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The Impact of Monetary Policy on Aggregate Bank Performance in South Africa

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DEDICATION

This dissertation is dedicated to my parents, Mulaudzi Thomas Mbengeni and the late Sarah Thinandavha Mulaudzi Fhedzisani. To my father, thank you for your strength, guidance and unwavering support throughout my academic journey. To my late mother, your love, sacrifices and belief in me continue to inspire and carry me forward, even in your absence. Your memory lives on in everything I do. This achievement is a reflection of your love and the values you instilled in me.

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ABSTRACT

This study investigates the impact of monetary policy changes on aggregate bank performance in South Africa using monthly data from January 2019 to May 2025. Employing the Autoregressive Distributed Lag (ARDL) model, the analysis explores both long-run and short-run relationships between the repo rate and key performance indicators, namely: return on equity (ROE), return on assets (ROA), and net interest income to interest-earning assets (NIIIEA). The study incorporates bank-specific variables such as the capital adequacy ratio (CAR) alongside macroeconomic indicators, including the production index (PROD), REPO (repurchase) rate, debt securities issuance (DEBT), and the real effective exchange rate (REER). The findings confirm statistically significant associations between monetary policy and bank performance, with repo rate adjustments exhibiting asymmetrical and time-varying effects. The study tests three hypotheses concerning the link between monetary policy and bank performance, the effects of policy easing and tightening, and the asymmetry in policy pass-through. Results showed both short- and long-run relationships: repo rate adjustments and inflation significantly influence profitability and operational efficiency. Tightening improves interest margins but reduces short-term lending profitability, while inflation supports returns on equity and short-term assets. Strong capital buffers and higher economic output bolster performance, whereas currency appreciation weakens borrower repayment capacity. The findings confirm asymmetric effects, where delayed reductions in loan demand dampen immediate benefits from rate hikes. While tighter monetary policy improves interest margins in the long run, it constrains short-term profitability. The study concludes that strategic alignment with monetary policy is essential for banks to maintain resilience and operational efficiency. Recommendations are provided for the South African Reserve Bank (SARB), commercial banks, and policymakers, and future research directions are proposed to deepen the understanding of monetary transmission mechanisms in the banking sector.

Key Words

Monetary policy, bank performance, ARDL model, profitability indicators, return on assets, return on equity, and net interest income to interest-earning assets.

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CHAPTER 1
INTRODUCTION

1.1. Background of the Study

South African Reserve Bank (SARB), as the central bank in South Africa, formulates different instruments to control the aggregate demand in South Africa and stabilise prices by managing inflation. During overheating of the economy, the SARB increases interest rates to decrease the money supply and thus will make credit more expensive and discourage consumer credit, which affects the performance of the banks. During the slump periods, SARB decreases the interest rate to increase the money supply to stimulate the economy, thus causing consumer demand to increase. The SARB is mandated with the conception and pursuit of monetary policy, and intends to attain and sustain price stability, leading to equitable and rational economic advancement SARB, 2025. The banking community, portrayed as the primary channel for monetary policy conveyance, is considerably troubled by these policies Pirozhkova et al. (2024), affecting their lending activities, borrowing costs, consumption, investment, and overall financial stability.

After the endorsement of inflation targeting in 2000, the SARB has made numerous readjustments to interest rates to control inflation and stimulate economic growth. This study aims to determine the extent to which monetary policy simulates aggregate bank performance. Fresh movements between 2023 and 2025, identifying a period of monetary adjustment, showing changes in cost-push factors, GDP expansion, and worldwide market fluctuations. For example, SARB’s ruling to enhance interest rates in 2023 was pursued by a deliberate monetary easing phase in 2024 and a foreseen steady rate cut in 2025. These adjustments have clear effects for South African banks, affecting their borrowing volume, net interest margins, non-performing loans, and overall financial strength.

The SARB inflation targeting rate is 3% - 6%, and the main objective of the South African Central Bank is to keep the inflation rate at 4,5%. 4.5% inflation allows SARB to respond to different economic shocks while maintaining price stability. Between 2023 and 2024, the SARB's monetary policy. Between 2023 and 2025, the South African Reserve Bank (SARB) made significant changes to its monetary policy to respond to changing economic conditions. In January 2023, the SARB raised the repo rate by 25 basis points to 7.25% to tackle rising inflation. By mid-2024, inflation started to slow down, dropping to 5.1% in June, which was within the SARB's target range. This decrease in inflation allowed the SARB to start easing its monetary policy. On September 19, 2024, the SARB cut the repo rate by 25 basis points, reducing it to 8%. This was the first rate cut in more than four years, putting South Africa in line with other emerging markets that were also beginning to lower interest rates.

In 2023 and 2024, when economic growth was slow, demand for credit stayed low because businesses and consumers were cautious about borrowing. This led to slower growth in banks' loan portfolios, making it harder for them to earn interest income. At the same time, economic difficulties like high unemployment and businesses shutting down caused more loans to go unpaid. As a result, banks had to set aside more money to cover these bad loans, which put additional pressure on their profits and weakened their financial strength.

Monetary policy will continue to focus on achieving inflation targets, while high debt levels will require fiscal consolidation efforts. In the developing world, financing conditions are expected to remain tight, and growth moderate, and weaker household consumption and falling property prices may drag on growth for a sustained period. Emmanuel et al. (2015); Akanbi & Ajagbe (2012). Climate change and geopolitical tensions threaten supply chains, output, and prices, and with high interest rates and uncertainty, financial markets and asset prices are expected to remain volatile, dampening investor appetite and capital flows.

Monetary policy is concerned with changing the supply of money stock and rate of interest to stabilise the economy at full–employment or potential output level by influencing the level of aggregate demand. More specifically, in times of recession, monetary policy involves the adoption of monetary tools that tend to increase the money supply and lower interest rates. It may, however, be noted that in developing countries, in addition to achieving equilibrium at full employment or potential output levels, monetary policy encourages economic growth both in the industrial and agricultural sectors of the economy Meshak & Nyamute (2016).

According to Anastasia et al. (2012)It is a deliberate attempt by the monetary authority to control the money supply and credit conditions in the economy to achieve certain economic objectives. Some of the macroeconomic objectives include price stability, full employment, sustainable economic growth, and balance of payment equilibrium. The monetary instruments include the bank rate, open market operations, reserve requirements, etc. Economic activities are not directly affected by monetary policy instruments; they work through their effects on the financial markets. It affects economic activities through its effects on available resources in the banking sector.

This research aims to study how the SARB's monetary policy changes have affected the performance of South African banks. The reason for this study is to know how changes in monetary policy impact banks' profit, the quality of their assets, and financial strength, and to show the challenges banks face when accepting changes in monetary policy.

1.2. Problem Statement

The South African Reserve Bank (SARB) employs various monetary policy instruments to influence macroeconomic conditions, which in turn affect the performance of commercial banks. Changes in monetary policy directly influence banks' profitability by altering the spread between lending rates and deposit rates Borio et al. (2017). Additionally, monetary policy decisions shape financial market conditions, thereby affecting the valuation of banks' investment portfolios and securities holdings. For instance, a tightening of monetary policy may trigger economic slowdowns or recessions, increasing the risk of loan defaults and non-performing loans, which ultimately weaken banks' financial health Bernanke & Gertler (1995).

Bank performance is widely regarded as a key indicator of the stability and resilience of the financial system and the broader economy. Strong profitability enhances banks' capital bases and liquidity buffers, enabling them to withstand both domestic and external shocks Mbabazize et al. (2020). According to Demirguc-Kunt & Huizinga (1999), bank profitability is influenced by both internal factors and macroeconomic conditions, including monetary policy. Similarly, Classens et al. (2018) highlight that monetary policy significantly affects bank lending behaviour, risk-taking, and overall financial performance.

