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Effect of Exchange rate, Gross Domestic Product, Real Interest rate and Inflation on Banking Financial Stability in Kenya

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Abstract

Financial institutions and markets are the backbone of any economy and the banking sector is the most important engine for economic growth development of any country. Kenya has a vibrant banking sector and well regulated, however it has had a history of bank failures, with about thirty-seven banks failing between 1986 to 1998. In 2015, three Kenyan banks were placed under statutory management due to financial distress. The stability of commercial banks in Kenya has not been that robust. With financial openness and liberalization, financial stability issues in the banking industry in relation to the macroeconomic environment has become a concern. It was therefore vital to investigate the relationship between macroeconomic variables and financial stability. Specifically, the objectives of the study were to; determine effect of real Gross Domestic Product (GDP) on banking financial stability; Examine the effect of real interest rates on banking financial stability; Evaluate the effect of exchange rates on banking financial stability; Determine the effect of inflation on banking financial stability in Kenya. The study was anchored on the Mundell-Fleming Model also known as AD-AS-IS-LM-BOP framework. The study was quantitative in nature and adopted a positivist research philosophy, having a correlational design using the econometric methodology. The study used the Autoregressive Distributed Lag Model Cointegration and error correction; Variance decomposition and impulse response in its data analysis. Data presentation was done by use of tables and graphs. The findings indicate existence of both long run and short run relationship between the exchange rate, GDP, real interest rate, inflation and Banking financial stability in Kenya. The error correction coefficient was estimated to be -0.2122 (0.0025) and significant, and this implies that there is a fairly 21% of speed of adjustment to equilibrium after a shock. The Variance decomposition and Impulse response indicates that exchange rate and GDG has a large effect on financial stability as compared to Real interest rate and inflation rate. The results further indicate that financial stability in the sector depends so much on the previous year's performance, this has been attributed to the regulatory framework in the sector. The study recommends that the regulator continues to lay the macro prudential regulations to maintain the stability of the sector. Secondly, the central bank needed to grow its exchange rate reserves if it were to face down the threat of external and internal drains on the exchange rate that later has an in effect to financial stability. Thus, reserve adequacy has to be gauged against the size of the banking sector.

Keywords: Exchange rate, GDP, Financial Stability

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1.1 Introduction and Background of the study

World over, financial institutions and markets are the backbone of any economy and the banking sector is the most important engine for economic growth development of any country. Financial intermediaries are major sources of funding for businesses; they enhance economic growth, and contribute to financial stability against the shocks of financial crises.

In Africa, Commercial banks dominate the Financial Sector and therefore have a tremendous impact on the economic growth and financial stability of any Country. Flamini et al. (2009) indicated that studies carried out in the last two decades show commercial banks in the Sub-Sahara Africa are more profitable with an average return on Asset of 2%. According to Ouma and Muriu (2014), commercial banks performance is critical to the growth of the industry, which contributes to an economy's prosperity as a whole.

Kenya has a vibrant banking sector and well regulated. In spite of the aforementioned, the stability of commercial banks in Kenya has not been that robust. Kenya has had a history of bank failures, with about thirty-seven banks failing between 1986 to 1998 (Kithinji & Waweru, 2007; Ngugi, 2001). In 2015, three Kenyan banks were placed under statutory management due to financial distress (Gathaiya, 2017**).** It's important to study the relationship between the exchange rate, inflation rate, real interest rate and gross domestic product and financial stability in Kenya.

After the economic consequences of the global financial crisis that occurred in 2008-2009, this prompted an assessment of the nexus between macroeconomic developments and banking financial sector stability. Monitoring and evaluation of the exogenous and endogenous factors and risks to financial stability has gained prominence and particularly led to the need to better understand the way in which how the macroeconomic factors may have influenced the vulnerabilities in the sector over time and resulted to banking sector crises and compromised the banking sector stability. The changes in exchange rate, inflation rate, real interest rate, Gross domestic rate have a diverse effect across the economic spectrum, however this has not been studied and therefore it's important to study how the changes in the mentioned variables affect the banking financial stability in emerging markets like Kenya.

The exchange rate is a critical determinant of an economies performance, as it influences international trade, investment, and capital flows. In Kenya, a significant portion of the economy relies on imports and exports, making exchange rate fluctuations particularly relevant to the banking sector. Changes in the exchange rate can impact the profitability of banks, the value of their assets and liabilities, and their ability to manage currency risks. On the other hand, Interest rates are fundamental to the functioning of the banking sector, as they determine the cost of borrowing and the return on savings and investments. In Kenya, the Central Bank sets monetary policy rates, which influence the interest rates charged by commercial banks. Fluctuations in interest rates can affect the profitability of banks, the demand for credit, and the overall stability of the banking system. There is no known empirical study to show how the macroeconomic variables affect the financial stability of the sector.

Inflation erodes the value of money, reduces purchasing power, and distorts economic decision-making. Inflation has been a persistent challenge in Kenya, impacting on the cost of living and business operations. Banks must adapt to inflationary pressures by adjusting their lending rates, managing liquidity, and implementing risk management strategies in the long run it may have an effect on financial stability. Economic growth on the other hand is closely linked to banking stability, as it reflects the overall health and performance of the economy. A sustained economic growth has fueled demand for banking services, driving expansion and innovation within the sector. However, economic growth can also pose challenges, such as increased credit risk, asset price volatility, and regulatory pressures.

Understanding the interplay between exchange rate dynamics, interest rate movements, inflationary pressures, and economic growth is essential for assessing the stability of the banking sector in Kenya. By examining how these factors interact and influence banking performance, policymakers, regulators, and industry stakeholders can develop strategies to enhance financial stability, promote sustainable growth, and mitigate systemic risks.

The analysis of systemic risks within a macro prudential policy framework requires effective understanding of the factors in the macroeconomic environment that may trigger distress in banking institutions and propagate risks to the whole banking system. The issue often faced by the policy makers, economist is determining the empirical characterization of how a change in either real GDP, inflation, unemployment, interest rate, exchange rate is translated into changes in indicators of banking system stability, as this has not been done in emerging economies and Kenya in particular.

In the monitoring of financial stability, most central monetary authorities rely on qualitative analysis based around Financial Stability Indicators (FSIs). While FSIs are a useful diagnostic for the current health of financial institutions, they fail to quantify possible inter-relationships with the macro economy and to be specific the exchange rate, inflation rate, real interest rate, GDP and the shocks that may stress financial institutions.

Scenario-based stress-testing frameworks are often used as a vehicle for the latter, although a major limitation is the over-reliance on ad hoc judgement in framing the scenarios and on the transmission mechanism. This study employs the macro econometric tools to assess the empirical characterization of the exchange rate, inflation rate, real interest rate, Gross domestic product and financial stability and come out with the transmission mechanism between the variables of the study.

1.2 Statement of the Problem and Objectives of the study

Following the global financial crisis more financial institutions in different parts of the world failed. Some governments together with their central monetary authorities became proactive in the market in an attempt to rescue their banks and other sectors of the economy. Central Banks become more active as market stabilizers and regulators, this has influenced the internal operations of most banks but left out the external environment of banks. In recent years, Kenya's banking industry has been subjected to various macroeconomic factors due to financial openness and liberalization environment in the sector, there is no known knowledge on the interaction and effect of exchange rate, real interest rate, GDP and inflation on financial stability in the industry. Furthermore, their specific nature and extent of their effects in the Kenyan context remain unclear.

Therefore, this study aims to investigate and provide a comprehensive empirical understanding of the dynamic interplay between Exchange rate, Real interest rate, inflation, economic growth and banking financial stability in Kenya.

Specifically, the objectives of the study were to;

i. Determine effect of real Gross Domestic Product (GDP) on banking financial stability in Kenya.
ii. Examine the effect of real interest rates on banking financial stability in Kenya.
iii. Evaluate the effect of exchange rates on banking financial stability in Kenya
iv. Determine the effect of inflation on banking financial stability in Kenya

Research Hypothesis

In order to achieve the objectives of the study, the following hypotheses were being tested:

H_{01} : There is no significant effect of real Gross Domestic Product (GDP) on banking financial stability in Kenya.

H_{02} : There is no significant effect of real interest rates on banking financial stability in Kenya.

H_{03} : There is no significant effect of exchange rates on Banking financial stability in Kenya.

H_{04} : There is no significant the effect of inflation on banking financial stability in Kenya.

1.3 Significance of the Study

Given the increasing changing macroeconomic environment in the world, Africa and Kenya to be specific, the study is important in determining the empirical linkage and transmission between the macroeconomic factors and banking financial stability. Thus the empirical long run equilibrium and error correction mechanism together with causality relationship (transmission mechanism) between the macroeconomic variables and banking financial stability will be of importance to the Policy Makers, Academia, Central Monetary Authority (Central Bank) and Treasury (Ministry of Finance and Planning) in trying to balance between the macroeconomic stability and financial institutions stability. This will enable the country to use the appropriate policy mix both in the short-run and long-run in detection and avoiding financial crisis.

1.4 Scope and limits of the Study

The study was carried out in Kenya. It targeted the banking industry which comprised all commercial banks in Kenya. The study used data between 1991- 2021.It's important to note that Kenyan financial stability index that is z-score started being calculated in 1991. Thus the study duration was pegged on availability of data. The study was limited to the use of secondary data from world bank, Central bank of Kenya and Kenya National Bureau of Statistics data bases. These data sources are the most reliable and valid sources in economics.

1.5 Theoretical Framework of the Study

The study was anchored on the Mundell-Fleming Model also known as AD-AS-IS-LM framework. This framework entails a detailed monetary sector and how it relates to the other sectors of the economy. This was made possible by the flexibility provided by the macro econometric type models in terms of their application and ability to describe relationship based on economic theory.

From figure 1 below, Money market is depicted in Quadrant I; AD-AS is depicted in Quadrant II, foreign exchange market is shown in Quadrant III and lastly Quadrant IV depicts the internal and External balance.

Quadrant I: Goods/Product and the Money Market

The IS curve is a combination of levels of interest rate (r) and output (Y) at equilibrium in the goods market. The negative sloping of the IS curve indicates that the higher the interest rates the less the investment spending, which in turn reduces aggregate demand and income. On the other hand, the LM curve shows a combination of interest rates and output derived in the money market at equilibrium. This occurs when money demand equals money supply. The demand for money is demand for real balances. The LM curve is upward sloping, indicating that demand for real balances increases with increases in income when the money supply is fixed. Goods and Money market are at equilibrium when IS and LM curve intersects.

Quadrant II: Aggregate Demand and Aggregate Supply

The AD and AS curves intersect at a general equilibrium price level. The AD curve is derived from the IS–LM equilibrium income at different price levels. The AS curve reflects the economy's price adjustment mechanism. The AS curve is positively/upward sloping in the short run but vertical in the long run, as it is expected that equilibrium in the labor market remains the same at different price levels. The labor market does not respond to surprises, this makes it to be upward-sloping AS curve in the short run, this is attributed to nominal rigidities such as the sticky wages.

Quadrant III: The Foreign Exchange Market

In the model, we assume an open economy and therefore a floating exchange rate regime. In the foreign exchange market, In this model we assume exchange rate, E, to be endogenous variable, whereas the domestic interest rate (rd), the foreign interest rate (rf), the expected exchange rate Ee, domestic prices (Pd) and foreign prices (Pf) are all assumed to be exogenous variables. The value of the equilibrium exchange rate is affected by domestic and foreign rates of return in the market.

