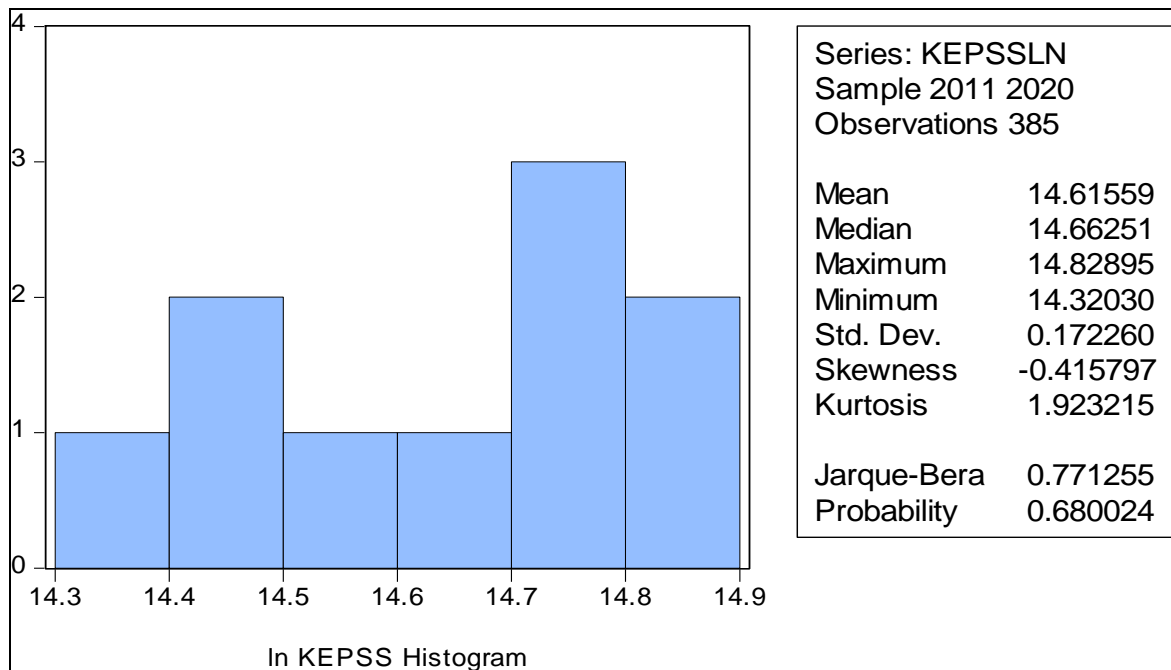
The inflation rate rose in 2014 (12-month IR was 6.88%) and remained relatively stable between 2014 and 2016. Nevertheless, in 2017, it increased to 8.01%, before decreasing in 2018 to 4.69%. The inflation rate increased again in 2019 (5.23%) and 2020 (5.29%).

4.2.4 Value of Kenya Electronic Payment and Settlement Systems

The study sought to find out the effect of Kenya Electronic Payment and Settlement Systems (KEPSS) on financial performance of commercial banks in Kenya. Descriptive statistics and histogram of natural log of KEPSS is presented in Figure 9.

Figure 9

Summary Statistics and Histogram of Natural Log of KEPSS

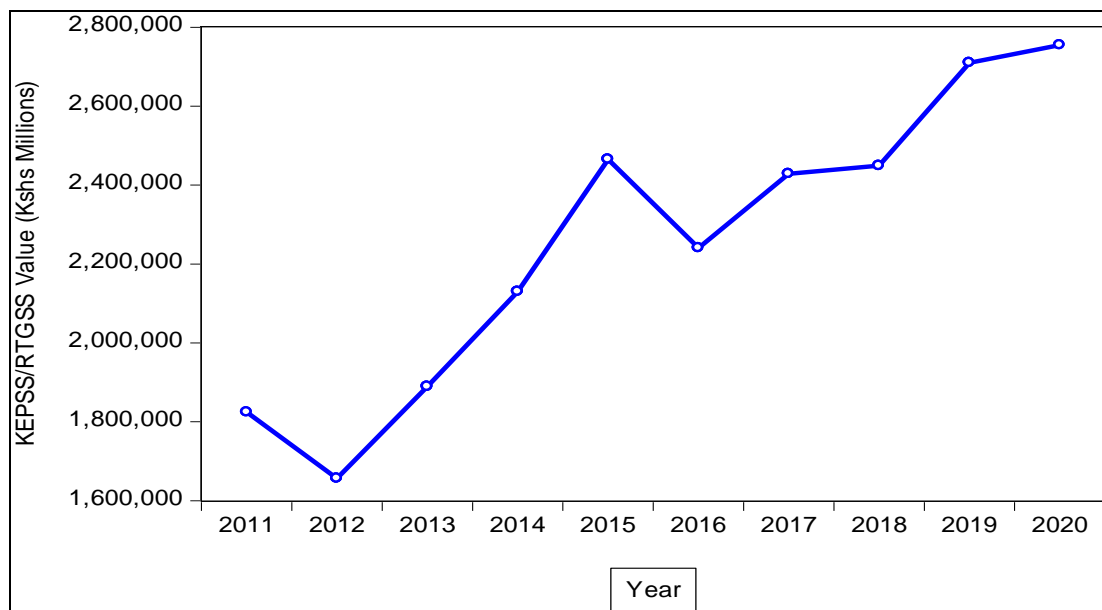


KEPSS (ln) ranged from 14.320 to 14.829, with a mean of 14.616. The median (14.662) was very close to the mean, suggesting the series could be normal. The standard deviation was 0.172, which showed that most values occurred in the range of 14.444 and 14.788. The skewness (-0.416) and kurtosis (1.923) were all within the benchmark ± 2 , suggesting that the distribution was normal. This conclusion was supported by the *JB* test = 0.771, $p=0.680$. in which the null hypothesis of the test that the data is normally distributed was accepted.

Figure 10 presents the value of KEPSS between 2011 and 2020.

Figure 10

Value of KEPSS (2011 – 2020)



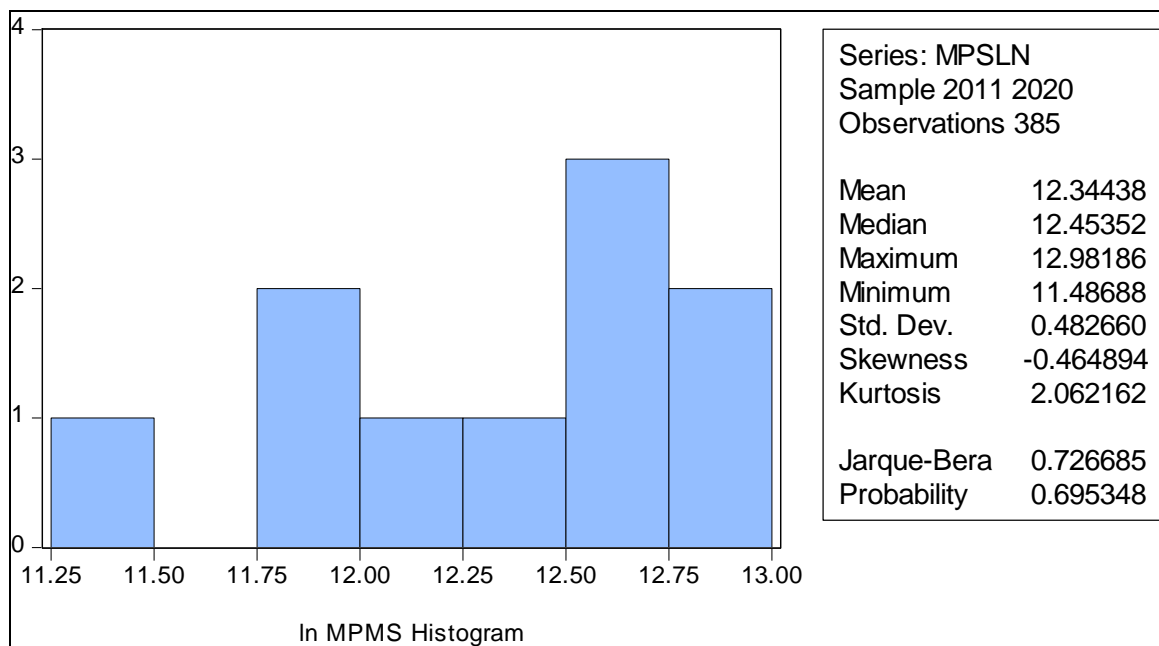
Findings showed that, generally, the value of KEPSS has increased between 2011 and 2020. In 2011, the value of KEPSS transactions was 1,824,484 million Kenya shillings, which dropped to 1,656,630 million Kenya shillings in 2012. Nevertheless, it increased in 2013 to 1,889,081 million Kenya shillings and continued to go up in 2014 and 2015. The value of KEPSS dropped to 2,240,497 million Kenya shillings in 2016 before increasing in 2017. Since, then the value of transactions using the electronic payment and settlement system has continued to increase to 2,755,068 million Kenya shillings in 2020. The results showed that between 2011 and 2020, the value of KEPSS transactions have increased by 51%.

4.2.5 Value of Mobile Phone Money Services Transactions (MPMS)

The study sought find out the effect of MPMS on financial performance of commercial banks in Kenya. Figure 11 presents the descriptive statistics and histogram of natural log of MPMS.

Figure 11

Summary Statistics and Histogram of Natural Log of MPMS

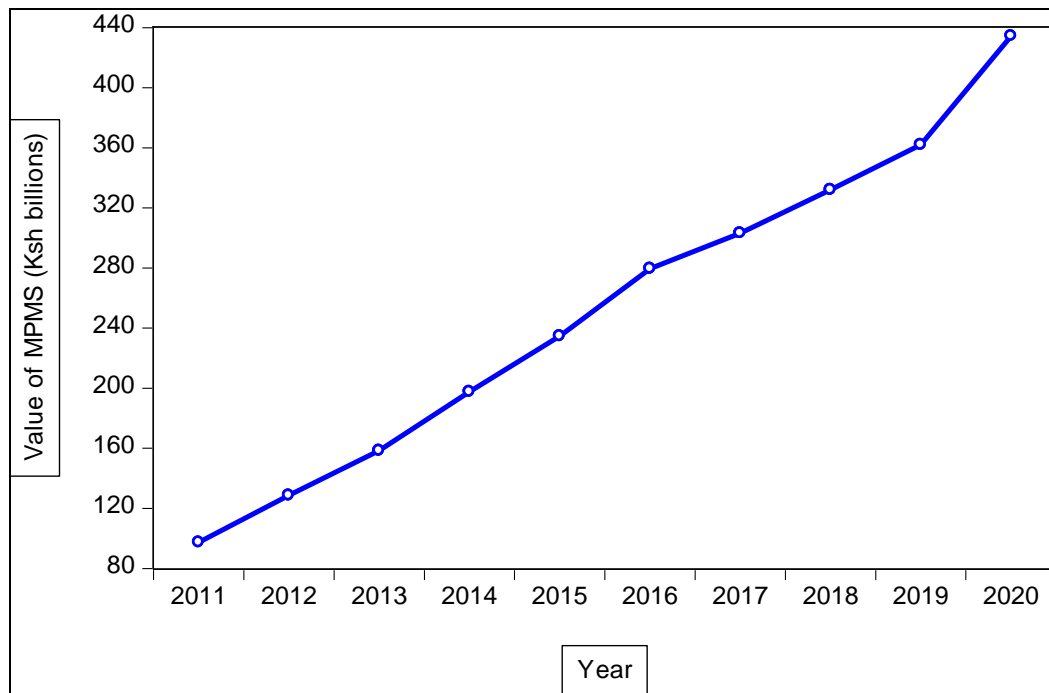


The ln of MPMS had a mean of 12.344 and ranged from a minimum 11.486 to a maximum of 12.981. The standard deviation was 0.483, suggesting most values were found between 11.861 and 12.827. The skewness (-0.465) and kurtosis (2.06) were roughly within the ± 2 bounds, which suggested a normal distribution. This finding was supported by the *JB* test = 0.727, $p=0.695$, which was not statistically significant, indicating a normal distribution.

Figure 12 shows changes in the value of mobile phone money services transacted by the commercial banks between 2011 and 2020.

Figure 12

Value of Mobile Phone Money Services (2011 and 2020)



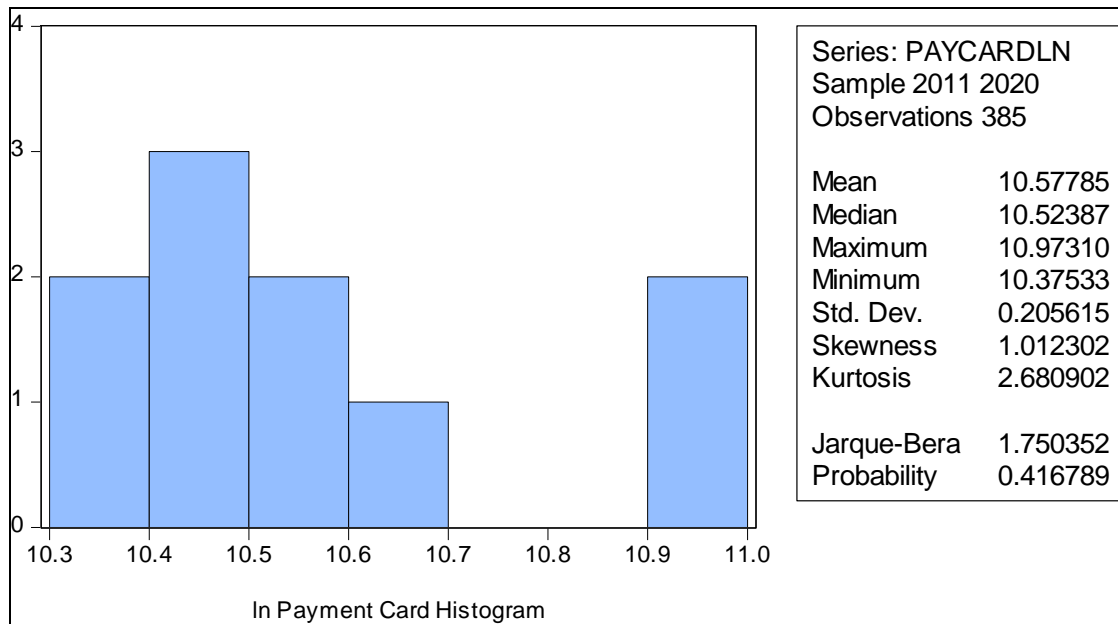
Findings showed that the value of mobile phone money services has steadily increased between 2011 and 2020. In 2011, the value of MPMS was 97 billion Kenya shillings whereas it was 434 billion Kenya shillings in 2020, showing that the value of mobile phone money services had gone up by a whopping 347.4% in the ten-year study period. The results also indicated that the value of MPMS has continuously increased each year, never undergoing any reversal in the ten-year period.

4.2.6 Value of Payment Cards Transactions

The study sought to find out the effect of payment cards transactions on financial performance of commercial banks in Kenya. Summary statistics and histogram of the natural log of payment cards is displayed in Figure 13.

Figure 13

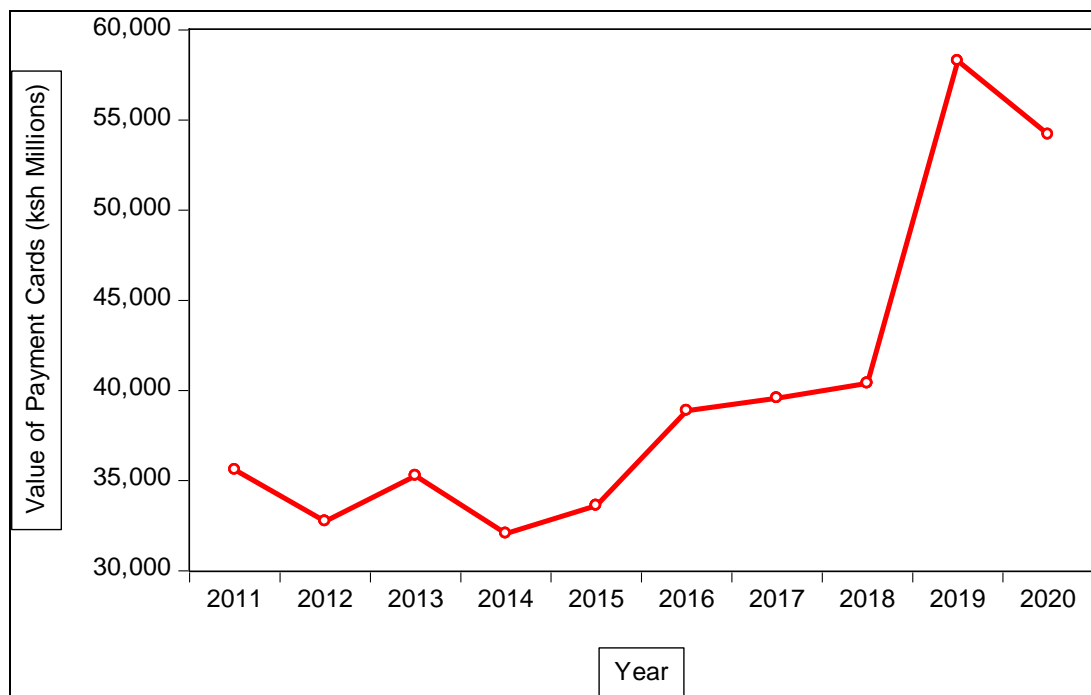
Summary Statistics and Histogram of Natural Log of Payment Cards



The mean of payment cards (ln) was 10.578 while it ranged from a minimum of 10.375 to a maximum of 10.973. The skewness was small (1.012) but kurtosis was slightly larger and positive (2.680), suggesting a slightly leptokurtic distribution. However, since JB test = 1.750, $p=0.416$ was not statistically significant, it indicated that the distribution of ln payment cards was roughly normal. Figure 14 shows changes in the value of payment cards transactions by the commercial banks between 2011 and 2020.

Figure 14

Value of Payment Cards (2011 and 2020)



Findings showed that the value of payment cards increased from 35,587 million Kenya shillings in 2011 to 54,201 million Kenya shillings in 2020, representing a 52% increment in the value of the cards. However, the increase was not uniformly linear. For instance, the value of payment cards decreased in 2012 to 32,739 million Kenya shillings before increasing to 35,267 million Kenya shillings in 2013 and then decreasing again in 2014 to 32 059 million Kenya shillings. The sudden rise in the value of payment cards between 2018 and 2019, rising from 40,401 to 58,285 million Kenya shillings, which represented a 44% increment in the value of the card usage.

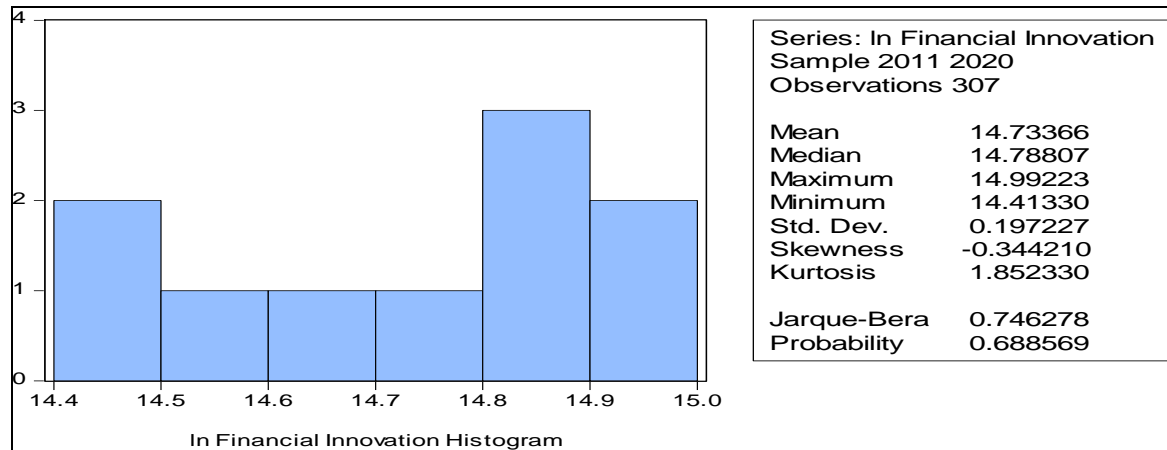
4.2.7 Financial Innovations

To compute financial innovation, the three variables (value of KEPSS, mobile phone transactions and payment cards) in millions Kenya shillings were summed up and an average taken. The average was converted to natural logarithms and this constituted the

variable, financial innovations. Summary statistics and histogram of financial innovation is displayed in Figure 15.

Figure 15

Summary Statistics and Histogram of Natural Log of Financial Innovations



Financial innovation (ln) ranged from a minimum 14.413 to a maximum 14.992, with a mean of 14.734. The median (14.788) was very close to the mean, suggesting the series could be normal. The standard deviation was 0.197, suggesting most values fell between from 14.537 to 14.931. The skewness (-0.344) and kurtosis (1.852) were all within the benchmark ± 2 (Field, 2005), suggesting that the distribution of financial innovation was normal. These conclusions were validated by results of the more explicit test for normality, *JB* (Jarque-Bera) = 0.746, $p=0.689$. The null hypothesis of the test is that the data is normally distributed. The results showed that the null hypothesis could not be rejected and hence the study concluded that the distribution of ln of financial innovations was normal. The results showed that transformation of the original data into natural logarithms ensured normality in the data.

4.2.8 Financial Performance of the Commercial Banks

The study measured financial performance of commercial banks using Return on Assets (ROA). Table 8 presents results on the performance of 39 commercial banks in the study.

Table 8

Performance of Commercial Banks

| ROA | Mean | Range | Std. Dev. |
|---------------------|-------|-----------------|-----------|
| Overall ($N=385$) | 1.262 | -24.59 – 10.4 | 3.492 |
| Between ($n=39$) | | -8.019 – 5.008 | 2.429 |
| Within ($T=9.87$) | | -17.689 – 9.831 | 2.529 |

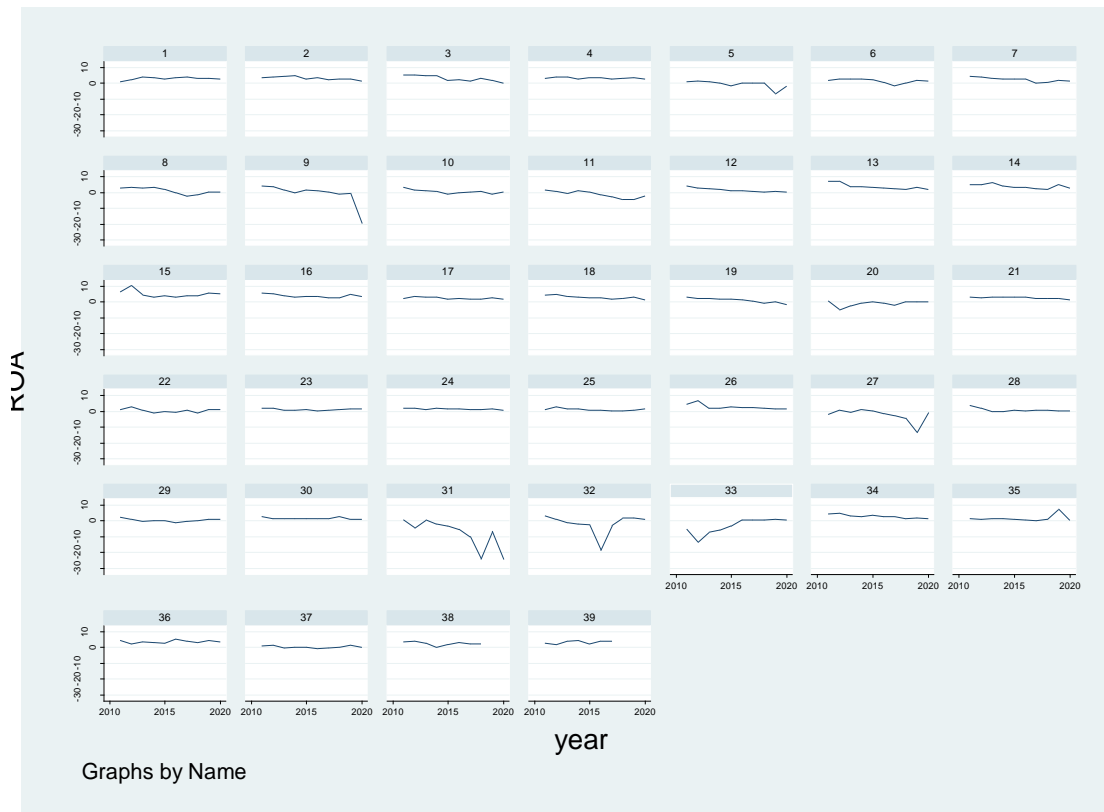
Key: Std. Dev = standard deviation.

Overall, ROA ranged from -24.59 to 10.400, with an average ROA of 1.262, showing that, generally, the financial performance of most banks was quite low. The standard deviation of 3.492, suggested that most of the banks' ROA ranged between -2.23 and 4.754, which buttressed the finding of relatively low ROA.

The average ROA for each bank varied between -8.019 and 5.008 % (the 'between' range) while the deviation from each bank's average varied from -17.689 to 9.831% (the 'within' range). The 'between' and 'within' standard deviations were 2.429 and 2.528, respectively, showing that slightly more variation in financial performance occurred within a bank in the ten-year study period rather than between different banks. That is, a bank is likely to have more variability in its financial performance in the ten-year study period compared with the way it performs with respect to other banks. These variations are as shown in Figure 16.

Figure 16

Return on Assets Variations



Also, Table 9 presents the average ROA, range and standard deviations for the years in the study.

Table 9*ROA Performance of Commercial Banks*

| Year | Average ROA | Range | Std. Dev. |
|------|-------------|-----------------|-----------|
| 2011 | 2.732 | -5.72 – 7.18 | 2.278 |
| 2012 | 2.331 | -13.6 – 10.4 | 3.726 |
| 2013 | 1.806 | -7.333 – 6.152 | 2.398 |
| 2014 | 1.619 | -5.930 – 4.886 | 2.137 |
| 2015 | 1.347 | -3.367 – 3.803 | 1.837 |
| 2016 | 0.836 | -18.703 – 5.006 | 3.789 |
| 2017 | 0.689 | -10.100 – 4.100 | 2.575 |
| 2018 | 0.302 | -24.438 – 3.890 | 4.498 |
| 2019 | 0.987 | -13.300- 7.400 | 3.717 |
| 2020 | -0.140 | -24.590 – 5.150 | 5.571 |

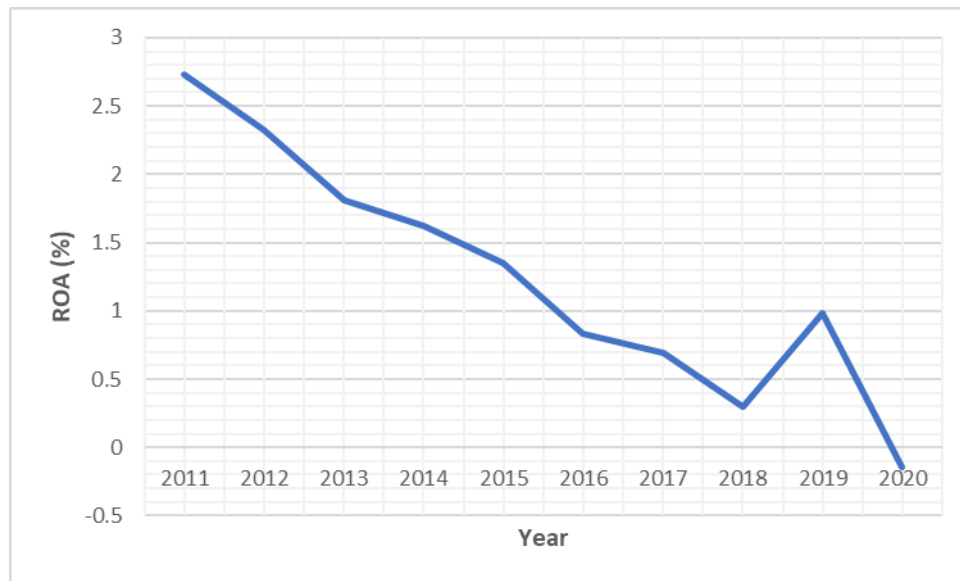
Key: Std. Dev = standard deviation.