However, the transmission of monetary policy through the banking sector is complex and operates through multiple channels, leading to ambiguous outcomes. While some studies find that contractionary monetary policy reduces bank profitability by increasing funding costs and credit risk Albertazzi & Gambacorta (2009), others suggest that higher interest rates may improve bank margins and profitability under certain conditions Borio et al. (2017). This lack of consensus reflects differences in financial structures, regulatory environments, and economic conditions across countries.

Despite extensive research on monetary policy transmission, there remains a notable gap in the literature regarding its impact on bank performance in emerging economies, particularly in South Africa. Most empirical studies are concentrated in developed economies, with limited context-specific evidence on how monetary policy affects bank profitability, stability, and risk exposure within the South African banking sector. Furthermore, existing studies often examine single policy instruments, neglecting the combined effects of multiple monetary policy tools on bank performance.

Therefore, the research problem addressed in this study is to examine the impact of monetary policy on bank performance in South Africa, to determine how changes in policy instruments influence key performance indicators such as profitability, liquidity, and asset quality within the banking sector.

1.3. Aim of the study

The study aims to investigate the impact of monetary policy changes on aggregate performance indicators of the banking industry in South Africa over the period 1991 – 2021. The study seeks to understand the relationship between monetary policy and bank performance, which can help banks adapt and compete in different economic environments.

1.4. Research Questions

The following research questions form the basis of this investigation:

The main research question of the study:

- What is the nature of the association between changes in the monetary policy variables and various indicators of aggregate bank performance in South Africa?

The sub-question of the study:

- What is the impact of changes in the monetary policy, i.e., monetary policy easing and monetary policy tightening, on aggregate bank performance in South Africa?
- What is the degree of asymmetry of monetary policy pass-through to aggregate bank performance indicators?

1.5. Objectives of the Study

The main objectives of the study are:

- To provide an overview of trends in monetary policy and trends in aggregate bank performance in South Africa.

The sub-objectives are

- To estimate the impact of changes in monetary policy on aggregate banking industry performance indicators in South Africa
- To test for non-linear short-run and long-run asymmetries between monetary policy and aggregate bank performance.

1.6. Hypothesis of the Study

The following three hypotheses are tested in this study:

Hypothesis 1

H_0: Trends in monetary policy variables do not exhibit any statistically significant association with trends in aggregate performance indicators of the banking industry in South Africa.

H_1: Trends in monetary policy variables exhibit a statistically significant association with trends in aggregate performance indicators of the banking industry in South Africa.

Hypothesis 2

H_0: Monetary policy easing and tightening do not exhibit any statistically significant impact on aggregate performance indicators of the banking industry in South Africa.

H_1: Monetary policy easing and tightening exhibit a statistically significant impact on aggregate performance indicators of the banking industry in South Africa.

Hypothesis 3

H_1: Changes in monetary policy exhibit a symmetrical impact on aggregate bank performance in South Africa.

H_1: Changes in monetary policy exhibit an asymmetrical impact on aggregate bank performance in South Africa.

1.7. Significance of the Study

This study is important because it helps fill a clear gap in research on how monetary policy affects bank performance in South Africa. Many past studies have looked at how monetary policy influences banking activities like lending, profits, and deposits. However, most of this work focuses on countries such as Nigeria, Ghana, and Italy, with very little attention given to South Africa. For example, earlier studies show that monetary policy can shape bank lending and economic performance in Nigeria and Ghana, and also affect how interest rates adjust in Italy Olofinlade et al. (2020); Gambacorta & Iannotti (2005). This means there is still a limited understanding of how these relationships work in the South African context.

This study also improves on earlier research by looking at more than just one policy variable at a time. Many previous studies focus only on one factor, such as interest rates or money supply, and link it to one outcome, like lending or profitability. Some find that interest rates have a strong effect on lending, while others show mixed results when it comes to profits Nanaka et al. (2022); Rao & Somaiya (2011); Kumar (2020). In contrast, this study looks at several monetary policy variables together and examines how they affect different aspects of bank performance at the same time. This gives a more complete and realistic picture.

Another strength of this study is that it brings together different measures of bank performance in one analysis. Earlier research often looks at only one area, such as lending or profitability, without connecting the two. Some studies show that monetary policy affects lending, while others focus on its impact on deposits or profits Ndugbu & Okere (2015); Ekpung et al. (2015). By combining these measures, this study provides a broader view of how banks respond to changes in policy.

Lastly, this study helps make sense of the mixed results found in earlier research. Some studies suggest that tighter monetary policy reduces bank profits because it raises costs and risk, while others show that it can improve profit margins in certain situations Albertazzi & Gambacorta (2009); Borio et al. (2017). By focusing on South African data and using suitable methods, this study aims to give clearer and more relevant results. In doing so, it provides useful insights for policymakers, banks, and other stakeholders and helps improve understanding of how monetary policy affects bank performance in South Africa.

1.8. Structure of the Study

The study is organized into five chapters as follows: Chapter 1 introduces the topic, problem statement, research questions, aim and objectives of the study, hypothesis of the study and significant of the study; Chapter 2 reviews theoretical framework, empirical literature, research gaps; Chapter 3 explains the research methods used: Chapter 4 contain data analysis, results and interpretation, limitation of the study, policy implications and suggestions for further studies. Finally, Chapter 5 concludes the dissertation by presenting the summary of findings, conclusion, and recommendations. The chapter also discusses limitations of this study as well as the areas for future research.

CHAPTER 2
THEORETICAL FRAMEWORK AND EMPIRICAL LITERATURE REVIEW

2.1. Introduction

In this chapter, a review of the literature, both theoretical and empirical, on the impact of monetary policy on the aggregate bank performance in South Africa is carried out to shed more light on understanding the essential link between monetary policy and the performance of the banks. A critical review of empirical studies is undertaken to evaluate contributions made and pertinent knowledge gaps identified. The review of the literature takes three perspectives: the first one is the theoretical framework, the second is an empirical review, and the third is an assessment of the literature.

2.2. Theoretical Framework

In this study, the impact of monetary policy on bank performance in South Africa is examined under the classical theory, Keynesian theory, and the monetarist theory.

2.2.1. Classical theory

"The widely accepted approach to monetary economics was known as the quantity theory of money, used as part of a broader approach to micro and macro issues referred to as classical economics, from the works of Irving Fisher (1867–1947), who laid the foundation of the quantity theory of money through his equation of exchange" Fisher (1896); Dimand & Betancourt (2012).

The classical school developed through the collective contributions of economists such as Jean-Baptiste Say, Adam Smith, David Ricardo, and others who held similar intellectual perspectives Rhodes (2008). The classical theorists adopted the quantity theory of money as the primary explanation for the general price level. They generally maintained that the money supply influences aggregate demand, which subsequently determines the overall price level, as argued by Ryan, Amacher, Holley, & Ulbrich (1989). Jung (2024) argues that the quantity theory of money was not only a theory about the influence of money on the economy and how a Central Bank should manage the economy's money supply, but it represented a specific view of the private market economy and the role of government.

According to the traditional view of monetary policy based upon the quantity theory of money (MV=PQ), monetary growth is the main long-run factor behind the inflation phenomenon and has no long-run influence on real economic indicators, such as output and employment Friedman & Schwartz (2008). The theory posits the principle of money neutrality, which holds significant implications for this study. From this theoretical perspective, the monetary policy is regarded as the so-called 'veil' in the sense that the increase (or contraction) in the money supply has no effect on the real economy on variables like output, employment and real economic profit in the long term, as they are reflected in only the nominal variables like the general price level and the nominalinterest rates Fisher (1911).