Quadrant IV: The Balance of Payments

The Balance of payment internal equilibrium is attained through

$$Y = C(y) + I(r) + G + X(e) - Z(e,Y) \quad (1.1)$$

And

$$Ms/p = L(r) + k(y) \quad (1.2)$$

To gain the appreciation of the exchange rate, e, it requires a reduction in the government expenditures in order to attain the internal equilibrium. An appreciation of exchange rate worsens the current account balance position but increases output (Y) through the multiplier effect. In order to counteract the change in Y, government spending has to decline. An external balance is attained through the balance-of-payments (BOP) equilibrium of an open economy. This may be defined by

$$BOP = X(p,e,y) - Z(p,e,y) - F(r) \quad (1.3)$$

In this Quadrant IV, the balance of payments is assumed to be endogenous and other variables such as prices (P), the exchange rate (E) and income (output) (Y) are assumed to be exogenous. It needs to be noted that as government spending rises, trade deficits and hence balance-of-payments deficits also rises. As a consequence, the government must utilize its foreign reserves to maintain the exchange rate.

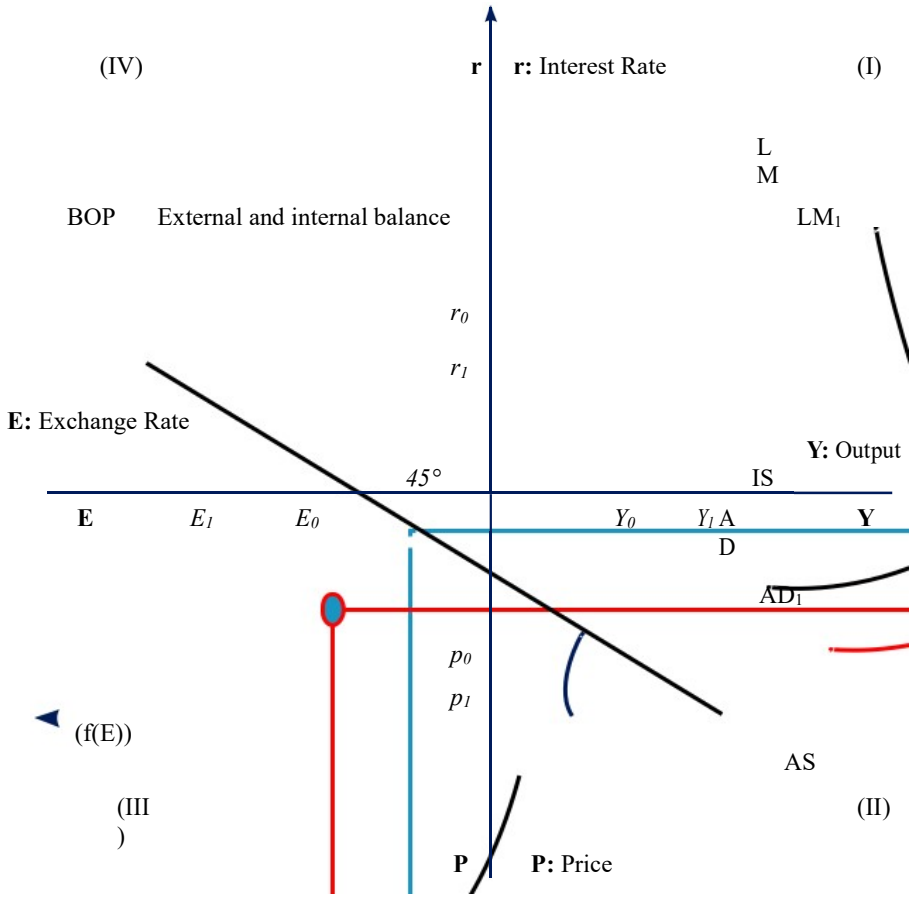

Figure 1.1: Quadrants for AD-AS-IS-LM-BOP Framework

2.Literature Review

2.1 Introduction

Literature review on macroeconomic variables and financial stability reveals a substantial body of research that explores how various economic factors can impact the stability of financial systems. Financial stability is a crucial aspect of a well-functioning economy, as disruptions in the financial sector can have far-reaching consequences for economic growth and overall prosperity. These section provides an overview of some key findings and trends in this literature by looking at the theoretical underpinnings of financial stability; empirical literature for both financial stability and macroeconomic factors and the gaps to be filled.

2.2 Theoretical Literature Review

The theoretical literature review helps the study to provide an explanation of phenomena that explains existing knowledge on the topic of interest. It explains how theories support the study and some of the assumptions that have been adopted. No single theory has come out to explain and give an account for the concept of macroeconomic factors and financial stability. Various institutions and academicians have come up with financial stability frameworks. Some frameworks have been formulated from an academic point of view with limited attention to policy implications (Mishkin, 1999, and Davis, 2002). Crockett (1996) provides an extensive survey of the underling literature.

Mishkin (1996) study explores the theoretical underpinnings of financial crises and the role of macroeconomic policies in maintaining stability. He points out that the asymmetric information analysis has helped in

understanding the structure of the financial system and the rationale for bank regulation in developing a theory of banking and financial crises. The theory was created to explain banking and financial crises mostly in the developed country context, particularly for the United States. However, the institutional framework in the U.S. has been quite different from that existing currently in many developing countries, and thus, it required modification to understand the banking and financial crises phenomena in developing countries.

According to Lindgren and Folkerts-Landau (1998) in their study titled "Towards a framework for Financial stability" notes that an unstable macroeconomic environment is a principal source of vulnerability in the financial system. The continue to indicate that significant swings in the performance of the real economy, and volatile interest rates, exchange rates, asset prices, and inflation rates make it difficult for banks to assess accurately the credit and market risks they incur. They conclude that banks in most developing and transition economies have limited scope to diversify these risks as much as is possible in industrial economies.

Houben, Kakes, and Schinasi (2004), examines the emergence of financial stability as a key policy objective. They developed a framework that seeks to integrate the analytical and policy elements of financial stability by building on the characteristics of finance and the definition of financial stability. They note that it all revolved around an assessment that brings together macroeconomic, monetary, financial market, supervisory and regulatory input. Their framework's objectives was to provide a logical and consistent structure for the analysis of financial stability issues in order to: (i) foster an early identification of potential vulnerabilities; (ii) promote preventative and timely remedial policies to avoid financial instability; and (iii) resolve instabilities when preventative and remedial measures fail.

Houben, Kakes, and Schinasi (2004) framework goes beyond the traditional 'shock-transmission' approach that is the basis of most policy-oriented frameworks. The focus is on identifying and dealing with the build-up of vulnerabilities prior to downward corrections in markets, problems within institutions or failures in financial infrastructure. The assumption implicit in this approach is that the shocks that may eventually trigger such adjustments are usually less relevant by themselves.

2.3 Empirical Literature

2.3.1 Literature Review on the Kenyan Banking Industry

According to Beck and Fuchs, (2004), Kenya has a well-developed financial system for a country of its income level in the Sub-Saharan Africa. Allen et al (2012) indicates that the Kenyan level of financial development is not too off from the predicted level in a global cross-country model. A Study by Christensen (2010) classifies Kenya as a frontier market economy whose financial market is advanced but not the same as those of emerging markets like South Africa. Mwega (2016) concludes that its therefore unlikely that the size of Kenya's financial sector is beyond the threshold to negatively impact on economic growth.

The financial system in Kenya is organized along conventional lines. The system consists of the Central Bank, the commercial banks and the non-bank financial institutions licensed under the Banking Act, building societies, development finance companies funded mainly by government and external development agencies, a Post Office Savings Bank, a National Social Security Fund, insurance companies, pension funds, and a stock exchange, (Mullei and Ng'elu,1990).

Immediately after independence in 1963, locally owned banks were established, namely, the Central Bank of Kenya (1966), the Co-operative Bank of Kenya (1968) and the National Bank of Kenya (1968). In the period 1980-1986, the number of commercial banks continued to increase. In 1986 the commercial banks in Kenya were 24, 15 being foreign owned banks *(ibid)*.

The Banking industry in Kenya is highly competitive with 38 banking institutions, 14 microfinance banks and 97 non- banking financial institutions. Of these ten (10) are listed and account for more than 75% of market share based on assets. Kenya Commercial Bank and Equity lead with 41% market share due to the increase in financial inclusion levels and a growing economy. The Bank in Kenya have seen their asset base grow at a CAGR of 10.5% over the period 2016-2021 to KES 6.0Tn. and Thus, the state of the Kenyan banking sector reflects the interplay between the state of the economy, the broader macroeconomic policy and regulatory environment.

Kirimi, Kariuki and Ocharo (2022) in their study on effect of financial soundness on financial performance of commercial banks in Kenya using the dynamic panel model analyzed data from commercial banks for the period

2009 to 2020. The study being modelled on the concept of CAMEL using the five CAMEL variables as financial soundness indicators and Four indicators that is, net interest margin (NIM), earnings per share (EPS), return on assets (ROA) and return on equity (ROE) being used as used as measures of financial performance. The findings established that that financial soundness had a statistically significant effect on NIM, ROA and ROE. It was also found that asset quality and earning quality had a statistically significant effect on net interest margin. It also indicated that management efficiency had significant effect on ROE. While the study looked at the financial soundness and performance of banks it never looked at the relationship between macroeconomic variables and financial stability of the industry as a whole.

A study done in Kenya by Cherotich, et al 2015, on financial innovation on financial performance, the results indicated there is a strong relationship between the variables mentioned. They concluded that that financial innovations positively affect financial performance. Based on these results, the study recommends that financial innovation information should be available particularly to regulatory and advisory bodies for guidance to the commercial banks on the need to craft and employ sound strategies geared towards continuously embracing innovativeness since innovation leads to improved financial performance. While the authors looked at financial innovation and performance they never looked at macroeconomic factors vs the financial stability in Kenya which has an impact on financial innovation.

The main purpose of the study by Kamande,(2017) was to determine the effects of bank specific factors on the financial performance of commercial banks in Kenya. The scope being between 2011-2015 using the 11 listed banks on the Nairobi Security Exchange. In his study the dependent variable was return on assets (ROA). The independent variables were capital adequacy, asset quality, management efficiency, earnings ability and liquidity. These variables were bank specific factors that affect the banks' financial performance. Data was analyzed using multiple linear regression models. The results showed that there was positive and significant association between ROA and all the independent factors. The results showed that there has been a significant decrease in capital adequacy during the five-year period. There was also a finding that asset quality affects profitability and the financial performance of banks. The study concludes that Asset quality of the bank have the highest influence on ROA of banks. While the study attempts to look at bank specific factors affecting the financial performance, he didn't look at the external factors which happen to be macroeconomic factors.

In a study investigating the effect of Internal Controls on Financial Performance of Commercial Banks in Kenya adopting a descriptive research and using 43 commercial banks in Kenya. The study findings indicated that the banking industry enjoys a strong financial performance partly because of implementing and maintaining effective internal controls and the existence of effective internal control was attributed to the highly regulated and structured environment in the sector (Asiligwa and Rennox, 2017) while study the was done in the banking industry in Kenya, it focused more on the internal controls and left out the macroeconomic factors that affect the banking stability and performance at large.