The results showed that the average ROA for the banks in this study in 2011 was 2.732 which had dropped to -0.140 by 2020. The results suggested that ROA generally deteriorated over the course of the study. The standard deviation was smaller in the earlier years of study (for instance, 2.278, 3.726 and 2.398 in 2011, 2012 and 2013, respectively) while it was relatively larger in the latter years (4.498, 3.717 and 5.571 in 2018, 2019 and 2020, respectively). The results suggested that there was greater variance in bank performance in the latter years relative to earlier years. Put differently, some banks performed very well while others did very poorly in the latter years compared to earlier years where performance of most banks was similar.

Furthermore, the trend in the changes of ROA between 2011 and 2020 is plotted in Figure 17.

Figure 17

Trend in Changes in ROA (2011 and 2020)



The results showed that the average ROA decreased steadily between 2011 and 2018. Nevertheless, there was an uptick in ROA from 0.302 in 2018 to 0.987 in 2019. It decreased again in 2020 to -0.140.

4.3 Correlation Analysis

Correlation statistics is a method of assessing the relationship between variables/factors. Given the data was sufficiently normal, Pearson's correlation was conducted to determine the relationship between the independent variables in the study and ROA. Table 10 presents these results.

Table 10*Correlations Between ROA and Independent Variables*

| Variable (n = 10) | | ROA | GDPcapln | IRln | Int.ln | KEPSSln | MPMSln | ATMln |
|----------------------|----------|---------|----------|---------|----------|---------|--------|-------|
| ROA | <i>r</i> | 1 | | | | | | |
| GDPcapln | <i>r</i> | - | 1 | | | | | |
| IRln | <i>r</i> | 0.838** | -0.588 | 1 | | | | |
| Int.ln | <i>r</i> | 0.461 | -0.769** | 0.635* | 1 | | | |
| KEPSSln | <i>r</i> | 0.872** | 0.903** | -0.707* | -0.832** | 1 | | |
| MPMSln | <i>r</i> | - | 0.979** | -0.606 | -0.727* | 0.932** | 1 | |
| ATMln | <i>r</i> | 0.862** | 0.786** | -0.544 | -0.827** | 0.733* | 0.731* | 1 |
| | | - | | | | | | |
| | | 0.846** | | | | | | |
| | | - | | | | | | |
| | | 0.815** | | | | | | |

r = Pearson correlation coefficient; **, * =correlation significant at .01and .05 levels, respectively (2-tailed); ROA=return on assets; ln=natural logarithm, GDPcapln= gross domestic product per capita, IR=inflation rates/consumer price index, Int.=interest rates, KEPSS=Kenya Electronic Payment and Settlement System, ATM=automated teller machines/payment cards.

The results revealed that the natural logarithm of interest rates had significant, positive and strong relationship with ROA ($r = 0.872$, $p=0.001$). The relationship between interest rates and ROA was positive. This means that the variables move together in the same direction, that is, they increase or decrease together. The correlation coefficient therefore predicts that when the natural logarithm of interest rates increases by one unit, ROA goes up by 76% (r^2 =coefficient of determination= 0.872^2).

On the other hand, the natural logarithm of GDP per capita had a significant, strong but negative correlation with ROA ($r = -0.838, p=0.002$). The results suggest that when GDP per capita improves, bank profitability as measured by ROA decreases and vice versa. The other macroeconomic variable in the study, annual inflation rate/consumer price index was found not be significantly correlated with ROA ($r = 0.461, p=0.179$).

In addition, the study found that whereas inflation rate was not correlated with GDP per capita, it had a significant, positive and fairly strong correlation with interest rates. On the other hand, interest rates had a significant, strong but negative correlation with GDP per capita.

All bank innovations were found to have significant, strong but negative relationships with ROA (KEPSSln: $r = -0.862, p=0.001$; MPMSln: $r = -0.846, p=0.002$; ATMln: $r = -0.815, p=0.004$). The results indicated that when the innovations increase, the banks' ROA decreases. Additionally, all bank innovations had significant, strong and positive correlations with GDP per capita but had either negative or non-significant relationships with both inflation and interest rates. On the other hand, significant, positive and strong correlation were found between the various bank innovations.

4.4 Stationarity Tests

Descriptive statistics from the foregoing section suggested that some variables serially be dependent on previous years' data. Consequently, autocorrelation functions (ACF) and partial correlation functions (PCF) were computed to visually examine the behaviour of the variables over several lags. More explicit tests for stationarity were also conducted. For time series data, Augmented Dickey-Fuller (ADF) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests were conducted. The ADF computes probabilities and critical

values using 20 observations. However, this study's time series had only 9 observations (ten years' study period) and statistics computed might not have been accurate. Thus, it was important to complement the ADF test with the KPSS test.

For panel data, the study also used two types of tests to assess stationarity of the study variables: Harris-Tzavalis test and the Fisher type. The former assumes that the number of panels tends to infinity while the number of time periods is fixed. This was apt for data in this study because there were only a limited number of time periods (10 years) whereas the number of panels was greater (39). Nevertheless, Harris-Tzavalis test works only with balanced data. Where data was unbalanced, the Fisher type tests were used.

4.4.1 Gross Domestic Product (GDP) Per Capita

The autocorrelation functions (ACF) and partial correlation functions (PCF) of the LN of GDP per Capita is presented in Table 11.

Table 11
ACF and PCF of LN of GDP per Capita

| Autocorrelation | | Partial Correlation | | AC | PAC | Q-Stat | Prob | |
|-----------------|------------|---------------------|------------|----|----------|----------|--------|-------|
| | ██████████ | | ██████████ | 1 | 0.663 | 0.663 | 5.8552 | 0.016 |
| | ██████ | | ███ | 2 | 0.383 | -0.10... | 8.0550 | 0.018 |
| | ███ | | ███ | 3 | 0.121 | -0.16... | 8.3056 | 0.040 |
| | ██ | | ██ | 4 | -0.06... | -0.08... | 8.3771 | 0.079 |
| | ██ | | ██ | 5 | -0.21... | -0.14... | 9.4598 | 0.092 |
| | ██ | | ██ | 6 | -0.34... | -0.19... | 13.090 | 0.042 |
| | ██ | | ██ | 7 | -0.41... | -0.12... | 20.069 | 0.005 |
| | ██ | | ██ | 8 | -0.38... | -0.02... | 28.749 | 0.000 |
| | ██ | | ██ | 9 | -0.24... | 0.047 | 36.156 | 0.000 |

As indicated in Table 11, the ACF plot showed three large but decreasing spikes in the first three lags, with all of them statistically significant at $p < 0.05$, suggesting a serial

correlation (nevertheless, a reducing one) in GDP per capita between Lag 1 (2012) and Lag 3 (2014). A serial correlation but in an inverse direction is observed between lags 6 and 9, which were also statistically significant. This showed that the series had a trend. Except for lag 1, which was the largest and touched the maximum line, the others were smaller. Whenever a shock arose (for example lag 1 and lag7), it reverted back to zero relatively quickly, suggesting that the series could be stationary at the level.

Consequently, Table 12 presents the results of the ADF and KEPSS tests on GDP per Capita.

Table 12

Results of ADF and KEPSS tests on GDP Per Capita

| Panel A. | | | |
|----------------------------|-----------|-------------|--------------|
| ADF Test | | t-Statistic | p-value |
| ADF test statistic | | -3.086 | 0.168 |
| Test Critical values | 1% level | -5.522 | |
| | 5% level | -4.107 | |
| | 10% level | -3.515 | |
| Panel B. | | | |
| KEPSS Test | | | LM-Statistic |
| KEPSS test statistic | | | 0.5000 |
| Asymptotic critical values | 1% level | | 0.216 |
| | 5% level | | 0.146 |
| | 10% level | | 0.119 |

Exogenous: Constant

The null hypothesis in ADF test is that GDP per capita has a unit root. The t-statistic (-3.086) was more negative than all the critical values at 1%, 5%, and 10% levels while the p-value was not statistically significant at $p=0.168$ as indicated in Table 12. The results suggest the presence of a unit root in the results of LN of GDP per capita. Nevertheless, since the observations were too few relative to the 20 required to compute probabilities

and critical values, it was germane to look at another test.



















The KEPSS test statistic was 0.500, and was greater than the asymptotic critical values at all the three significance levels. Therefore, the study accepted the null hypothesis that LN of GDP per capita was stationary.

4.4.2 Inflation Rates

Table 13 presents the autocorrelation functions (ACF) and partial correlation functions (PCF) of the LN of annual inflation rates.

Table 13

ACF and PCF of LN of Annual Inflation Rates

| Autocorrelation | Partial Correlation | AC | PAC | Q-Stat | Prob |
|---|---|------------|----------|--------|-------|
|  |  | 1 0.063 | 0.063 | 0.0532 | 0.818 |
|  |  | 2 -0.02... | -0.03... | 0.0659 | 0.968 |
|  |  | 3 -0.03... | -0.02... | 0.0824 | 0.994 |
|  |  | 4 -0.04... | -0.04... | 0.1297 | 0.998 |
|  |  | 5 0.164 | 0.169 | 0.7732 | 0.979 |
|  |  | 6 -0.08... | -0.11... | 0.9953 | 0.986 |
|  |  | 7 -0.28... | -0.27... | 4.1631 | 0.761 |
|  |  | 8 -0.21... | -0.20... | 7.0116 | 0.535 |
|  |  | 9 -0.03... | -0.01... | 7.1411 | 0.622 |

As shown in Table 12, the ACF consists of small spikes in lags 7 and 8. However, no lag was found to be statistically significant at $p < 0.05$. Table 13 presents the autocorrelation functions (ACF) and partial correlation functions (PCF) of the LN of 12-month inflation rates.

Table 14*ACF and PCF of LN of 12-Month Inflation Rates*

| Autocorrelation | Partial Correlation | AC | PAC | Q-Stat | Prob |
|-----------------|---------------------|------------|----------|--------|-------|
| | | 1 0.291 | 0.291 | 1.1314 | 0.287 |
| | | 2 -0.04... | -0.13... | 1.1563 | 0.561 |
| | | 3 0.003 | 0.062 | 1.1565 | 0.763 |
| | | 4 -0.05... | -0.09... | 1.2208 | 0.875 |
| | | 5 0.074 | 0.141 | 1.3523 | 0.929 |
| | | 6 0.032 | -0.06... | 1.3823 | 0.967 |
| | | 7 -0.32... | -0.33... | 5.5565 | 0.592 |
| | | 8 -0.28... | -0.11... | 10.564 | 0.228 |
| | | 9 -0.19... | -0.14... | 14.895 | 0.094 |

As indicated in Table 14, all the lags of ACF were statistically insignificant at $p < 0.05$. However, the spike in lag 1 of 12-month inflation rate was greater relative to that of annual inflation rate, suggesting a greater dependency of 2012 statistic of 12-month IR on 2011 data compared with annual IR. The spikes in both the annual IR and the 12-month IR were small and close to zero, suggesting little serial correlation and no stationarity in the data. Small spikes tended to be followed by small spikes; whereas bigger ones were also followed by bigger ones suggesting the presence of linear trend in the data.

Table 15 presents the results of the ADF and KPSS tests conducted on annual inflation rates.

Table 15*Results of ADF and KEPSS tests on LN of Annual Inflation Rates*

| Panel A. | | | |
|----------------------------|-----------|-------------|--------------|
| ADF Test | | t-Statistic | p-value |
| ADF test statistic | | -4.117 | 0.049 |
| Test Critical values | 1% level | -5.519 | |
| | 5% level | -4.108 | |
| | 10% level | -3.515 | |
| Panel B. | | | |
| KEPSS Test | | | LM-Statistic |
| KEPSS test statistic | | | 0.5000 |
| Asymptotic critical values | 1% level | | 0.216 |
| | 5% level | | 0.146 |
| | 10% level | | 0.119 |

Exogenous: Constant

The null hypothesis in ADF test is that annual inflation rates have a unit root. The t-statistic (-4.117) was more negative than the critical values at 1% and 5% but not 10% level while the p -value was 0.049 as shown in Table 15. Thus, the null hypothesis of the presence of a unit root was rejected. This suggested that the series of LN of annual IR was stationary at the level. This conclusion was buttressed by results from the KEPSS test, in which the test statistic (0.500), and was greater than the asymptotic critical values at all the three significance levels, suggesting that LN of annual inflation rate was stationary.

The results of the ADF and KEPSS tests 12-month inflation rates are presented in Table 16.

Table 16*Results of ADF and KEPSS tests on LN of 12-month Inflation Rate*

| Panel A. | | | |
|----------------------------|-----------|-------------|--------------|
| ADF Test | | t-Statistic | p-value |
| ADF test statistic | | -3.114 | 0.163 |
| Test Critical values | 1% level | -5.522 | |
| | 5% level | -4.108 | |
| | 10% level | -3.515 | |
| Panel B. | | | |
| KEPSS Test | | | LM-Statistic |
| KEPSS test statistic | | | 0.275 |
| Asymptotic critical values | 1% level | | 0.216 |
| | 5% level | | 0.146 |
| | 10% level | | 0.119 |

Exogenous: Constant

The ADF statistic was no statistically significant ($t = -3.114$, $p = 0.163$), suggesting the presence of a unit root in 12-month inflation rate data as shown in Table 16. Nevertheless, the KEPSS statistic (0.275) was greater than the asymptotic critical values at the three significance levels, suggesting that LN of 12-month inflation rate was stationary.

4.4.3 Interest Rates

Table 17 displays the autocorrelation functions (ACF) and partial correlation functions (PCF) of the LN of interest rates.

Table 17*ACF and PCF of LN of Interest Rates*

| Autocorrelation | Partial Correlation | AC | PAC | Q-Stat | Prob |
|-----------------|---------------------|------------|----------|--------|-------|
| | | 1 0.580 | 0.580 | 4.4792 | 0.034 |
| | | 2 0.308 | -0.04... | 5.9064 | 0.052 |
| | | 3 0.065 | -0.14... | 5.9799 | 0.113 |
| | | 4 -0.14... | -0.17... | 6.3995 | 0.171 |
| | | 5 -0.32... | -0.21... | 9.0023 | 0.109 |
| | | 6 -0.36... | -0.06... | 12.979 | 0.043 |
| | | 7 -0.35... | -0.10... | 18.090 | 0.012 |
| | | 8 -0.26... | -0.02... | 22.143 | 0.005 |
| | | 9 0.002 | 0.215 | 22.143 | 0.008 |

The ACF plot showed two large spikes in lag 1 and 2, which decreases to almost zero in lag 3, with both of them statistically significant at $p < 0.05$, suggesting a serial correlation (nevertheless, a reducing one) in interest rates between lag 1 (2012) and lag 2 (2013) as shown in Table 17. A serial correlation but in an inverse direction is observed between lag 6 and lag 8, which were also statistically significant. This showed that the series had a trend. The behaviour of the interest rates' ACF plot mirrored the plot for GDP per capita. Except for lag 1, which was the largest and touched the maximum line, the others were smaller. Whenever a shock arose (for example lag 1), it reverted back to zero relatively quickly, suggesting that the series could be stationary.

The ADF results displayed in Table 28 showed that the t-statistic was statistically significant ($t = -6.189$, $p = 0.005$), suggesting that LN interest rates data did not contain a unit root at all the significant levels.

Table 18*Results of ADF and KEPSS tests on Interest Rates*

| Panel A. | | | |
|----------------------------|-----------|--------------|---------|
| ADF Test | | t-Statistic | p-value |
| ADF test statistic | | -6.189 | 0.005 |
| Test Critical values | 1% level | -5.522 | |
| | 5% level | -4.107 | |
| | 10% level | -3.515 | |
| Panel B. | | | |
| KEPSS Test | | LM-Statistic | |
| KEPSS test statistic | | 0.149 | |
| Asymptotic critical values | 1% level | 0.216 | |
| | 5% level | 0.146 | |
| | 10% level | 0.119 | |

Exogenous: Constant

The KEPSS test statistic was 0.149 and was greater than the asymptotic critical values at both the 10% and 5% significance levels as shown in Table 18. The results showed that the null hypothesis that LN of interest rates were stationary was acceptable at both the 10% and 5% significance levels but not at 1% level.

4.4.4 Value of Mobile Phone Money Services

Table 19 displays the autocorrelation functions (ACF) and partial correlation functions (PCF) of the LN of mobile phone services.

Table 19*ACF and PCF of LN of mobile phone money Services*

| Autocorrelation | Partial Correlation | AC | PAC | Q-Stat | Prob |
|-----------------|---------------------|------------|----------|--------|-------|
| | | 1 0.660 | 0.660 | 5.8027 | 0.016 |
| | | 2 0.385 | -0.08... | 8.0281 | 0.018 |
| | | 3 0.132 | -0.15... | 8.3256 | 0.040 |
| | | 4 -0.07... | -0.13... | 8.4357 | 0.077 |
| | | 5 -0.24... | -0.16... | 9.9170 | 0.078 |
| | | 6 -0.34... | -0.09... | 13.418 | 0.037 |
| | | 7 -0.38... | -0.12... | 19.482 | 0.007 |
| | | 8 -0.36... | -0.06... | 27.356 | 0.001 |
| | | 9 -0.26... | 0.006 | 35.513 | 0.000 |

As shown in Table 19, ACF plot showed three larger but decreasing spikes in the first three lags, with all of them statistically significant at $p < 0.05$, suggesting a serial correlation (nevertheless, a reducing one) in GDP per capita between lag 2 (2012) and Lag 3 (2014). A serial correlation but in an inverse direction is observed between lags 6 and 9, which were also statistically significant. This showed that the series had a trend. Except for lag 1, which was the largest and touched the maximum line, the others were smaller. Whenever a shock arose (for example lag 1 and lag7), it reverted back to zero relatively quickly, suggesting that the series could be stationary.

The ACF plot of mobile phone money services resembled the ACF plots of both the GDP per capita and commercial banks' interest rates. The results of the various tests of stationarity are presented in Table 20.

Table 20*Stationarity Tests on Mobile Phone Money Services*

| Method | Statistic | <i>p</i> -value | Cross-sections | Obs |
|--|-----------|-----------------|----------------|-----|
| Null: Unit root (assumes common unit root process) | | | | |
| Levin, Lin & Chu <i>t</i> * | -23.5667 | 0.0000 | 39 | 307 |
| Null: Unit root (assumes individual unit root process) | | | | |
| Im, Pesaran and Shin <i>W</i> -stat | -5.32214 | 0.0000 | 39 | 307 |
| ADF - Fisher Chi-square | 170.197 | 0.0000 | 39 | 307 |
| PP - Fisher Chi-square | 92.4749 | 0.1257 | 39 | 346 |



















Key: Obs=observations

The null hypothesis for all the tests is the presence of a unit root. As indicated in Table 20, the Levin, Lin & Chu ($t = -23.567$, $p < 0.0001$), Im, Pesaran and Shi ($W = -5.322$, $p < 0.0001$), and ADF-Fisher ($\chi^2 = 170.197$, $p < 0.0001$) were statistically significant. Only the PP- Fisher Test ($\chi^2 = 92.475$, $p = 0.126$) was found not to be significant. The results strongly suggested the absence of a unit root in LN of mobile phone money services.

4.4.5 Value of Payment Cards Transactions

Table 21 shows the autocorrelation functions (ACF) and partial correlation functions (PCF) of the LN of the value of payment cards transactions.

Table 21*ACF and PCF of LN of Mobile Phone Money Services*

| Autocorrelation | Partial Correlation | AC | PAC | Q-Stat | Prob | |
|---|---|----|----------|----------|--------|-------|
|  |  | 1 | 0.607 | 0.607 | 4.9135 | 0.027 |
|  |  | 2 | 0.202 | -0.26... | 5.5247 | 0.063 |
|  |  | 3 | 0.110 | 0.196 | 5.7308 | 0.125 |
|  |  | 4 | -0.14... | -0.47... | 6.1368 | 0.189 |
|  |  | 5 | -0.35... | 0.034 | 9.1005 | 0.105 |
|  |  | 6 | -0.29... | -0.10... | 11.778 | 0.067 |
|  |  | 7 | -0.28... | -0.12... | 15.070 | 0.035 |
|  |  | 8 | -0.25... | 0.036 | 18.997 | 0.015 |
|  |  | 9 | -0.08... | -0.03... | 19.828 | 0.019 |

Lag one showed the largest spike, which was statistically significant ($Q=4.914$, $p=0.027$), suggesting that ATM transactions of Lag 2 (2012) were strongly correlated with those of lag 1 (2011) as shown in Table 21. However, in subsequent years (from Lag 2 (2012) to Lag 7 (2018), ATM transactions were not serially correlated (p values for lags 2 to 7 were statistically insignificant). Except for lag 1, which was the largest and touched the maximum line, the others were smaller. Whenever a perturbation occurred (for example lag 1 and lag5), the series reverted back to zero relatively quickly, suggesting that the series could be stationary.

The ACF plot of payment card transactions were also found to be similar to the ACF plots of phone money services, GDP per capita, and commercial banks' interest rates.

The results of the various tests of stationarity are presented in Table 22.

Table 22*Stationarity Tests on Payment Card Services*

| Method | Statistic | <i>p</i> -value | Cross-sections | Obs |
|--|-----------|-----------------|----------------|-----|
| Null: Unit root (assumes common unit root process) | | | | |
| Levin, Lin & Chu <i>t</i> * | -18.9096 | 0.0000 | 39 | 307 |
| Null: Unit root (assumes individual unit root process) | | | | |
| Im, Pesaran and Shin <i>W</i> -stat | -4.88652 | 0.0000 | 39 | 307 |
| ADF - Fisher Chi-square | 160.299 | 0.0000 | 39 | 307 |
| PP - Fisher Chi-square | 123.327 | 0.0008 | 39 | 346 |



















Key: Obs=observations

The Levin, Lin & Chu ($t = -18.909$, $p < 0.0001$), Im, Pesaran and Shi ($W = -4.886$, $p < 0.0001$), ADF-Fisher ($\chi^2 = 160.299$, $p < 0.0001$) and PP-Fisher Test ($\chi^2 = 123.327$, $p = 0.0008$) were strongly significant. The results strongly suggested the absence of a unit root in LN of payment card services.

4.4.6 Kenya Electronic Payment and Settlement Systems (KEPSS)

The autocorrelation functions (ACF) and partial correlation functions (PCF) of the LN of the Kenya Electronic Payment and Settlement Systems (KEPSS) are shown in Table 23.

Table 23*ACF and PCF of LN of KEPSS*

| Autocorrelation | Partial Correlation | AC | PAC | Q-Stat | Prob |
|---|---|------------|----------|--------|-------|
|  |  | 1 0.675 | 0.675 | 6.0769 | 0.014 |
|  |  | 2 0.283 | -0.31... | 7.2810 | 0.026 |
|  |  | 3 0.013 | -0.05... | 7.2837 | 0.063 |
|  |  | 4 -0.07... | 0.059 | 7.3876 | 0.117 |
|  |  | 5 -0.11... | -0.11... | 7.6829 | 0.175 |
|  |  | 6 -0.32... | -0.44... | 10.886 | 0.092 |
|  |  | 7 -0.42... | 0.099 | 17.940 | 0.012 |
|  |  | 8 -0.38... | -0.06... | 26.716 | 0.001 |
|  |  | 9 -0.15... | 0.126 | 29.743 | 0.000 |

Source: Author's Conceptualization (2023)

Except for lag 1, the spikes for all the others were smaller and closer to zero as presented in Table 23. Whenever a perturbation occurred (for example lag 1 and lag7), the series reverted back to zero fairly quickly, which indicated that the series could be stationary. Results showed serial correlation in lag 1 and 2 (2012 and 2013 value of KEPSS were strongly correlated with those of the previous year). Lags 3 to 6 were not statistically significant (all had $p > 0.05$), suggesting little serial correlation in in KEPSS in the years between 2014 and 2017. However, between 2018 and 2020, serial correlation win KEPSS data was observed with the previous years, as evidenced by statistically significant lags 7 to 9. Table 24 presents various tests conducted to test the presence of a unit root in KEPSS at the level.

Table 24*Stationarity Tests on LN of KEPSS at the Level*

| Method | Statistic | Prob.** | Cross- sections | Obs |
|--|-----------|---------|--------------------|-----|
| Null: Unit root (assumes common unit root process) | | | | |
| Levin, Lin & Chu t* | -5.60914 | 0.0000 | 39 | 307 |
| Null: Unit root (assumes individual unit root process) | | | | |
| Im, Pesaran and Shin W-stat | -0.88401 | 0.1883 | 39 | 307 |
| ADF - Fisher Chi-square | 89.5963 | 0.1739 | 39 | 307 |
| PP - Fisher Chi-square | 177.843 | 0.0000 | 39 | 346 |

As presented in Table 23, the Levin, Lin & Chu ($t = -5.609$, $p < 0.0001$) and PP-Fisher Test ($\chi^2 = 123.327$, $p = 0.0008$) were strongly significant, suggesting the absence of a unit root. However, Im, Pesaran and Shi ($W = -0.88401$, $p = 0.1883$) and ADF-Fisher ($\chi^2 = 89.5963$, $p = 0.1739$) could not reject the null of the presence of unit root. Because the four tests were finely balanced, this study accepted the null hypothesis of the presence of a unit root at the level.

The tests were repeated at first difference and the results are presented in Table 25.