Furthermore, the classical theory states that the role of government is to provide a system of laws and security to protect private property, as well as provide a stable financial and monetary framework. Olofinlade et al. (2020) "acknowledge that theory posits that money affects the economy, which is the reason why Central banks adopt monetary policy to control the flow of money in the economy through banks that are regarded as the private market industry that mobilises the largest volume of money in any economy". Onoh and Nwachukwu (2017) "Say that the economic depression of the 1930s drastically changed attitudes about the role of money and monetary policy as a tool of economic stabilisation. Monetary policy was then viewed as an ineffective method of fighting depressions, and the belief in a self-regulating market that reached socially desirable results was destroyed".

Derived from the classical theory, the direct implication for aggregate bank performance in South Africa is that actions taken by the SARB, such as altering the repo rate or money supply, should not have a lasting influence on the real performance metrics of the banking sector. Banks, as rational economic agents, would simply adjust their nominal lending and deposit rates to account for inflation, leaving their real interest margins, real asset quality, and overall real profitability unchanged. While this provides a crucial theoretical baseline, recent analyses challenge its strict application in modern financial systems characterised by significant frictions. For instance, studies suggest that information asymmetries and sticky-price mechanisms within the banking sector can create short-to-medium-term non-neutralities, allowing monetary policy to temporarily affect real bank lending and profitability Pirozhkova & Viegi (2024); Petzer & Roberts-Lombard (2024).

Moreover, not all researchers agree with the classical approach to discussing financial market adjustments to monetary shocks due to the assumption of an immediate market-clearing; the post-pandemic economic situation has once again become a subject of debate Isik et al. (2025). Thus, a classical theory is used as a basic null hypothesis in the dissertation: any statistically significant long-term correlation between the monetary policy and the real aggregate performance of banks would imply that the assumption of the classical schools of thought would be broken and that the market imperfections are at work.

2.2.2. Keynesian theory

The Keynesian framework rests on the idea that money is "neutral" in its basic form Emmanuel et al. (2015). Keynes' publication of the General Theory of Employment, Interest and Money in 1936 marked the beginning of what became known as the "Keynesian Revolution" Keynes (1936). Later scholars, particularly Hicks (1937) and members of the Cambridge school, expanded on Keynes' work by arguing that money influences the economy primarily through its impact on interest rates, which in turn shape investment behaviour and the cash-holding decisions of economic agents Al-Tal & Makiwa (2024). According to Keynes, monetary policy on its own has limited power to stimulate economic activity because it operates through this indirect interest-rate channel.

In the Keynesian view, monetary policy alters interest rates, which then affect the investment decisions of banks and other economic actors, ultimately influencing output and income through the multiplier process Iddrisu & Alagidede (2020). Keynes posits that the government has the responsibility to undertake actions to stabilise the economy and maintain full employment and economic growth, using fiscal policies. He therefore recommends a proper blend of monetary and fiscal policies, as on some occasions, monetary policy could fail to achieve its objective" Loate et al. (2021).

"The original Keynesian view that emerged from the Great Depression was challenged on two fronts. First, the early view that money and monetary policy were relatively unimportant was judged incorrect Kregel (1994); Werner (2014); Rivera (2023). Second, the basic premise of the Keynesian model was the inherent instability of the market system and the right and responsibility of the government to conduct an active stabilisation policy Dullien & Tober (2022). "On a more analytical note, if the economy is initially at equilibrium and there is the open market purchase of government securities by the Central Bank, this open market operation will increase the commercial bank's reserve (R) and raise the bank's reserves. The bank then operates to restore its desired ratio by extending new loans or by expanding bank credit in other ways. Such new loans create new demand deposits, thus increasing the money supply (MS). A rising money supply causes the general level of interest rate (r) to fall. The falling interest rates affect commercial bank performance and, in turn, stimulate investment, given that businessmen expect profit. The induced investment expenditure causes successive rounds of final demand spending by GNP to rise by a multiple of the initial change in investment".

The Keynesian theory offers a critical framework for this study by providing a critical argument in the manner the monetary policy influences the total performance of the banks. Essentially, the ideas behind Keynesian economics insist that the state has the capacity and rights to intervene in a situation to control the aggregate demand and stabilize the economy, and that the main tool of such operations is control of interest rates Keynes (1936). In South Africa, the change in the rate used by SARB in the repurchase (repo) facility is an active mechanism applied to influence the cost of borrowing, investments, and consumption. The significance to the banking industry is tremendous; banks are the main facilitators of this policy.

To take an example, the expansionary monetary policy (reduction in interest rates) aimed at stimulating the demand for credit, which can increase the loan portfolios and revenue of the banks. On the other hand, an anti-inflationary contractionary policy (higher interest rates) that tries to suppress inflation may hurt the growth of credit and risk defaults, and hence reduce the bank profits and stability. This association underscores the fact that, in addition to its internal management, bank performance should also be viewed as a factor that is highly dependent upon the macroeconomic environment, which is crafted by the central bank Naili & Lahrichi (2022); Citterio (2024). Recent literature supports this interconnection, pointing out that the post-pandemic tightening by the SARB in order to curb inflation had a direct effect on the net interest margin and loan asset quality in South African banks, making the Keynesian approach to the relationship between central banks and the financial sector crucially applicable Citterio (2024); Pirozhkova & Viegi (2024); SARB (2025).

2.2.3. Monetarist theory

"The monetarist theory was propounded by Milton Friedman in 1956. The role of monetary policy, which is, of course influencing the volume, cost, and direction of money supply, was effectively conversed by Friedman (1956), whose position is that inflation is always and everywhere a monetary phenomenon. He recognises that in the short run increase in money supply can reduce unemployment but can also create inflation, and so the monetary authorities should increase money supply with caution" Loate et al. (2021).

Monetarist, who built on the quantity theory of money, relied on fisher's equation of exchange Fisher (1896) to explain their view. They treated it mainly as a framework for understanding the demand for money rather than a model of output, prices, or income, linking the desire to hold real money balances to a few key variables Gao et al. (2025). Influential Monetarists like Friedman (1956) argued that the money supply is the most important factor shaping overall economic conditions. For this reason, they believed the money supply should grow at a steady and predictable rate instead of being frequently adjusted by monetary authorities. Friedman also pointed out that money can act as substitute not just for financial assets like bonds but also many goods and services. Because of this, any change in the money supply affects spending directly and influences investment indirectly Congdon (2021).

Monetarists further introduced price expectations as an important factor in determining interest rates. They argued that increasing the money supply triggers three major effects: a liquidity effect, an income effect, and a price effect. Overall, monetarists placed strong emphasis on the role of money in shaping macroeconomic behaviour. As Sieroń (2019) explains, this focus on the importance of money and monetary policy later became a defining feature of the neoclassical school.

Friedman and Schwartz (1982) state that an expansive open market operation by the central bank increases the stock of money, which also leads to an increase in commercial bank reserves and the ability to create credit and hence increase money supply through the multiplier effect. To reduce the quantity of money in their portfolios, the bank and non-bank organisations purchase securities with characteristics of those sold by the Central Bank, thus stimulating activities in the real sector.

Tobin (1978)It reinforces this perspective by analysing how monetary policy works through shifts in asset portfolios. He argues that changes in policy prompt investors to move funds among equities, bonds, commercial paper, and bank deposits. According to him, a tight monetary stance reduces liquidity and limits banks' lending capacity. As a result, credit becomes concentrated on prime borrowers and established firms, while mortgages and consumer loans are squeezed out, ultimately reducing effective demand and dampening investment. In contrast, Keynesian theory maintains that changes in the money supply stimulate activity in financial markets, influencing interest rates and, in turn, investment, output and employment Keynes (1936).

Gertler & Gilchrist (1991) "support the view that small businesses experience declines in loan facilities during tight monetary policy, and they are affected more adversely by changes in bank-related aggregates like broad money supply". Further investigation by Borio (1996) "Those who investigated the structure of credit to non-government borrowers in fourteen industrialised countries observe that it has been influenced by factors such as terms of loan, interest rates, collateral requirements, and willingness to lend". Researchers found varying results on the effect of monetary policy on banks' performance using banks' asset portfolios and credit creation. Amacher & Ulbrich (1989).