A project by Ng'ang'a, (2017), whose objective was to determine the impact of the capping interest rates on the financial performance of commercial banks in Kenya. While adopting a descriptive research design and using all the 42 banks at the time, found out that the financial performance of banks as measured by Return of Equity was negatively affected by the introduction of capping of interest rates in the country. Asset quality which was measured by Non Performing Assets ratio was found to have a negative relationship with Return on Equity and hence the higher the Non Performing Assets ratio the lower the Return on Equity. Operating efficiency as measured by operating costs to total operating income was found to have a negative relationship to Return on Equity since the higher the operating costs vis a vis the operating income, the lower the Return on Equity. The conclusion of the project was that the interest rate spread had a negative impact on the financial performance of commercial banks in Kenya. The point of departure with the current study is that the Ng'ang'a never looked at different macroeconomic variables including GDP, exchange rate and inflation.

Ahmed (2015) in his study about firm exposure to exchange risk in selected banks listed on NSE in Kenya and utilizing descriptive design. The study found that first, interest rates had an insignificant positive effect on commercial bank performance, secondly, foreign exchange exposure has negative effect on the performance of listed commercial banks in Kenya and finally, inflation has negative effect on bank performance. The point of departure with the current study is that Ahmed used selected banks that doesn't represent the banking industry, secondly he omitted important macroeconomic variables like GDP. The current study is a macro study looking at all the essential variables and the banking industry as a whole.

Murerwa (2015), studied the determinants of banks' financial performance in developing economies with a focus

on Kenyan commercial banks. He sought to answer three questions which were; what are the industry specific factors that influence the financial performance of commercial banks in Kenya? what are the firm specific factors which influence the financial performance of the commercial banks? The last research question was; what are the macroeconomic which influence the financial performance of the commercial banks? Using the descriptive research design with a population of 44 commercial bank licensed to operate in Kenya at that date. The findings indicated that industry specific factors relating to competition, product innovation and the development of mobile banking mostly affected the profitability of the banks; On firm specific factors influencing bank performance, the distribution networks, information systems and strategic positioning were regarded as key bank specific determinants of profitability. The same was seen with capital adequacy and management efficiency; In relation to the macro-economic factors, the study reviewed that they had least impact on profitability because they have been relatively stable. However, volatility in interest and exchange rates had some considerable impact on profitability. While this study tried to bring in macroeconomic factors, the scholar never compared the variables with financial stability, It's important to note that financial stability is totally different to profitability of banks.

2.3.2 Financial Stability

In the last two decades, financial stability has become a policy priority. Despite the efforts made the policy makers and academicians are still having a problem in developing a satisfactory operational framework. Crockett (2000) and Borio (2003a) notes that any operational financial stability framework would have a "macroprudential", as opposed to "microprudential", orientation. This orientation was defined by two characteristics that follow from the nature of financial instability. The first one is the focus on the financial system as a whole as opposed to individual institutions, paying particular attention to the costs of instability in terms of the real economy; secondly, relying on a notion of risk that stresses the potentially destabilizing effects of the collective behaviour of economic agents, i.e. what might be termed the "endogenous" nature of risk.

According to Borio, C., & Drehemann, M. (2010) Most definitions of financial stability share three useful elements. First they focus on the financial system as a whole, as opposed to individual institutions. Second, they do not consider the financial system in isolation, but ultimately measure the economic (welfare) benefits and costs in terms of the "real economy" (economic activity). Third, they make an explicit reference to financial instability, the converse of stability, which is more concrete and observable.

According to Haldane (2004) Some definitions are very broad, including any allocative distortions arising from financial "frictions" relative to an ideal benchmark; others are more restrictive, like Mishkin (1999) focusing on the absence of episodes of acute distress and significant disruptions to the functioning of the system. Some highlight the robustness of the financial system to external shocks (eg, Allen and Wood (2006), Padoa-Schioppa (2003)); others cover the possibility that the financial system may itself be a source of shocks (eg, Schinasi (2004)). Some tie the definition closely to the equally common but elusive notion of "systemic risk" (eg, Group of Ten (2001), De Bandt and Hartmann (2000)); others avoid it.

Aikman, Haldane, Hinterschweiger and Kapadia, (2019) indicate that global financial crisis has prompted for a complete rethink of financial stability and policies for achieving it. They provided an overview of the state of progress of these reforms, and assess whether they have achieved their objectives and where gaps remain. They find out that additional insights gained since the start of the reforms paint an ambiguous picture on whether the current level of bank capital should be higher or lower. In addition, they present new evidence that a combination of different regulatory metrics can achieve better outcomes in terms of financial stability than reliance on individual constraints in isolation. They discuss in depth several recurring themes of the regulatory framework, such as the appropriate degree of discretion versus rules, the setting of macro prudential objectives, and the choice of policy instruments and suggest for future research and policy, including on models of financial stability, market-based finance, the political economy of financial regulation, and the contribution of the financial system to the economy and to society.

Atellu, (2021) in his thesis contributes to growing literature on financial stability by investigating the trade-offs or synergies between inclusive finance, bank regulation, bank concentration and financial stability in Kenya between the period 1990-2017. He used Structural Equation Model (SEM) technique in uncovering the determinants of financial stability. The findings reveal that financial access and usage play a significant role in ensuring stability of the financial system. Specifically, deposit mobilization, opening of branches and automated teller machines (ATMs) in rural areas, internet banking and utilization of electronic systems fosters financial stability. It also indicated that inflation, credit growth and real interest rate negatively affects financial stability. In addition, the study also established that micro and macro prudential regulations affect financial stability.

While this study tried to look at the factors affecting financial stability he left out the most important macroeconomic variables e.g GDP, Inflation, exchange rate and interest rate.

In a study that sought to identify the bank-specific determinants of commercial banks financial stability in Kenya between the periods 2000-2015, by examining the effect of; regulatory capital, credit exposure, bank funding, bank size and corporate governance variables on banks financial stability. The Altman's Z-Score plus Model was adopted as a measure of banks financial stability. The study used all the banks licensed by Central Bank of Kenya. The study adopted the panel regression to capture both cross sectional and longitudinal data characteristics. Specified panel regression model for fixed effects supported by the Hausman test results was estimated. Panel Generalized Method of Moments (GMM) regression. The results indicated that bank size, regulatory capital; bank funding and corporate governance had a positive and statistically significant effect on financial stability for commercial banks in Kenya. However, credit exposure was found to have negative and statistically significant effect on financial stability for commercial banks in Kenya. Based on these findings the study concluded increase in bank size, regulatory capital, bank funding and corporate governance boasted financial stability for commercial banks in Kenya. On other hand increase in credit exposure lowered the financial stability for commercial banks (Kiemo, Olweny, Muturi and Mwangi,2019).

A study in Kenya by Ndinda, M. (2023), with the objective of establish the link between firm specific factors and commercial banks financial stability in Kenya employing explanatory design with forty (40) commercial banks. While using descriptive statistics and linear regression techniques with various diagnostic tests application the study found that capital adequacy, operational have no significant effect on financial stability of commercial banks in Kenya. It as also established that credit size, earnings have a significant effect on financial stability of commercial banks in Kenya. The point of departure with the current study is that it centered on firm specific factors and how they affect financial stability leaving out the macroeconomic factors.

Odundo and Orwaru (2018) in contributing to the financial stability, established whether or not bank size has a significant effect on financial stability of commercial banks in Kenya. The study used return on assets (ROA) as a measure of financial stability, controlling for the banks' loan portfolio, capital strength and reliance on deposits. The study used a correlation research design targeting the ten (10) listed commercial banks listed at the Nairobi Securities Exchange (NSE).The results indicated that that bank size has a significant negative effect on bank stability thus, supporting the too big to fail hypothesis. Their findings also confirmed that bank capital has a significant positive effect on stability. On the other hand, the banks' loan portfolio was found to have a significant positive effect while reliance on deposit was established to be negative and insignificant with the banks' soundness. The point of departure from this study is that the scholars only picked the listed banks and that doesn't represent the industry. Secondly, ROA cannot be used to measure the financial stability of the industry.

2.3.3 Macroeconomic Variables

The empirical literature on macroeconomic factors and financial stability has attracted several studies, but so far, the empirical evidences have yielded mixed and inconclusive results. Guerrieri and Welch (2012) in their study 'Can macro variables used in stress testing forecast the performance of banks?" they indicate when stress tests for the banking sector use a macroeconomic scenario, an unstated premise is that macro variables should be useful factors in forecasting the performance of banks. They assess whether variables such as the ones included in stress tests for U.S. bank holding companies help improve out of sample forecasts of charge offs on loans, revenues, and capital measures, relative to forecasting models that exclude a role for macro factors. Using only public data on bank performance. The findings indicate that macro variables are helpful, but not for all measures.

Costeiu and Neagu (2013) build a macro-prudential tool designed to assess whether the banking sector is adequately prepared to orderly withstand losses resulting from normal or stressed macroeconomic and microeconomic scenarios. The nexus between the banking sector and the real sector was established via the corporate sector channel. The macro-prudential tool consisted of a two-step approach. In the first step, they built a model for the probability of default (PD) in the corporate sector, so as to quantify one year ahead developments in the quality of banks' corporate loans, the framework was established using micro data, with a bottom-up approach. The second step consisted of bridging the PD model with a macroeconomic module in order to capture the feedback effects from the macroeconomic stance into the banking sector, via the corporate sector channel.
The macro-prudential tool is tested on the Romanian economy, the conclusion indicates that the banking sector under is in relatively good shape to withstand developments that could manifest in the corporate sector portfolio and in the macroeconomic scenario under consideration. The up-trending level of provisioning can be rather easily accommodated in an orderly manner. The main microeconomic factors identified as hindering companies from servicing their bank debt are: a deterioration in the receivables turnover ratio, sales-to-total assets ratio,

short-term bank debt-to-total assets and debt-to-equity, while the macroeconomic factors affecting the corporate default rate are annual GDP growth, a change in the real effective exchange rate, the annual inflation rate and the FX interest rate spread *(ibid).*

A study by Agade (2014) sought to establish the effect of macroeconomic variables on operational efficiency of banking sector in Kenya using a descriptive as well as correlation research designs. Data Envelopment Analysis (DEA) was used to measure technical efficiency of the commercial banks. The research conducted regression statistical test to identify any common features of the efficient banks and to investigate the significance of the relationship between the technical efficiency score and various determinants. The results indicated that there were factors influencing the operational efficiency of the banking sector in Kenya, which are exchange rates, lending rates, GDP and inflation. The study concluded that the relationship between inflation and operational efficiency of the banking sector in Kenya is negative and significant. While the study looked at the macroeconomic factors it did not look at financial stability but rather concentrated on operational efficiency.

Kiganda (2014) in his study purposed to establish the effect of macroeconomic factors on bank profitability in Kenya with Equity bank in focus in order to understand country and bank specific characteristics. The specific objectives of the study were to determine the effect of; economic growth (real GDP), inflation and exchange rate on bank profitability of Equity bank. This study was modeled on the theory of production and based on correlation research design. Sample size consisted annual data spanning 5 years from 2008- 2012. He used a transformed Cobb-Douglas production function and employed OLS to establish the relationship between macroeconomic factors and bank profitability. The Findings indicated that real GDP, inflation and exchange rate have insignificant effect on bank profitability of the bank at 5% level of significance. While this study looked at macroeconomic factors it did not relate it to financial stability, secondly the study only focused on an individual bank other than the banking industry as a whole.