Table 25*Stationarity Tests on LN of KEPSS at First Difference*

| Method | Statistic | Prob.** | Cross-sections | Obs |
|--|-----------|---------|----------------|-----|
| Null: Unit root (assumes common unit root process) | | | | |
| Levin, Lin & Chu t^* | -5.18776 | 0.0000 | 38 | 264 |
| Null: Unit root (assumes individual unit root process) | | | | |
| Im, Pesaran and Shin W-stat | -2.73800 | 0.0031 | 38 | 264 |
| ADF - Fisher Chi-square | 120.820 | 0.0008 | 38 | 264 |
| PP - Fisher Chi-square | 353.119 | 0.0000 | 38 | 302 |

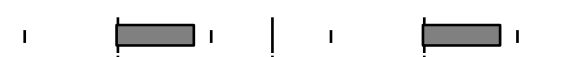
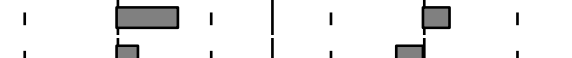



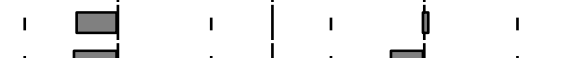
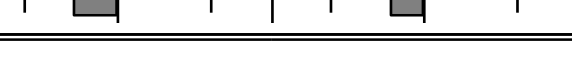



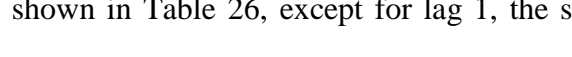
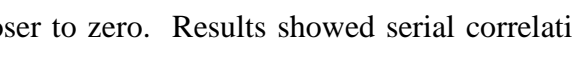



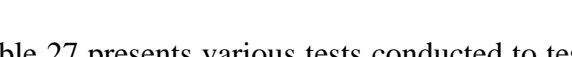
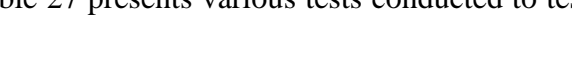

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

The Levin, Lin & Chu ($t = -5.1877$, $p < 0.0001$), Im, Pesaran and Shi ($W = -2.738$, $p = 0.0031$), ADF-Fisher ($\chi^2 = 120.820$, $p = 0.0008$) and PP-Fisher Test ($\chi^2 = 353.119$, $p < 0.0001$) were strongly significant as presented in Table 25. The results strongly suggested the absence of a unit root in KEPSS LN at first difference. This showed that the KEPSS series was integrated at the order of 1(1).

4.4.7 Return on Assets

The autocorrelation functions (ACF) and partial correlation functions (PCF) of the LN of the ROA are shown in Table 26.

Table 26*ACF and PCF of LN of ROA*

| Autocorrelation | Partial Correlation | AC | PAC | Q-Stat | Prob | |
|---|---|----|----------|----------|--------|-------|
|  |  | 1 | 0.525 | 0.525 | 3.6749 | 0.055 |
|  |  | 2 | 0.406 | 0.181 | 6.1520 | 0.046 |
|  |  | 3 | 0.140 | -0.18... | 6.4899 | 0.090 |
|  |  | 4 | -0.05... | -0.19... | 6.5563 | 0.161 |
|  |  | 5 | -0.27... | -0.23... | 8.3666 | 0.137 |
|  |  | 6 | -0.34... | -0.10... | 12.023 | 0.061 |
|  |  | 7 | -0.34... | 0.001 | 16.695 | 0.019 |
|  |  | 8 | -0.26... | 0.026 | 20.837 | 0.008 |
|  |  | 9 | -0.28... | -0.20... | 30.645 | 0.000 |

Source: Author's Own Conceptualization (2023)

As shown in Table 26, except for lag 1, the spikes for all the others were smaller and closer to zero. Results showed serial correlation in lag 2 (2013), lag 7, 8 and 9 (2018, 2019 and 2020, respectively) as all had $p > 0.05$), suggesting some correlation in ROA in these years.

Table 27 presents various tests conducted to test the presence of a unit root in KEPSS at the level.

Table 27*Stationarity Tests on LN of KEPSS at the Level*

| Method | Statistic | Prob.** | Cross- sections | Obs |
|--|-----------|---------|--------------------|-----|
| Null: Unit root (assumes common unit root process) | | | | |
| Levin, Lin & Chu t* | -12.7157 | 0.0000 | 39 | 307 |
| Null: Unit root (assumes individual unit root process) | | | | |
| Im, Pesaran and Shin W-stat | -3.91200 | 0.0000 | 39 | 307 |
| ADF - Fisher Chi-square | 156.161 | 0.0000 | 39 | 307 |
| PP - Fisher Chi-square | 164.083 | 0.0000 | 39 | 346 |

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

The Levin, Lin & Chu ($t=-12.716$, $p<0.0001$), Im, Pesaran and Shi ($W= -3.912$, $p<0.0001$), ADF-Fisher ($\chi^2 = 156.161$, $p<0.0001$) and PP-Fisher Test ($\chi^2 =164.083$, $p<0.0001$) were strongly significant as presented in Table 27. The results strongly suggested the absence of a unit root in ROA at first difference. This showed that the ROA series was integrated at the order of 1(0).

4.4.8 Summary of Stationarity Tests

The summary of the stationarity tests is presented in Table 28.

Table 28*Stationarity Tests Summary*

| Variable | Tests | | | | | Conclusion |
|------------------------|-------|-------|-----|-----|----|----------------|
| | ADF | KEPSS | LLC | IPS | PP | |
| 1. GDP per capita | X | √ | | | | Stationary |
| 2. Inflation/annual IR | √ | √ | | | | Stationary |
| 3. Interest rates | √ | √ | | | | Stationary |
| 4. MPMS | √ | | √ | √ | X | Stationary |
| 5. Payment cards value | √ | | √ | √ | √ | Stationary |
| 6. Value KEPSS | X | | √ | X | √ | Non-stationary |
| 7. ROA | √ | | √ | √ | √ | Stationary |

Key: √ = Unit root absent, X = Unit root present

From Table 28 results, the symbol (√) indicates absents of the unit root and (X) indicates the presents of the unit root for GDP per Capita, Interest Rates, Inflations, MMS, Payments Cards and KEPSS

4.5 Long-Term Relationship Among Study Variables

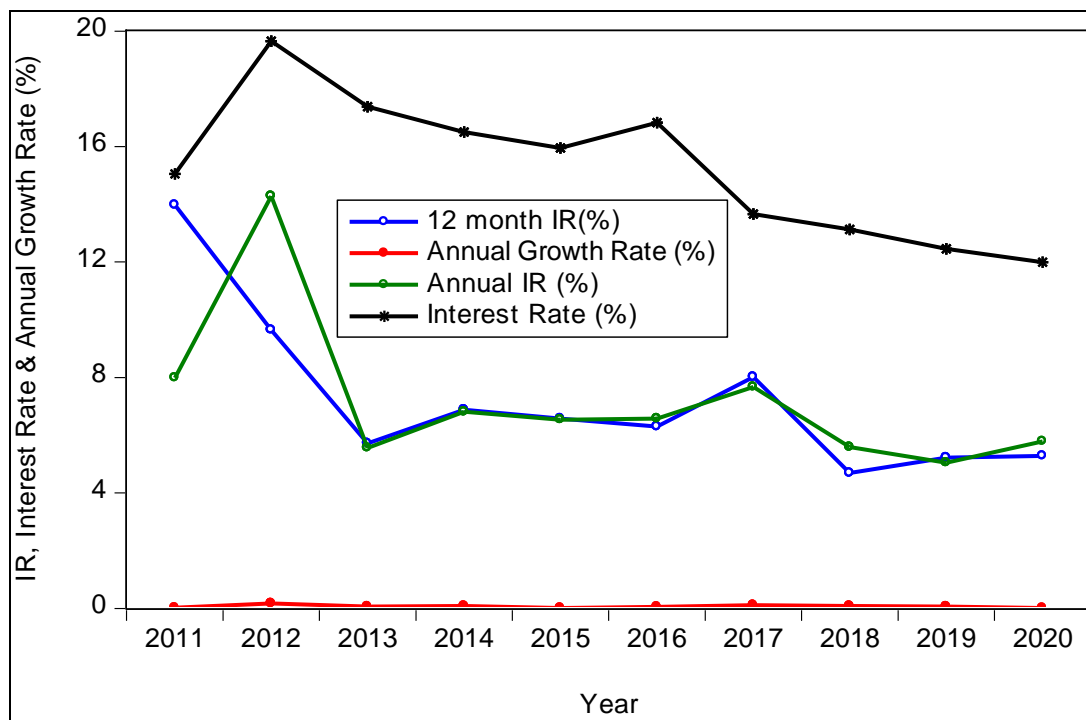
This section presents results on the long run relationships among the study variables. These variables were divided into time series variables (macroeconomic variables) and into panel variables (financial innovations).

4.5.1 GDP per capita, Interest rates, Inflation and VAR Model

The trend in gross changes in macroeconomic variables of GDP per capita, interest rates, and inflation all plotted on one graph are shown in Figure 18. For GDP per capita, annual growth rate, which is expressed as a percentage, was used.

Figure 18

Gross Changes in Macroeconomic Variables



To model the dynamic behaviour of the macroeconomic variables in the study, a vector autoregression (VAR), which does not require strong restrictions was used. As established in Section 4.6.1 these variables (GDP per capita, annual inflation rate and annual interest rate) were likely stationary. The study specified lags one to two and the results of the VAR regressions are displayed in Table 29 indicates that only one lag was specified in the equation.

Table 29*Results of the VAR Regressions on the Macroeconomic Variables*

| Equation | Parms | RMSE | R-sq | chi2 | P>chi2 |
|------------|-------|---------|--------|----------|--------|
| gdpcapln | 4 | .040728 | 0.9666 | 260.5543 | 0.0000 |
| annualirln | 4 | .162129 | 0.8273 | 43.10878 | 0.0000 |
| intratesln | 4 | .055009 | 0.9347 | 128.7642 | 0.0000 |

| | Coef. | Std. Err. | z | P> z | [95% Conf. Interval] | |
|------------|-----------|-----------|-------|-------|----------------------|-----------|
| gdpcapln | | | | | | |
| gdpcapln | | | | | | |
| L1. | .7867147 | .0777681 | 10.12 | 0.000 | .634292 | .9391375 |
| annualirln | | | | | | |
| L1. | .0004727 | .0462125 | 0.01 | 0.992 | -.0901022 | .0910476 |
| intratesln | | | | | | |
| L1. | -.1519673 | .1115797 | -1.36 | 0.173 | -.3706596 | .066725 |
| _cons | 2.025443 | .7767483 | 2.61 | 0.009 | .5030445 | 3.547842 |
| annualirln | | | | | | |
| gdpcapln | | | | | | |
| L1. | -2.011747 | .3095794 | -6.50 | 0.000 | -2.618512 | -1.404983 |
| annualirln | | | | | | |
| L1. | -.2919622 | .1839629 | -1.59 | 0.112 | -.6525228 | .0685984 |
| intratesln | | | | | | |
| L1. | -1.262853 | .4441766 | -2.84 | 0.004 | -2.133423 | -.392283 |
| _cons | 20.45587 | 3.09208 | 6.62 | 0.000 | 14.3955 | 26.51623 |
| intratesln | | | | | | |
| gdpcapln | | | | | | |
| L1. | -.8448887 | .1050388 | -8.04 | 0.000 | -1.050761 | -.6390165 |
| annualirln | | | | | | |
| L1. | -.0228917 | .0624177 | -0.37 | 0.714 | -.1452281 | .0994447 |
| intratesln | | | | | | |
| L1. | -.0007299 | .1507069 | -0.00 | 0.996 | -.2961101 | .2946502 |
| _cons | 8.858154 | 1.049127 | 8.44 | 0.000 | 6.801903 | 10.91441 |

The results showed that GDP per capita was likely affected only by its own lagged values ($p < 0.0001$) but not of those of annual IR ($p = 0.992$) or annual interest rates ($p = 0.173$). Nevertheless, the results showed that interest rates ($p < 0.0001$) and inflation rates ($p < 0.0001$) were likely to be strongly affected by lagged values of GDP per capita.

The VAR model was assessed for stability and for autocorrelation of the residuals. The results showed that all the eigen values were less than one (that is, they all lied inside the unit circle), suggesting that the model satisfied the stability condition. A Lagrange multiplier test was conducted to test the joint null hypothesis of no auto-correlation of the residuals.

The p values for lags 1 to 4 were all greater than 0.05, suggesting the absence of autocorrelation at the requisite lag. The results of the Granger causality Wald tests are presented in Table 30.

Table 30

Results of the Granger Causality Wald tests

| Equation | Excluded | chi2 | df | Prob > chi2 |
|------------|------------|--------|----|-------------|
| gdpcapln | annualirln | .0001 | 1 | 0.992 |
| gdpcapln | intratesln | 1.8549 | 1 | 0.173 |
| gdpcapln | ALL | 2.1813 | 2 | 0.336 |
| annualirln | gdpcapln | 42.228 | 1 | 0.000 |
| annualirln | intratesln | 8.0834 | 1 | 0.004 |
| annualirln | ALL | 42.858 | 2 | 0.000 |
| intratesln | gdpcapln | 64.699 | 1 | 0.000 |
| intratesln | annualirln | .13451 | 1 | 0.714 |
| intratesln | ALL | 66.959 | 2 | 0.000 |

Results of the granger causality Wald tests mirror those in Table 12 because there was a single lag. The results show that neither lagged interest rates ($p=0.173$) nor lagged inflation rates ($p=0.992$) are likely to help predict GDP per capita. However, lagged values of GDP are strong predictors of both interest rates ($p<0.0001$) and inflation rates ($p<0.0001$). The VAR also shows that while lagged interest rates help predict inflation rates ($p=0.004$), lagged inflation rates do not predict interest rates ($p=0.714$). This is logical because GDP per capita is computed by dividing the GDP of a country by its population (Brock, 2020).

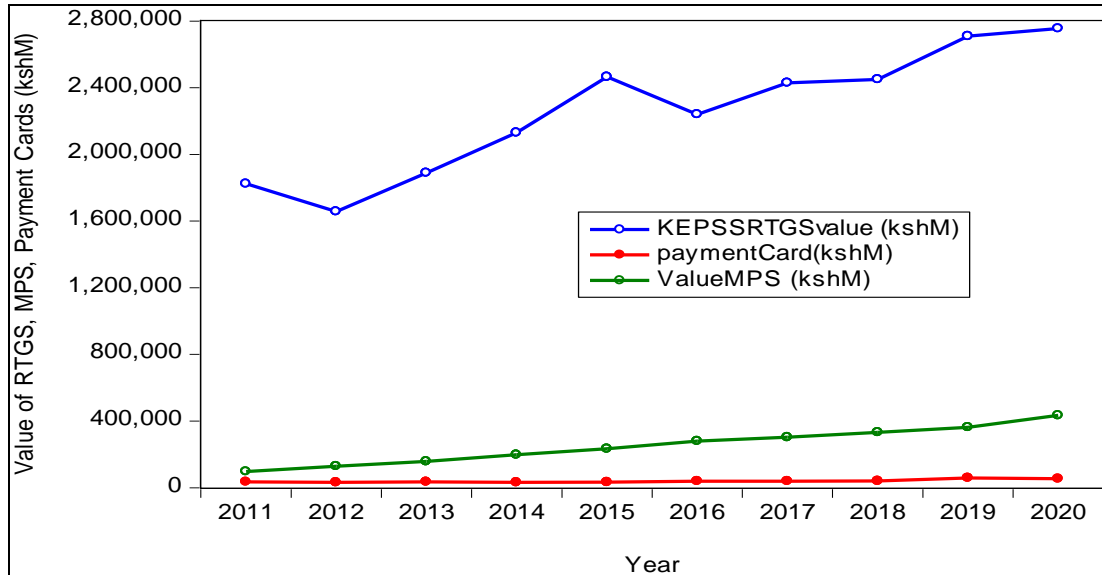
4.5.2 Financial Innovations Relationships

As presented in Table 22, some bank innovations, for instance, Kenya Electronic Payment and Settlement Systems (KEPSS) was found to be non-stationary. It was therefore germane to test whether a co-integration relationship between was extant between variables representing financial innovations.

Figure 19 shows the results of the three financial innovations trends.

Figure 19

Trends in KEPSS, Payment Cards and Mobile Phone Money Services



4.5.3 Cointegration Tests

A co-integration test could determine whether there was a long-run equilibrium relationship between variables. The co-integration test is used to test the hypothesis that linear combinations of the variables are stationary. Hence, all the stationary variables can move together to achieve long-run equilibrium.

Two tests were conducted to assess cointegration: Panel Pedroni Cointegration and Kao (Engle-Granger based) cointegration tests. Table 30 presents the results of the panel Pedroni Cointegration tests.

Table 31*Panel Pedroni Cointegration Tests for Financial Innovations*

| lnATM lnMPMS | lnKEPSS | Individual Intercept | | Deterministic intercept and trend | |
|---------------------|---------|---------------------------|-----------------------|---|-----------------------|
| Within-dimension | | Statistic | Weighted statistic | Statistic | Weighted statistic |
| Panel v-Statistic | | -2.833405 | -2.580751 | -5.039804 | -5.118640 |
| Panel rho-Statistic | | 1.348556 | 2.099951 | 3.417938 | 4.471539 |
| Panel PP-Statistic | | -16.61326*** | -10.75525*** | -22.39529** | -16.32881*** |
| Panel ADF-Statistic | | -11.83747*** | -7.331648*** | -10.31701*** | -10.64982*** |
| Between-dimension | | | | | |
| Group rho-Statistic | | | | | |
| Group PP-Statistic | | 4.935182 | | 7.196798 | |
| Group ADF-Statistic | | -17.36311*** | | -18.22962*** | |
| Null Hypothesis | | -3.791811*** | | -2.850976*** | |
| Trend Assumption | | No Cointegration | | No Cointegration | |
| | | No deterministic trend | | Deterministic intercept and trend | |

Key: ***, ** and * indicates statistical significance at 0.01, 0.05 and 0.1 levels, respectively.

ROA=return on assets, LN=natural logarithm, ATM=payment card transactions, MPMS=mobile phone money services.

The tests were divided into two types, depending on the assumption about the trend: those in which the trend was not deterministic and those assuming a deterministic intercept and trend. The null hypothesis was that there was no cointegration.

Assuming the absence of a deterministic trend, results from the Panel Pedroni cointegration tests showed that only three out of seven statistics failed to reject the null hypothesis of no cointegration while four of them (Panel PP, Panel ADF, Group PP and Group ADF) rejected the null of no cointegration. Since majority of the tests rejected the null hypothesis, this study concluded that the variables were likely cointegrated.

Moreover, Pedironi (1999) found the panel ADF statistics to be more reliable. Consequently, this study concluded that the variables in question were likely to be cointegrated.

Similar results were obtained when the trend and intercept were assumed to be deterministic, with four tests (Panel PP, Panel ADF, Group PP and Group ADF) rejecting the null hypothesis of no cointegration while three tests (Panel v, Panel rho, and Group rho) failing to reject it. Again, on the balance of the number of tests rejecting the null hypothesis, this study concluded that there was likely to be a cointegrating relationship amongst the variables.

The Kao (Engle-Granger based) cointegration test was conducted to supplement the results from the Pedironi cointegration tests. These results are presented in Table 32.

Table 32

Kao Cointegration Test Results

| Individual Intercept | (t-statistic) | Prob. |
|----------------------|------------------------|--------|
| ADF | 3.797*** | 0.0001 |
| Residual variance | 7.701 | |
| HAC variance | 3.279 | |
| Null Hypothesis: | No cointegration | |
| Trend Assumption: | No deterministic trend | |

Key: *** p value significant at 0.01 level

The null hypothesis of the test, like the Pedironi test, is that there is no cointegration. Results from the Kao Residual Cointegration Test showed that the t-statistic for the ADF test was 3.797, $p=0.0001$. Consequently, the null of no cointegration was rejected. Results from the two tests in the study (Pedironi and Kao Cointegration tests) offered strong support for the existence of a cointegrating relationship between financial

innovations results.

4.5.4 Panel Vector Error Correction Model (VECM)

The panel vector error correction model for the financial innovations in the study are presented in Table 33.

Table 33

Panel Vector Error Correction Model for Financial Innovations

| The dependent variable is ATMLn | | | | |
|---------------------------------|-------------|------------|-------------|--------|
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| Long-run Component | | | | |
| ECT (-1) | -0.2785 | 0.04373 | -6.3685 | 0.0000 |
| Short-run Components | | | | |
| ATMLN (-1) | -0.0511 | 0.0583 | -0.8781 | 0.3802 |
| ATMLN (-2) | -0.0341 | 0.0554 | -0.6148 | 0.5388 |
| KEPSSLN (-1) | -0.0499 | 0.0256 | -1.9504 | 0.0500 |
| KEPSSLN (-2) | -0.0061 | 0.0335 | -0.1829 | 0.8549 |
| MPMSLN (-1) | 0.0327 | 0.0745 | 0.4391 | 0.6607 |
| MPMSLN (-2) | -0.1475 | 0.0732 | -2.0145 | 0.0443 |
| C | 0.0091 | 0.0112 | 0.8115 | 0.4173 |
| | 0.2062 | | | |
| R-squared | 0.1848 | | | |
| Adj. R-squared | 9.6459 | | | |
| F-statistic | 86.0569 | | | |
| Log likelihood | -0.5825 | | | |
| Akaike AIC | -0.4753 | | | |
| Schwarz SC | | | | |

Key: ***, ** and * indicates statistical significance at 0.01, 0.05 and 0.1 levels, respectively.

ROA=return on assets, LN=natural logarithm, ATM=payment card transactions, MPMS=mobile phone money services.

The raw results of VECM are presented in Appendix VI. The coefficient of the ECT (-0.2785) was negative and statistically significant ($p < 0.0001$), two crucial requirements for an error correction term. The results suggested the existence of long-run and cointegrating relationships between value of KEPSS transactions, value of mobile phone money services and value of payment card transactions. Secondly, since the coefficient was statistically significant, the study concludes that KEPSS and MPMS granger causes the value of payment cards. The PVECM model determines the required period to correct any shock or disequilibrium (speed of adjustment) among the variables. Results in Table 14 showed that the speed of adjustment from the short run towards the long run equilibrium is about 28% for payment card transactions.

To estimate short-run causality among financial innovations, a joint significance test of the lagged explanatory variables was conducted using Wald test. The explanatory variables included in the model were KEPSS and MPMS. Explicitly, these were $\text{KEPSSln}(-1)$, $\text{KEPSSln}(-2)$, $\text{MPMSln}(-1)$ and $\text{MPMSln}(-2)$. The results of the Wald Coefficient Test are presented in Table 34.

Table 34*Results of the Wald Coefficient Test*

| Test Statistic | Value | df | Probability |
|----------------|----------|----|-------------|
| Chi-square | 9.527096 | 4 | 0.0492 |

Null Hypothesis: $KEPSS_{ln}(-1) = KEPSS_{ln}(-2) = MPMS_{ln}(-1) = MPMS_{ln}(-2) = 0$
Null Hypothesis Summary:

| Normalized Restriction (= 0) | Value | Std. Err. |
|------------------------------|-----------|-----------|
| KEPSS _{ln} (-1) | -0.049988 | 0.025630 |
| KEPSS _{ln} (-2) | -0.006134 | 0.033526 |
| MPMS _{ln} (-1) | 0.032749 | 0.074587 |
| MPMS _{ln} (-2) | -0.147500 | 0.073217 |

The null hypothesis of the Wald test states that the coefficients for $KEPSS_{ln}(-1)$, $KEPSS_{ln}(-2)$, $MPMS_{ln}(-1)$ and $MPMS_{ln}(-2)$ are jointly equal to zero, that is, $KEPSS_{ln}(-1) = KEPSS_{ln}(-2) = MPMS_{ln}(-1) = MPMS_{ln}(-2) = 0$.

The results, $\chi^2 = 9.5271$, $df=4$, $p=0.049$ showed that the coefficients are jointly statistically significant and different from zero. The results indicated the existence of short-run relationships and causality between payment cards, mobile phone money services and KEPSS transactions. Specifically, the lagged-1 values of KEPSS and lagged-2 values of MPMS were significantly related with payment card transactions in the short-run. The results suggested that an increase in the \ln of KEPSS causes a reduction in the \ln of Payment cards. Moreover, an increase in the lag-2 value of the \ln of mobile phone services causes a reduction in the \ln of Payment cards. Regression Analysis

4.6 Regression Analysis

This section presents results on the moderating effect of financial innovation on the relationship between macroeconomic factors and financial performance of commercial banks in Kenya. First, the results of the direct effects in the study: the effect of GDP per capita, Interest rates and Inflation on financial performance of commercial banks in Kenya are presented.

4.6.1 Results of Direct Effects

Tests for the direct effects in the study were conducted by univariate linear regression. As established in table 34, the variables that were hypothesized to directly affect ROA (GDP per capita, annual inflation rate and annual interest rate) were likely stationary. ROA was found to be stationary. Nonetheless, the number of cases used in the tests were relatively few. Consequently, the study conducted regression analyses using predictors at the level, first and second differences. However, the lagged predictors did not significantly improve the models and they are not reported.

Results presented in table 34 showed that the series of GDP per capita, annual inflation rate, annual interest rate and ROA had a deterministic trend. Consequently, the real effects of the independent variables could not be delineated in the presence of the trend. Regression results in Appendix VII showed that when time was included explicitly as a predictor in the model in which ROA was regressed on the macroeconomic variables, it was found to be a significant, strong and negative predictor. This indicated that between 2011 and 2020, financial performance of banks as measured by ROA had generally deteriorated with time. It was germane to remove the trend (that is, detrend) the series before conducting least squares (OLS) regression (Maddala, 2001). Briefly, ROA and the natural logs of GDP per capita, annual inflation rate, annual interest rate were each

individually regressed on a constant and the time trend, t . The ensuing residuals were saved and used in a multiple linear regression in which the detrended ROA was regressed on the independent variables with no intercept. These results are presented in Table 35 was conducted.

Table 35

Results of Regression Analysis for Detrend ROA and Direct Effects

| Variable ($n=10$) | B | Std. Error | β | t | Prob. | 95% CI | Collinearity statistics | |
|---------------------|--------|------------|---------|--------|-------|--------------|-------------------------|-------|
| | | | | | | | Tolerance | VIF |
| detrend_GDPcapl | 0.594 | 0.202 | 0.594 | 2.939 | 0.022 | 0.116-1.071 | 0.815 | 1.227 |
| n | -0.430 | 0.191 | -0.430 | -2.247 | 0.050 | -0.883- | - 0.908 | 1.101 |
| detrend_IRln | 0.418 | 0.211 | 0.418 | 1.983 | 0.088 | 0.998 | 0.748 | 1.336 |
| detrend_intln | | | | | | -0.081-0.917 | | |
| | | 0.767 | | | | | | |
| R^2 | 0.701 | | | | | | | |
| Adjusted R^2 | 7.689 | | | | | | | |
| F Change | 0.013 | | | | | | | |
| Sig. F change | -5.786 | | | | | | | |
| Log likelihood | 1.950 | | | | | | | |
| Durbin-Watson | | | | | | | | |

Key: B = b coefficient (unstandardized), β = Beta (standardized coefficient), detrend_ =detrended, ROA=return on assets; ln=natural logarithm, GDP capln= gross domestic product per capita, IR=inflation rates/consumer price index, Int.=interest rates

4.6.1.1 GDP Per Capita on Financial Performance of Commercial Banks

The first objective of this study was to analyse the direct effect of GDP per capita on financial performance of commercial banks in Kenya whose results are presented in Table 34. The results show that GDP per capita has positive effect on financial performance of commercial banks in Kenya and it is statistically significant at 5% level.

It indicates that a 1% increase in GDP per capita leads to 0.594% increase in financial performance of commercial banks. This is because when there is an increase in GDP per capita then investors demand for more financial services for investment increases. Therefore, the hypothesis that there is no statistically significant effect of Gross Domestic Product per Capita on the financial performance of Commercial Banks in Kenya was rejected.