The monetarist theory presents a significant paradigm that can be used to explain the relationship between the monetary policy and the performance of the banking sector in South Africa. The main implication of this theory, as was expressed in the landmark work of Friedman (1956), is that the money supply is the single biggest predictor of nominal income and, consequently, the price level. Hence, a monetary policy that places a lot of emphasis on the stable, predictable growth rate of money supply is the best instrument for providing macroeconomic stability and controlling inflationary pressures. Throughout the sector, this stability is not only an abstract ideal but is actively a figure of performance. With the low and steady inflation setting, uncertainty is minimal, and the banks can properly evaluate the credit risk, maintain interest rate margins, and the real values of their assets and obligations. This anticipated economic environment will contribute to a healthier and more lucrative banking environment. The applicability of this approach has not been lost, and recent studies have indicated that in the aftermath of the unpredictable global macroeconomic conditions, a revisit of money supply aggregates can serve as a critical source of financial stability in emerging economies, which has a direct impact on the functioning conditions of commercial banks and prop their stability Nkosi & Dlamini (2023).

2.3. Empirical Literature

This study investigates the impact of monetary policy on aggregate bank performance in South Africa. Monetary policy variables include interest rates, such as the repo rate, inflation rates, which central banks aim to keep within a target range, money supply, the total amount of money in an economy, and exchange rates SARB (2025). These influence banks along a variety of channels: interest-rate spreads and net interest income, credit demand and supply, asset quality and provisioning, and ultimately profitability indicators, including the returns on assets (ROA) and returns on equity (ROE). However, it should be noted that the transmission of the monetary policy is complex in South Africa due to structural unemployment, prevalent evidence of supply shocks (load-shedding), and periods of high inflation/exchange rate volatility Miyajima (2021); Gwatidzo (2024). In this subsection, various empirical studies related to the topic of the present study have been conducted over different periods using different methodologies, and different sources of data have been reviewed to assist in identifying the research gap.

2.3.1. Impact of monetary policy on lending

Olofinlade et al. (2020) investigated the effect of monetary policy on bank lending and economic performance in Nigeria for the period of 35 years, which covered 1984 to 2018. The study employed two models to analyse the effect of monetary policy on bank lending and economic performance, respectively, by applying the estimation techniques of the Augmented Dickey Fuller stationary test and regression analysis. The study concluded that monetary policy positively affects bank lending.

Gambacorta and Iannotti (2005) investigated the velocity and asymmetry in response of bank interest rates (lending, deposit, and inter-bank) to monetary policy changes from 1985 to 2002 using an Auto-regressive Vector Correction Model (AVECM) that allows for different behaviours in both the short-run and long run. The study shows that the speed of adjustment of bank interest rates to monetary policy changes increased significantly after the introduction of the 1993 Banking Law.

Interest rate adjustment in response to positive and negative shocks is asymmetric in the short run, with the idea that in the long run, the equilibrium is restored. They also found that banks adjust their loan (deposit) prices at a faster rate during periods of monetary tightening in Italy".

Amidu (2006) examined the constrained implication of monetary policy on bank lending in Ghana between 1998 and 2004. The study revealed that Ghanaian banks' lending behaviour was affected significantly by the country's economic support and changes in money supply. These findings also support the findings of previous studies that the Central Bank prime rate and inflation rate negatively affect bank lending. The prime rate was found statistically significant, while inflation was insignificant. Based on the firm-level characteristics, their study revealed that bank size and liquidity significantly influence a bank's ability to extend credit when demanded".

Kovtun (2017) explored the monetary policy instruments that influence the development or degradation of the regional banking sector in Russia. The study helps to see the different commercial bank responses to changes in the conducted monetary policy. Ordinary Least Squares estimator and generalised least squares techniques were used to assess the effect of macroeconomic shocks and instruments of banking supervision on lending activity. The results said that the interest rate does not affect the lending activity in most regions".

Another study by Nanaka et al. (2022) examined the effect of monetary policy on commercial banks' lending operation in Nigeria between February 1991 and October 2020 using the macroeconomic time series variables of exchange rate, interest rate, maximum lending rate, and prime lending rate. The vector error correction model was employed. Monthly data were sourced from the Statistical Bulletin of the Central Bank of Nigeria. The vector error correction model (VECM) estimated from the results obtained shows that all the variables had a positive effect on commercial banks' lending operations.

Shirya et al. (2023) examine the impact of monetary policy on bank credits to the Nigerian economy from 1981 to 2013. Data were obtained from the Central Bank of Nigeria records. A three-variable unrestricted VAR (1) model involving banks' total credit to the economy, money supply, and monetary policy rate was estimated. Pre-estimation results show all the variables to be integrated at first difference, I (1), but were not co-integrated. Further results show that money supply has an instantaneous influence on both the monetary policy rate and banks' credit to the economy. Other results show that the direction of the reaction of money supply to a standard deviation structural monetary policy shock is not certain; money supply and banks' credit to the economy responded negatively to structural shocks in monetary policy rate; banks' credit to the economy responded positively to nominal structural shocks and whereas money supply and banks credit to the economy responds positively to banking sector's reforms monetary policy rates response is negative. The study concluded that short-run monetary policy in Nigeria is important in controlling interest rates and credit to the economy. It is recommended that efforts should be geared towards strong banking sector reforms".

A study conducted by Pillay and Makrelov (2025) in South Africa evaluated the effects of monetary and financial stability policies, as well as decisions regarding the amount of excess capital, on sectoral lending in South Africa. It used a set of microdata from the Prudential Authority of South Africa for the banking industry in that country from 2008 to 2020, and found that monetary policy actions have a strong impact on bank lending, while changes in SARB regulations significantly impact the capital requirements. The study further found that the effect of changes in monetary policy instruments differs with the size of the banks; small banks respond more strongly to changes in policies through lending Pillay & Makrelov (2025). A SARB working paper by Sibande et al. (2024) also utilised microdata from bank balance sheets was utilised in the study to determine how lending changed in response to macroeconomic, regulatory, and policy changes. The study calculated how lending rates and volumes would be affected by macroprudential and regulatory changes, and it demonstrated how regulatory restraints and monetary policy responses interact to influence bank lending behaviour Sibande et al. (2024).

2.3.2. Impact of monetary policy on return of assets and profitability

Rao and Somaiya (2011) "investigated the impact of monetary policy on the profitability of banks in India between 1995 and 2000. The monetary variables employed were bank rate, lending rates, cash reserve ratio, and statutory ratio, and each was regressed on banks' profitability independently. Lending rate was found to have a positive and significant influence on banks' profitability, which indicates that a fall in lending rates will reduce the profitability of the banks. Also, the bank cash reserve ratio and the statutory ratio were found to have significantly affected the profitability of banks negatively. These findings were the same when the lending rate, bank cash reserve ratio, and statutory ratio were pooled to explain the relationship between bank profitability and monetary policy instruments in the private sector".

Another study by Okoye and Eze (2013) examined the effect of monetary policy on corporate profitability in the banking sector with a reflection on the Nigerian economy. The study employed regression analysis to carry out the investigations. The data for the study were secondary. The study developed four models, which are expected to serve the purpose of forecasting the future profit of the banks examined. The result of the findings indicated that monetary policy has constrained the corporate profitability of banks in Nigeria. Owing to this, it is recommended, among others, that the monetary authorities adopt strict adherence to deregulation". Udeh (2015) "Also examined the impact of monetary policy instruments on the profitability of commercial banks in Nigeria using the Zenith Bank Plc experience. The paper used a descriptive research design. It utilised time series data collected from published financial statements of Zenith Bank Plc as well as Central Bank of Nigeria Bulletins from 2005 to 2012. Four research questions and four hypotheses were raised for the study. Pearson product-moment correlation technique was used to analyse the data collected, while the t-test statistic was employed in testing the hypotheses. The study discovered that cash reserve ratio, liquidity ratio, and interest rate did not have a significant impact on the profit before tax of Zenith Bank Plc. However, the minimum rediscount rate was found to have a significant effect on the profit before tax of the bank. The paper concluded that a good number of monetary policy instruments do not significantly impact the profitability of commercial banks in Nigeria. The paper recommended that the management of commercial banks in Nigeria should look beyond monetary policy instruments to enhance their profits".