Gikombo and Mbugua (2018), notes that Profitability of financial institutions is a function of many variables including economic variables and institution based factors. Each institution may have control on the internal factors but not the economic factors. The general objective of their study was to determine the effect of selected economic variables on profitability of commercial banks in Kenya by looking at real interest rates; Gross domestic product; exchange rates and inflation on profitability of commercial banks. The study adopted descriptive research design by focusing on the 44 banks. The findings indicate that real interest rate; GDP; exchange rate and inflation have a significant effect on ROA and ROE. While this study looked at economic factors, the scholars only compared it with the profitability of the commercial banks but didn't look at the financial stability of the industry at large.

2.4 Summary of the Literature and gaps to be filled

Most studies conducted in the area of macroeconomic factors have not related with financial stability but have gone for profitability of banks and have been micro in nature other than taking the industry at large. The measurement of financial stability in most studies is wanting as they used return on asset (ROA) other than the Z-score that is for the whole industry.

In some studies, that have looked at the macroeconomic factors have gone for selected macroeconomic variables leaving out the most valuable ones like inflation and even exchange rate. Some studies concentrated on banks listed on the Nairobi Securities exchange market (NSE), these doesn't represent the whole banking industry.
The methodology used in analysis of data in most studies used has been purely ordinary least square (OLS) method, this suffers from spurious results especially if the data is non stationary. OLS is not a robust method of analysis.

The present study seeks to fill this gap by empirically analyzing macroeconomic (gross domestic product inflation, Exchange rate and interest rate) and financial stability for the banking industry by use of robust analysis tests, thus making a significant contribution to existing body of literature, and bringing high originality value. This study provides deep insight into the relationships that various macroeconomic factors has on the financial stability.

3.Econometric Methodology

3.1 Research Philosophy and Approach

The study adopted Positivism philosophy which emphasizes that information is derived from logical and mathematical treatments, and reports of sensory experience is the exclusive source of all authoritative knowledge,

and that there is valid knowledge (truth) only in this derived knowledge. The concept of Positivism is the basis of quantitative research methodology (Sanya, 2021). The study adopted a quantitative approach in which it explained the economic phenomenon using numerical data by means of mathematical and statistical methods by testing hypothesis that has measurable variables.
In quantitative research, researchers seek to develop a generalizable explanation about what is being investigated by using statistically measurable tools (Yilmaz, 2013), and their methodology is often described as experimental (Slevitch,2011).

3.2 Research Design

The study adopted a correlational design using the econometric methodology; which is a meta-study of how econometrics contributes to economic science. According to Hoover (2005) the principal methodological issues for econometrics are the application of probability theory to economics and the mapping between economic theory and probability models.

3.2.1 Model Specification
In order to achieve the general objective of the study on the effect of Exchange rate, GDP, Real Interest rate and Inflation on banking financial stability, the study adopted the following model with financial stability being the dependent variable against the Macroeconomic variables mentioned above being the independent variable.

$$FS_t = \text{f}(MV_t) \quad (3.1)$$

Where;

FS *is a* $nx1$ *vector representing banking financial stability*
MV_t *is a* $nx4$ *vector representing GDP, Exchange Rate, Interest Rate, Inflation*

Equation 3.1 can be re-written as;

$$FS_t = f(GDP, EXR, IR, IF) \quad (3.2)$$

$$FS_t = \beta_0 + \beta_1 GDP_t + \beta_2 EXR_t + \beta_3 IR_t + \beta_4 IF_t + \varepsilon_t \quad (3.3)$$

t represents time and ε_t is stochastic error term.

3.2.2 Measurement of variables
Table 3.1 Definition and Measurement of Variables and Priori Signs

Variable	**Definition**	**Measurement**
Financial Stability(FS)	Is a condition in which the financial system is capable of withstanding shocks and the unravelling of financial imbalances.	Z-score
Gross Domestic Product (GDP)	The monetary value of final goods and services—that is, those that are bought by the final user—produced in a country in a given period of time	GDP
Exchange Rate (EXR)	the value of one currency for the purpose of conversion to another.	Ksh/USD
Interest Rate(IR)	*is the amount a lender charges a borrower and is a percentage of the principal—the* amount loaned.	the proportion of a loan that is charged as interest to the borrower, typically expressed as an annual percentage of the loan outstanding. (r)
Inflation Rate (IF)	An general increase in the level of prices of the goods and services that households buy	the rate of increase in prices over a given period of time.

The Z-score is a single measure of the financial stability of banks. The Z-Score formula is formed as follows: ROA plus the capital ratio (or total equity (TE) over total asset (TA)), and this expression is divided by the standard deviation (δ) of ROA. The formula employed by Hesse (2007) is as follows:

$$Z - score = \frac{ROA - TE/TA}{\delta ROA} \quad (3.4)$$

3.3 Data Type and Data Sources

The study made use of secondary data. Data was obtained from the CBK annual bank supervision reports and

world Bank database. CBK and World Bank have consistent, reliable data for the macroeconomic variables and the Z-score for the Banking sector and cross referenced with Kenya National Bureau of Statistics (KNBS) database.

3.4 Data Analysis and Presentation

3.4.1 Data Analysis

The study used descriptive statistic, stationarity, cointegration and error correction; granger causality tests; Impulse response and diagnostic test.

3.4.1.1 Descriptive statistics

The study used descriptive statistics to provide summary of data in terms of maximum, minimum, mean, median, standard deviation, Skewness and Kurtosis and provide the pattern of the same.

3.4.1.2 Stationarity Tests

Stationarity tests aims at determining the order of integration of each variable. These will also help in determining the Data Generation Process (DGP) of the variables before Cointegration and Error correction tests are done. The study used the Augmented Dickey Fuller (ADF) test and Phillips and Perron (PP) test.

Testing procedure for the ADF unit root test involved running the following model;

$$\Delta y_t = \propto + \beta t + \gamma y_{t-1} + \sum_{j=1}^{\rho} \delta_j \Delta y_{t-j} + \varepsilon_{it} \quad (3.5)$$

Where $\propto$ is a constant, β the coefficient on a time trend series, γ the coefficient of y_{t-1}, ρ is the lag order of the autoregressive Process, $\Delta y_t = y_t - y_{t-1}$ are first differences of y_t, y_{t-1} are lagged values of order one of $y_t, \Delta y_{t-j}$ are changes in the lagged values and ε_{it} is the white noise. The ADF test will be tested with and without constant and time trend and both.

Phillips and Perron test is a nonparametric method of controlling for serial correlation when testing for a unit root. The PP test estimates the non-augmented DF test equation of the form;

$$\Delta y_t = \alpha y_{t-1} + x_t' \delta + \varepsilon_t \quad (3.6)$$

where $\alpha = \rho - 1$ and modifies the t-ratio of the α coefficient so that serial correlation does not affect the asymptotic distribution of the test statistic. PP test is based on the statistics;

$$t_\alpha = t_\alpha \left(\frac{\gamma_0}{f_0} \right)^{1/2} - \frac{T(f_0 - \gamma_0)(se(\hat{\alpha}))}{2 f_0^{1/2} s} \quad (3.7)$$

where $\hat{\alpha}$ is the estimate, and t_α the t-ratio of α, $se(\hat{\alpha})$ is coefficient standard error, and s is the standard error of the test regression. In addition, γ_0 is a consistent estimate of the error variance in (3.6) (calculated as, $(T-k)s^2/T$ where k is the number of regressors). The remaining term, f_0 , is an estimator of the residual spectrum at frequency zero.

3.4.1.3 Cointegration Analysis and Error Correction

In order to estimate the long-run and short-run relationship among the variables referred to as cointegration and Error correction. The study adopted the Autoregressive Distributed Lag (ARDL) cointegration technique. The ARDL cointegration technique was preferred in this study because of the advantage of using it irrespective of the order of integration of variables involved in the study, its robustness and provides consistent results when dealing with single long run relationship between the underlying variables in a small sample size.

$$Setting\ FS_t = y_t\ and\ MV_t = x_t \quad (3.8)$$

The cointegration equation and error correction model under the ARDL model can be expressed as follows;

$$\Delta y_t = \gamma_0 + \gamma_j y_{t-1} + \gamma_k x_{t-1} + \sum_{t=1}^{m} \gamma_j \Delta y_{t-1} + \sum_{t=0}^{m} \gamma_k \Delta x_{t-1} + \varepsilon_t \quad (3.9)$$

Equation 3.9 has two parts; the first part represents the long-run dynamics of the model and the second part represents the short run relationship.

3.4.1.4 Impulse Response Analysis

Impulse response analysis is vital in econometric analysis. The analysis employed the VAR model. It aims at describing the evolution of a model's variables in relation to a reaction to a shock in one or more variables. This allowed to trace the transmission of a single shock within an otherwise noisy system of equations and, thus, makes them very useful tools in the assessment of economic policies.

3.4.1.5 Diagnostic Tests

3.4.1.5.1 Normality Assumption

In testing the normality of data the study used the Jarque–Bera test, it tested whether the sampled data have the skewness and kurtosis matching a normal distribution. J-B statistic is nonnegative, if it's far from zero, it indicates that the data is not normally distribution. If its zero that indicates perfect normality in the data. J-B test is defined as follows;

$$JB = \frac{n}{6}\left(S^2 + \frac{1}{4}(K-3)^2 \right) \quad (3.10)$$

where n is the number of observations (or degrees of freedom in general); S is the sample skewness, K is the sample kurtosis: $S = \frac{\hat{\mu}_3}{\hat{\sigma}^3}$, $K = \frac{\hat{\mu}_4}{\hat{\sigma}^4}$ where $\hat{\mu}^3$ and $\hat{\mu}^4$ are the estimates of the third and fourth central moments respectively and $\hat{\sigma}^3$ and $\hat{\sigma}^4$ is the third and fourth central moment the variance.

J-B statistic is asymptotically follows a chi-squared distribution with two degrees of freedom. The null hypothesis is a joint hypothesis of the skewness being zero and the excess kurtosis being zero. Samples from a normal distribution have an expected skewness of 0 and an expected excess kurtosis of 0 (which is the same as a kurtosis of 3).

3.4.1.5. 2 Lag Length determination

Lag length determination in Economics is vital. According to Lutkepohl (1993) he indicates that selecting a higher order lag length than the true lag length causes an increase in the mean-square forecast errors and that under fitting the lag length often generates autocorrelated errors. The study relied on different information criteria (Akaike, Schwarz, Hannan-Quinn).

$$AIC_{(p)} = \log\det(\tilde{\sum_u}(p)) + \frac{2}{T}pK^2 \quad (3.11)$$

$$HQ_{(p)} = \log\det(\tilde{\sum_u}(p)) + \frac{2\log(\log T)}{T}pK^2 \quad (3.12)$$

$$SIC_{(p)} = \log\det(\tilde{\sum_u}(p)) + \frac{\log(T)}{T}pK^2 \quad (3.13)$$

3.4.1.5.3 Autocorrelation LM Test

The study adopted the Lagrange multiplier Multiplier(LM) test statistics for residual serial correlation up to the specified order. The LM test is a Breusch-Godfrey test statistic for autocorrelation. It was computed at lag order h by running an auxiliary regression of the residuals u_t on the original right-hand regressors and the lagged residual u_{t-h}, where the missing first h values of u_{t-h}, are filled with zeros.

3.4.1.5.4 Heteroscedasticity

In order to test for heteroscedasticity, the study used the LM test for autoregressive conditional heteroscedasticity (ARCH).

3.4.1.5.5 Multicollinearity

Multicollinearity is a problem of the independent variables. In the study the VIF test was conducted to check for multicollinearity.

$$VIF = \frac{1}{(1-R^2)} \quad (3.14)$$

If VIF is 10 and above indicates a multicollinearity problem.