This finding is in line with a rich corpus of research. For instance, Hong & Razak (2015) conducted a study on the impact of nominal GDP and inflation on the financial performance of Islamic banks in Malaysia between 2007 and 2011 and found that nominal GDP has significant and positive impact on ROAA (return on average asset) and liquidity ratio and EQL (equity to total liquidity). Njau (2013) in a study on the relationship between macroeconomic variables and financial performance of private equity (PE) firms in Kenya between 2011 and 2012 found that GDP growth rate (among other macroeconomic variables) had the highest impact on financial performance of PE firms. Juliana (2016) in a study of the effect of macroeconomic variables on the financial performance of commercial banks in Kenya found a positive and significant correlation with changes in macroeconomic variables. Osamwonji and Chijuka (2014) investigated the effect of macroeconomic variables on profitability of commercial banks in Nigeria between 1990 to 2013 and found a significant positive relationship between GDP and return on equity.

Nevertheless, results on the relationship between GDP per capita and financial performance of commercial banks have sometimes been ambivalent. For instance, Kanwal and Nadeem (2013), Simiyu and Ngile (2015), Kiganda (2014), and Wabita (2013) either found no significant or weak relationships between GDP per capita and

financial performance. For example, Wabita (2013) reported a weak positive but significant correlation between GDP and performance in a study on financial performance of aviation industry in Kenya. Simiyu and Ngile (2015), on the other hand, found no significant relationship between GDP and profitability of banks, in a study of ten Kenyan commercial banks between 2001 and 2012. Likewise, Kanwal and Nadeem (2013) reported an insignificant positive relationship between GDP and profitability in a study of public commercial banks in Pakistan between 2001 and 2011.

The findings were also in line with Keynesian Economics theory (1930) which advocated for increased government expenditures and lower taxes to stimulate demand and pull the global economy out of the depression. Subsequently, Keynesian economics was used to refer to the concept that optimal economic performance could be achieved and economic slumps prevented by influencing aggregate demand through activist stabilization and economic intervention policies by the government.

4.6.1.2 Interest Rates on Financial Performance of Commercial Banks

The second objective of this study was to assess the direct effect of Interest rates on financial performance of commercial banks in Kenya whose results are presented in Table 34. The results show that Interest rates has negative effect on financial performance of commercial banks in Kenya and it was found not to be statistically significant at 5% level. This shows that interest rate was not a significant predictor of financial performance of banks as measured by ROA. This is because when interest rates are high, they attract low risk clients when low they attract high risk clients. In this study, interest rates do not predict ROA at 5% significance level, however it was statistically significant at 10% level. Therefore, the hypothesis that there is no

statistically significant effect of Interest rates on the financial performance of Commercial Banks in Kenya could not be rejected.

Findings from this study are in line with those by Osamwonji and Chijuka (2014) and Simiyu and Ngile (2015). Simiyu and Ngile (2015) in their study of listed commercial banks in Kenya. Between 2001 to 2012, found a significant negative relationship between interest rate and profitability. However, the period for Simiyu and Ngile's study came much earlier before the one for this study (2011 to 2020). On the other hand, Osamwonji and Chijuka (2014) reported a significant negative relationship between return on equity and interest rate in a study of commercial banks in Nigeria between 1990 and 2013. However, this study was conducted in a different country, Nigeria.

However, findings from this study contradicts with those of Kipngetich (2011), Ngure (2014), Irungu (2013), and Ongeru (2014). Kipngetich (2011) in his study on the performance of commercial banks in Kenya between 2006 and 2010 found a positive relationship between interest rates and financial performance of Commercial Banks in Kenya. Ngure (2014) reported a significant positive effect between interest rates and financial performance of commercial banks in Kenya between 2009 and 2013. Irungu (2013) found that there is strong positive relationship between financial performance of 43 Kenyan commercial banks with interest rate spread. Ongeru (2014) in a study of non-banking financial institutions in Kenya between 2004 and 2013 found a weak positive relationship between interest rate and return on assets.

However, these findings are also contradicting with those of Interest Parity theory developed by Keynes in 1936 which argues that variations in the rate of interests between one nation's currency and that of its counterparts in other countries who trade across borders account for the fluctuations in the nominal rate of interest. Banks charge

interest on loans in order to make profits so as to sustain market share and perform their role of intermediation efficiently. Thus, the financial performance of banks is often affected by the rate of interest charge on loans. Increased interest rates lead to higher profitability while decreased interest rates leads to lower profitability and hence poor financial performance of banks.

4.6.1.3 Inflation Rates on Financial Performance of Commercial Banks

The third objective of this study was to determine the direct effect of Inflation rates on financial performance of commercial banks in Kenya whose results are presented in Table 34. The results show that Inflation rates has negative effect on financial performance of commercial banks in Kenya and it is statistically significant at 5% level. It indicates that a 1% increase in Inflation rates leads to 0.430% decrease in financial performance of commercial banks. This is because when there is high inflation, future value of the money that their debtors owe decreases and the cost of operations also increases narrowing down on profitability. Therefore, the hypothesis that there is no statistically significant effect of Inflation rates on the financial performance of Commercial Banks in Kenya was rejected.

Findings from this study are supported by results from other studies. For instance, Vena (2012) in a study of companies in Kenya between 1998 and 2013, that inflation has an adverse effect on profitability and it was concluded that stock returns are low when there is high inflation since investments are moved from stock exchange into business ventures that are not influenced by inflation. Wamucii (2010) reported that when inflation decreased, the profits for the same period increased, in a ten (10) year study of Commercial Banks in Kenya. Wanjohi (2003) in a study of commercial banks' profits in

Kenya reported that inflation was a determinant of profitability since it affects the costs and revenues of the business.

Findings in this study appear to contradict the tenets of deflation theory (Fisher, 1933). The theory postulates that decrease in general price levels bring about depreciation in the net value of businesses and investments, which further lowers profitability, thereby triggering bankruptcies and other forms of business collapses. Furthermore, decreased inflation brings about reduced revenue of banks and ultimately reduced bank profitability which eventually led to banks running into bankruptcy.

R square measures how much variability in the dependent variable the predictors account for. The R^2 in this model was found to be 0.767, which implied that detrended GDP per capita, annual inflation rate and interest rates could explain for about 77% of the variation in bank performance, as measured by ROA. Since R^2 values above 40% are considered high (Field, 2005), this model could therefore explain considerable variation in the dependent variable. In other words, we can predict, to a great degree, financial performance of banks using these independent variables. The remaining unexplained variation in bank performance could partly be attributed to other factors not specified in the model and partly to the error term in the regression equation.

Adjusted *R* Square provides information on how well a model can be generalized in the population. If this model had been derived from the population rather than the sample, then it would have accounted for approximately 70% of the variance in the dependent variable, which is just about 7% less than what the model explains.

The change statistics show the effect of adding or removing independent variables from the regression model. The three macroeconomic variables were all entered at once and

these effects was significant, $F(3, 7) = 7.689$, $p=0.013$, suggesting that the three variables were significant predictors of financial performance of banks.

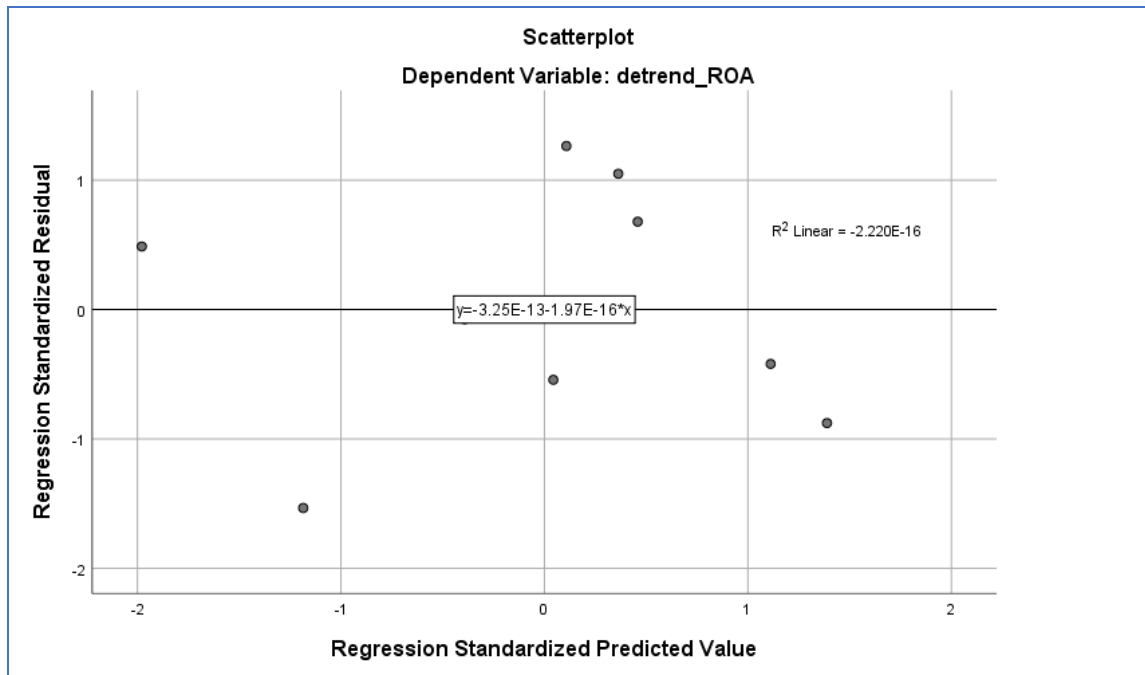
The standard partial regression coefficients, also known as b -primes, beta coefficients, or beta weights are all measured in standard deviation units and are therefore not dependent on the units of measurement of the variables. The advantage of the standard partial regression coefficients then is that their magnitudes can be compared directly to show the relative standardized strengths of the effects of several independent variables on the same dependent variable. A standardized partial regression coefficient gives the rate of change in standard deviation units of Y per one standard deviation unit of X (when all other X variables are kept constant). Nevertheless, since the study used residuals in the regression analysis, the standardized regression coefficients are identical to the B coefficients.

The Durbin-Watson statistic shows whether the assumption of independent errors (lack of autocorrelation) is tenable. In this model, it was 1.950, meaning that the errors were not correlated. Examination of the scatterplot of residuals in univariate linear regression between ROA and the independent variables showed that they were randomly scattered around the center line of zero, with no discernible pattern.

Figure 20 shows Residuals plot between standardized residuals against standardized predicted of the Univariate Linear Regression between detrend ROA and detrended \ln GDP per capita, \ln Inflation rates and \ln interest rates

Figure 20

Residuals Plot Between Standardized Residuals



The prediction line coefficient ($1.97E-16$) and the R square ($-2.220E-16$) were insignificant, showing that the data points had no specific pattern. This suggested that the residuals or errors had a constant variance, that is, they were homoscedastic. It also suggested that the errors were approximately normally distributed, and independent of another (non-autocorrelated).

In this model, tolerance values for all the independents were very high and close to one (0.815 , 0.908 and 0.748 for GDP per capita, inflation rate and interest rates, respectively), suggesting that multicollinearity might not have been a problem. VIF (Variance Inflation Factor) merely expresses tolerance in a mathematically different way, since it is simply its inverse (for example, for detrend GDP per capita, $1/0.815 = 1.227$).

4.6.2 Results of Indirect Effects

The indirect effects in this study consisted of testing for the moderating effect of financial innovation on the relationship between macroeconomic factors and financial performance of commercial banks in Kenya. To test for moderation, panel data with 385 observations was used. Direct effects could not have been tested with use of time series data because of near singularity in the data arising from the fact that for a particular year, all panels in the study had the same value for a macroeconomic variable.

First, before running tests for moderation, the effect of financial innovations on ROA was tested. A Hausmann test was conducted to determine whether a fixed or a random effects model was appropriate for the data. Results from the Hausman test, $\chi^2(1) = 1.49$, $p=0.222$, showed that the null hypothesis (that individual effects are not significantly correlated with at least one of the regressors) could not be rejected at 0.05 level. Thus, the results suggested that financial innovations were not significantly correlated with individual effects, showing that a random effects model was more appropriate for the data relative to a fixed effects model. The results of the random effects regression of ROA and financial innovations is given in Table 36.

Table 36*Regression Analysis for ROA and Financial Innovation*

| N=307 | B | Std. Error | t | Prob. | 95% CI |
|---------------|--------|------------|-------|-------|------------------|
| Constant | -9.650 | 1.707 | -5.65 | 0.00 | -12.997 - -6.303 |
| Fin. Innov.ln | 2.195 | 0.335 | 6.54 | 0.00 | 1.537 – 2.852 |

R^2 :
 Within = 0.155
 Between = 0.015
 Overall = 0.103
 Wald $\chi^2 = 42.76$
 Prob. = 0.000
 Rho=0.528

Key: Fin. Innov.ln=Natural logarithm of financial innovation, CI=confidence interval.

The Wald's Chi- square test was found to be significant, $\chi^2 (1) = 42.76, P=0.0001$, which indicated that the model adequately fitted the data. The results suggested that all the coefficients in the model were significantly different from zero. The value of *rho* (intraclass correlation) was 0.528, which indicated that about 53% of the variance in the error term was due to differences across panels.

The *B* coefficient for financial innovation was 2.195 and it was statistically significant at 5% significance level; ($t= 6.54, p=0.0001$). This suggested that showed that financial innovations have a significant and positive effect on financial performance of banks as measured by ROA. These findings are similar to those of Nyathira (2012) which reported that financial innovation contributes to and is positively correlated to profitability in the banking sector particularly that of commercial banks, in a study of 43 commercial banks in Kenya over a period of 4 years beginning 2012. The results indicated that when natural log of financial innovations increases by one unit across time and between banks, ROA goes up by 2.195 or 481% ($r^2 = 2.195^2, p= 4.818$). The 95% confidence interval for

the coefficient ranged from 1.527 to 2.852. Thus, 95 times out of 100, when the population is sampled, there is 95% chance that the interval will cover the B coefficient for the variable. Since the confidence interval did not include a value of zero, it further supported the conclusion that the B coefficient was likely to be significant.

The within R^2 was 0.155, which indicated that financial innovations could explain about 16% of the variance in each bank. On the other hand, the between R^2 was 0.015, which showed that financial innovations could account for just about 2% of the variation between different banks. Overall, financial innovations could explain about 10% of the variation between and within banks.

Standardized beta coefficients were not reported for panel data because they are meaningless. Instead, confidence limits were reported. This is because standard deviation in panel data is not clear whether it applies to the whole sample (pooled) or within each panel separately and what each means (Park, 2011; Baltagi, et al., 2013).

4.6.2.1 Financial Innovations on Relationship Between Gross Domestic Product Per Capita and Financial Performance of Commercial Banks in Kenya

Table 36 presents results on the moderating effect of financial innovations on the effect of gross domestic product per capita on financial performance of commercial banks in Kenya.

Table 37*Financial Innovation on GDP per Capita and ROA*

| N=307 | <i>B</i> | Std. Error | <i>t</i> | Prob. | 95% CI |
|---------------|----------|------------|----------|--------|----------------|
| Constant | 1.544 | 0.152 | 10.192 | 0.000 | 1.246 – 1.843 |
| GDPcapln | 3.329 | 0.896 | 3.715 | 0.002 | 1.565 – 5.093 |
| Fin. Innov.ln | 1.494 | 0.364 | 4.100 | 0.0001 | 0.776 – 2.211 |
| GDPlnXFln | 1.871 | 2.417 | 0.774 | 0.439 | -2.887 – 6.629 |
| $R^2 = 0.139$ | | | | | |
| $F. = 9.817$ | | | | | |
| $p = 0.000$ | | | | | |

Key: Fin. Innov.ln=Natural logarithm of financial innovation, CI=confidence interval.

GDP=GDP per capita.

The fourth objective of this study was to ascertain the moderating effect of financial innovations on the relationship between of GDP per capita and financial performance of commercial banks in Kenya whose results are presented in Table 36. The results showed that financial innovations have no moderating effect on the relationship between GDP per capita and financial performance of commercial banks in Kenya, it was not statistically significant at 5% level ($t= 0.774, p=0.439$). This is because GDP per capita is an external event that banks cannot manipulate. Commercial banks do not have direct control over the GDP per capita. Consequently, although banks could manipulate financial innovations, they cannot do so for GDP per capita. Therefore, the hypothesis that there is no statistically significant moderating effect of financial innovation on the relationship between Gross Domestic Product per Capita and financial performance of Commercial Banks in Kenya could not be rejected.

There are few empirical studies that report the moderating effect of financial innovations on the effect of macroeconomic variables on financial performance. Thus, this could be

one of such studies. For example, Hasan *et al.* (2012) used descriptive survey research design to track an integrated and comprehensive view of the significance of IT on the retail payments for the performance of Commercial Banks and found a significant relationship in regions with better retail payment transaction systems such as ATMs and POS. Nyathira (2012) reported that financial innovation contributes to and is positively correlated to profitability in the banking sector particularly that of commercial banks, in a study of 43 commercial banks in Kenya over a period of 4 years beginning 2012.

Okibo and Wario (2014) found that e-banking has influenced the development of the client base for the Commercial Banks in Kenya, by improving the accessibility of banking services to a larger populace in the nation. The foregoing studies all document the relationship between various financial innovations and performance of banks. However, they all fail to report on the moderating role financial innovations could play in the relationship between GDP per capita and financial performance of commercial banks.

4.6.2.2 Financial Innovations on the Relationship Between Interest Rates and Financial Performance of Commercial Banks in Kenya

Table 38 presents results on the moderating effect of financial innovations on the effect of interest rates on financial performance of commercial banks in Kenya.

Table 38*Financial Innovation on Interest Rates and ROA*

| N=307 | <i>B</i> | Std. Error | <i>t</i> | Prob. | 95% CI |
|----------------------|----------|---------------|----------|-------|--------------------|
| Constant | -82.24 | 31.798 | -2.586 | 0.010 | -144.843 - -19.639 |
| intRateIn | 28.171 | 11.915 | 2.364 | 0.018 | 4.713 – 51.628 |
| Fin. Innov.ln | 15.837 | 6.434 | 2.461 | 0.014 | 3.169 – 28.504 |
| intRateXFIn | -5.292 | 2.402 | -2.202 | 0.028 | -10.022 - -0.561 |
| $R^2 = 0.115$ | | | | | |
| $F(3, 273). = 11.82$ | | | | | |
| $p = 0.000$ | | | | | |

Key: Fin. Innov.ln=Natural logarithm of financial innovation, CI=confidence interval. int Rate=interest rate.

The fifth objective of this study was to analyze the moderating effect of financial innovations on the relationship between of interest rates and financial performance of commercial banks in Kenya whose results are presented in Table 37. The results showed that financial innovations have a moderating effect on the relationship between interest rates and financial performance of commercial banks in Kenya and was statistically significant at 5% level ($t= -2,202, p=0.028$). This is because manipulation of interest rates to improve ROA occurs only well when bank innovations are low. Once a bank has attained a very high level of innovation (mobile phone banking, ATMS, KEPSS), manipulation of interest rates does not lead to great changes in ROA Therefore the hypothesis that there is no statistically significant moderating effect of financial innovation on the relationship between Gross Domestic Product per Capita and financial performance of Commercial Banks in Kenya was rejected.

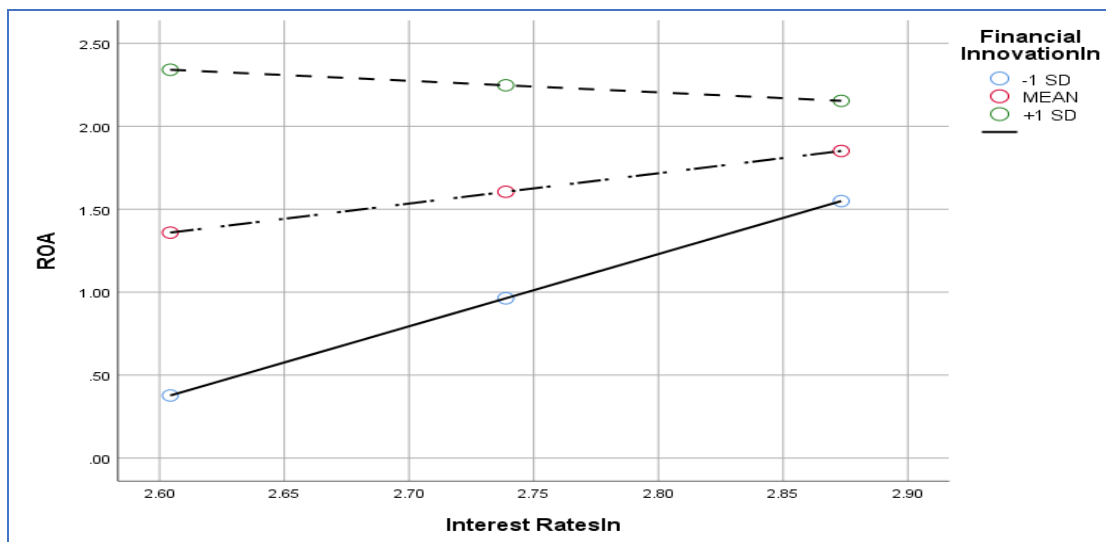
The *B* coefficient for the interaction between financial innovations and interest rates was -5.292 and was statistically significant at at 5% significance level; ($t= -2,202, p=0.028$).

Moreover, the CI for the coefficient (-10.022 to -0.561) did not include a value of zero, suggesting that this coefficient could not be zero in the population. Thus, the study rejected the null hypothesis and concluded that there is a statistically significant moderating effect of Financial Innovations on the effect of interest rates on Financial Performance of Commercial Banks in Kenya.

Figure 21 graphs the interaction between interest rates and financial innovations on ROA.

Figure 21

Interest Rates with Financial Innovations on ROA



The graph shows the relationship between interest rates and ROA at three levels of financial innovations (mean, one standard deviation below and above the mean). The results show that when financial innovations are low, increasing interest rates will result in the greatest increase in ROA. When financial innovations are medium, ROA is higher but increases in interest rates will produce only small increases in ROA. On the other hand, when financial innovations are at the highest, the ROA will also be at the highest level. However, increasing interest rates at this point will result either in little change or

even slight decrease in ROA. The findings imply that bank performance is at the highest with the highest innovations. However, at this point, changes in interest rates produce little or even slightly decrease in ROA.

There are few empirical studies that report the moderating effect of financial innovations on the effect of interest rates on financial performance of banks. This is one of such studies. For example, Olalere et.al (2021) studied the moderating role of financial innovations on financial risks, business risk and firm value nexus and found that financial innovation significantly moderates the relationship between financial risks, business risk and firm value of the banks. Yossy, (2017) conducted a study on the moderating effect of innovation on strategy-financial performance relationship. Okibo and Wario (2014) found that e-banking has influenced the development of the client base for the Commercial Banks in Kenya, by improving the accessibility of banking services to a larger populace in the nation. Ngumi (2013) reports that innovations in the banking system have greater influences on profitability of the financial institutions in Kenya. None of these studies look at the moderating effect of financial innovations on the effect of interest rates macroeconomic variables on financial performance

4.6.2.3 Financial Innovations on the Relationship Between Inflation and Financial Performance of Commercial Banks in Kenya

Table 39 presents results on the moderating effect of financial innovations on the effect of inflation rate on financial performance of commercial banks in Kenya.

Table 39

Financial Innovation on Inflation Rate and ROA

| N=307 | <i>B</i> | Std. | <i>t</i> | Prob. | 95% CI |
|-------|----------|------|----------|-------|--------|
|-------|----------|------|----------|-------|--------|

| | Error | | | | |
|----------------------|---------|--------|--------|-------|------------------|
| Constant | -10.988 | 14.531 | -0.756 | 0.450 | -39.595 - 17.619 |
| <i>IN</i> . | 2.034 | 7.743 | 0.263 | 0.793 | -13.209 – 17.278 |
| Fin. Innov.ln | 1.754 | 2.876 | 0.609 | 0.543 | -3.908 – 7.417 |
| infRateXFln | -0.015 | 1.527 | -0.009 | 0.992 | -3.023 – 2.993 |
| $R^2 = 0.114$ | | | | | |
| $F(3, 273) = 11.751$ | | | | | |
| $p = 0.000$ | | | | | |

Key: Fin. Innov.ln=Natural logarithm of financial innovation, IN=inflation rate, CI=confidence interval.

The sixth objective of this study was to evaluate the moderating effect of financial innovations on the relationship between of inflation rates and financial performance of commercial banks in Kenya whose results are presented in Table 39. The results showed that financial innovations have no moderating effect on the relationship between inflation rates and financial performance of commercial banks in Kenya, it was not statistically significant at 5% level ($t = -0.009$, $p = 0.992$). This is because just like GDP per capita, is an external event that banks cannot easily manipulate. Commercial banks do not have direct control over the inflation rate. Consequently, although banks could manipulate financial innovations, they cannot do so for inflation rate. Therefore, the hypothesis that there is no statistically significant moderating effect of Financial Innovations on the effect of inflation rates on Financial Performance of Commercial Banks in Kenya could not be rejected.

Few studies have reported the moderating effect of financial innovations on the effect of macroeconomic variables on financial performance, as previously noted. For instance, studies such as those by Harelimana (2018), Mugane and Njuguna (2019), Kibicho and Mungai (2019), (Harelimana (2018), Adhitya and Sembel, (2020), Biwott et al., (2019),

Anyango and Mutunga (2020), Mustapha (2018), Adewoye and Omoregie (2013), Ngango et al., (2015), Ndung'u (2011), Ngumi (2013), Jegede (2014), Manjushree (2020), Kamau and Oluoch (2016), Edoka and Anyanwaokoro (2019), Kithinji (2017) and Kamande (2018) all document the relationship between various financial innovations and performance of banks. However, they do not consider the possible moderating effect financial innovations can have on the relationship between macroeconomic variables and financial performance.

For example, Okibo and Wario (2014) examined a random group of selected banks in Kenya to examine the impacts of e-banking on growth of client base. Ngumi (2013) conducted a research study to determine the impacts of innovative practices on the profitability of the Kenyan Commercial banks.

Harelimana (2018) undertook a study that sought to examine the influence of mobile banking on financial performance of Unguka Microfinance Bank Ltd. Adhitya and Sembel (2020) examined the impact of the mobile banking technology on the performance of commercial banks in Indonesia. Biwott *et al.* (2019) examined the role of the mobile banking services on the financial performance in Kenya. The foregoing studies all document the relationship between various financial innovations and performance of banks. However, they all fail to report on the moderating role financial innovations could play in the relationship between inflation rates and financial performance of commercial banks.

4.7 Post Estimation Diagnostic Test

The data collected in this study was panel time series. To ensure the validity of the results, it was pertinent to verify that assumptions behind the data were tenable. All variables were transformed into natural logarithms (LN) to improve the interpretability

of final results and to solve time and growth problems. The exception was Return on Assets (ROA) because it contained negative or zero values and hence logarithms could not be generated. The study consisted of two types of variables: macroeconomic variables (GDP per capita, interest rates, and inflation), which were panel (bank) non-specific and financial innovations (value of KEPSS transactions, value of mobile phone money services, and value of payment cards transactions) and ROA, which were bank specific. Consequently, the data comprised of purely time series data (macroeconomic variables) and a mixture of cross-sectional and time series (panel) data (financial innovations and ROA).

Consequently, autocorrelation functions (ACF) and partial correlation functions (PCF) were computed to visually examine the behaviour of the variables over several lags. More explicit tests for stationarity were also conducted. For time series data, Augmented Dickey-Fuller (ADF) and Kwiatkowski-Phillips-Schmidt-Shin (KEPSS) tests were conducted. The ADF computes probabilities and critical values using 20 observations. However, this study's time series had only 9 observations (ten years' study period) and was complement by the ADF test with the KEPSS test.