Another study by Kumar (2020) used the generalised method of moments (GMM) estimator to investigate the relationship between monetary policy and the profitability of the banks in New Zealand. The findings of the study explain that an increase in the short-term rate leads to an increase in the banks' profit. In addition, an increase in long-term interest rates reduces the profitability of banks. The study used monetary policy variables, capital adequacy ratio, non-performing loan ratio, and cost-to-income ratio as the determinants of the profitability of banks in New Zealand. The results say that only the capital adequacy ratio has a positive impact on the profitability of banks, whereas the non-performing loan ratio and cost-to-income ratio impact the profitability of banks negatively.

In the context of South Africa, there are several relevant studies conducted in recent years. The first study by Gwatidzo (2024) used bank-level data (2005–2018) to investigate the impact of bank regulation on bank performance. The study found that the regulatory environment and market discipline significantly affect bank performance measures, including ROA and ROE; the working paper emphasises that macro prudential and regulatory factors interact with the macro environment to shape profitability. Although the paper focuses on regulation, it explicitly analyses how macro-financial conditions (including interest rate and market discipline) relate to ROA.

2.3.3. Impact of monetary policy on bank deposits

Ndugbu and Okere (2015) "Investigated the impact of monetary policy on the performance of deposit money banks – the Nigerian Experience (1993-2013). Data for this study were collected from the Central Bank of Nigeria (CBN) statistical bulletin, annual reports, and statement of accounts. Ordinary Least Squares (OLS) and co-integration were used to evaluate the impact of monetary policy on the performance of deposit money banks. The Augmented Dicker Fuller (ADF) unit root test and co integration proved that the variables were stationary, and a long-run relationship existed among the variables The OLS revealed that amongst all the monetary policy variables (bank deposit rate, bank lending rate, cash reserve ratio and liquidity ration) considered in the model, only bank deposit rate had a significant relationship, though the relationship inverse. On this premise, the study recommends, among others, that the CBN should moderate the deposit rate as a tool for regulating deposit money banks. It was also noted that there is a need to modify the monetary policy instruments to reflect and respond more rapidly and easily to local economic conditions".

Obidike et al. (2015) Examine the impact of interest rate spread on the performance of the Nigerian banking industry from 1986 through 2012. The study used the OLS method of estimation to analyse the data generated from the CBN statistical Bulletin and the World Bank online database. Testing for the properties of time-series, the ADF test indicates that all the variables were integrated of the same order I (*1*). The co-integration test revealed that there exists a long-run relationship among the variables under consideration. The results showed that interest rate spread negatively and significantly impacted bank performance in the long run. Exchange rate and GDP were found to be positively and significantly affecting bank performance in Nigeria in the long run. The result of the error correction model (ECM) indicated that 23.37 per cent of the disequilibrium in the model will be corrected annually. Moreover, in the short run, interest rate spread also negatively but insignificantly affects bank performance in Nigeria".

Aminzadeh and Irani (2015) "scrutinised the effect of using monetary policy-related tools on the return of private bank stocks admitted in the stock exchange, with a focus on the volume of liquidity, the rate of interest, and the amount of partnership bonds. Using panel data, testing the research hypotheses was carried out through an analysis of multiple regression. The result shows that there was a weak significant correlation between the volume of liquidity and the amount of published partnership bonds and the return of the stocks of private banks admitted in the stock market; meanwhile, the interest rate at an assurance level of 95% had a negative and significant correlation with the return of the stocks of private banks admitted in the stock exchange".

Ekpung et al. (2015) investigate the effect of monetary policy on the banking sector performance in Nigeria. The study period covers 36 years from 1970 to 2006, using selected indicators and employing the OLS regression technique. The results showed that overall, monetary policy has a significant effect on the banks' deposit liabilities. Mainly, on an individual basis, we discovered that Deposit Rate (DR) and Minimum Discount Rate (MDR) had a negative influence on the banks' deposit liabilities in Nigeria, whereas Exchange Rate (EXR) had a positive and significant influence on the banks' deposit liabilities in Nigeria. They conclude, therefore, that monetary policy plays a vital role in determining the volume of banks' deposit liabilities in Nigeria. The study recommends that the government and its monetary authorities should strive to create a conducive environment for the banking sector to grow in the country by packaging appropriate monetary policies that would guarantee and enhance the growth and development of the banking sector in Nigeria.

2.3.4. Impact of monetary policy on the real sector of the economy

Kyari (2015) "assesses the effect of monetary policy variables on savings, national income, and investment as proxies for the real sector economy in Nigeria. The paper explores the significance of this channel using the VAR model, as tests suggest the null hypothesis of no significant effect was rejected, and a conclusion was drawn that one of the monetary variables, such as money supply, exerts a significant impact on the real sector economy. The main implication to be drawn from these results seems to be the importance of the monetary policy channel in regulating the real sector economy in Nigeria. The effect of money supply shocks on real sector variables is similar and seems to be significant, too. Thus, concerning this result, monetary policy regulators should use the money supply regularly as a mechanism to improve the real sector economy in Nigeria".

Okoro (2013) "examined the impact of monetary policy on Nigerian economic growth from 1970 to 2010. Using time series data, the study employed the Augmented Dickey-Fuller (ADF) test, the Phillips-Perron Unit Root Test, the Co-integration test, and the error correction model (ECM) techniques in the analysis of the data collected. The study result shows that there exists a long-run equilibrium relationship between monetary policy instruments and economic growth in Nigeria. From the result, interest rate and inflation rate were negatively correlated with gross domestic product (GDP), while exchange rate, money supply, and credit to the economy were positively related to GDP, based on the long-run test. It suggests that there is a need for a suitable monetary supply policy through inflation targeting".

Akanbi and Ajagbe (2012) "Investigate the analysis of monetary policy on commercial banks in Nigeria. The data ran from 1992 to 1999, and this was collected through various issues of the Central Bank of Nigeria statistical bulletin and analysed with the use of a regression model. The results showed net profit, liquidity ratio, cash ratio, and interest rate on savings, which confirms the prior expectation. This could be further explained with the regression estimate, whereby an increase in interest rate will lead to a decrease in the lending rate, while liquidity ratio and cash ratio were statistically significant to the profit of the selected banks".

Ajayi and Atanda (2012) examine the effect of monetary policy instruments on banks' performance with a view to determining the existence of a long-run relationship between 1978 and 2008. Using the Engle-Granger two-step co-integration approach, their empirical estimates indicated that bank rate, inflation rate, and exchange rate are total credit-enhancing, while liquidity ratio and cash reserves ratio exert a negative effect on banks' total credit. Although it is only the cash reserve ratio and exchange rate found to be significant at the 5% critical value. However, the co-integration test indicated that the null hypothesis of no co-integration was accepted. They concluded that monetary policy instruments are not effective to stimulate credit in the long run, while banks' total credit is more responsive to the cash reserve ratio and thus proposed that the monetary authority should moderate the minimum policy rate as a tool for regulating commercial banks' operations and facilitating investment in the economy".