3.4.2 Data Presentation

Data presentation was done by use of tables and graphs.

4. Results and Discussions

4.1 Introduction

These chapter provides the results and discussions of the study. Section 4.2 provides the descriptive statistics of the study variables, section 4.3 shows the trend of the variables, section 4.4 indicates the correlation analysis, 4.5 provides the stationarity and unit root tests, 4.6 gives the Cointegration and error correction mechanism, section 4.7 provides variance decomposition and impulse response; lastly section 4.8 indie the hypothesis testing.

4.2. Descriptive statistics of study variables

The descriptive statistics are used to summarize and describe the main features of a dataset in order to help understand the properties and patterns as well as compare variables of interest during the study period. Table 4.1 below indicates that measures central tendency (mean, median and mode) and the measures of variability (Standard deviation, minimum and maximum, kurtosis and skewness).

Table 4.1 Descriptive Statistics of the study variables

	Bank Z-Score	Exchange Rate	GDP per	Inflation	Real Interest

			Capita		Rate
Mean	19.89759	76.48181	0.874533	11.22121	7.997875
Median	19.53260	77.35201	1.365934	8.864087	7.831101
Maximum	25.37654	109.6377	5.520436	45.97888	21.09633
Minimum	15.61310	27.50787	-3.766723	1.554328	-10.09600
Std. Dev.	2.883316	20.36484	2.452694	9.442934	7.530204
Skewness	0.341234	-0.432344	-0.162015	2.088440	-0.530679
Kurtosis	1.875398	2.925081	2.113682	7.400840	3.110420
Jarque-Bera	2.235218	0.973009	1.150300	47.55105	1.470784
Probability	0.327061	0.614771	0.562620	0.000000	0.479317
Observations	31	31	31	31	31

In the period of study, the mean of Z-score was 19.89759 with a minimum of 15.61310 and maximum of 25.37654. The Jarque-Bera(JB) 2.235218 (0327061) indicating that the z-score is normally distributed. The mean exchange rate is 76.48181, with a minimum of 27.50787 and maximum of 109.6377; The JB statistics of 0.973009(0.614771) indicates that the exchange rate is normally distributed. The GDP per capita has had a mean of 0.874533, with a minimum of -3. 766723 and maximum of 5.520436; the JB statistics of 1.15030(0.562620) indicates that the exchange rate is normally distributed. Real interest rate has had a mean of 7.997875; minimum of -10.09600; maximum of 21.09633; the JB statistics of 1.470784(0.479317), indicating that Real interest rate is normally distributed. Inflation exhibited a minimum of 1.554328 and maximum of 45.97888; the JB statistics of 47.55105 (0.0000) indicating that inflation is not normally distributed. However, normality or non normality of the variables is not an issue in econometric estimation; of concern it econometric estimation is the normality of residuals.

4.3 Trend of Macroeconomic Variables and Financial stability

The figures 4.1 to 4.5 below indicates the trend analysis for the Bank Z- score and the selected macroeconomic variables. The results indicate that Bank Z-Score, GDP per capita, and exchange rate are having an upward trend. On the other hand, inflation and Real interest rate have a downward trend.

The upward trend in Bank z-score indicates that the probability of insolvency of financial institutions in Kenya has tended to reduces over time. The upward trend in GDP per capita indicates that the economic growth is in an upward trajectory. On the other hand, an upward trend in exchange rate implies the decrease in value of the Kenyan shilling with respect to US dollar this can also imply the weakening of the Kenyan shilling. Within the period of study, the downward trend inflation is a good sign of general prices going down; on the other hand, the down ward trend in the real interest rate indicate that the cost of borrowing has also been on a downward trend.

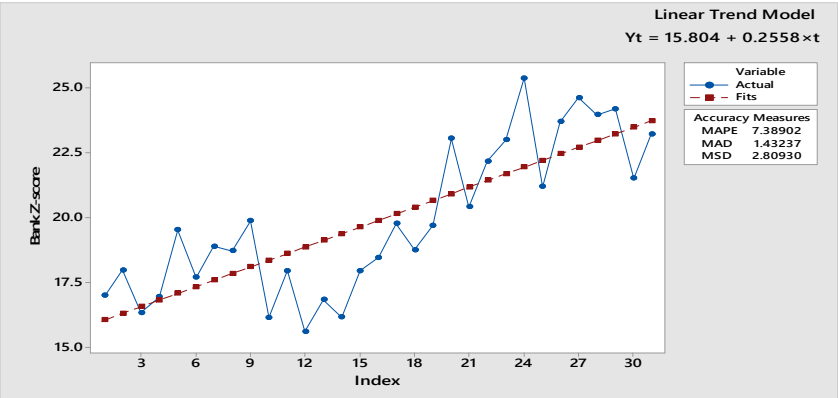

Figure 4.1 Trend Analysis for Bank Z-Score

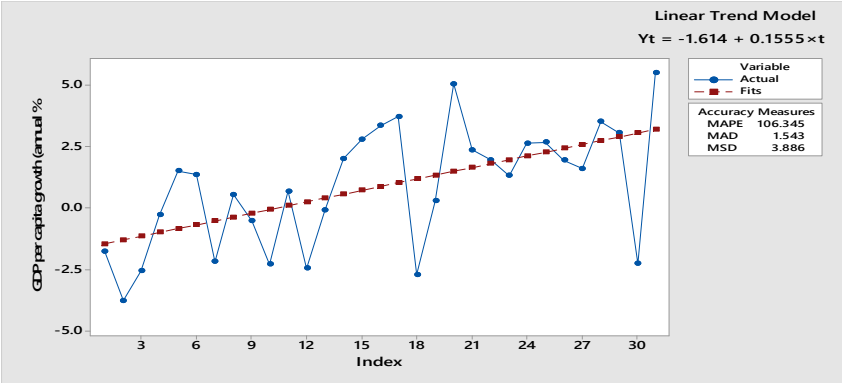

Figure 4.2 Trend Analysis for GDP Per Capita Growth

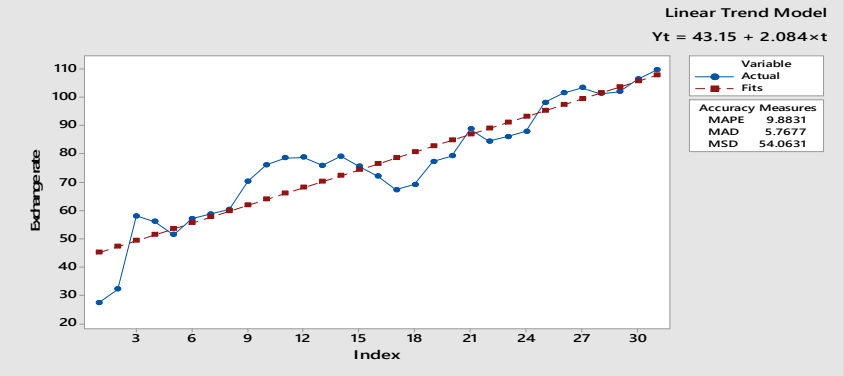

Figure 4.3 Trend Analysis for Exchange Rate

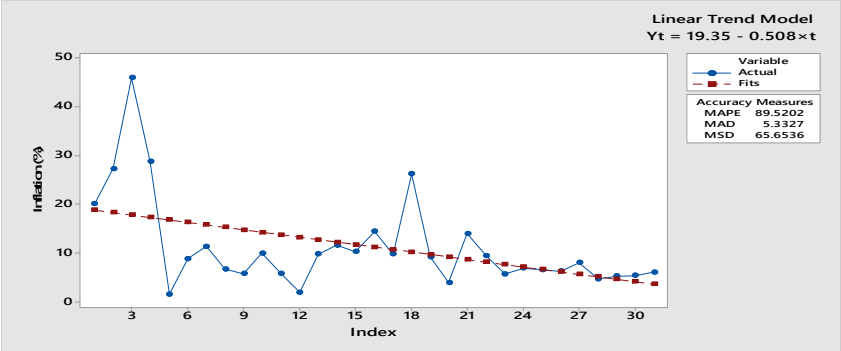

Figure 4.4 Trend Analysis for Inflation Rate

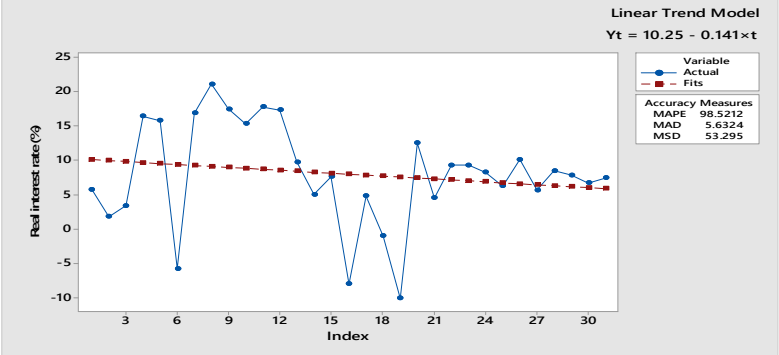

Figure 4.5 Trend Analysis for Real Interest Rate

4.4 Correlation Analysis of the study Variables

Correlation analysis indicates the degree and direction of association between two or more variables. The study run the bivariate correlation analysis between the study variables. The results for correlation analysis are indicated in table 4.2 below.

Table 4.2 Correlation Analysis

Correlation (Probability)	Bank Z-Score	Exchange Rate	GDP per Capita	Inflation Rate	Real Exchange Rate
Bank Z-Score	1.000000				

Exchange Rate	0.671634*	1.000000			
	(0.0000)	-----			
GDP Per Capita	0.583825*	0.519260*	1.000000		
	(0.0006)	(0.0028)	-----		
Inflation Rate	-0.446161*	-0.514989*	-0.488733*	1.000000	
	(0.0119)	(0.0030)	(0.0053)	-----	
Real Interest Rate	-0.026789	0.004130	-0.104405	-0.291500	1.000000
	(0.8863)	(0.9824)	(0.5762)	(0.1116)	-----

* correlations that are significant at 5% ; P-values are in parenthesis (); n=31 study period 1991-2021

The results indicate that Bank Z-scores that measures the financial stability has a positive significant correlation of 0.67163 with exchange rate; positive and significant correlation of 0.583825 with GDP per capita; and negative but significant correlation of -0.446161 with inflation. The Bank z-score is negatively correlated to real interest rate with -0.026789 but not significant. The exchange rate has a positive and significant correlation of 0.519260 with GDP per capita; and a negative and significant correlation of -0.514989 with inflation rate; While there is a weak positive correlation of 0.004130 between exchange rate and real interest rate, it was found not to be significant. The results also indicate that GDP per capita has a negative and significant correlation of -0.488733 with inflation rate. On the other hand, the correlation between GDP per capita and real interest rate was found to be -0.104405 but insignificant.