For panel data, the study also used two types of tests to assess stationarity of the study variables: Harris-Tzavalis test and the Fisher type. The former assumes that the number of panels tends to infinity while the number of time periods is fixed. This was apt for data in this study because there were only a limited number of time periods (10 years) whereas the number of panels was greater (39). Nevertheless, Harris-Tzavalis test works only with balanced data. Where data was unbalanced, the Fisher type tests were used.

4.7.1 Autocorrelation Tests

A Lagrangian-Multiplier test was conducted to assess the presence of serial correlation

(autocorrelation) in the data. The results of the test, $F(1, 39) = 2.26$, $p = 0.14$, $p > 0.05$ indicating that the study failed to reject the null hypothesis of the test. The results also, showed that the data did not contain first-order autocorrelation. Implicitly, the study also examined autocorrelation functions (ACF) presented in Section 4.4 to determine the extent of autocorrelation in the data.

4.7.2 Heteroskedasticity Tests

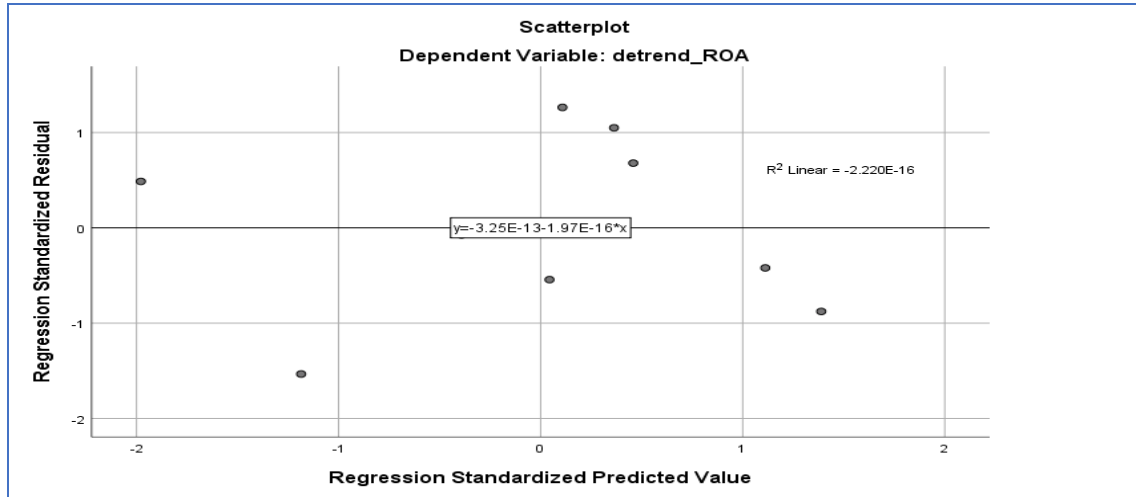
Homoscedasticity implies that the variance of the error term is constant. The violation of this assumption (heteroscedasticity) when using OLS leads to estimates that are unbiased and consistent but inefficient also known as spurious results. Three types of regressions were conducted in the study: A MLR between detrended ROA and detrended ln GDP per capita, ln Inflation rates and ln interest rates, a Random effects Regression Analysis for ROA and financial innovation, and regressions of the moderating effect of financial innovation on the effect of GDP per capita, interest rates and inflation rates on ROA.

4.7.2.1 Return on Assets and Inflation Rates

The plot between standardized residuals against standardized predicted of the Linear Regression between detrend ROA and detrended ln GDP per capita, ln Inflation rates and ln interest rates are shown in Figure 22.

Figure 22

Plot of Residuals Against Fitted Values in Regression between detrend ROA and detrended ln GDP per capita, ln Inflation rates and ln interest rates



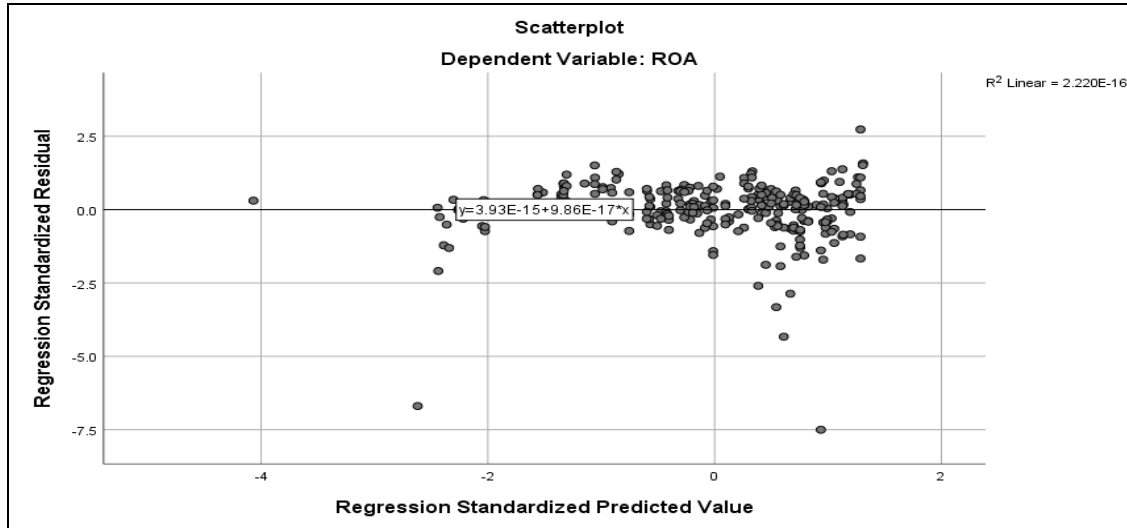
When residuals were plotted against fitted values, the errors exhibited random distribution around the centre line of zero, with no definite pattern. The prediction line coefficient ($1.97E-16$) and the R square ($2.220E-16$) were insignificant, showing that the residuals formed no discernible pattern. The results showed that the errors had the same variance, were not autocorrelated and had normal distribution.

4.7.2.2 Return on Assets and Financial Innovations

A plot between residuals against fitted values in the regression between ROA and ln financial innovations (Figure 23) showed that the errors were randomly scattered around the centre line of zero, with no discernible pattern.

Figure 23

Plot of Residuals Against Fitted Values in Regression Between ROA and ln Financial Innovations



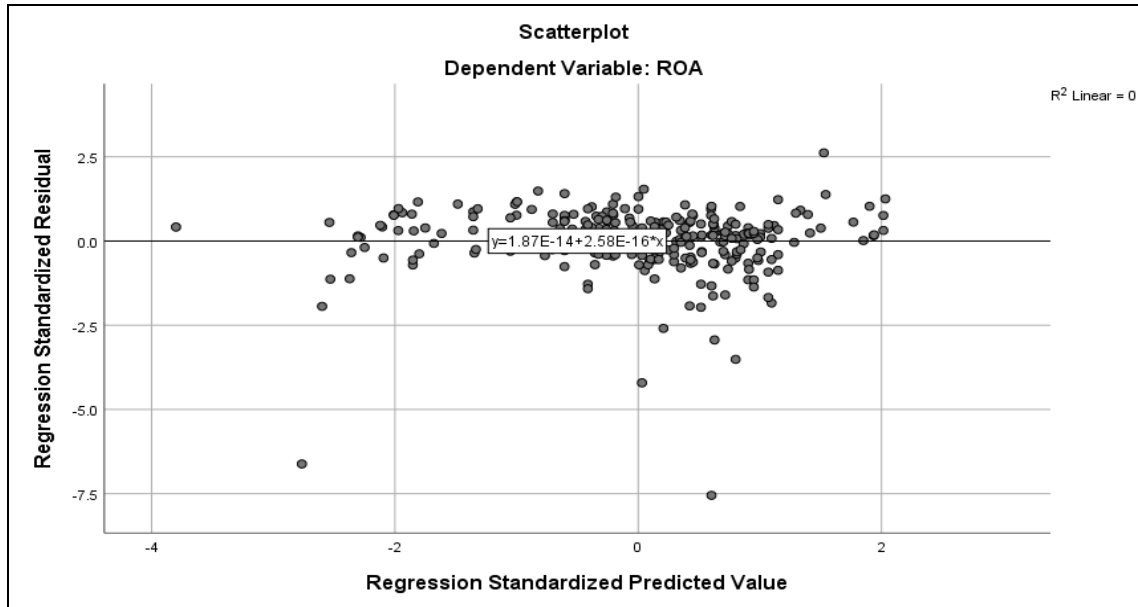
The prediction line coefficient (9.86E-17) and the R square (2.220E-16) were insignificant, showing that the data points had no specific pattern. These findings suggested that the residuals or errors had a constant variance (were homoscedastic), were approximately normally distributed, and were independent of each other (non-autocorrelated).

4.7.2.3 Return on Assets, Financial Innovations and GDP Per Capita

Figure 24 presents the plot between residuals against fitted values in moderated regression between ROA and the interaction between ln financial innovations and ln GDP per Capita.

Figure 24

Plot of residuals against fitted values in moderated regression between ROA and ln financial innovations X lnGDP



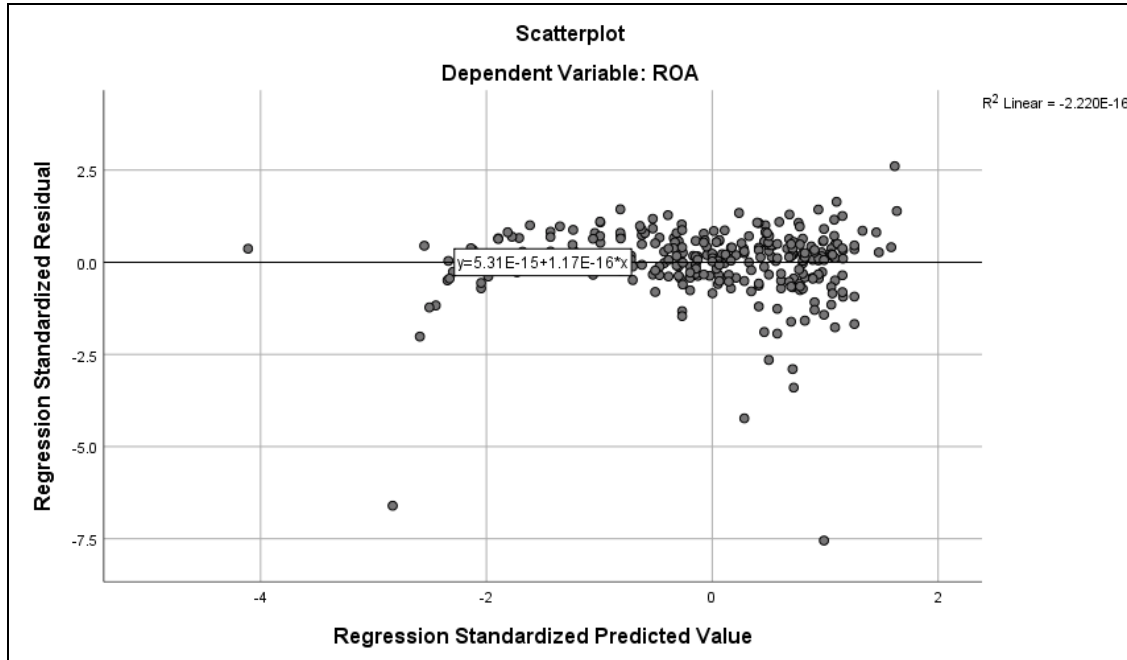
The results showed that the errors were randomly scattered around the centre line of zero, with no distinct pattern. The prediction line coefficient (2.58 E-16) was insignificant while the R square was zero, showing that the data points had no specific pattern. These findings suggested that the residuals had a constant variance and were not correlated to each other.

4.7.2.4 Return on Assets, Financial Innovations and Interest Rates

Figure 25 shows the plot between residuals against fitted values in moderated regression between ROA and the interaction between ln financial innovations and ln Interest rates.

Figure 25

Plot of residuals against fitted values in moderated regression between ROA and ln financial innovations X ln Interest rates



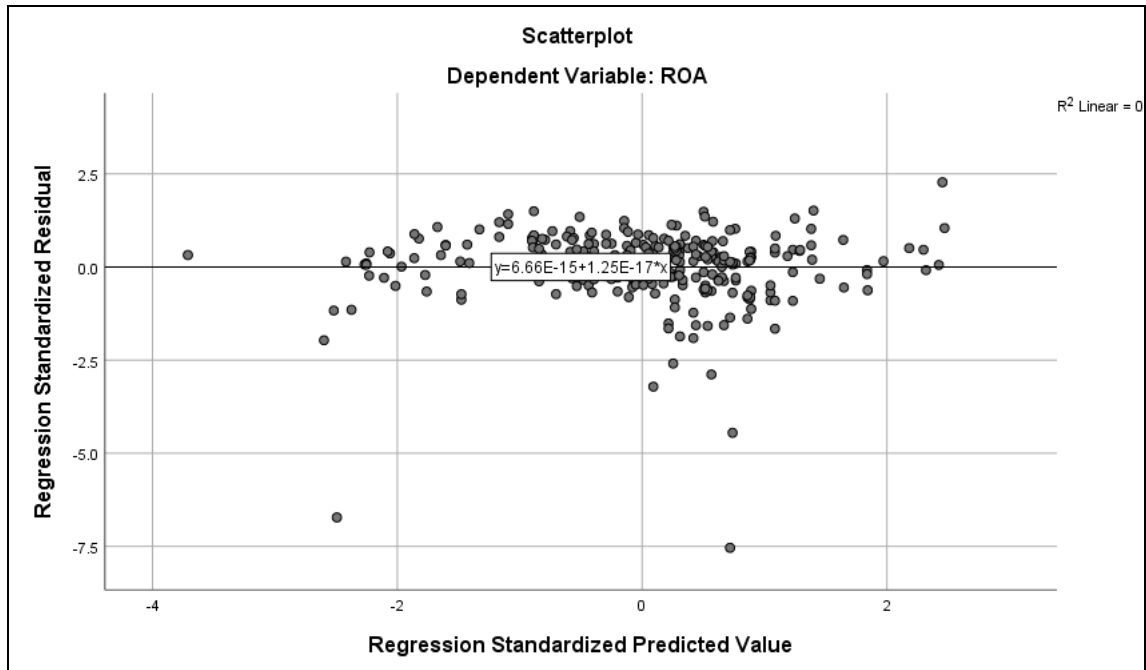
The results showed that the errors were randomly scattered around the centre line of zero, with no discernible pattern. This was seen from the prediction line coefficient (1.17E-16) and the R square (2.220E-16) were insignificant, showing that the data points had no specific pattern. This showed that the residuals had a constant variance and were not autocorrelated.

4.7.2.5 Return on Assets, Financial Innovations and Inflation Rate

The plot between residuals against fitted values in moderated regression between ROA and the interaction between ln financial innovations X ln Inflation rate are presented in Figure 26.

Figure 26

Plot of residuals against fitted values in moderated regression between ROA and ln financial innovations X ln Inflation rate



The results showed that the errors were randomly scattered around the centre line of zero, with no definite pattern. This finding is buttressed by an insignificant prediction line coefficient ($1.25E-17$) and a zero R square value, which showed that the residuals formed no discernible pattern. The results showed that the errors had homogenous variance and were not correlated with each other.

For panel regression (regression between ROA and ln financial innovations) a modified Wald test was also used to test for GroupWise heteroskedasticity in the residuals, in addition to the inspection of the plots. The test's null hypothesis is the presence of a constant variance (homoscedasticity). The results from the test, $\chi^2(39) = 76.07, p=0.341$, showed that the null hypothesis of constant variance in the data could not be rejected. The results indicated that the variance of the error term was homoscedastic.

4.7.3 Normality Tests

The normality of distribution was tested by the Kolmogorov-Smirnov and Shapiro-Wilk tests. A p value less than or equal to 0.05 indicated non-normality in the data while $p > 0.05$ showed that the data was normal. All the variables in the study had $p > 0.05$ on either Kolmogorov-Smirnov, Shapiro-Wilk tests or both shown in Table 40.

Table 40

Results of Kolmogorov-Smirnov and Shapiro-Wilk Normality tests

| | Kolmogorov-Smirnov ^a | | | Shapiro-Wilk | | |
|-----------------------------|---------------------------------|----|-------|--------------|----|------|
| | Statistic | df | Sig. | Statistic | df | Sig. |
| ROA | .158 | 10 | .200* | .903 | 10 | .235 |
| GDP Per Capital \ln | .124 | 10 | .200* | .957 | 10 | .748 |
| Inflation \ln | .211 | 10 | .200* | .822 | 10 | .027 |
| Interest Rates \ln | .136 | 10 | .200* | .960 | 10 | .789 |
| KEPSS \ln | .194 | 10 | .200* | .934 | 10 | .487 |
| MPS \ln | .158 | 10 | .200* | .956 | 10 | .744 |
| payCard \ln | .244 | 10 | .092 | .842 | 10 | .046 |
| Financial innovations \ln | .171 | 10 | .200* | .941 | 10 | .568 |

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

These indicated that all the transformed variables (into natural logarithms) were normally distributed. The study also examined the normal Q-Q plot of residuals for the variables to determine if the distribution of errors was normal. These plots are presented in Figure 27 to Figure 34).

Figure 27 presents examination of ROA residuals which showed that most points lay close to the straight line, indicating that the residuals were close to normality.

Figure 27

Normal P-P Plot of ROA Residuals

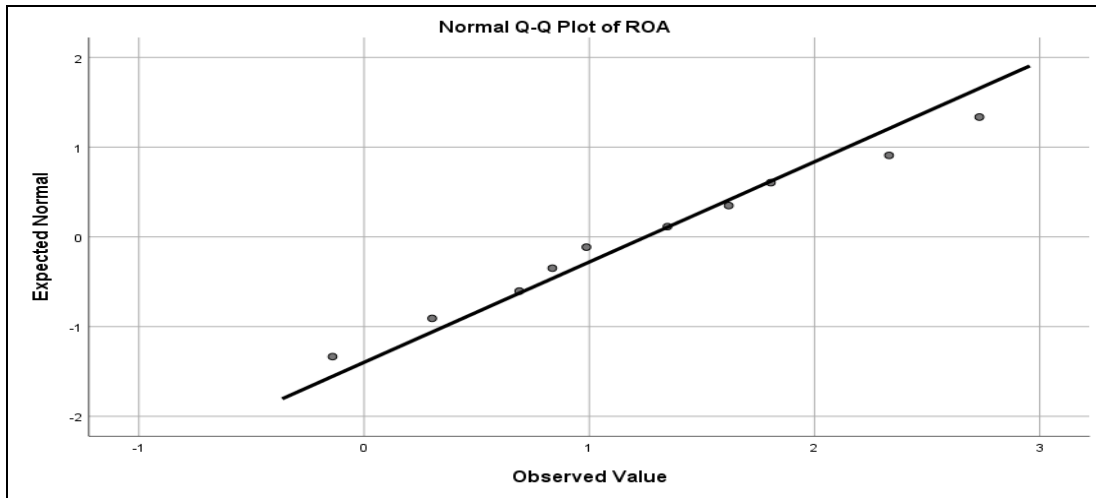
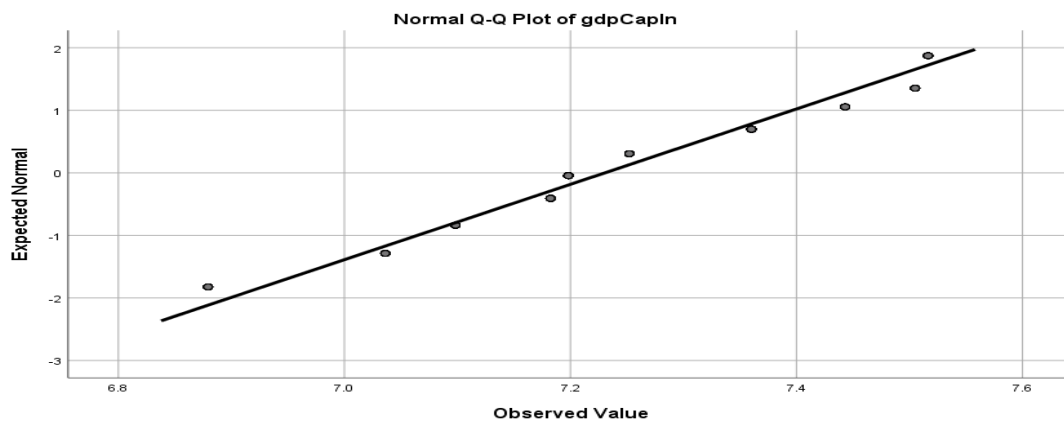


Figure 28 presents examination of ROA residuals which showed that most points were close to the straight line, which indicated that the residuals were normal.

Figure 28

Normal P-P Plot of ln GDP Per Capita (gdpCap) Residuals



The plot for ln annual inflation rate in figure 29 showed that except for one data point, all the others were very close to the straight line. This showed that the distribution of the residuals was approximately normal.

Figure 29

Normal P-P Plot of ln Annual Inflation Rate (annIRln) Residuals

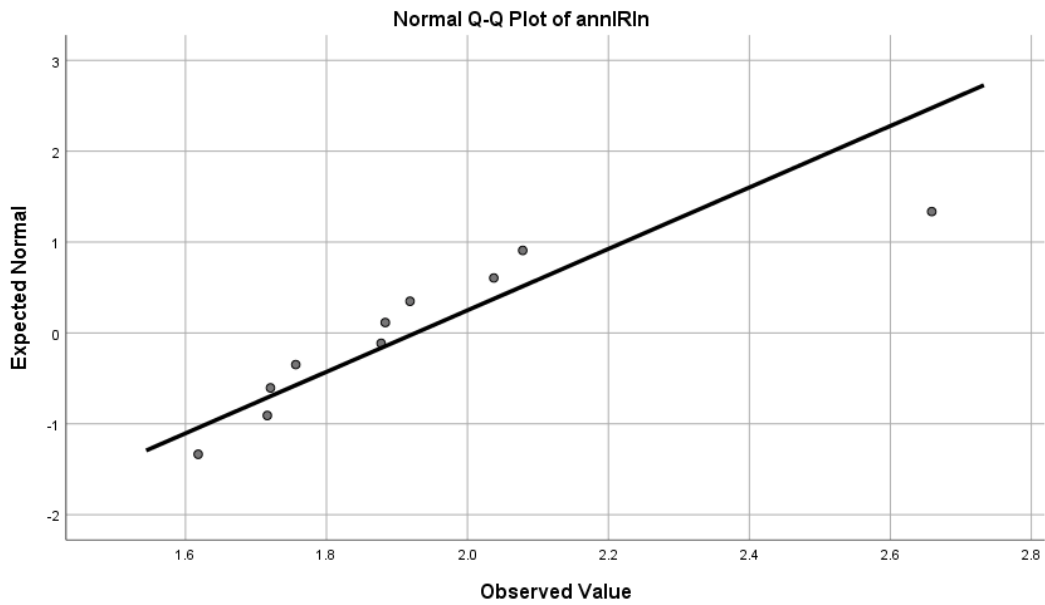
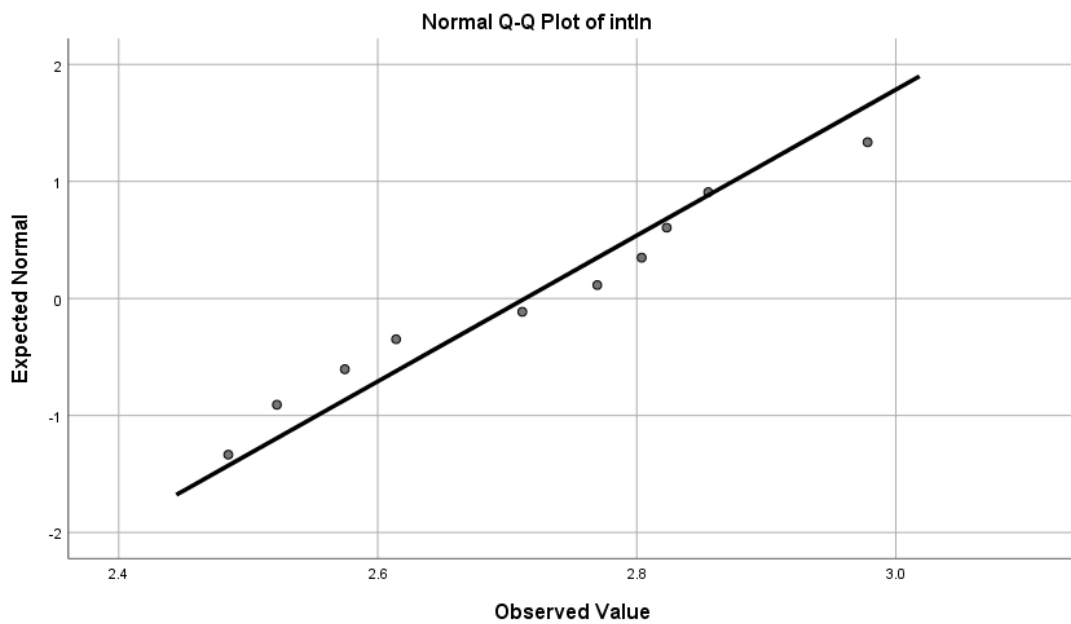


Figure 30 shows the normal P-P Plot for ln interest rates. Inspection of the plot showed that most points fell close on the straight line, indicating normality.

Figure 30

Normal P-P Plot of ln Interest Rates (intln) Residuals



The plot for ln KEPSS as presented in figure 31 showed that most data points were very close to the straight line, showing that the distribution of the residuals was approximately normal.