2.4. Research Gap

The SARB plays a pivotal role in shaping the growth and stability of the banking sector through its monetary policy decisions. These decisions have profound implications for the broader economy, influencing variables such as government expenditure, trade, fixed capital formation, aggregate consumption, productivity, inflation rates, and exchange rates. The SARB recently raised interest rates by 50 basis points, pushing them to their highest level in years, as part of its strategy to combat rising inflation over 12 months. Despite the significant impact of monetary policy on the economy, there is a lack of research in South Africa that specifically examines how monetary police affects the performance of commercial banks. Although literature like that of Mishi & Tsegaye (2020) highlights channels of monetary policy transmission, its data sets were limited to the years before COVID-19 and the crucial 2021 to 2023 monetary tightening period. In the same vein, the International Monetary Fund (IMF) *'Staff Discussion Note'* (Bergant et al.2022) provides a highly timely and pertinent view of bank profitability and inflation, but it is an overall discussion paper, not a specific, South African-related, empirical study quantifying the effect of monetary policy on all the demanded bank performance indicators.

Importantly, no recent empirical study was found that would investigate all the given monetary policy variables (interest rate, exchange rate, and inflation) and their long-run effect on the whole set of South African bank performance metrics (ROA, ROE, Net interest income, and lending) in one framework, covering the COVID and post-COVID period. The lack of such a study is an obvious opportunity to add new information to the literature on monetary policy transmission in South Africa.

This new empirical investigation is therefore not only warranted but needed to give a more comprehensive and updated picture of this dynamic relationship. Because it can accommodate variables of mixed orders of integration, it is also robust whenever the sample is small, and it has the potential of identifying both the short and long run effects. The most suitable econometric model that can address this gap is the Autoregressive Distributed Lag (ARDL) model. Such a study would be of use to the SARB and the bank management, as it would help them understand and therefore predict and control the impacts of monetary policy actions on the highly complex economic environment better.

Although there is a large body of research on how monetary policy affects banking performance, several gaps remain. Many studies show that interest rates and macroeconomic conditions influence bank profitability and lending. However, most research looks at these factors separately rather than together. For example, some studies focus on how monetary policy affects lending and interest rate spreads Zhemelko & Kocisova, (2026), while others examine bank characteristics such as efficiency or business models Ho (2021). This separation makes it harder to see how policy changes interact with internal bank factors like capital buffers to influence outcomes such as profits and credit supply. A more integrated approach could provide a clearer picture of how banks respond to policy in practice.

Another important gap concerns timing. Many studies examine long-run effects, but fewer explore how quickly banks react to policy changes. The speed of adjustment can differ depending on market conditions and bank characteristics Zhemelko & Kocisova, (2026). Most research still relies on annual data, which can miss short-term trends or delays in bank responses. Using higher-frequency data, like monthly or quarterly observations, can help capture how banks adjust lending, interest margins, and risk in the short term. Understanding these dynamics is crucial for policymakers who need to know how monetary interventions take effect in practice.

Finally, there is limited research on the role of financial instruments and other modern channels in transmitting monetary policy. Instruments such as debt securities and funding structures can influence how banks react to policy, yet most studies focus only on interest rates or broad money supply Shuja et al. (2024); Ho (2021). Some research also shows that differences in bank business models can affect policy outcomes, but this is rarely incorporated into broader studies of bank performance. Addressing these gaps with richer data, additional variables, and a combined focus on policy and bank characteristics would help explain inconsistent findings in the literature and improve our understanding of how monetary policy truly influences banking performance.

The study is critical for policymakers and other stakeholders in the financial sector. This research gap will not only assist academic understanding but also provide actionable insights for improving the resilience and efficiency of South Africa's banking industry in the face of monetary policy adjustments. This research will contribute to informed decision-making and policy formulation, ensuring that the banking sector remains robust and responsive to economic changes.

CHAPTER 3
RESEARCH DESIGN AND METHODOLOGY

3.1. Introduction

This chapter sets out different subsections that were followed in completing the study. This chapter is an overall structure conceived to aid the study in answering the research question raised. In this chapter, the research identified the procedures and techniques used to collect and analyses data. The following subsections include research design, data sources and sampling, model specification, definition of variables, signs of expected impact, and estimation techniques.

3.2. Research Design

The research design adopted in this study is quantitative, correlational, and explanatory. The correlational design is suitable since the objective is to test the causal relationships between variables of monetary policies (interest rate, exchange rate, inflation) and the variables of aggregate bank performance indicators (ROA, ROE, NIIIEA, lending, profitability) in South Africa over time. An explanatory design is appropriate because the emphasis is not just on defining associations but also on discovering short-run dynamics and long-run equilibrium relationships among variables. The study assumes the positivist research paradigm Lim (2023). This approach assumes that reality is measurable and that relationships between variables can be objectively observed and quantified Grass (2024). Furthermore, this study employs an autoregressive distributed lag (ARDL) regression model that investigates how a given dependent or outcome variable changes following changes in a particular variable or variables of interest, called independent or explanatory variables. Descriptive statistics of the data being used and a description of the relationship between the variables are provided.

3.3. Data Sources and Sampling

The study uses secondary monthly data covering 2019 m1 to 2025m4, totalling 413 observations. The data was obtained from the South African Reserve Bank. The statistical package of analysis is E-Views 12. The SARB is this study's preferred data source for the following reasons. The SARB is the custodian of reliable and accurate monetary and financial data for South Africa and is therefore the most preferred data source. This monetary and financial data from the SARB is freely available for public use, particularly for economic research and policy.

3.4. Model Specification

The study formulates the following linear regression model to analyse the impact of monetary policy shocks on bank performance. This study modifies the model specification adopted by Heffernan & Fu (2010). The general formulation of the three models is as follows:

Model 1: $ROE_t = \beta_0 + \beta_1 \boldsymbol{X_t} + \beta_2 \boldsymbol{B_t} + \beta_3 \boldsymbol{M_t} + \varepsilon_t$ ………………………………………… (3.1)

Model 2: $ROA_t = \beta_0 + \beta_1 \boldsymbol{X_t} + \beta_2 \boldsymbol{B_t} + \beta_3 \boldsymbol{M_t} + \varepsilon_t$ …………………………………………(3.2)

Model 3: $NIIIEA_t = \beta_0 + \beta_1 \boldsymbol{X_t} + \beta_2 \boldsymbol{B_t} + \beta_3 \boldsymbol{M_t} + \varepsilon_t$ ………………………………….. (3.3)

Where:

$\boldsymbol{ROE_t}$	Return on Equity, a proxy for bank performance
$\boldsymbol{ROA_t}$	Return on Assets, a proxy for bank performance
$\boldsymbol{NIIIEA_t}$	Net interest income to interest-earning assets, a proxy for bank performance
$\boldsymbol{X_t}$:	a vector of monetary policy variable(s)
$\boldsymbol{B_t}$:	a vector of aggregate bank-specific or internal factor(s)
$\boldsymbol{M_t}$**:**	a vector of macroeconomic variables (s)
ε_t:	is an error term

The specific formulation of the three models is as follows:

Model 1:

$$\boldsymbol{ROE_t} = \beta_0 + \beta_1 \boldsymbol{REPO_t} + \beta_2 \boldsymbol{CAR_t} + \beta_3 \boldsymbol{DEBT_t} + \beta_4 \boldsymbol{PROD_t} + \beta_5 \boldsymbol{IAGLA_t} + \beta_6 \boldsymbol{REER_t} + \varepsilon_t \quad (3.4)$$

Model 2:

$$\boldsymbol{ROA_t} = \beta_0 + \beta_1 \boldsymbol{REPO_t} + \beta_2 \boldsymbol{CAR_t} + \beta_3 \boldsymbol{DEBT_t} + \beta_4 \boldsymbol{PROD_t} + \beta_5 \boldsymbol{IAGLA_t} + \beta_6 \boldsymbol{REER_t} + \varepsilon_t \quad (3.5)$$

Model 3:

$$NIIIEA_t = \beta_0 + \beta_1 REPO_t + \beta_2 CAR_t + \beta_3 DEBT_t + \beta_4 PROD_t + \beta_5 IAGLA_t + \beta_6 REER_t + \varepsilon_t \quad (3.6)$$

Where:

$REPO_t$: Repurchase rate at which banks borrow from the SARB in period *t*

CAR_t: Capital adequacy ratio of banks in period *t*

$DEBT_t$: Debt securities issuance by the general government in period *t*

$PROD_t$: Production index measuring real output in manufacturing in period *t*

$IAGLA_t$ Impaired advances to gross loans in period t

$REER_t$: Real effective exchange rate of the rand against a weighted average of 20 trading partners in period *t*.