4.5. Stationarity and Unit Root Tests

In order to test the underlying properties of the variables of the study and establish established the existence of unit roots/stationarity the study used the ADF and PP tests. The study assumed all variables followed a random walk or random walk with intercept or a random walk with intercept and trend. These tests are necessary to determine the underlying properties of processes that generated the data when modelling long run relationships in time series analysis. This is essential to avoid the problem of spurious regression encountered when non stationary series/random walks are “regressed” against each other producing a statistically insignificant long run relationships inform of contemporaneous correlations. The results are shown in the table 4.3 below

Table 4.3 Unit Root Tests

Variables	Augmented Dickey Fuller (ADF) Test			Phillips Perron (PP) Test			Inference
	None	Intercept	Intercept with Trend	None	Intercept	Intercept with Trend	
			Level				
Z-score	0.7335(0.8676)	-0.9305 (0.7638)	-3.5706**(0.0498)	1.6423(0.9727)	-1.8572(0.3470)	-3.6464**(0.0425)	*Inconclusive*
Ex. Rate	-1.8451(0.9820)	-1.9560(0.3036)	-3.2441 (0.0952)	-1.9218(0.9847)	-1.9710(0.2973)	-3.2441(0.0952)	*Inconclusive*
GDP	-3.3308**(0.0016)	-3.7682**(0.0079)	-5.2216**(0.0011)	-3.3263**(0.0017)	-3.6344**(0.0109)	-5.5412**(0.0005)	*I(0)*
Infl	-3.5474**(0.0009)	-2.9569(0.0508)	-3.3665 (0.0751)	-1.7717(0.0728)	-2.7464 (0.783)	-3.3045(0.0848)	*Inconclusive*
Interest	-1.4598(0.1320)	-2.8065(0.0697)	-2.9830(0.1537)	-2.3731**(0.0194)	-4.1613**(0.0030)	-4.1207**(0.0150)	*Inconclusive*
			First Difference				
ΔZ-Score	-9.7732**(0.0000)	-9.7687**(0.0000)	-9.579**1(0.0000)	-9.7732**(0.0000)	-10.5165**(0.0000)	-10.3048**(0.0000)	*I(1)*
ΔEx Rate	-4.4479 (0.0001)	-5.1236**(0.0000)	-5.1356**(0.0000)	-4.4479**(0.0001)	-5.1563** (0.0002)	-5.1541**(0.0013)	*I(1)*
ΔInfl	-7.5549**(0.000)	-7.7891**(0.0000)	-8.1900**(0.0000)	-7.2391**(0.0001)	-7.8231**(0.0000)	-8.7925**(0.0000)	*I(1)*
ΔInterest	-8.5132**(0.000)	-8.3628**(0.0000)	-6.8940**(0.0000)	-10.1418**(0.0000)	-9.9400**(0.0000)	-9.7936**(0.0000)	*I(1)*

Notes: The Null hypothesis is that the series has a unit root. The rejection of the null hypothesis for the DF and PP test is based on the Mackinnon critical values.** indicate the rejection of the null hypothesis of Unit root at 5% level of significance. The parenthesized values are the probability of rejection while Δ denotes the first difference.

From table 4.3 above, the results indicate that the variables Z-Score, exchange rate, inflation rate and interest rate are all integrated of order one depicted by I (1) with no intercept and trend. This indicates that they become stationary after first difference. On the hand GDP per capita was found to be stationary at levels that is I (0) with no intercept and trend.

4.6 Cointegration and Error Correction Mechanism

4. 6.1 Cointegration (Long Run Relationship)

In order to test the long run relationship between the study variables, the study employed the Autoregressive distributed-lag models (ARDL). This model is employed in the analysis of long-run relations when the data generating process underlying the time series is integrated of order one (i.e. I (1)). The ARDL model uses the Bound tests of F and t- statistics to test the significance of the lagged levels of the variables in a univariate error correction system when it is unclear if the data generating process underlying a time series is trend or first difference stationary; secondly Bounds test is preferred to other methods due to its relative better performance when the sample size T is small and its applicability to a mixture of stationary and non-stationary time series. The results in table 4.4 show the Bound test.

The F- statistic tests the joint null hypothesis that the coefficients of the lagged level variables are zero (i.e. no long-run relationship exists between them), The results in table 4.4 indicate that the calculated F-Statistics = 4.559570 is higher than the bound critical value 2.86 at the 5% level at I (0) and 4.01 at 5% level at I (1). Thus, the null hypotheses of no cointegration are rejected, implying there is a long-run cointegration relationships amongst the variables when the regressions are normalized.

Table 4.4 Bound Test for Cointegration with ARDL

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	4.559570	10%	2.45	3.52
K	4	5%	2.86	4.01
		2.5%	3.25	4.49
		1%	3.74	5.06
			Finite Sample: n=35	
Actual Sample Size	27			
		10%	2.696	3.898
		5%	3.276	4.33
		1%	4.59	6.368
			Finite Sample: n=30	
		10%	2.752	3.994
		5%	3.354	4.47
		1%	4.768	6.67
t-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
t-statistic	6.752459	10%	-2.57	-3.66
		5%	-2.86	-3.99
		2.5%	-3.13	-4.26
		1%	-3.43	-4.6

Once the study established that there was a cointegration relationship existing between the variables, the long run relationship was estimated using the following ARDL (4,4,4,2,4) specification. The long run equation is reported in table 4.5 below.

Table 4.5 ARDL Long Run Form

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.547563	5.697745	1.149150	0.3145
BANK Z-Score(-1)*	1.273673	0.573606	2.220465	0.0906
Exchange Rate(-1)	-0.339736	0.100165	-3.391770	0.0275**
GDP Per Capita(-1)	1.136552	0.601726	1.888820	0.1319
Inflation(-1)	-0.152690	0.176940	-0.862949	0.4368
Real Interest Rate(-1)	-0.266270	0.149469	-1.781432	0.1494
D(BANK Z-Score(-1))	-2.652390	0.695066	-3.816025	0.0188**
D(BANK Z-Score(-2))	-2.029644	0.618244	-3.282915	0.0304**
D(BANK Z-Score(-3))	-0.887538	0.386214	-2.298047	0.0831
D(Exchange Rate)	-0.549496	0.192131	-2.860011	0.0459**
D(Exchange Rate(-1))	0.077401	0.091489	0.846014	0.4452
D(Exchange Rate(-2))	0.077480	0.093123	0.832016	0.4522
D(Exchange Rate(-3))	-0.067730	0.083230	-0.813770	0.4614
D(GDP Per Capita)	0.527042	0.174070	3.027755	0.0389**
D(GDP Per Capita(-1))	-0.079249	0.501920	-0.157892	0.8822
D(GDP Per Capita(-2))	-0.676032	0.252911	-2.673007	0.0556
D(GDP Per Capita (-3))	-0.493492	0.237102	-2.081350	0.1059
D(Inflation)	0.049114	0.107478	0.456969	0.6714
D(Inflation(-1))	0.188134	0.096614	1.947265	0.1233
D(Real Interest Rate)	-0.200060	0.107853	-1.854928	0.1372
D(Real Interest Rate(-1))	0.098044	0.110030	0.891063	0.4233
D(Real Interest Rate(-2))	0.130476	0.075786	1.721648	0.1602
D(Real Interest Rate(-3))	0.064081	0.063045	1.016437	0.3669

* p-value incompatible with t-Bounds distribution. ** significant at 5% level
Dependent Variable: D(Bank Z- Score); Model selection: ARDL(4,4,4,2,4)

Levels Equation
Case 3: Unrestricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Exchange Rate	0.266738	0.061642	4.327209	0.0124**
GDP Per Capita	-0.892342	0.734961	-1.214135	0.2915
Inflation	0.119882	0.136212	0.880113	0.4285
Real Interest Rate	0.209057	0.100603	2.078025	0.1063

EC = BANK Z-Score - (0.2667*Exchange Rate -0.8923*GDP Per capita+ 0.1199*Inflation+0.2091*Real Interest Rate)

From the table above, the findings indicate that D (Bank Z-Score) at lag 1 and 2 are significantly related with D(Bank Z-score) at 5% significant level with coefficients of -2.6523 and -2.0696. This indicates that Bank Z-Score depends on its previous year's performance. This has the implication that the sector is also self-regulating.

The results indicate that exchange rate at one lag with a coefficient of -0.3397 and exchange rate at first difference with a coefficient of -0.5494 have a significant relationship with the dependent variable D(Bank z-score) at 5% level. D(bank Z-score) at one and two period lag are significantly related to itself that is D(Bank z-score) at 5% level, these is consistent with the study by Domac and Peria (2000), which found that flexible exchange rate regimes in developing countries are more likely to lead to banking crises; in the same breadth Georgiadis and Zhu.(2020) indicates that foreign-currency exposures on an economy's external balance sheet may jeopardize financial stability when the exchange rate depreciates. Our study findings differ with a study by De Grauwe and Marianna (2002) who concluded that emerging countries should not allow for more exchange rate flexibility as a means to reduce the probability of financial crises.
On the other hand, D (GDP Per capita) is significantly related to the dependent variable with a coefficient of 0.5270. At levels the exchange rate is significantly related to the Bank Z-score with a coefficient of 0.266738. While there is a long run relationship between Bank financial stability with inflation and real interest rate, the relationship is not significant at lags or first difference.

The implication for these results is that while cointegration exists between macroeconomic variables and financial stability in the banking industry, it shows that exchange rate plays a big role in determining the financial stability of the sector, this is followed by the GDP per capita. On the other hand, it also indicates that the Banking sector itself tries to improve its stability, this may be attributed to the regulatory framework in the sector.

4.6.2 Error Correction Model (Short run Relationship)

The short-run dynamic relationship associated with the long-run relationships obtained in the section 4.6.1 above is given in table 4.6 below. The error correction coefficient was estimated to be -0.2122 (0.0025) and significant, has the correct negative sign. This implies that there is a fairly 21% of speed of adjustment to equilibrium after a shock. Approximately 21% of disequilibria from the previous year's shock converge back to the long-run equilibrium in the current year.

Table 4.6: ARDL Error Correction Regression

ECM Regression, Case 3: Unrestricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.547563	0.926023	7.070630	0.0021
D(BANK Z-Score(-1))	-2.652390	0.356608	-7.437841	0.0017
D(BANK Z-Score(-2))	-2.029644	0.355193	-5.714201	0.0046
D(BANK Z-Score(-3))	-0.887538	0.230460	-3.851156	0.0183
D(Exchange rate)	-0.549496	0.078516	-6.998475	0.0022
D(Exchange rate(-1))	0.077401	0.063953	1.210286	0.2928
D(Exchange rate(-2))	0.077480	0.059178	1.309275	0.2606
D(Exchange Rate(-3))	-0.067730	0.044986	-1.505584	0.2066
D(GDP Per Capita)	0.527042	0.101158	5.210065	0.0065
D(GDP Per Capita(-1))	-0.079249	0.129967	-0.609766	0.5750
D(GDP Per Capita(-2))	-0.676032	0.149596	-4.519060	0.0107
D(GDP Per Capita(-3))	-0.493492	0.153971	-3.205092	0.0327
D(Inflation)	0.049114	0.038384	1.279541	0.2699
D(Inflation(-1))	0.188134	0.049215	3.822710	0.0187
D(Real Interest Rate)	-0.200060	0.049998	-4.001365	0.0161
D(Real Interest Rate(-1))	0.098044	0.049427	1.983597	0.1183
D(Real Interest Rate(-2))	0.130476	0.042530	3.067876	0.0374
D(Real Interest Rate(-3))	0.064081	0.037955	1.688352	0.1666
CointEq(-1)	-0.212278	0.031437	-6.752459	0.0025*

R-squared	0.960434	Mean dependent var	0.232776
Adjusted R-squared	0.871411	S.D. dependent var	2.017147
S.E. of regression	0.723335	Akaike info criterion	2.381123
Sum squared resid	4.185706	Schwarz criterion	3.293008

Log likelihood	-13.14516	Hannan-Quinn criter.	2.652274
F-statistic	10.78859	Durbin-Watson stat	2.097082
Prob(F-statistic)	0.000939		

4.6.3 Diagnostic tests

To ensure that the model valid and is stable and follows all the assumptions of linear model, the study run the diagnostic tests that follows.