Figure 31

Normal P-P Plot of ln KEPSS (KEPSSln) Residuals

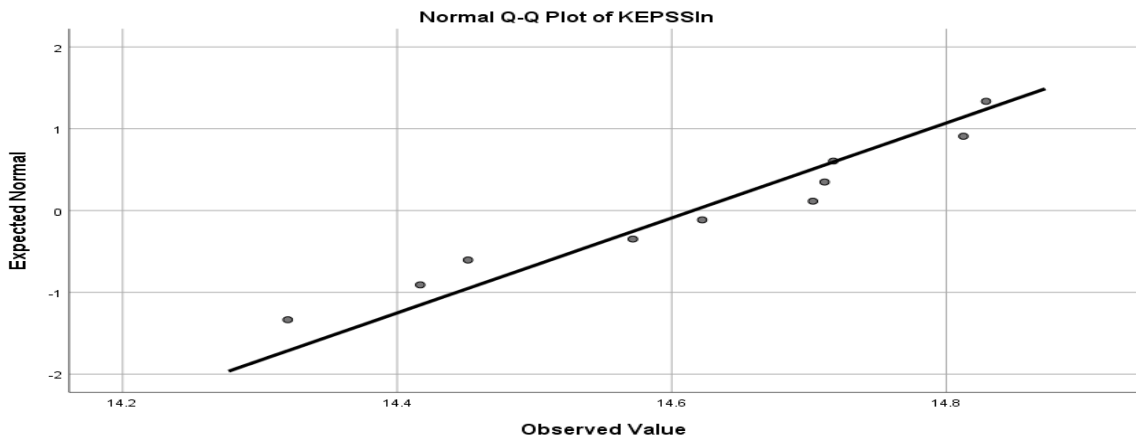
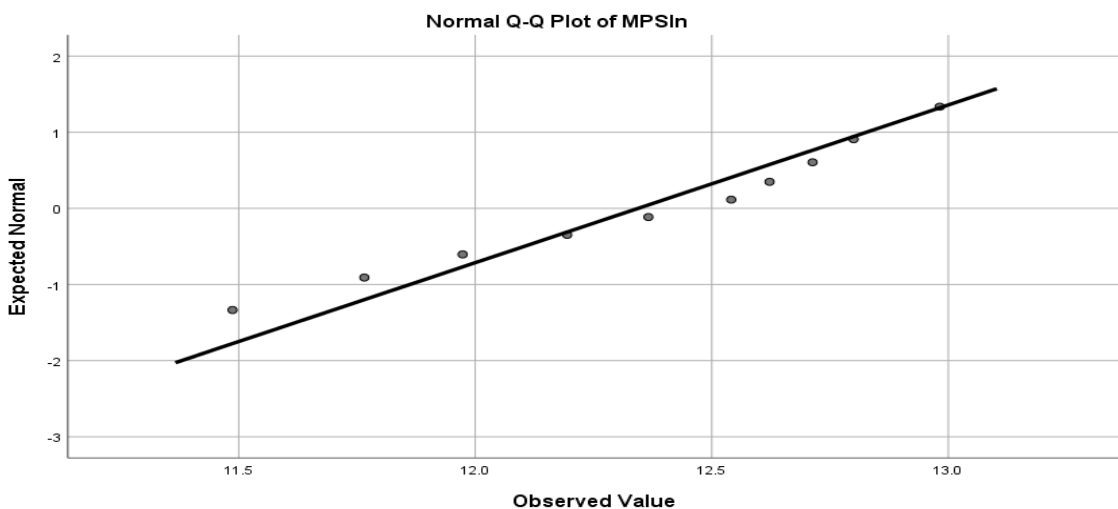


Figure 32 presents examination of ROA residuals which showed that most points lay close to the straight line, indicating that the residuals were normally distributed

Figure 32

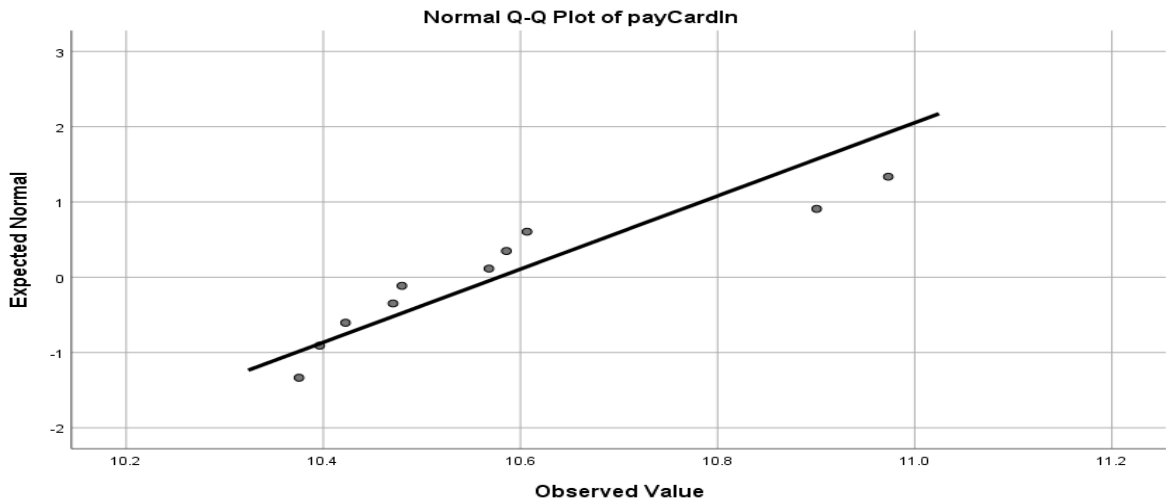
Normal P-P Plot of ln Mobile phone money service (MPSln) Residuals



Inspection of the plot of residuals of ln of payment cards showed that most points were close to the straight line as presented in figure 33, which indicated that the residuals were normal.

Figure 33

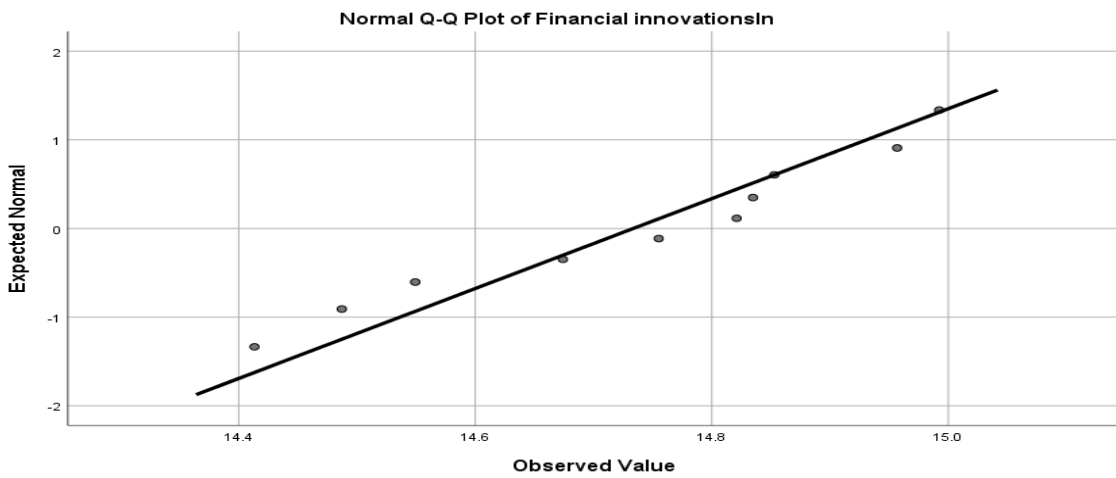
Normal P-P Plot of ln Payment Card (payCardln) Residuals



Lastly, Figure 34 shows the normal P-P Plot for ln financial innovations. Inspection of the plot showed that most points were close on the straight line, indicating normality.

Figure 34

Normal P-P Plot of ln Financial Innovations Residuals



4.7.4 Multi-Collinearity Tests

Multi-collinearity was assessed by means of tolerance and Variance Inflation Factor (VIF) values. For each independent variable, tolerance is the proportion of variability of that variable that is not explained by its linear relationships with the other independent variables in the model. Tolerance ranges from 0 to 1. When tolerance is zero, there is high multicollinearity of that variable with other independents and the beta coefficients become unstable. Normally, a tolerance value of below 0.10 or a VIF value greater than 10 reveals serious multi-collinearity problem (Maddala, 2001). VIF is the inverse of tolerance statistic. The results from these tests are presented in Table 16. Partial regression coefficients for GDP per capita were ($t=2.939, p=0.022$) and inflation rate, ($t=-2.247, p=0.05$) which were statistically significant and interest rates was not significant at 5% significance level, it was significant at 10% significance level ($t=1.983, p=0.088$), giving strong evidence that interest rates could significantly predict ROA.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents summary, conclusion and policy recommendations for further studies. The discussion is made in relation to the study objectives and hypothesis. The findings were used to draw conclusions and the recommendations made were based on the conclusions drawn.

5.2 Summary of the Major Findings

The study set out to investigate the moderating effect of financial innovation on the effect of macroeconomic factors on financial performance of commercial banks in Kenya. The specific objectives of the study were; to investigate the effect of gross domestic product per capita, interest rates, inflation on financial performance of commercial banks and to assess the moderating effect of financial innovations on the relationship. Data was analysed using descriptive statistics, correlation analysis, Co-integration Tests, Regression Analysis, tests for assessing assumptions, and Post estimation diagnostic tests (tests for assessing model structure). Major findings of the study are presented in the following sub sections:

5.2.1 Gross Domestic Product Per Capita on Financial Performance of Commercial Banks in Kenya

This study found that the GDP per capita in the country has roughly doubled over the study period, increasing from US\$ 972 in 2011 to US\$ 1838 in 2020. This was in line with various reports, for instance, World Bank (2020a, c). Since GDP measures a people's economic wellbeing, the results suggested that the economic welfare of

Kenya, has generally improved between 2011 and 2020. The highest increase in GDP per capita was exhibited between 2011/12 (0.17%) and 2016/17 (0.11%). This study cannot definitively explain this finding. Nevertheless, these periods of anomalous increases were witnessed at the end of electoral terms, just before the next general election. This study suggests that these abnormal increases could be the culmination of a regime's economic policies enacted during that regime's time in power. The smallest annual increase in GDP per capita between 2019/20 could have resulted from the beginning of what ultimately became a highly disruptive global pandemic (Covid-19) and a host of other natural calamities such as locust invasion, long rains and drought (KNBS, 2020).

Results suggested the absence of a unit root but with a deterministic trend. A VAR was used to model the dynamic behaviour of the macroeconomic variables: GDP per capita, annual inflation rate and annual interest rate. The results showed that GDP per capita was likely affected only by its own lagged values ($p < 0.0001$) but not by those of annual IR or annual interest rates. This is logical because GDP per capita is computed by dividing the GDP of a country by its population (Brock, 2020). The GDP of any particular year is built upon those of previous years, meaning that lagged values of GDP per capita could affect the current values. The study also found that lagged values of GDP are strong predictors of both interest rates ($p < 0.0001$) and inflation rates ($p < 0.0001$).

Correlation analysis found significant and negative relationship between GDP per capita and interest rates but no significant relationship between GDP per capita and inflation rate. This finding contradicts Pandey (2009) contention that higher inflation (that is price levels) leads to losses in the purchasing power of money and increase in operating

costs and further the interest rates in the banking industry and economy at large. As a result of this loss of purchasing power of money and reduced value of money, the growth of the country's economy is hampered and thus, hence negatively impacting on GDP growth of the country.

The partial regression coefficients for GDP per capita ($b=0.594$, $t=2.939$, $p=0.022$) was statistically significant, which showed that GDP per capita is a significant predictor of financial performance of banks as measured by ROA. The regression model predicted that when GDP per capita increases by one unit on its scale, ROA goes up by 35% (coefficient of determination = $r^2 = 0.5942$) *ceteris paribus*. This finding is in line with a rich corpus of research, for instance, Osamwonji and Chijuka (2014), Juliana (2016), Ongeru (2014), Kungu (2013), Tora (2018), Njuguna (2013), and Hong and Razak (2015), which also found significant and positive relationships between GDP per capita and financial performance of banks. This could be explained as follows: decline in GDP growth (and therefore, GDP per capita) causes a contraction in demand for products at the market and credit services from financial institutions. Since interest earnings is one of the key sources of income for financial institutions, decrease in demand for credit services will cause a decline in their profitability. On the other hand, in a growing economy as expressed by positive GDP growth, the demand for credit is high due to the nature of business cycle.

5.2.2 Interest Rates on Financial Performance of Commercial Banks in Kenya

The study found that interest rates fluctuated in the course of study. They rose from 15.05% in 2011 to the highest level of 19.65%, before decreasing in 2012, 2014 and 2015. They peaked again in 2016 to 16.83% before steadily decreasing in subsequent years. The behaviour of interest rates could partly be explained by the enactment of

interest capping law, which became operational on September 14, 2016 (CBK, 2018b). Results show that from 2017, interest rates have remained below 14%, following the cap. However, before 2017, interest rates fluctuated wildly, for instance, rising to 19.65% and 16.83% in 2012 and 2016, respectively because of the absence of the cap.

Although the ADF test suggested the presence of a unit root, the study accepted results from the KPSS test, which suggested that the series was stationary because the ADF test requires at least 20 observations to compute probabilities and critical values. Most macroeconomic variables have been found to be integrated to the order 1(1) in most studies (Baltagi, 2013; Maddala, 2001). The lack of this finding in this study could be added to the low number of cases in the series data. After all, if current values are correlated with past values, then, the lagged values must be many to build up a clear picture of correlation.

The VAR model found that lagged values of interest rates could help predict inflation rates. On the other hand, while lagged interest rates could not predict GDP per capita, the latter was a strong predictor of interest rates. The Monetary Policy Committee (MPC) of the CBK sets out the CBR, which ultimately determines the interest rates charged by commercial banks. To set the CBR, the MPC looks at a set macroeconomic factors in the country, for instance, the GDP, inflation rates, and exchange rates. Therefore, it is logical that GDP per capita influences interest rates but not vice versa. This is because it is by looking at variables, for instance, GDP that the MPC will set the CBR, which will determine the commercial interest rates. Lagged values of Interest rates could not explain the current values, suggesting that the MPC sets CBR based on the prevailing economic circumstances rather than the past CBRs.

The VAR also showed that although lagged values of interest rates help to predict inflation rates ($p=0.004$), lagged inflation rates do not predict interest rates ($p=0.714$). Similar findings were revealed by correlation analysis, in which inflation rate had a significant, positive and fairly strong correlation with interest rates. This was expected. As explained earlier, interest rate is one of the tools in a government's monetary policy armamentarium. When inflation rises, one of the mechanism governments turn to in order to stem it is to increase interest rates. This would reduce borrowing and hence help to lower the money in circulation. On the other hand, when inflation is low, governments reduce interest rates to encourage more borrowing and therefore, increase the money in circulation. This could help to explain the positive correlation between interest rates and inflation.

The B coefficient for interest rates was not significant at 5% significance level ($b=0.418$, $t=1.983$, $p=0.088$). Thus, the null hypothesis that there is no statistically significant effect of Interest rates on the financial performance of Commercial Banks in Kenya could not be rejected. Nevertheless, the coefficient for interest rates was significant at 10% significance level, suggesting that interest rates could significantly predict ROA. This data looked at annual interest rates from 2011 to 2020, to coincide with ROA reported by commercial banks. Thus, the effective sample size for interest rates was just 10. It is possible that the sample size was small. When the sample size is too small, one may not be able to detect an important existing effect due reduction in power of statistical tests. This also increases the probability of making Type II error, that is, asserting that there is no significant effect when, in fact, it is present (Norusis, 2010).

Correlation results appeared to support the conclusion that interest rates could be related with ROA, with the results showing that interest rates had significant, positive and strong

relationship with ROA ($r = 0.872, p=0.001$). In deed the coefficient of determination implied that when the natural logarithm of interest rates increases by one unit, ROA goes up by 76%. Where the interest rates spreads are very high, the banks often lend to individual who are perceived as low risk, while low interest rate spreads lead to crossing out of individual borrowers who are perceived as high risk (Ochanda, 2018). Thus, when interest rates are high, it is expected that financial performance of banks will be lower because they will lend to fewer people. However, this does not appear to be the case, with ROA being positively influenced with higher interest rates. This could be because when interest rates are high, banks tend to lend to the government, which has high returns and very little risk (Ochanda, 2018). Consequently, their financial margins do not appear to suffer; in fact, it thrives. A juxtaposition of the trends of ROA and interest rates in this study show that periods of high interest rates are accompanied by high ROA whereas periods of low interest rates (for instance, when interest rates were capped) are concomitant with low ROA. While it might be simplistic to ascribe a causal relationship between interest rates and ROA, the circumstantial evidence for such a relationship is substantial.

The reason as to why interest rates in Kenya have stubbornly remained high relative to other countries in the region remain mystifying. In 1990 banks were allowed to determine interest rates that reflected their lending charges and fees on the cost of credit but within the stipulated ceilings. Nevertheless, in July 1991, interest rates were finally liberalized. Consequently, the interest rate spreads ballooned, with large banks maintaining higher interest rate spreads, followed by medium-sized banks while small banks had the lowest spreads. Corporate clients enjoyed lower lending rates relative to personal and business categories (CBK (2018b; Maimbo & Gallegos, 2014). For instance, in 2000 the average interest rate spread in Kenya was 14.2% compared with

South Africa (5.3%), Algeria (2.5%), Botswana (6.1%), Egypt (3.8%), and the world average (7.4%). In 2016, although the interest rate spread in Kenya had decreased to an average of 9.5%, it was still high relative to South Africa (3.3%), Algeria (6.3%), Botswana (5.2%), Egypt (5.7%), and the world average (5.5%). Interestingly, despite the decrease in interest rates by 2016, the profitability ratios (such as ROA and ROE) of the Kenyan banking sector remained higher relative to African countries (CBK (2018b). This is further support to the finding of this study that interest rates are positively correlated with banks' profitability as measured by ROA.

5.2.3 Inflation Rate on Financial Performance of Commercial Banks in Kenya

CPI was measured by inflation rates. Findings showed that except in 2011 and 2012, there was a high degree of congruence between the 12-month and the annual inflation rates. In 2011, the 12-month IR was a high of 13.98% which dropped to 9.64% in 2012. On the other hand, the annual inflation rate was 7.99% in 2011 and increased to 14.28% in 2012. The results showed that the highest 12-month inflation rate experienced was in 2011 (13.98%), which dropped to 9.64% in 2012, before further dropping to 5.72% in 2013. The inflation rate rose in 2014 (12-month IR was 6.88%) and remained relatively stable between 2014 and 2016. Nevertheless, in 2017, it increased to 8.01%, before decreasing in 2018 to 4.69%. The inflation rate increased again in 2019 (5.23%) and 2020 (5.29%).

An examination of the trends in interest rates and inflation rate revealed a close congruence, especially with the annual inflation rates. For instance, in 2011 the annual inflation rate was 7.99% while interest rate was 15.054%. In 2012, whereas inflation rate rose to 14.277%, interest rate went up to 19.652%. In 2013, when inflation decreased to 5.563%, interest rates reduced to 17.377%. Although, increase in inflation

has both positive and negative effects on an economy, many governments like to keep it low, because high inflation increases the cost of goods and services, reduces the purchasing power of citizen's money, erodes people's savings, and makes the population restive. Consequently, an upsurge in the rate of increase in the CPI will prompt government or policy formulators to lean toward raising interest rates in its policy deliberations. And a decrease in the CPI will lead to decrease of interest rates in the banking sector. This could explain the synchronization between inflation and interest rates (Jason & Peter; 2020; Sharma, 2016).

These conclusions are supported by results from the VAR model, which found that whereas lagged interest rates help predict inflation rates ($p=0.004$), lagged inflation rates do not predict interest rates ($p=0.714$). The VAR results were corroborated by findings from correlation analysis, in which inflation rate had a significant, positive and fairly strong correlation with interest rates. This study therefore found strong evidence for the correlation between interest and inflation rates.

In the model, the partial regression coefficients for inflation rate, ($b= -0.430$, $t= -2.247$, $p=0.05$) was statistically significant, which showed that inflation rate is a significant predictor of financial performance of banks as measured by ROA. The coefficient for inflation rate was negative (-0.430), which indicated that when inflation increases by one unit on its scale, ROA of banks decreases by 17%, *ceteris paribus*. Hence, the null hypothesis that there is no statistically significant effect of Consumer price index on the financial performance of Commercial Banks in Kenya was rejected.

The effect of inflation on ROA could be complex, given its relationship with interest rates. For example, when inflation is high, there could be an increase in interest rates, which will dissuade more people from borrowing, leading less profitability in the banks

(Pandey, 2009). But some governments especially the populist ones might choose not to increase interest rates or even reduce them when inflation rate increases, which might increase the banks' profits.

Increase in Consumer price index has both positive and negative effects on an economy. Negative effects of CPI include loss in stability in the real value of money and other monetary items over time; uncertainty about future returns and may discourage investment and saving, it leads to shortages of goods if consumers begin hoarding out of concern that prices will increase in the future. Positive effects include a mitigation of economic recessions, and debt relief by reducing the real level of debt (Jason & Peter, 2020).

5.2.4 Moderating Effect of Financial Innovations on the Relationship Between Gross Domestic Product per Capita and Financial Performance of Commercial Banks in Kenya

The *B* coefficient for the interaction between GDP per capita and financial innovation was 1.871 and was not statistically significant at $p < .05$ ($t = 0.774$, $p = 0.439$; CI: -2.887 – 6.629). The study therefore found that financial innovations do not moderate the effect of gross domestic product per capita on financial performance of commercial banks in Kenya. This study contends that GDP per capita is an external event that banks cannot manipulate. Commercial banks do not have direct control over the GDP per capita. Consequently, although banks could manipulate financial innovations, they cannot do so for GDP per capita. This lack of flexibility over GDP per capita could explain the inability of financial innovations to moderate the relationship between the former and financial performance of banks.

Consider the following. A bank consciously invests in financial innovation and hence increasing it, resulting in higher ROA. However, it cannot do much about GDP per capita, which could remain constant or even decrease even when financial innovations are increasing. Thus, while financial innovations will have a positive effect of ROA (as borne out by the results from the study), there will be lack of an interaction between financial innovations and GDP per capita.

5.2.5 Moderating Effect of Financial Innovations on the Relationship Between Interest Rates on Financial Performance of Commercial Banks in Kenya

The *B* coefficient for the interaction between financial innovations and interest rates was -5.292 and was statistically significant at $p < .05$ ($t = -2.202$, $p = 0.028$). This study therefore found a moderating effect of financial innovations on the relationships between interest rates and financial performance of commercial banks in Kenya. The study found that bank performance is at the highest with the highest innovations. However, at this point, changes in interest rates produce little or even slight decrease in ROA. On the other hand, when financial innovations are low, ROA will also be low, but increasing interest rates will result in the greatest increase in ROA. The results suggest that manipulation of interest rates to improve ROA occurs only well when bank innovations are low. Once a bank has attained a very high level of innovation (mobile phone banking, ATMS, KEPSS), manipulation of interest rates does not lead to great changes in ROA. This study concludes that when a bank's innovations are at the highest, it can achieve a very high ROA even when it keeps its interest rates very low. This could be a novel and potentially revolutionary finding from this study.

The moderating effect of financial innovations on the relationship between interest rates and financial performance could be explained by the fact that, unlike GDP per capita,

banks can, to some extent, manipulate interest rates. Commercial banks do not control GDP per capita but exercise some control on interest rates. For example, although the CBK sets out CBR, the bank can manipulate the interest rate, so long as it remains within the acceptable range. This study argues that innovations and interest rates are, to some extent, manipulable by commercial banks, and hence the significant moderating effect. However, the provenance of GDP per capita is external to the bank whereas innovations are internal, consequently, there is absence of any moderating effect.

5.2.6 Moderating Effect of Financial Innovations on the Relationship Between Inflation Rates on Financial Performance of Commercial Banks in Kenya

The *B* coefficient for the interaction between inflation rate and financial innovation was -0.015 and was not statistically significant at $p < .05$ ($t = -0.009$, $p = 0.992$; CI: -3.023 – 2.993). The study therefore found that, financial innovations do not moderate the effect of inflation rate on the financial performance of commercial banks in Kenya. This study argues, that inflation rates, like GDP per capita, is an external event that banks cannot easily manipulate. Commercial banks do not have direct control over the inflation rate. Consequently, although banks could manipulate financial innovations, they cannot do so for inflation rate. This inability to tune inflation rate in response with changes in financial innovations could explain the inability of financial innovations to moderate the relationship between the former and financial performance of banks. This study argues that the *modus operandi* behind the lack of moderating effect of financial innovation on financial performance is similar for GDP per capita and inflation rates.

5.3 Conclusion

This study investigated the moderating effect of financial innovation on the relationship between macroeconomic factors and financial performance of commercial banks in

Kenya. The study found that GDP per capita is a significant predictor of financial performance of banks as measured by ROA, with a unit increase of GDP per capita producing 35% increase in ROA. A VAR showed that GDP per capita was likely affected only by its own lagged values but not by those of annual IR or annual interest rates.

The study found that interest rates fluctuated in the course of study. The VAR also showed that although lagged values of interest rates help to predict inflation rates ($p=0.004$), lagged inflation rates do not predict interest rates ($p=0.714$). Similar findings were revealed by correlation analysis, in which inflation rate had a significant, positive and fairly strong correlation with interest rates. The B coefficient for interest rates was not significant at 5% significance level ($b=0.418$, $t=1.983$, $p=0.088$) suggesting that interest rates have no effect on the financial performance of Commercial Banks in Kenya. Nevertheless, the coefficient for interest rates was significant at 10% significance level, suggesting that the finding of non-significance could arise from a small sample size, with its consequent less statistical power.

An examination of the trends in interest rates and inflation rate revealed a close congruence, especially with the annual inflation rates. Results from VAR and correlation analysis found that inflation rate had a significant, positive and fairly strong correlation with interest rates ($r = 0.635$, $p=0.001$). The study found a significant but negative effect of inflation rate on ROA. Thus, the null hypothesis that there is no statistically significant effect of inflation on the financial performance of Commercial Banks in Kenya was rejected.

The study found that financial innovations do not moderate the effect of gross domestic product per capita on financial performance of commercial banks in Kenya. This study

concluded that because of the external nature of GDP per capita, commercial banks cannot easily manipulate it, unlike for financial innovations, explaining the absence of the moderating effect. This study concludes that when a bank's innovations are at the highest, it can achieve a very high ROA even when it keeps its interest rates very low. This could be a novel and potentially revolutionary finding from this study. This study argues that innovations and interest rates are, to some extent, manipulable by commercial banks, and hence the significant moderating effect. However, the provenance of GDP per capita is external to the bank whereas innovations are internal, consequently, there is absence of any moderating effect.

The study found that financial innovations do not moderate the effect of inflation rate on the financial performance of commercial banks in Kenya. This study argues, that inflation rates, like GDP per capita, is an external event that banks cannot easily manipulate. This inability to tune inflation rate in response with changes in financial innovations could explain the inability of financial innovations to moderate the relationship between the former and financial performance of banks. The *modus operandi* behind the lack of moderating effect of financial innovation on financial performance could be similar for GDP per capita and inflation rates.

5.4 Recommendations

The general objective of this study was to investigate the moderating effect of financial innovation on the relationship between macroeconomic factors and financial performance of commercial banks in Kenya. The study makes the following recommendations:

5.4.1 Policy Recommendations

The study recommends that;

The National Government as well the County Governments must strive to improve the economic livelihoods of the populace (GDP per capita) as these will improve the profitability of financial institutions. GDP per capita is often driven by consumer spending and business investment. Government should use tax cuts and rebates to return money to consumers and boost spending. Deregulation relaxes the rules imposed on businesses and have been credited with creating this is considering the fact that financial wellbeing of the banks leads to economic wellbeing of the populace.

In relation to interest rates, the study found that interest rates and affects financial performance of commercial banks. High interest rates lead to high profitability and this at times leads to customer exploitation. The Government, through the Central bank of Kenya should monitor and curb interest rates to prevent customer exploitation.

Given that interest rates charged by Kenyan banks are amongst the highest in Sub-Saharan Africa, Commercial Banks in Kenya should consider reducing them. This is driven by the fact that Return on Assets (ROA) amongst Kenya's banks are among the highest in the region even when interest rates were capped in 2016. This is a strong case for the banks to look for alternative ways to increase profitability that is by adoption of financial innovations and instead reduce interest rates.

Inflation rate was negatively related to Commercial Bank performance. Inflation affects profits by reducing volume of sales, increasing the cost of production and

thus affecting the relationship between costs and prices. The government should review its policies and strive to reduce inflation by use wage and price controls to curb inflation and improve profitability of Commercial Banks in Kenya.

With regard to financial Innovations, the moderation model showed that when a bank's innovations are at the highest, it can achieve a very high Return on Assets even when it keeps its interest rates very low. Consequently, Commercial Banks in Kenya should implement financial innovations, which could allow them to reduce drastically the interest rates they charge on customers.