3.5. Definition of Variables and Signs of Expected Impact

Table 3.1: Signs of expected impact

Variable	Symbol	Expected Sign	References
Return on assets	ROA	Dependent variable	
Return on equity	ROE	Dependent variable	
Net interest income to interest-earning assets	NIIIEA	Dependent variable	
Repurchase rate	REPO	+/-	Borio et al. (2017); Mishkin (1995)
Capital adequacy ratio	CAR	+/-	Kumar et al. (2020); Borio et al. (2017)
Debt securities issuance	DEBT	+/-	Fabozzi & Fabozzi (2021); Borio et al. (2017)
Production index	PROD	+/-	Borio et al. (2017)

Variable	Symbol	Expected Sign	References
Impaired advances to gross loans	IAGL	+/-	Saunders & Cornett (2021); Borio et al. (2017)
Real effective exchange rate	REER	+/-	Krugman (1980); Borio et al (2017)

3.5.1. *Return on equity*

Return on equity (ROE) evaluates a company's ability to generate profits from its shareholders' equity. It is calculated by dividing net income by average shareholders' equity. ROE indicates how effectively a bank uses the capital invested by its shareholders to produce earnings. A higher ROE signifies greater efficiency in generating shareholder returns, making it a key indicator of financial health and management performance. Ross et al. (2018). In this study, ROE is a dependent variable for the second model, used as a proxy for bank performance to assess how monetary policy changes impact the profitability of equity investments in South African banks.

3.5.2. *Return on assets*

Return on assets (ROA) is a financial ratio that measures a company's profitability and efficiency in utilising its assets to generate profits. It is calculated by dividing the net income by the average total assets and is typically expressed as a percentage. ROA provides insights into how effectively a company generates profits relative to its asset base. A higher ROA indicates efficient asset utilisation and better profitability. It is an important metric for assessing a company's financial performance Brigham & Houston (2019). It is a dependent variable.

3.5.3. *Net interest income to interest-earning assets*

Net interest income to interest-earning assets (NIIIEA) measures the profitability of a bank's interest-generating activities relative to its interest-earning assets, such as loans and securities. It is calculated by dividing net interest income (interest income minus interest expense) by the average interest-earning assets, expressed as a percentage. NIIIEA reflects a bank's ability to manage interest rate spreads and generate revenue from its core lending and investment activities. A higher NIIIEA indicates better efficiency in earning interest income. Saunders et al. (2003). In this study, NIIIEA is a dependent variable, serving as a proxy for bank performance to evaluate the impact of monetary policy on South African banks' interest-based profitability.

3.5.4. Repurchase rate

The repurchase rate (REPO) is the interest rate at which the South African Reserve Bank (SARB) lends funds to commercial banks through repurchase agreements. It is the primary monetary policy tool influencing money supply and economic activity. It affects banks' borrowing costs, lending rates and overall liquidity in the financial system. Changes in the repo rate can impact bank profitability by altering net interest margins and loan demand. Mishkin (1995). In this study, REPO is an independent variable, expected to have a positive or negative impact on bank performance, as tighter policy (higher rates) may reduce lending but increase margins, while looser policy (lower rates) may stimulate lending but compress margins.

3.5.5. Capital adequacy ratio

The capital adequacy ratio (CAR) measures a bank's capital strength, calculated as the ratio of its capital (Tier 1 and Tier 2) to its risk-weighted assets, expressed as a percentage. It ensures banks have sufficient capital to absorb losses, promoting financial stability. A higher CAR enhances a bank's resilience but may limit lending capacity if capital is held excessively by the Basel Committee on Banking Supervision (2020). CAR is expected to positively or negatively impact bank performance, as strong capital buffers may boost stability and profitability. However, overly high ratios could constrain lending in South African banks.

3.5.6. Debt securities issuance

Debt securities issuance (DEBT) refers to the total value of debt securities issued by the general government in South Africa, representing public borrowing through bonds and other instruments. It reflects fiscal policy dynamics and can influence bank performance by affecting liquidity and interest rates in the financial system. High issuance may crowd out private lending and provide banks with investment opportunities. Fabozzi & Fabozzi (2021). In this study, DEBT is an independent variable, expected to have a positive or negative impact (±) on bank performance, as it may stimulate or constrain banking activities depending on fiscal conditions in South Africa.

3.5.7. Production index

The production index (PROD) measures real output in South Africa's manufacturing sector, serving as a proxy for economic activity and industrial performance. It reflects the health of the real economy, influencing loan demand and borrowers' repayment capacity. Strong production growth supports bank lending and profitability, while economic downturns may increase defaults. Mankiw (1998). In this study, PROD is an independent variable, expected to positively or negatively impact (±) bank performance, as economic growth may enhance bank profitability. However, recessions could weaken it in South Africa.

3.5.8. Impaired advances to gross loans

Impaired advances to gross loans (IAGL) measures the proportion of a bank's loan portfolio that is impaired (non-performing or at risk of default), calculated by dividing impaired advances by total gross loans, expressed as a percentage. A higher IAGL indicates greater credit risk, potentially reducing profitability due to increased provisions for loan losses Saunders & Cornett (2021). IAGL is expected to positively or negatively impact bank performance, as higher impaired loans may erode profitability. However, effective risk management could mitigate losses in South African banks.

3.5.9. Real effective exchange rate

The real effective exchange rate (REER) measures the value of the South African rand against a weighted average of 20 trading partners' currencies, adjusted for inflation differentials. It reflects the rand's international competitiveness, impacting export-driven industries and borrowers' repayment capacity. A stronger REER (appreciation) may reduce export competitiveness, increasing loan defaults, while a weaker REER (depreciation) may boost exports but raise import costs. Krugman (1980). REER is an independent variable, expected to positively or negatively impact bank performance, depending on its effect on borrowers' financial health in South Africa.

3.5.10. Error term

The error term (μ) represents all unexplained variables that affect bank performance but are not explicitly captured in the model. It accounts for random shocks, omitted variables, or measurement errors that influence the dependent variables (ROA, ROE, NIIIEA). The error term ensures the model captures residual variation, maintaining the integrity of the regression analysis. Wooldridge (2010). This study includes the error term in all three models to represent unmodeled factors impacting South African bank performance.

3.6. Estimation Technique

The Autoregressive Distributed Lag (ARDL) estimation technique was employed to address the objectives of this study. The ARDL model is a robust econometric model designed for analysing time series data, particularly when variables exhibit mixed orders of integration, such as stationary (I(0)) and first-difference stationary (I(1)) properties. This flexibility makes ARDL well-suited for the study's dataset, which includes a combination of monetary policy variables (repurchase rate, inflation), bank-specific factors (capital adequacy ratio, liquidity coverage ratio), and macroeconomic indicators (production index, real effective exchange rate) with mixed orders of integration.

3.7. Estimation Procedure

3.7.1. Descriptive statistics

Descriptive statistics provide an overview of the data and help identify patterns and relationships. It includes mean, median, mode, and measures of how the data is spread out. Furthermore, a perform correlation analysis was conducted on all three (3) dependent and six (6) explanatory variables to establish whether there is high collinearity between pairs of variables.