4.6.3.1 Model Selection Summary

ARDL model is vital because we want to have Gaussian error terms (i.e. standard normal error terms that do not suffer from non-normality, autocorrelation, heteroscedasticity etc.). In order to select an optimal/ appropriate model of the long run equation, it was necessary to determine the optimum lag length(k) by using proper model order selection criteria the Akaike Information

For the estimation of the optimal ARDL model the Akaike information criterion selected model 11 of the form ARDL (4,4,4,2,4) which gives the smallest estimates was selected., this is shown in the figure 4.6 below.

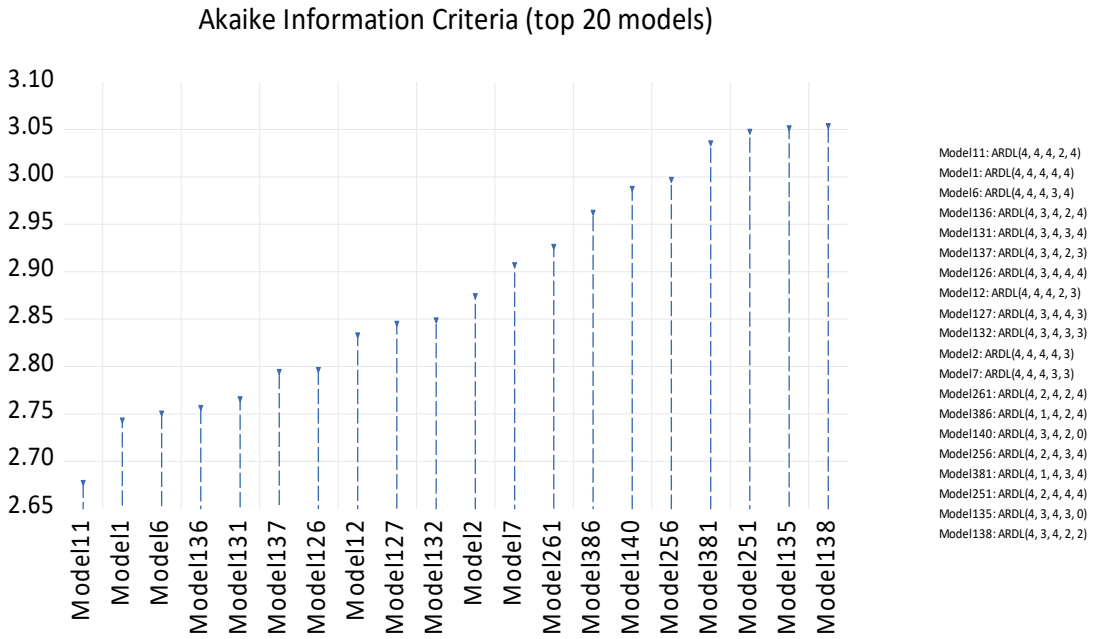

Figure 4.6 Model Selection

4.6.3.2 Residual Diagnostics

The results in the figure 4.7, the Jargue Bera statistics for the residuals was 0.657990 (0.719647). This indicated that the residual was normally distributed.

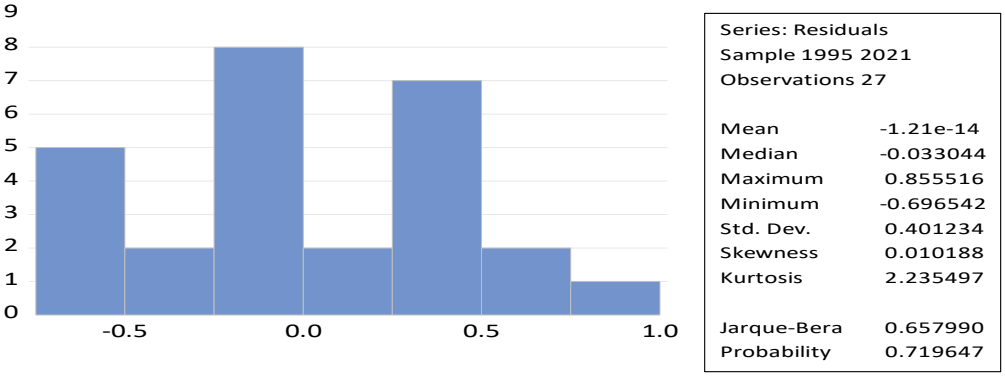

Figure 4.7 Normality test for Residual

The results in table 4.7 and 4.8 below indicate that there was no autocorrelation and heteroscedasticity among the

residuals/error terms.

Table 4.7 Breusch-Godfrey Serial Correlation LM test

F-statistic	0.191568	Prob. F(2,2)	0.8392
Obs*R-squared	4.340787	Prob. Chi-Square(2)	0.1141

Null hypothesis: No serial correlation at up to 2 lags

Table 4.8 Heteroscedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.904943	Prob. F(22,4)	0.6209
Obs*R-squared	22.48283	Prob. Chi-Square(22)	0.4314
Scaled explained SS	0.304828	Prob. Chi-Square(22)	1.0000

Null hypothesis: Homoscedasticity

4.6.3.3 Stability Diagnostics

The study examined the stability of the long-run parameters together with the short- run movements for the equations. The study used the cumulative sum (CUSUM) and cumulative sum squares (CUSUMSQ) tests proposed by Borensztein et al. (1998). This procedure has been utilized before by Pesaran and Pesaran (1997), to test the stability of the long-run coefficients. Figure 4.8 plot the CUSUM and CUSUM of squares statistics and It can be seen from Figure that the plot of CUSUM and CUSUMSQ stays within the critical 5% bounds that confirms the long-run relationships among variables and thus shows the stability of coefficient over the period of the study.

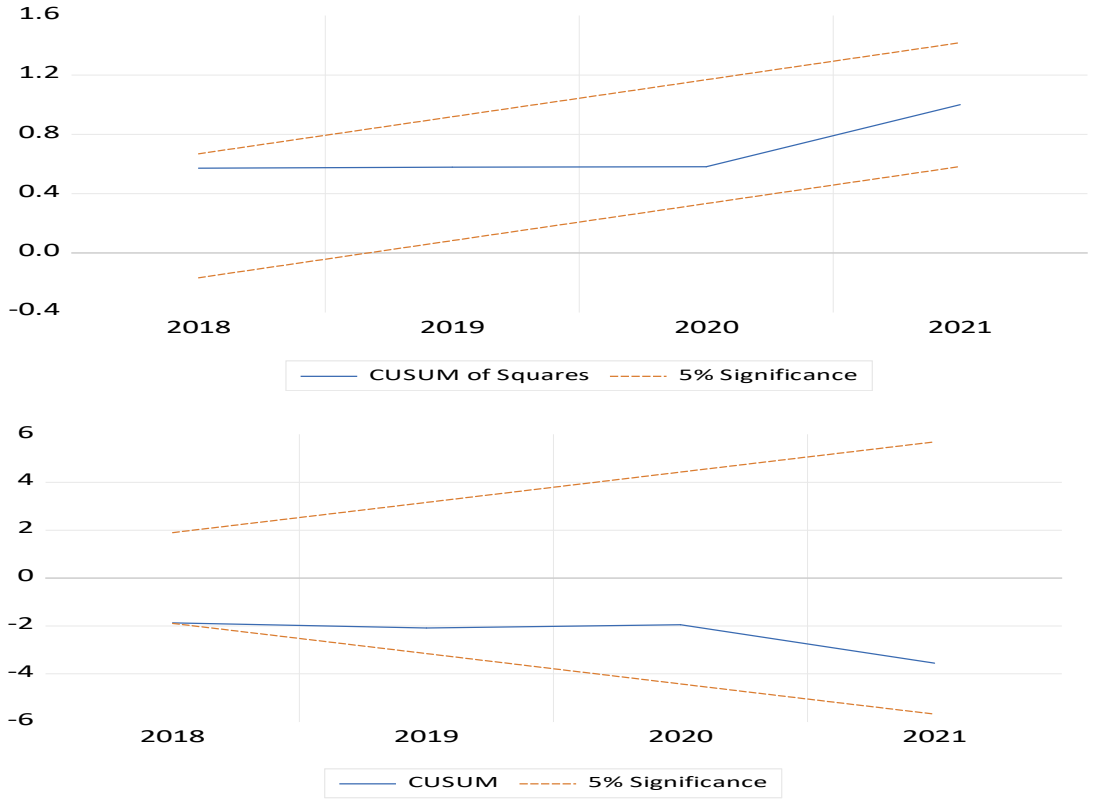

Figure 4.8 CUSUM and CUSUM of Squares

4.7 Variance Decomposition and Impulse Response Analysis

Variance decomposition analysis is an econometric technique that helps to partition the total variance in an outcome variable, into several components or group of factors and being able to identify effects that explain a significant portion of the variation in the outcome variable. Variance decomposition analysis helps shed light on areas researchers should focus their attention to explain the phenomena. Such analysis provides policymakers with guidance regarding the most important sources of total variance in the outcome variable. Variance decomposition techniques have been widely utilized in economics in enabling researchers to study the relative importance of various effects for behavior and outcomes of economic actors. Table 4.9 and Figure 4. presents the variance decomposition.

Table 4.9 Variance Decomposition of Bank Z-Score (Banking Financial stability)

Variance Decomposition of BANK_Z-SCORE:

Period	S.E.	Bank Z-Score	Exchange Rate	GDP Per Capita	Inflation Rate	Real Interest Rate
1	1.948056	100.0000	0.000000	0.000000	0.000000	0.000000
2	2.084953	89.99134	5.872861	1.770091	1.678865	0.686840
3	2.331292	83.24997	7.257588	4.745565	4.090331	0.656545
4	2.803366	64.71737	11.01873	20.21687	3.198922	0.848100
5	3.069461	65.15844	9.281653	21.33143	3.187798	1.040682
6	3.102294	64.11211	9.963409	21.12317	3.757348	1.043964
7	3.192229	60.57693	12.07087	21.88171	4.184302	1.286186
8	3.222738	59.57457	12.02022	22.47886	4.560950	1.365395
9	3.250916	58.56802	12.18814	22.53904	5.212027	1.492767
10	3.321193	60.08055	11.68809	21.69215	5.044178	1.495036