The study recommends that policies put in place to be enhanced by encouraging banks to embrace highest innovations with respect to chaining technologies. This is because at highest innovations changes in interest rates produce little or even slight decrease in ROA. From this point now, the banks can reduce their interest rates which will encourage borrowing by the populace for investments and will eventually lead to increased GDP per capita.

5.4.1 Recommendations for Further Research

This study found a moderating effect of financial innovation on the relationship between interest rates and financial performance of commercial banks in Kenya but not on GDP per capita and inflation. This study therefore recommends future research to consider incorporating more macroeconomics variables covering long period of time since some of the macroeconomic variables may not have immediate effect on financial performance of commercial banks. In addition, future scholars may also consider using other measure of financial performance to determine the effect of macroeconomic variables on the entire financial sector as opposed to commercial banks alone.

REFERENCES

- Adamu, A. (2009). The effects of global financial crisis on Nigerian economy. *International Journal of Investment and Finance*, 1, 11-21.
- Adebayo, E. O., & Gambiyo, S. P. (2020). Economic analysis of the determinants of foreign direct investment (FDI) in Nigeria. *Arch Bus Res*, 8(1), 74-81.
- Adekola, O. A. (2016). The effect of banks profitability on economic growth in Nigeria. *Journal of Business and Management*, 18(3), 1-9.
- Ademola, A., & Badiru, A. (2016). The impact of unemployment and inflation on economic growth in Nigeria (1981–2014). *International Journal of Business and Economic Sciences Applied Research*, 9(1).
- Adesoye, A. B., Maku, O. E., & Atanda, A. A. (2012). Capital flight and investment dynamics in Nigeria: A time series analysis (1970-2006).
- Adewoye, J. O., & Omoregie, N. V. (1970). The impact of automatic teller machines on the cost efficiency of Nigeria. *The Journal of Internet Banking and Commerce*, 18(3), 1-21.
- Adhitya, A., & Sembel, H. R. (2020). The Impacts of Mobile Banking Technology Adoption on The Financial Performance and Stock Performance of Big Banks in Indonesia. *Language*, 14(148p), 30cm.
- Ajayi & Atanda, 2012, Effects of monetary policy on the commercial banks lending in Nigeria. *Review of Public Administration and Management*, 400(3614), 1-13.
- Akhavein, J., Frame, W. S., & White, L. J. (2005). The diffusion of financial innovations: An examination of the adoption of small business credit scoring by large banking organizations. *The Journal of Business*, 78(2), 577-596.
- Akhisar, I., Tunay, K. B., & Tunay, N. (2015). The effects of innovations on bank performance: The case of electronic banking services. *Procedia-Social and Behavioral Sciences*, 195, 369-375.
- Alabdullah, T. T. Y., Ahmed, E. R., & Muneerali, M. (2019). Effect of board size and duality on corporate social responsibility: what has improved in corporate governance in Asia?. *Journal of Accounting Science*, 3(2), 121-135.
- Albani, M., Anyfantaki, S., & Lazaretou, S. (2019). How do digital technologies drive Greece's economic growth? Opportunities and challenges. *Economic Bulletin*, (49), 75-92.
- Al-Smadi, M. O. (2012). Factors affecting adoption of electronic banking: An analysis of the perspectives of banks' customers. *International journal of business and social science*, 3(17).
- Alkhazaleh, A. M. K. (2017). Does banking sector performance promote economic growth? Case study of Jordanian commercial banks. *Problems and Perspectives in Management*, (15, Iss. 2), 55-64.
- Amin, H. (2007). An analysis of mobile credit card usage intentions. *Information Management & Computer Security*, 15(4), 260-269.
- Amromin, G., & Chakravorti, S. (2007). Debit card and cash usage: a cross-country analysis.

- Anbar, A., & Alper, D. (2011). Bank specific and macroeconomic determinants of commercial bank profitability: Empirical evidence from Turkey. *Business and economics research journal*, 2(2), 139-152.
- Arumugarajan, R., & Ponnudurai, S. A. R. (2019). A Study on Satisfaction of Customers Towards Private Sector Banks in Tuticorin District. *Think India Journal*, 22(33), 42-47.
- Ayako, A., Kungu, G., & Githui, T. (2015). Determinants of the performance of firms listed at the Nairobi Securities Exchange. *Research Journal of Finance and Accounting*, 6(12), 157-164.
- Baghdadli, A., Noyer, M., & Aussilloux, C. (2007). *Interventions éducatives, pédagogiques et thérapeutiques proposées dans l'autisme*. CREAI-Centre régional pour l'enfance et l'adolescence inadaptées-Languedoc Roussillon.
- Baltagi, B. H., Egger, P., & Pfaffermayr, M. (2013). A generalized spatial panel data model with random effects. *Econometric reviews*, 32(5-6), 650-685.
- Barasa, J. W. (2014). *Macro-economic determinants of stock market performance in Kenya: case of Nairobi securities exchange* (Doctoral dissertation, University of Nairobi).
- Bayar, Y., & Ceylan, I. E. (2017). Impact of macroeconomic uncertainty on firm profitability: a case of bist nonmetallic mineral products secto. *Journal of Business Economics and Finance*, 6(4), 318-327.
- Beloke, N. B., & AP, M. E. S. (2021). The Influence of Digital Financial Services on the Financial Performance of Commercial Banks in Cameroon.
- Bergman, U. M., & Hutchison, M. (2020). Fiscal procyclicality in emerging markets: The role of institutions and economic conditions. *International Finance*, 23(2), 196-214.
- Bech, M. L., & Hobijn, B. (2006). Technology diffusion within central banking: the case of real-time gross settlement. FRB of New York Staff Report, (260).
- Bhole, L. M., & Dash, P. (2002). Industrial Recession in India: Is interest rate the cause. *Productivity*, 43, 268-77.
- Biwott, I. C., Tanui, E., & Ayuma, C. (2019). Effect of Mobile Banking on Financial Performance of Commercial Banks in Eldoret Town, Kenya.
- Biwott, M. K. (2020). *Impact of Prudential Regulations on Technical Efficiency of Deposit Taking Cooperative Societies in Kenya* (Doctoral dissertation, JKUAT-COHRED).
- Boskin, M. J., Dulberger, E. L., Gordon, R. J., Griliches, Z., & Jorgenson, D. W. (1998). Consumer prices, the consumer price index, and the cost of living. *Journal of economic perspectives*, 12(1), 3-26.
- Bougie, R., & Sekaran, U. (2019). *Research methods for business: A skill building approach*. John Wiley & Sons.
- Bounie, D., François, A., & Van Hove, L. (2016). Merchant acceptance of payment cards: "Must take" or "wanna take"? *Review of Network Economics*, 15(3), 117-146.

- Bourgeon, J. M., Easter, K. W., & Smith, R. B. (2008). Water Markets and Third- Party Effects. *American Journal of Agricultural Economics*, 90(4), 902-917.
- Broadstock, D. C., Shu, Y., & Xu, B. (2011). Do macroeconomic conditions affect firm-level earnings forecasts?. *International Journal of Trade, Economics and Finance*, 2(5), 450..
- Brueggeman, W. B., & Fisher, J. D. (2011). *Real estate finance and investments* (pp. 5-6). New York: McGraw-Hill Irwin.
- Brueggeman, W. B., & Fisher, J. D. (2011). *Real estate finance and investments* (pp. 5-6). New York: McGraw-Hill Irwin.
- Callen, T. (2008). Back to basics: what is gross domestic product?. *Finance & Development*, 45(004).
- Campanella, F., Della Peruta, M. R., & Del Giudice, M. (2017). The effects of technological innovation on the banking sector. *Journal of the Knowledge Economy*, 8(1), 356-368.
- Carlos, N., & Ronald, M. O. Analyzing Effect of Alternative Banking Channels on Financial Performance of Burundi Commercial Banks: Evidence from Kenya Commercial Bank in Burundi.
- CBK (2018a). Bank supervision annual report 2018. Retrieved 10th January, 2022 from: <https://www.go.ke>
- CBK (2018b). The impact of interest rate capping on the Kenyan economy. Retrieved 20th June, 2022 from <https://www.go.ke>.
- Chigada, J., & Hirschfelder, B. (2017). Mobile banking in South Africa: A review and directions for future research. *South African Journal of Information Management*, 19(1), 1-9.
- Choi, I. (2001). Unit root tests for panel data. *Journal of international money and Finance*, 20(2), 249-272.
- Cho, T. Y., & Chen, Y. S. (2021). The impact of financial technology on China's banking industry: An application of the metafrontier cost Malmquist productivity index. *The North American Journal of Economics and Finance*, 57, 101414.
- Cicea, C., & Hincu, D. (2009). Performance evaluation methods in commercial banks and associated risks for managing assets and liabilities. *Communications of the IBIMA*, 7, 97-101.
- Cox, J. C., Ingersoll Jr, J. E., & Ross, S. A. (2005). A theory of the term structure of interest rates. In *Theory of valuation* (pp. 129-164).
- Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches*, 4th edition. Los Angeles: Sage.
- Dadoukis, A., Fiaschetti, M., & Fusi, G. (2021). IT adoption and bank performance during the Covid-19 pandemic. *Economics Letters*, 204, 109904.
- Daniel, B., Kumar, V., & Omar, N. (2018). Postgraduate conception of research methodology: implications for learning and teaching. *International Journal of Research & Method in Education*, 41(2), 220-236.

- Danlami, M. I., & Mayowa, D. R. (2014). An empirical investigation of automated teller machines (ATMs) and customers' satisfaction in Nigeria: A case study of Ilorin, Kwara State. *Faculty of Social Sciences, Kogi State University, Anyigba, PMB, 1008*.
- De Hoyos, R. E., & Sarafidis, V. (2006). Testing for cross-sectional dependence in panel-data models. *The stata journal*, 6(4), 482-496.
- Djalilov, K., & Piesse, J. (2016). Determinants of bank profitability in transition countries: What matters most?. *Research in International Business and Finance*, 38, 69-82.
- Dong et al. (2020) dynamics in finance and business: a literature review and research opportunities. *Financial Innovation*, 6(1), 1-22.
- Enyioko, N. (2012). Impact of interest rate policy and performance of deposit money banks in Nigerian. *Global journal of management and business research*, 12(21).
- Eric, M. K., & Oluoch, O. (2017). Effects of mobile banking on capital structure of Commercial Banks in Kenya. *International Journal of Finance and Accounting*, 2(6), 20-33.
- Everline Anyango Odipo, D., & Mutunga, O. effect of mobile banking services on financial performance of Deposit-Taking Saccos in Kenya.
- Field, A. (2013). *Discovering statistics using IBM SPSS statistics*. sage.
- Flamini, V., McDonald, C. A., & Schumacher, L. B. (2009). The determinants of commercial bank profitability in Sub-Saharan Africa.
- Francis, M. E. (2013). Determinants of commercial bank profitability in Sub-Saharan Africa. *International journal of economics and finance*, 5(9), 134-147.
- Gado, M. A., & Sanusi, A. W. International Financial Institutions and Policy of Development: An Assessment of World Bank Development Programs in Nigeria from 2010 to 2015.
- Gerlach, S., Peng, W., & Shu, C. (2005). Macroeconomic conditions and banking performance in Hong Kong SAR: a panel data study. *BIS papers*, 22(2), 481-497.
- Gerlach, S., Peng, W., & Shu, C. (2005). Macroeconomic conditions and banking performance in Hong Kong SAR: a panel data study. *BIS papers*, 22(2), 481-497.
- Ghauri, P., Grønhaug, K., & Strange, R. (2020). *Research methods in business studies*. Cambridge University Press.
- Gikombo, E. M., & Mbugua, D. (2018). Effect of select macro economic variables on performance of listed commercial banks in Kenya. *International Academic Journal of Economics and Finance*, 3(1), 80-109.
- Greene, W. H. (2000). *Econometric analysis 4th edition. International edition, New Jersey: Prentice Hall, 201-215*.
- Gujarati, D. N. (2011). *Econometrics by example (Vol. 1)*. New York: Palgrave Macmillan.
- Hakim, V. (2014). *The effect of inflation on the stock market returns of the Nairobi securities exchange* (Doctoral dissertation, University Of Nairobi).

- Halima, R., & Wepukhulu, J. M. (2020). Effect of financial innovations on financial performance of tier one commercial banks in Kenya. *International Academic Journal of Economics and Finance*, 3(6), 181-196.
- Harelimana, J. B. (2017). Impact of mobile banking on financial performance of Unguka microfinance bank LTD, Rwanda. *Global Journal of Management and Business Research*.
- Harrington & Wilson, 1989, Improving credit protection analysis methods Reports of main agricultural enterprises. *Baltic Journal of Economic Studies*, 4(2), 1-7.
- Harris, R. D., & Tzavalis, E. (1999). Inference for unit roots in dynamic panels where the time dimension is fixed. *Journal of econometrics*, 91(2), 201-226.
- Hansen, D. R., & Mowen, M. M. (2005). Management Accounting: Akuntansi Manajemen. *Salemba Empat, Jakarta*.
- Hasan, I., Schmiedel, H., & Song, L. (2012). Returns to retail banking and payments. *Journal of Financial Services Research*, 41(3), 163-195.
- Hayes, A. S. (2021). The active construction of passive investors: rob advisors and algorithmic 'low-finance'. *Socio-Economic Review*, 19(1), 83-110.
- Holden, M. T., & Lynch, P. (2004). Choosing the appropriate methodology: Understanding research philosophy. *The marketing review*, 4(4), 397-409.
- Hong, S. C., & Abdul Razak, S. H. (2015). The impact of nominal GDP and inflation on the financial performance of Islamic banks in Malaysia. *Journal of Islamic Economics, Banking and Finance*, 113(3281), 1-24.
- Houenou, B., & Djogbenou, E. F. (2020). Predicting Household's Mobile Banking Saving Behavior in Western Kenya: An Algorithmic Approach. *Journal of African Development*, 21(1), 41-67.
- Hyndman, R. J., & Khandakar, Y. (2008). Automatic time series forecasting: the forecast package for R. *Journal of statistical software*, 27, 1-22.
- Imoughele, L. E. I. (2014). The impact of commercial bank credit on the growth of small and medium scale enterprises: An econometric evidence from Nigeria (1986-2012). *Journal of Educational Policy and Entrepreneurial Research*, 1(2), 251-261.
- Irungu, P. N. (2013). *The effect of interest rate spread on financial performance of commercial banks in Kenya* (Doctoral dissertation).
- Issah, M., & Antwi, S. (2017). Role of macroeconomic variables on firms' performance: Evidence from the UK. *Cogent Economics & Finance*, 5(1), 1405581.
- Izedonmi and Abdullahi (2011), Macroeconomic factors, firm characteristics and financial performance: A study of selected quoted manufacturing firms in Nigeria. *Asian Journal of Accounting Research*.
- Jaber, J. J., & Al-khawaldeh, A. A. (2014). The impact of internal and external factors on commercial bank profitability in Jordan. *International Journal of Business and Management*, 9(4), 22.
- Jamani, K. D., Harrington, E., & Wilson, H. J. (1989). Rigidity of elastomeric impression materials. *Journal of oral rehabilitation*, 16(3), 241-248.

- Jason M.L & Peter A(2020). Purchasing power parity. *NBER Working Paper*, (w1591).
- Jegede, C. A. (2014). Effects of automated teller machine on the performance of Nigerian banks. *American Journal of Applied Mathematics and Statistics*, 2(1), 40-46.
- Jelic, R., Briston, R., & Aussenegg, W. (2001). The Financial Performance of Privatised Firms: Evidence From Three Transition Economies. *Available at SSRN 273875*.
- Johnson, S. (2016). Competing visions of financial inclusion in Kenya: the rift revealed by mobile money transfer. *Canadian Journal of Development Studies/Revue canadienne d'études du développement*, 37(1), 83-100.
- Johnson, S., & Kwak, J. (2012). Is financial innovation good for the economy?. *Innovation policy and the economy*, 12(1), 1-16.
- Kamande, J. (2018). *The Effect of Electronic Banking on the Financial Performance of Commercial Banks in Kenya* (Doctoral dissertation, University of Nairobi).
- Kamau, D. M., & Oluoch, J. (2016). Relationship between financial innovation and commercial bank performance in Kenya. *International Journal of Social Sciences and Information Technology*, 2(4), 34-47.
- Kandir, S. Y. (2008). Macroeconomic variables, firm characteristics and stock returns: Evidence from Turkey. *International research journal of finance and economics*, 16(1), 35-45.
- Kanwal, S., & Nadeem, M. (2013). The impact of macroeconomic variables on the profitability of listed commercial banks in Pakistan. *European journal of business and social sciences*, 2(9), 186-201.
- Khan, I., Khan, M., & Tahir, M. (2017). Performance comparison of Islamic and conventional banks: empirical evidence from Pakistan. *international Journal of Islamic and middle eastern finance and management*.
- Kibicho, N. K., & Mungai, J. (2019). Mobile Banking Adoption and Financial Credit Accessibility in Wote Sub-County, Makueni County, Kenya. *International Journal of Current Aspects*, 3(IV), 65-79.
- Kiganda, E. O. (2014). Effect of macroeconomic factors on commercial banks profitability in Kenya: Case of equity bank limited. *Journal of Economics and Sustainable development*, 5(2), 46-56.
- Kipngetch, K. M. (2011). *The relationship between interest rates and financial performance of commercial banks in Kenya* (Doctoral dissertation, University of Nairobi).
- Kiptepkut, M. R. (2007). *The extent to which Kenya's national payment System (NPS) reform objectives have been achieved* (Doctoral dissertation, University of Nairobi).
- Kiptoo, H. C. (2012). *Determinants of the disparity between the central bank rate and the commercial bank prime rates in Kenya* (Doctoral dissertation).
- Kithinji, E. M. I. L. Y. (2017). *Effects of digital banking strategy on financial inclusion among commercial banks in Kenya* (Doctoral dissertation, University of Nairobi).
- Kobia, A. M. (2018). *Effect of inflation rate on profitability of commercial banks in Kenya* (Doctoral dissertation, university of nairobi).

- Kombe, S. K., & Wafula, M. K. (2015). Effects of internet banking on the financial performance of commercial banks in Kenya a case of Kenya Commercial Bank. *International Journal of Scientific and Research Publications*, 5(5), 1-10.
- Kothari, C. R. (2004). *Research methodology: Methods and techniques*. New Age International.
- Kou, G., Olgu Akdeniz, Ö., Dinçer, H., & Yüksel, S. (2021). Fintech investments in European banks: a hybrid IT2 fuzzy multidimensional decision-making approach. *Financial Innovation*, 7(1), 1-28.
- Kung'u, N. D. (2013). The effect of selected macroeconomic variables on the financial performance of private equity firms in Kenya. *Unpublished MBA Thesis, University of Nairobi*.
- Kurgat, F. (2019). Microfinance factors affecting women group enterprises in Kericho Town, Kenya. *Journal of Research and Opinion*, 6(10), 2543-2547.
- Lavrakas, P. J. (2008). *Encyclopedia of survey research methods*. Sage publications.
- Lerner, J. (2006). The new new financial thing: The origins of financial innovations. *Journal of Financial Economics*, 79(2), 223-255.
- Maddala, S. (2001). *Introduction to econometrics* (Third ed.). New York: Wiley.
- Magsamen-Conrad, K., Upadhyaya, S., Joa, C. Y., & Dowd, J. (2015). Bridging the divide: Using UTAUT to predict multigenerational tablet adoption practices. *Computers in human behavior*, 50, 186-196.
- Maimbo, S. M., & Henriquez Gallegos, C. A. (2014). Interest rate caps around the world: still popular, but a blunt instrument. *World Bank Policy Research Working Paper*, (7070).
- M'Amanja, D., Lloyd, T., & Morrissey, O. (2005). *Fiscal aggregates, aid and growth in Kenya: a vector autoregressive (VAR) analysis* (No. 05/07). CREDIT Research Paper.
- Manjushree, S. (2020). Customer Preference towards Use of ATM Services. *Profession*, 2, 4.
- Marshall, A. (2009). *Principles of economics: unabridged eighth edition*. Cosimo, Inc..
- Mateka, M., Gogo, J., & Omagwa, J. (2016). Effects of internet banking on financial performance of listed commercial banks in Kenya. *American Journal of Finance*, 1(2), 53-71.
- Mbabazize, and Shukla (2015), The effect of automation and workload on staff productivity in under developing country in Guinea: A conceptual study. *International Journal of Academic Research in Business and Social Sciences*, 9(3), 902-914.
- Mbua, S. N. (2017). *Effect of interest rates capping by the Central Bank of Kenya on the banks listed on the Nairobi Securities Exchange* (Doctoral dissertation, United States International University-Africa).
- McDonald, S., Gan, B. C., Fraser, S. S., Oke, A., & Anderson, A. R. (2015). A review of research methods in entrepreneurship 1985-2013. *International Journal of Entrepreneurial Behavior & Research*.

- Melubo, K. D., & Musau, S. (2020). Digital banking and financial inclusion of women enterprises in Narok County, Kenya. *International Journal of Current Aspects in Finance, Banking and Accounting*, 2(1), 28-41.
- Mishra, V., & Bisht, S. S. (2013). Mobile banking in a developing economy: A customer-centric model for policy formulation. *Telecommunications Policy*, 37(6-7), 503-514.
- Mohammed, O. (17 April 2019). Kenya's NIC Group shareholders back merger with CBA. *Thomson Reuters*. Retrieved 28 October 2020.
- Mostafa, A. A., & Eneizan, B. (2018). Factors affecting acceptance of mobile banking in developing countries. *International Journal of Academic Research in Business and Social Sciences*, 8(1), 340-351.
- Mueni, J. (2016). *The Effect of Macroeconomic Variables on the Financial Performance of Commercial Banks in Kenya* (Doctoral dissertation, University of Nairobi).
- Mugane, M., & Njuguna, R. (2019). Mobile Banking Services with Financial Performance on Commercial Banks in Kenya. *International Journal of Current Aspects*, 3(VI), 176-192.
- Mulwa, B. D. (2013). *The effect of exchange rate volatility on inflation rates in Kenya* (Doctoral dissertation, University of Nairobi).
- Muma, M., Nzulwa, J., Ombui, K., Odhiambo, R., Wekesa, S., Omondi, M., ... & Charles, M. (2019). Influence of recruitment strategies on retention of employees in universities in Kenya. *International Journal of Social Science and Humanities Research*, 7(2), 28-55.
- Muriu, P. (2011). *Microfinance Profitability: Does financing choice matter*. *Np*, May
- Murungi, D. U. (2014). *Relationship between macroeconomic variables and financial performance of insurance companies in Kenya* (Doctoral dissertation, University of Nairobi).
- Mustapha, S. A. (2018). E-Payment technology effect on bank performance in emerging economies—evidence from Nigeria. *Journal of Open Innovation: Technology, Market, and Complexity*, 4(4), 43.
- Mutai , N. C., Kiprop S, & Nzioki , P. M. . Moderating Effect of Financial Innovations on the Relationship Between Interest Rates and Financial Performance of Commercial Banks in Kenya. *Int. J. Innov. Finance and Econs Res.* 10(3):106-113, 2022
- Mutai , N. C., Nzioki , P. M. ., & Kiprop, S. (2022). Moderating Effect of Financial Innovations on the Relationship Between GDP Per Capita and Financial Performance of Commercial Banks in Kenya. *Journal of Finance and Accounting*, 6(4), 25–33. Retrieved from <https://stratfordjournals.org/journals/index.php/journal-of-accounting/article/view/1269>
- Mutemi, K., & Makori, D. (2019). Interest Rate Capping and Financial Performance of Commercial Banks in Kenya. *International Journal of Current Aspects*, 3(IV), 119-130.
- Mwangi, F. K. (2013). *The effect of macroeconomic variables on financial performance of aviation industry in Kenya* (Doctoral dissertation, University of Nairobi).

- Mwatsika, C. (2016). Factors influencing customer satisfaction with ATM banking. *International Journal of Academic Research in Business and Social Sciences*, 6(2), 26-41.
- Narwal, K. P., & Pathneja, S. (2016). Effect of bank-specific and governance-specific variables on the productivity and profitability of banks. *International Journal of Productivity and Performance Management*.
- Ndung'u, M. N., & Waema, T. M. (2011). Development outcomes of internet and mobile phones use in Kenya: the households' perspectives. *info*.
- Neuman, W.L. (2006). *Social research methods: qualitative and quantitative approaches*, 6th ed. Boston: Pearson Education Inc.
- Niemand, T., Rigtering, J. C., Kallmünzer, A., Kraus, S., & Maalaoui, A. (2021). Digitalization in the financial industry: A contingency approach of entrepreneurial orientation and strategic vision on digitalization. *European Management Journal*, 39(3), 317-326.
- Ngumi, P. M. (2014). *Effect of bank innovations on financial performance of commercial banks in Kenya* (Doctoral dissertation).
- Ngure, I. M. (2014). *The effect of interest rates on financial performance of Commercial banks in Kenya* (Doctoral dissertation, University of Nairobi).
- Njau, W. J. (2019). *Influence of Alternative Financing on the Relationship between Operational Characteristics and Efficiency of Small and Medium Enterprises in Kenya* (Doctoral dissertation, Karatina University).
- Njue, A. M., Kariuki, S. N., & Njeru, D. M. (2020). Liquidity Management and Financial Performance of Microfinance Institutions in Kenya. *The Journal of Social Sciences Research*, 6(11), 943-953.
- Njuguna, P. N. (2013). *Effects of macroeconomic factors on the financial performance of deposit taking micro-finance institutions in Kenya* (Doctoral dissertation, University of Nairobi).
- Nkeshimana & Onsiro, 2020. Analyzing Effect of Alternative Banking Channels on Financial Performance of Burundi Commercial Banks: Evidence from Kenya Commercial Bank in Burundi.
- Nofie, I. (2011). The diffusion of electronic banking in Indonesia. *Manchester Business School*.
- Norusis, M. J. (2010). *PASW statistics 18 advanced statistical procedures*. Prentice Hall Press.
- Novak, A. (2017). Knowledge management and organizational performance—Literature review. In *Management Challenges in a Network Economy: MakeLearn and TIIM International Conference* (pp. 433-440).
- Noyer, C. (2007). Hedge funds: what are the main issues?. *Financial Stability Review: Special Issue on Hedge Funds, Banque de France*, 10, 105-111.
- Nyathira, C. N. (2012). *Financial innovation and its effect on financial performance of commercial banks in Kenya* (Doctoral dissertation)

- Ochanda, C. A. (2018). *The Effect of Interest Rates Caps on Bank Performance Amongst Kenyan Commercial Banks* (Doctoral dissertation, United States International University-Africa).
- Ogunbiyi, S. S. (2014). Interest rates and deposit money banks' profitability nexus: the Nigerian experience. *Arabian Journal of Business and Management Review (OMAN Chapter)*, 3(11), 133.
- Okech, F. O. (2013). *The effect of lending interest rates on financial performance of commercial banks in Kenya* (Doctoral dissertation, University of Nairobi).
- Okibo, B. W., & Wario, A. Y. (2014). Effects of e-banking on growth of customer base in Kenyan banks. *The International Journal of Management Science and Information Technology (IJMSIT)*, (11-(Jan-Mar)), 48-64.
- Okoth, M. N. (2013). *The effect of interest rate and inflation rate on exchange rates in Kenya* (Doctoral dissertation, University of Nairobi).
- Olalere, O. E., Kes, M. S., Islam, M. A., & Rahman, S. (2021). The Effect of Financial Innovation and Bank Competition on Firm Value: A Comparative Study of Malaysian and Nigerian Banks. *The Journal of Asian Finance, Economics and Business*, 8(6), 245-253.
- Olukoye & Juma, 2018. Interest Rate Capping and Financial Performance of Commercial Banks in Kenya. *IOSR Journal of Business and Management*, 21(11), 27-30.
- Ongere, J. J. (2011). *The Effect of Stock Splits On The Ownership Structure Of Firms: Evidence From The Nairobi Stock Exchange* (Doctoral dissertation, University of Nairobi).
- Ongeri, G. M. (2014). *The effect of macroeconomic variables on the financial performance of non-bank financial institutions in Kenya* (Doctoral dissertation, University Of Nairobi).
- Determinants of financial performance of commercial banks in Kenya. *International journal of economics and financial issues*, 3(1), 237-252.
- Osamwonji and Chijuka (2014). Effect of macro-economic variables on profitability of selected commercial banks in Rwanda. *Journal of Asian Economics*, 1(2), 181-198.
- Otambo, T. D. (2016). *The effect of macro-economic variables on financial performance of commercial banking sector in Kenya* (Doctoral dissertation, University Of Nairobi).
- Owolabi, A. A., Nwobu, O. A., & Iyoha, F. O. (2017). Sustainability reporting in financial institutions: A study of the Nigerian banking sector. *The Journal of Internet Banking and Commerce*, 1-15.
- Oyomo (2018), Digital financial innovation services and their impact on the performance of Commercial Banks in Kenya.
- Pandey, M. K. (2010). Financial innovation and stability of money demand function in post-reform period in India. *Economics Bulletin*, 30(4), 2895-2905.

- Park, H. M. (2011). *Practical Guides to Panel Data Modeling: A Step-by-step Analysis Using Stata*. Tutorial Working Paper. Graduate School of International Relations, International University of Japan.
- Pedroni P (1999). Critical value for cointegration tests in heterogenous panels with multiple regressors. *Oxford Bulletin of Economics and Statistics* 61:653-670.
- Pedroni, P. (2004). Panel cointegration: asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis. *Econometric theory*, 20(3), 597-625.
- Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of applied econometrics*, 16(3), 289-326.
- Podder, B., Venkatesh, S., Wongsurawat, W., & Badir, Y. (2012). Determinants of profitability of private commercial banks in Bangladesh: An empirical study. *A thesis for a Professional Master in Banking Finance, Asian Institute of Technology, Thailand*.
- Rabaa and Younes (2016) Rueben, E. P., & Anyanwaokoro, M. (2019). Electronic Payment System and Financial Deepening in Nigeria, 2009-2017. *South Asian Journal of Social Studies and Economics*, 1-14.
- Rao N.D, Fuss, S., Chen, C., Jakob, M., Marxen, & Edenhofer, O. (2016). Could resource rents finance universal access to infrastructure? A first exploration of needs and rents. *Environment and Development Economics*, 21(6), 691-712.
- Rega, F. G. (2017). The bank of the future, the future of banking-An empirical analysis of European banks. *Available at SSRN 3071742*.
- Ryabov, O. (2020, November). Transformation of traditional financial companies into FinTech. In *Proceedings of the International Scientific Conference-Digital Transformation on Manufacturing, Infrastructure and Service* (pp. 1-7).
- Salazar-Núñez, H., Venegas-Martínez, F., & Tinoco-Zermeño, M. (2020). Impact of energy consumption and carbon dioxide emissions on economic growth: Cointegrated panel data in 79 countries grouped by income level. *International Journal of Energy Economics and Policy*, 10(2), 218-226.
- San, O. T., & Heng, T. B. (2013). Factors affecting the profitability of Malaysian commercial banks. *African Journal of Business Management*, 7(8), 649-660.
- Saunders, M., Lewis, P., & Thornhill, A. (2009). *Research methods for business students*. Pearson education.
- Shaikh, I. M., Qureshi, M. A., Noordin, K., Shaikh, J. M., Khan, A., & Shahbaz, M. S. (2020). Acceptance of Islamic financial technology (FinTech) banking services by Malaysian users: an extension of technology acceptance model. *foresight*, 22(3), 367-383.
- Shankar, A., & Kumari, P. (2016). Factors affecting mobile banking adoption behavior in India. *The Journal of Internet Banking and Commerce*, 21(1).
- Silber, W. L. (1983). The process of financial innovation. *The American Economic Review*, 73(2), 89-95.

- Simiyu, C. N., & Ngile, L. (2015). Effect of macroeconomic variables on profitability of commercial banks listed in the Nairobi securities exchange. *International Journal of Economics, Commerce and Management*, 3(4), 1-16.
- Simiyu, C. N., & Ngile, L. (2015). Effect of macroeconomic variables on profitability of commercial banks listed in the Nairobi securities exchange. *International Journal of Economics, Commerce and Management*, 3(4), 1-16.
- Siriba, R. M. (2019). Interest Rate Capping and Financial Performance of Commercial Banks in Kenya. *IOSR Journal of Business and Management*, 21(11), 27-30.
- Sing, T., Ho, K., & Mak, M. (2002). Real estate market reaction to public listings and acquisition news of Malaysian REITs. *Journal of Real Estate Portfolio Management*, 8(3), 209-227.
- Smith, J. A. (2004). Reflecting on the development of interpretative phenomenological analysis and its contribution to qualitative research in psychology. *Qualitative research in psychology*, 1(1), 39-54.
- Johnson, S., & Arnold, S. (2012). Inclusive financial markets: is transformation under way in Kenya?. *Development Policy Review*, 30(6), 719-748.
- Tam, L. T., Ngan, N. P., Trung, N. T., & Minh, C. P. (2020). Banking Relationship Ties to Firm Performance: Evidence from Food and Beverage Firms in Vietnam. *Journal of Economics and Business*, 3(2).
- Tang, Y. M., Chau, K. Y., Hong, L., Ip, Y. K., & Yan, W. (2021). Financial innovation in digital payment with wechat towards electronic business success. *Journal of Theoretical and Applied Electronic Commerce Research*, 16(5), 1844-1861.
- Tangen, S. (2003). An overview of frequently used performance measures. *Work study*.
- Tchouto, L., & Nguena, C. L. (2015). *Innovation financière et développement durable au Cameroun: pourquoi le développement du mobile banking est-il important* (Vol. 3, No. 29). AAYE PR Working Paper Series.
- Thomas, P. (2017). Does health spending need to outpace GDP per head. *Nanotechnology Perceptions*, 13(1), 17-30.
- Tidiani, B., Yddoussalah, O., Karmouni, T., Elkhader, K., Koutani, A., & Andaloussi, A. I. A. (2015). Angiomyolipomes épithélioïdes rénal bénin: à propos de deux cas. *The Pan African Medical Journal*, 22.
- Too, V. K., Ayuma, C., & Ambrose, K. (2016). Effects of mobile banking on the financial performance of commercial banks in Kapsabet (Kenya): A case of selected banks in Kapsabet town. *IOSR Journal of Business and Management*, 18(10), 37-48.
- Tora, J. (2018). *The Effect of Selected Macro-economic Variables on Financial Performance of the Banking Sector in Kenya* (Doctoral dissertation, University of Nairobi).
- Torres-Reyna, O. (2007). Panel data analysis fixed and random effects using Stata (v. 4.2). *Data & Statistical Services, Princeton University*, 112, 49.
- Tufano, P. (2003). Financial innovation. *Handbook of the Economics of Finance*, 1, 307-335.

- Tunay, K. B., Akhisar, I & Tunay, N. (2015). The effects of innovations on bank performance: The case of electronic banking services. *Procedia-Social and Behavioral Sciences*, 195, 369-375.
- Udu C.O, Egbunike, C. F., & Okerekeoti, C. U. (2018). Macroeconomic factors, firm characteristics and financial performance: A study of selected quoted manufacturing firms in Nigeria. *Asian Journal of Accounting Research*.
- Upadhyaya, M. (2015). An analytical study of mobile phone espousal and consumption patterns of university students in Bahrain. *Interlink Continental Journal of Business Management and Economics*, 1(1), 001-007.
- Vanderstoep, S. W., & Johnston, D. D. (2009). Qualitative research Tools: Interviewing, focus groups, and observation. *SW Vanderstoep, & DD Johnston, Research methods for everyday life*, 224-225.
- Vena (2012), Impact of inflation on stock market performance
- Vishwakarma, M. M. (2019). E-commerce: emerging trend for business management education. *Challenges and Opportunities in Social Sciences, Humanities and Business Management*, 114.
- Wabita, F. M. (2013). *Determinants of financial performance of insurance companies in Kenya* (Doctoral dissertation, University of Nairobi)
- Wadesango, N., & Magaya, B. (2020). The impact of digital banking services on performance of commercial banks. *Journal of Management Information and Decision Sciences*, 23, 343-353.
- Wamucii, J. C. (2010). *The relationship between inflation and financial performance of commercial banks in Kenya* (Doctoral dissertation, University of Nairobi).
- Wang et al. (2021) A survey of supply chain operation and finance with Fintech: Research framework and managerial insights. *International Journal of Production Economics*, 247, 108431.
- Wanjohi, J. G. (2013). *The effect of financial risk management on the financial performance of commercial banks in Kenya* (Doctoral dissertation, University of Nairobi).
- Yossy, I., & Tjahjadi, B. (2017, July). Moderating Effect of Innovation on Strategy-Financial Performance Relationship: Experience of " Batik" SMEs. In *2017 International Conference on Organizational Innovation (ICOI 2017)* (pp. 168-173). Atlantis Press.
- Zeitun, R., & Tian, G. G. (2007). Does ownership affect a firm's performance and default risk in Jordan?. *Corporate Governance: The international journal of business in society*.
- Zhang, X., & Daly, K. (2013). Emerging markets banks performance: Evidence from China's banks in Hong Kong. *Emerging Markets and the Global Economy: A Handbook*, 51.
- Zikmund-Fisher, B. J., Couper, M. P., Singer, E., Levin, C. A., Fowler Jr, F. J., Ziniel, S., ... Fagerlin, A. (2010). The DECISIONS study: a nationwide survey of United States adults regarding 9 common medical decisions. *Medical Decision Making*, 30(5_suppl), 20-34.

APPENDICES

Appendix I: List of Commercial Banks in Kenya in the Study

1. ABC Bank (Kenya)
2. Bank of Africa
3. Bank of Baroda
4. Bank of India
5. ABSA Kenya
6. CFC Stanbic Holdings
7. Chase Bank Kenya (In Receivership)
8. Citibank
9. Commercial Bank of Africa
10. Consolidated Bank of Kenya
11. Cooperative Bank of Kenya
12. Credit Bank
13. Development Bank of Kenya
14. Diamond Trust Bank
15. Eco bank Kenya
16. Equity Bank
17. Family Bank
18. Fidelity Commercial Bank Limited
19. First Community Bank
20. Giro Commercial Bank
21. Guaranty Trust Bank Kenya
22. Guardian Bank
23. Gulf African Bank
24. Habib Bank
25. Habib Bank AG Zurich
26. Housing Finance Company of Kenya
27. I&M Bank
28. Imperial Bank Kenya (In receivership)
29. Jamii Bora Bank
30. Kenya Commercial Bank

31. Middle East Bank Kenya
32. National Bank of Kenya
33. NIC Bank
34. Oriental Commercial Bank
35. Paramount Universal Bank
36. Prime Bank (Kenya)
37. Sidian Bank
38. Spire Bank
39. Standard Chartered Kenya
40. Trans National Bank Kenya
41. United Bank for Africa
42. Victoria Commercial Bank

Appendix II: List of Banks Analysed in the Study

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|-------|--------------------|-----------|---------|---------------|-----------------------|
| Valid | ABK | 10 | 2.6 | 2.6 | 2.6 |
| | Bank of Africa | 10 | 2.6 | 2.6 | 5.2 |
| | Barclays/ABSA | 10 | 2.6 | 2.6 | 7.8 |
| | Baroda | 10 | 2.6 | 2.6 | 10.4 |
| | BOI | 10 | 2.6 | 2.6 | 13.0 |
| | CBA | 8 | 2.1 | 2.1 | 15.1 |
| | Citi Kenya | 10 | 2.6 | 2.6 | 17.7 |
| | Consolidated | 10 | 2.6 | 2.6 | 20.3 |
| | Coop bank | 10 | 2.6 | 2.6 | 22.9 |
| | Credit Bank | 10 | 2.6 | 2.6 | 25.5 |
| | DBK | 10 | 2.6 | 2.6 | 28.1 |
| | DTB | 10 | 2.6 | 2.6 | 30.6 |
| | Ecobank | 10 | 2.6 | 2.6 | 33.2 |
| | Equity bank | 10 | 2.6 | 2.6 | 35.8 |
| | Family Bank | 10 | 2.6 | 2.6 | 38.4 |
| | FCB | 10 | 2.6 | 2.6 | 41.0 |
| | Giro Bank | 7 | 1.8 | 1.8 | 42.9 |
| | Guaranty/Fina | 10 | 2.6 | 2.6 | 45.5 |
| | Guardian Bank | 10 | 2.6 | 2.6 | 48.1 |
| | Gulf African | 10 | 2.6 | 2.6 | 50.6 |
| | Habib Bank | 10 | 2.6 | 2.6 | 53.2 |
| | Housing Fin | 10 | 2.6 | 2.6 | 55.8 |
| | I&M | 10 | 2.6 | 2.6 | 58.4 |
| | Jamii Bora/Kingdom | 10 | 2.6 | 2.6 | 61.0 |
| | KCB | 10 | 2.6 | 2.6 | 63.6 |
| | M-Oriental | 10 | 2.6 | 2.6 | 66.2 |
| | MEBK | 10 | 2.6 | 2.6 | 68.8 |
| | National Bank | 10 | 2.6 | 2.6 | 71.4 |
| | NIC/NCBABank | 10 | 2.6 | 2.6 | 74.0 |
| | Paramount | 10 | 2.6 | 2.6 | 76.6 |
| | Prime Bank | 10 | 2.6 | 2.6 | 79.2 |
| | SBM/Fidelity | 10 | 2.6 | 2.6 | 81.8 |
| | Sidian/K-Rep Bank | 10 | 2.6 | 2.6 | 84.4 |
| | Spire/Equatorial | 10 | 2.6 | 2.6 | 87.0 |
| | Stanbic | 10 | 2.6 | 2.6 | 89.6 |
| | Standard Ch | 10 | 2.6 | 2.6 | 92.2 |
| | Trans/Access Bank | 10 | 2.6 | 2.6 | 94.8 |
| | UBA Kenya | 10 | 2.6 | 2.6 | 97.4 |
| | Victoria | 10 | 2.6 | 2.6 | 100.0 |
| | Total | 385 | 100.0 | 100.0 | |

Appendix III: Vector Error Correction Estimates for Financial Innovations

Vector Error Correction Estimates

Date: 07/16/22 Time: 19:19

Sample (adjusted): 2014 2020

Included observations: 268 after adjustments

Standard errors in () & t-statistics in []

| Cointegrating Eq: | CointEq1 | | |
|-------------------|--------------------------------------|--------------------------------------|--------------------------------------|
| ATMLN(-1) | 1.000000 | | |
| KEPSSLN(-1) | -0.034632 (0.02866) [-1.20856] | | |
| MPMSLN(-1) | -0.006634 (0.12596) [-0.05267] | | |
| C | -8.372598 | | |
| Error Correction: | D(ATMLN) | D(KEPSSLN) | D(MPMSLN) |
| CointEq1 | -0.278520 (0.04373) [-6.36855] | -0.014923 (0.11311) [-0.13194] | -0.039844 (0.03050) [-1.30651] |
| D(ATMLN(-1)) | -0.051172 (0.05828) [-0.87812] | -0.226546 (0.15071) [-1.50314] | -0.040314 (0.04064) [-0.99206] |
| D(ATMLN(-2)) | -0.034109 (0.05548) [-0.61484] | 0.097762 (0.14348) [0.68137] | -0.075057 (0.03869) [-1.94018] |
| D(KEPSSLN(-1)) | -0.049988 (0.02563) [-1.95039] | -0.631129 (0.06629) [-9.52137] | 0.020440 (0.01787) [1.14370] |
| D(KEPSSLN(-2)) | -0.006134 (0.03353) [-0.18297] | -0.142296 (0.08671) [-1.64113] | -0.016135 (0.02338) [-0.69019] |
| D(MPMSLN(-1)) | 0.032749 (0.07459) [0.43907] | 0.417853 (0.19290) [2.16616] | -0.184098 (0.05201) [-3.53961] |
| D(MPMSLN(-2)) | -0.147500 (0.07322) [-2.01454] | 0.081233 (0.18936) [0.42899] | -0.169005 (0.05106) [-3.31019] |
| C | 0.009139 (0.01126) [0.81149] | 0.082626 (0.02913) [2.83693] | -0.008159 (0.00785) [-1.03893] |
| R-squared | 0.206159 | 0.280468 | 0.101551 |
| Adj. R-squared | 0.184786 | 0.261096 | 0.077362 |
| Sum sq. resids | 8.255616 | 55.21959 | 4.014350 |
| S.E. equation | 0.178192 | 0.460850 | 0.124257 |
| F-statistic | 9.645926 | 14.47803 | 4.198207 |
| Log likelihood | 86.05697 | -168.5999 | 182.6734 |
| Akaike AIC | -0.582515 | 1.317909 | -1.303533 |
| Schwarz SC | -0.475321 | 1.425103 | -1.196339 |
| Mean dependent | 0.004929 | 0.031819 | -0.008218 |
| S.D. dependent | 0.197357 | 0.536125 | 0.129362 |

| | |
|---|-----------|
| Determinant resid covariance (dof adj.) | 0.000102 |
| Determinant resid covariance | 9.30E-05 |
| Log likelihood | 103.1434 |
| Akaike information criterion | -0.568235 |
| Schwarz criterion | -0.206456 |

Appendix IV: Multiple Linear Regression Analysis of ROA and Macroeconomic Variables and Time

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|--------------------|-------------|-----------------------|-------------|----------|
| C | 1260.954 | 382.2746 | 3.298554 | 0.0215 |
| GDPCAPLN | 6.363760 | 2.562101 | 2.483806 | 0.0556 |
| ANNUALIRLN | -0.653365 | 0.343990 | -1.899373 | 0.1160 |
| INTRATESLN | 1.615986 | 0.964349 | 1.675726 | 0.1546 |
| I_YEAR | -0.648161 | 0.197891 | -3.275343 | 0.0221 |
| R-squared | 0.955616 | Mean dependent var | | 3.831000 |
| Adjusted R-squared | 0.920109 | S.D. dependent var | | 0.816462 |
| S.E. of regression | 0.230773 | Akaike info criterion | | 0.212090 |
| Sum squared resid | 0.266281 | Schwarz criterion | | 0.363382 |
| Log likelihood | 3.939552 | Hannan-Quinn criter. | | 0.046122 |
| F-statistic | 26.91332 | Durbin-Watson stat | | 1.949963 |
| Prob(F-statistic) | 0.001407 | | | |

Appendix V: NACOSTI Introduction Letter



KABARAK UNIVERSITY
OFFICE OF THE DIRECTOR
INSTITUTE OF POST GRADUATE STUDIES

Private Bag - 20157
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17th May 2022

The Director General
National Commission for Science, Technology & Innovation (NACOSTI)
P.O. Box 30623 – 00100
NAIROBI

Dear Sir/Madam,

RE: NELLY CHELANGAT MUTAI – GDB/M/0806/05/19

The above named is a student at Kabarak University. She is carrying out a research entitled “*Moderating Effect of Financial Innovations on the Relationship between Macroeconomic Factors and Financial Performance of Commercial Bank in Kenya*”.

The student has been granted ethical clearance by Kabarak University Research Ethics Committee and is ready to undertake field research.

Kindly provide the student with a research permit to enable her to undertake the research.

Thank you.

Dr. Wilson O. Shitandi
DIRECTOR, POSTGRADUATE STUDIES



Kabarak University Moral Code

As members of Kabarak University family, we purpose at all times and in all places, to set apart in one's heart, Jesus as Lord. (1 Peter 3:15)



Kabarak University is ISO 9001:2015 Certified

Appendix VI: NACOSTI Research Permit


REPUBLIC OF KENYA


**NATIONAL COMMISSION FOR
SCIENCE, TECHNOLOGY & INNOVATION**

Ref No: **773130** Date of Issue: **13/July/2022**

RESEARCH LICENSE



This is to Certify that Ms., NELLY CHELANGAT MUTAI of Kabarak University, has been licensed to conduct research in Bomet on the topic: MODERATING EFFECT OF FINANCIAL INNOVATIONS ON THE RELATIONSHIP BETWEEN MACROECONOMIC FACTORS AND FINANCIAL PERFORMANCE OF COMMERCIAL BANKS IN KENYA for the period ending : 13/July/2023.

License No: **NACOSTI/P/22/18687**

773130
Applicant Identification Number


Director General
**NATIONAL COMMISSION FOR
SCIENCE, TECHNOLOGY &
INNOVATION**

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Appendix VII: KUREC Clearance Letter



KABARAK UNIVERSITY RESEARCH ETHICS COMMITTEE

Private Bag - 20157
KABARAK, KENYA
Email: kurec@kabarak.ac.ke

Tel: 254-51-343234/5
Fax: 254-051-343529
www.kabarak.ac.ke

OUR REF: KABU01/KUREC/001/04/05/22

Date: 13th May, 2022

Nelly Chelangat Mutai,
Kabarak University,

Dear Nelly,


RE: MODERATING EFFECT OF FINANCIAL INNOVATIONS ON THE RELATIONSHIP BETWEEN MACROECONOMIC FACTORS AND FINANCIAL PERFORMANCE OF COMMERCIAL BANKS IN KENYA

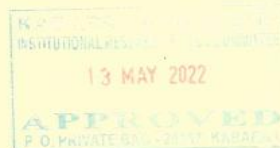
This is to inform you that **KUREC** has reviewed and approved your above research proposal. Your application approval number is **KUREC-040522**. The approval period is **13/05/2022 – 13/05/2023**.

This approval is subject to compliance with the following requirements:

- i. All researchers shall obtain an introduction letter to NACOSTI from the relevant head of institutions (Institute of postgraduate, School dean or Directorate of research)
- ii. The researcher shall further obtain a RESEARCH PERMIT from NACOSTI before commencement of data collection & submit a copy of the permit to **KUREC**.
- iii. Only approved documents including (informed consents, study instruments, MTA Material Transfer Agreement) will be used
- iv. All changes including (amendments, deviations, and violations) are submitted for review and approval by **KUREC**;
- v. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to **KUREC** within 72 hours of notification;
- vi. Any changes, anticipated or otherwise that may increase the risk(s) or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to **KUREC** within 72 hours;
- vii. Clearance for export of biological specimens must be obtained from relevant institutions and submit a copy of the permit to **KUREC**;
- viii. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal and;
- ix. Submission of an executive summary report within 90 days upon completion of the study to **KUREC**

Sincerely,


Prof. Jackson Kitetu PhD.
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(1 Peter 3:15)



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Moderating Effect Of Financial Innovations On The Relationship Between Interest Rates And Financial Performance Of Commercial Banks In Kenya

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ABSTRACT

Profitability of commercial banks in Kenya have been declining since 2010 which was largely attributed to macro-economic factors, fiscal policies introduced by central bank of Kenya and market activities such as issuance of bonds and capping of interest rates. There has also been increased integration due to embracement of financial innovations in the banking sector however the moderating effects of Financial innovations on the relationship between GDP per capita and financial performance is still uncertain. The objective of this study was to investigate the moderating effect of financial innovation on the relationship between interest rates and financial performance of commercial banks in Kenya. The study was based on two theories: Interest parity theory and Constraint Induced Financial Innovation Theory. The study utilized secondary data for 10-year period as from 2011 to 2020. The target population of the study was 42 commercial banks that are licensed and supervised by the Central Bank of Kenya. Secondary panel data on financial performance of Commercial Banks was obtained from the individual institutions' financial reports while data on macroeconomic factors will be obtained from both Central Bank of Kenya and Kenya National Bureau of Statistics. Return on assets was used to measure financial performance. The study found a moderating effect of interest rates on financial performance of commercial banks in Kenya ($b = -5.292$, $t = -2.202$, $p = 0.028$). This study concludes that when a bank's innovations are at the highest, it can achieve a very high Return on assets even when it keeps its interest rates very low. The study recommends that banks should implement the highest degree of innovations, which will enable them achieve very high Return on assets even when they keep their interest rates very low.

Keywords: Financial Innovations, Interest rates, Financial Performance, Commercial Banks.

INTRODUCTION

Background of the study

Commercial Banks play an important role in the economic resource allocation of countries and contribute to economic growth of the country by making funds available for investors to borrow as well as financial deepening in the country (Gikombo., & Mbugua, 2018). The banking sector is the backbone of every country's economy in the world. It implements and brings about economic reforms. Any change in this sector through technology has a sweeping impact on any country.

According to European Commercial Bank 2003, the definition of financial innovation is described as a factor which creates cost reduction in a product and the organization which are mainly banks or other service sector. According to Akhavein et. al. (2005) there are three types of financial innovations: institutional innovation, process innovations and product innovations. Macroeconomic variables are the elements that typify the national economy and business environment. In an economy, these macroeconomic factors are not within the influence of one individual firm (Brueggeman & Fisher, 2011). Macroeconomic variables influence the complexity and volatility of the business setting (San & Heng, 2013). Due to increasing globalization and technological advances, economic turbulence in other (international) economies might creep into the local business environment. In this era of globalization, it is important for financial institutions to be

Moderating Effect of Financial Innovations on the Relationship Between GDP Per Capita and Financial Performance of Commercial Banks in Kenya

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Abstract

Profitability of commercial banks in Kenya have been declining since 2010 which was largely attributed to macro-economic factors, fiscal policies introduced by central bank of Kenya and market activities such as issuance of bonds and capping of interest rates. There has also been increased integration due to embracement of financial innovations in the banking sector however the moderating effects of financial innovations on the relationship between GDP per capita and financial performance is still uncertain. The objective of this study was to investigate the moderating effect of financial innovation on the relationship between GDP per capita and financial performance of commercial banks in Kenya. The study was based on two theories: Keynesian Economics theory and Constraint Induced Financial Innovation Theory. The study utilized secondary data for 10-year period as from 2011 to 2020. The target population of the study was 42 commercial banks that are licensed and supervised by the Central Bank of Kenya. Secondary panel data on financial performance of Commercial Banks was obtained from the individual institutions' financial reports while data on macroeconomic factors was obtained from both Central Bank of Kenya and Kenya National Bureau of Statistics. Return on assets was used to measure financial performance. The study found a significant and positive relationship ($b=0.594$, $t=2.939$, $p=0.022$) between GDP per capita and ROA. The study found no moderating effect of financial innovations on the relationship between GDP per capita and financial performance of commercial banks. The study recommends that banks should implement the highest degree of innovations, which will enable them achieve very high ROA.

Keywords: *Financial Innovations, GDP per capita, Financial Performance, Commercial Banks, Moderating effect.*

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Appendix IX: Evidence of Conference Participation