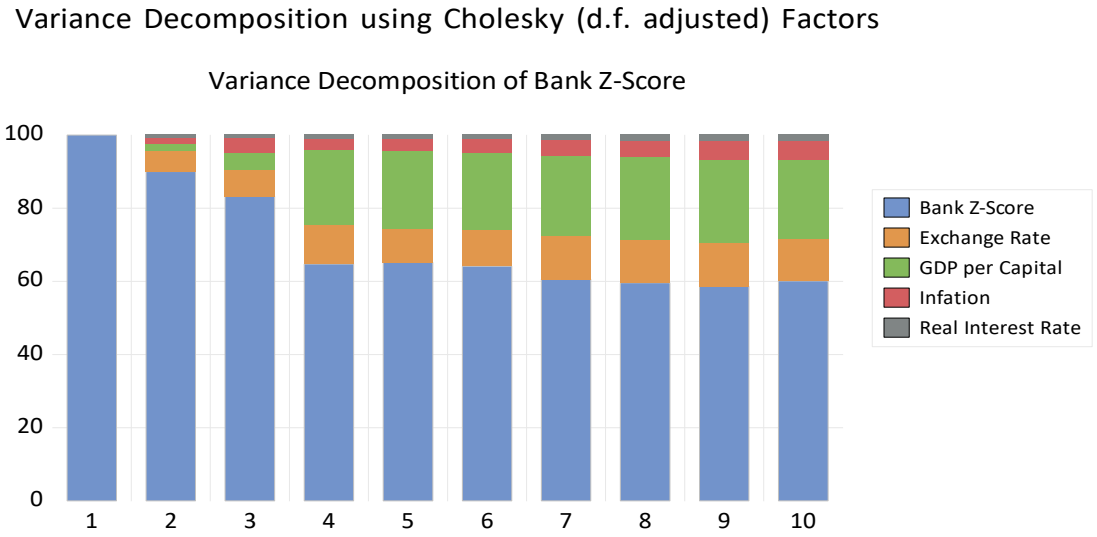

Figure 4.9 Variance Decomposition Using Cholesky

The results from the table 4.9 and figure 4.9 indicate that as the period increases the sources of variance in the financial stability which is represented by Bank Z-Score is accounted for by itself followed by the GDP per capita and Exchange rate, then later followed by inflation. At period 1; the bank Z-score accounts for itself at 100% variance. At period 4, Bank Z-Score accounts for 64.71% of its outcome variance(self); exchange rate accounts for 11.018% of the variance in the Bank z-score, the GDP per capita accounts for 20.21% of the variance; inflation at 3.19% and Real exchange rate at 0.84%. In the long run that is at period 10, the sources of

variance in stability of the sector emanates from itself with 60.08%, followed by GDP per capita with 21.69%, then exchange rate with 11.68%, inflation at 5.04% and lastly Real interest rate at 1.49%. This results have a policy implication that bank financial stability depends on its previous performance, this indicates that financial stability is driven by the industry due to regulation in the sector, followed by the Economic growth per capita, then exchange rate, then inflation and lastly real interest rate, the last two having an insignificant implication. This results confirm the cointegration results mentioned above.

An impulse response function traces the response to a one-time shock in the innovation. The accumulated response is the accumulated sum of the impulse responses. It can be interpreted as the response to step impulse where the same shock occurs in every period from the first. Impulse response complements the variance decomposition. From figure 4.10 below, it can be seen that Bank Z-score is affected by itself. The shock is more from GDP per capita; and also from exchange rate.

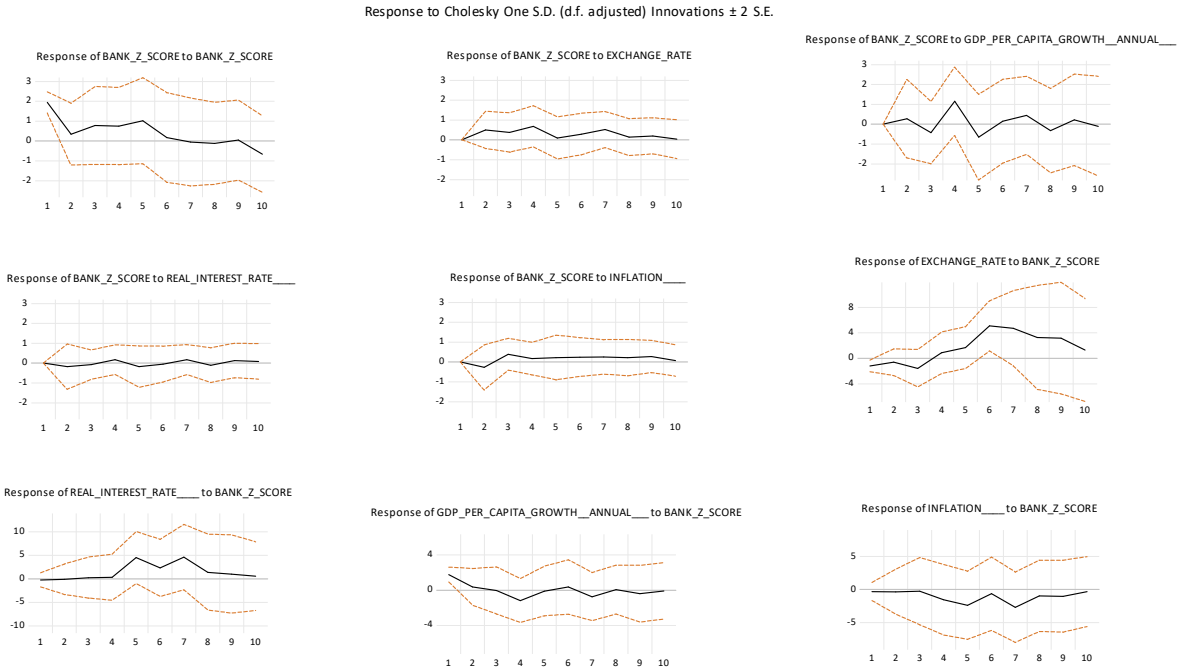

Figure 4.10 Response to Cholesky by One SD

4.8 Hypothesis Testing

Results indicate there is cointegrating long run and short run relationship between the variables GDP Per capita, Exchange rate, Inflation rate Real interest rate and Banking Financial stability.

a) H_{01} : There is no significant effect of real Gross Domestic Product (GDP) on banking financial stability in Kenya.

The Bank Z-score has a positive and significant correlation of 0.583825 with GDP per capita. From the cointegration equation, GDP Per capita at first difference is significantly related to the dependent variable with a coefficient of 0.5270. *From these results, the study rejects the Null hypothesis that there is no significant effect of real Gross Domestic Product on Banking financial stability.*

These results are confirmed by the variance decomposition analysis which indicates that at period 4, GDP per capita accounts for 20.21% of the variance of the Bank Z-score and at period 10 which is assumed to be long run in this case accounts for 21.69% of the variance outcome of financial stability.

b) H_{02} : There is no significant effect of real interest rates on banking financial stability in Kenya.

The Bank z-score is negatively correlated to real interest rate with -0.026789 but not significant. While there is a

long run relationship between Bank financial stability with interest rate the relationship is not significant at lags or first difference. *Following these results, the study cannot reject the Null hypothesis that there is no significant effect of real interest rate on Banking financial stability.*

These results are confirmed by the findings from variance decomposition that indicate that at period 4, real interest rate accounts for an insignificant variance of the Bank Z-Score that is 0.84%. In the long run that is at period 10, it accounts for 1.49%.

c) H_{03} : There is no significant effect of exchange rates on Banking financial stability in Kenya.

The results indicate that Bank Z-scores that measures the financial stability has a positive and significant correlation of 0.67163 with exchange rate. The results from the long run relationship equation indicate that exchange rate at one lag with a coefficient of -0.3397 and exchange rate at first difference with a coefficient of -0.5494 have a significant relationship with the dependent variable D(Bank z-score) at 5% level. At levels the exchange rate is significantly related to the Bank Z-score with a coefficient of 0.266738. *From these results, the study rejects the Null hypothesis that there is no significant effect of exchange rate on Banking financial stability.*

From variance decomposition, at period 4, exchange rate accounts for 11.018% of source of the variance in the Bank z-score. In the long run that is at period 10, it accounts for 11.68% of the variance in Bank Z-score. This confirms the earlier results from cointegration which indicated significant relationship between exchange rate and Banking financial stability.

d) H_{04} : There is no significant the effect of inflation on banking financial stability in Kenya.

While cointegration reports a long run relationship between Bank financial stability with inflation the relationship is not significant at lags or first difference. *Following these results, the study cannot reject the Null hypothesis that there is no significant effect of inflation on Banking financial stability.*

At period 4, the variance decomposition analysis indicates that inflation accounts for 3.19% of the sources of variance in financial stability of the sector, in the long run it accounts for 5.04%. This figures are quite low both in the short run and long run that the cointegration relationship indicated that inflation is not a significant

5.Conclusions, Recommendation and Policy Implication

5.1 Conclusions

From the findings the study concludes that there is both long run and short run relationships between exchange rate, Gross Domestic product, Real interest rate, inflation and Financial stability in Kenya. The ARDL cointegration bounds test suggested that the GDP and exchange rate have a large banking financial stability as compared to inflation rate and real interest rate.The results further help us to conclude that financial stability in the industry depends on the previous happenings within the industry and therefore strengthening the regulatory framework in the banking sector.

5.2. Policy Implication

Our findings have important policy implications; the results indicate that the Bank Financial stability is driven by the industry itself due to the regulations within the sector; our framework therefore builds on crisis-inspired discussions of banking problems that lead to self-regulations (regulatory framework in the sector).

The implication for these results is that while cointegration exists between study variables and financial stability in the banking industry, it shows that exchange rate plays a big role in determining the financial stability of the sector, this is followed by the GDP per capita in the sector, then inflation and lastly real interest rate, the last two having an insignificant implication.

It's vital that the country tries to improve the Gross Domestic Product per capita, findings show that higher income is associated with higher levels of financial inclusion and therefore increasing financial stability. This indicates that a strong economic growth is a pillar of financial stability, growth and development in any economy.

It's important that country reduces substantially the domestic banking system's vulnerability to the exchange rate. The study argues that reserve accumulation is a key tool for managing domestic financial instability as well as exchange rates in a world of increasing globalization in the sector. The study builds on the view that a primary reason for a central bank to hold reserves is to protect the domestic banking sector, and domestic credit markets, while limiting external currency depreciation.

5.3 Contribution of the study

The current study is important in its contribution towards policy and academia in various ways through theoretical and empirical perspective.

5.3.1 Contribution to Policy

This study contributes empirically and in theory, and it's a major motivation and informs policy for the government to strengthen the financial regulatory framework in order to maintain the financial stability in the country. Secondly, it involves policy makers in putting into place mechanism to improve the GDP per capita in order to support the financial stability. Lastly, the study has provided a clear link between exchange rate market

and financial stability and therefore policy makers should advise central monetary authority to hold international reserves to support the financial system/stability while on the other hand avoiding extreme currency depreciation.

5.3.2 Contribution to Academia

The study adds to the pool of literature in academia by being the first of its kind to focus on macroeconomic variables and financial stability in a macro perspective, secondly the use of robust analysis tools in econometrics that is Autoregressive distributed lag model (ARDL) cointegration. This has confirmed the strong empirical linkage between the exchange rate and GDP per capita with financial stability. The study also adds to the knowledge gap by confirming the importance of regulations in the sector in ensuring that financial stability is achieved.

5.4. Recommendations

From the findings the study would recommend that the regulator continues to lay the macro prudential regulations to maintain the stability of the sector. Secondly, the central bank needed to grow its exchange rate reserves if it were to face down the threat of external and internal drains on the exchange rate that later has an in effect to financial stability. Thus, reserve adequacy has to be gauged against the size of the banking sector.

It's important that the central bank and the treasury makes an informed decision on choice of exchange rate regime to adopt in order to help them achieve their domestic macroeconomic goals and help in facilitating the country's interaction with the rest of the system, allowing smooth adjustment to external imbalances and facilitating cross-border flows of goods and capital as we strive to maintain the financial stability.

5.5 Areas for Further Research

There is need for a study to establish the transmission link between exchange rate and financial stability and also find which exchange rate regime favour or doesn't favour financial stability or crisis in the sector. Secondly, it's important that such a study is conducted in the East Africa Community is this verge of having a monetary union in the community.

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