3.7.2. Stationarity and unit root test

The ARDL model is typically used when variables are a mix of **I(0)** (stationary) and **I(1)** (integrated of order one). Stationarity is a time series exhibiting constant mean, variance, and covariance properties over time. A unit root, on the other hand, indicates that the series has a stochastic or non-stationary trend. It's essential to use stationary variables because estimations rely on the assumption that the underlying data-generating process is stable over time, which allows for valid statistical inference and prediction. Using non-stationary variables typically leads to spurious regression, where a highly significant relationship is found between unrelated variables, resulting in inconsistent and unreliable parameter estimates and invalid hypothesis tests.

One of the most used unit root tests is the Augmented Dickey-Fuller (ADF) test. The ADF test builds upon the Dickey-Fuller test and estimates an autoregressive model to assess whether the coefficient of the lagged dependent variable is significantly different from one. If the coefficient is significantly different from one, it suggests the presence of a unit root in the series. The unit root test is critical in time series analysis as it helps determine the order of integration of a variable. If a variable is found to have a unit root, it implies that differencing may be necessary to achieve stationarity before applying other statistical techniques or models Dickey & Fuller (1979).

3.7.3. Co-integration analysis

Co-integration refers to a long-term equilibrium relationship among time series variables that may exhibit non-stationary behaviour. It enables the identification of stable relationships between variables that, despite short-term deviations, converge over time. Co-integration analysis is conducted using the bounds testing approach within the ARDL framework, which is particularly effective for variables with mixed integration orders (I(0) or I(1)). The ARDL model cannot be applied if any variable is integrated of order two or higher. The bounds test, developed by Pesaran, Shin, and Smith (2001), assesses the presence of a long-run relationship by comparing the F-statistic to critical bounds, without requiring pre-specification of whether variables are stationary or non-stationary. If co-integration is confirmed, an error correction model is estimated to capture long-run and short-run dynamics. This approach is widely used in economics and finance to model long-term relationships, making it suitable for analysing the impact of monetary policy on South African bank performance. Pesaran et al. (2001).

3.7.4. Vector Error Correction Model

The Vector Error Correction Model (VECM) is an econometric tool used to analyse the short-run and long-run dynamics among non-stationary time series variables that are co-integrated. Unlike models that only capture short-term fluctuations, VECM incorporates an error correction term (ECT) that reflects the speed at which variables return to equilibrium after a shock. This makes it particularly suitable for macroeconomic and financial studies where long-run relationships exist, such as between monetary policy instruments and bank performance indicators. The model is derived from a Vector Auto-regression (VAR) framework but is adjusted to account for co-integration, ensuring that the long-run equilibrium constraints are respected while allowing for short-run deviations.

The key component of the VECM is the error correction term (ECT), which quantifies the extent of disequilibrium from the long-run relationship in the previous period and guides the adjustment in the current period. A statistically significant and negative ECT coefficient confirms the presence of long-run causality and indicates that the dependent variable responds to restore equilibrium. For example, if the ECT coefficient is −0.15, it implies that 15% of the deviation from the long-run equilibrium is corrected each month. This interpretation is crucial for understanding how quickly bank performance indicators adjust in response to changes in monetary policy variables. In this study, the VECM complements the ARDL bounds testing approach by providing additional insights into the dynamic interactions and adjustment mechanisms among the variables under investigation.

3.7.5. Autoregressive distributed lag model

The Autoregressive Distributed Lag (ARDL) model is an econometric technique designed to analyse long-run and short-run relationships between time series variables, particularly when they exhibit mixed orders of integration I(0) and I(1)). The ARDL model is well-suited for this study, as it accommodates the dynamic effects of monetary policy, bank-specific, and macroeconomic variables on bank performance indicators. It incorporates lagged values of both the dependent variable (ROA, ROE, NIIIEA) and independent variables (repo rate, debt, exchange rate, etc.), allowing for flexible modelling of temporal dependencies. The estimation process involves ordinary least squares (OLS) regression to derive long-run coefficients representing equilibrium relationships and short-run coefficients capturing dynamic adjustments through an error correction term.

3.7.6. Long-run and short-run coefficient analysis

Long-run and short-run coefficient analyses interpret the relationships between monetary policy variables and bank performance within the ARDL framework. Long-run coefficients quantify the equilibrium impact of independent variables (repo rate, capital adequacy ratio) on dependent variables (ROA, ROE, and NIIIEA), providing insights into the sustained effects of monetary policy changes. Short-run coefficients, derived from the error correction model, capture immediate and dynamic adjustments toward equilibrium, with the error correction term indicating convergence speed. This analysis helps identify the magnitude and direction of monetary policy effects, enabling us to understand both immediate responses and long-term trends in bank performance.

3.7.7. Diagnostic tests

3.7.7.1 Heteroscedasticity

The White test, also known as the White heteroscedasticity-consistent standard errors test or the White robust test, was proposed by Hilbert White in 1980. It is commonly employed to check the validity of assumptions in regression models, particularly in the presence of potential heteroscedasticity. The White test involves estimating the regression model and then examining the residuals to detect patterns of heteroscedasticity. The test statistic is computed based on the squared residuals. It is compared to a critical value from a chi-squared distribution with degrees of freedom equal to the number of explanatory variables. If the calculated test statistic exceeds the critical value, it suggests the presence of heteroscedasticity in the regression model. Alternatively, if the corresponding p-value exceeds 0.05, it is concluded that there is no heteroscedasticity in the model. Adjusting the standard errors or employing robust regression techniques is necessary to obtain reliable parameter estimates White (1980).

3.7.7.2 Serial correlation

The Breusch-Godfrey LM test is a statistical test used in econometrics to examine the presence of autocorrelation, or serial correlation, in the residuals of a regression model. It extends the Durbin-Watson test and can detect higher-order serial correlation. To conduct the test, the regression model is estimated, and the residuals are obtained. Auxiliary regression models are then constructed using lagged values of the residuals as additional explanatory variables. The test statistic is calculated based on the residuals and auxiliary regression, and it follows a chi-squared distribution under the assumption of no serial correlation. If the calculated test statistic exceeds the critical value, it indicates the presence of serial correlation in the regression model. Alternatively, if the corresponding p-value exceeds 0.05, it is concluded that there is no serial correlation in the model. In such cases, adjustments need to be made, such as including lagged dependent variables or employing autoregressive models, to account for the autocorrelation and obtain reliable parameter estimates Breusch & Godfrey, 1978).

3.7.7.3 Normality test

The assumption of normally distributed residuals is important for the validity of statistical inference, including hypothesis testing and confidence intervals. In this study, the Jarque-Bera (JB) test is used to assess whether the residuals follow a normal distribution. The JB test evaluates the null hypothesis that the residuals are normally distributed, based on their skewness and kurtosis. A p-value greater than 0.05 indicates that the null hypothesis cannot be rejected, suggesting that the residuals are normally distributed. Conversely, a p-value below 0.05 implies that the residuals deviate significantly from normality. Ensuring residual normality enhances the reliability of the model's estimates and supports the robustness of diagnostic tests.

3.7.7.4 Multi-collinearity test

Multi-collinearity occurs when independent variables are strongly correlated, potentially inflating standard errors and compromising model reliability. A multi-collinearity test was employed to detect high correlations among independent variables in a regression model. Multi-collinearity was assessed using a correlation matrix, where correlation coefficients exceeding 0.8 indicate significant collinearity, prompting the exclusion of affected variables to ensure model validity. This approach is widely used in econometric analysis to maintain the integrity of regression results. Gujarati (2021). Alternatively, the variance inflation factor (VIF) test for multi-collinearity can be used. A VIF of 1 indicates no multi-collinearity; $1 < VIF < 5$ moderate multi-collinearity; $VIF > 10$ high multi-collinearity. However, the VIF was not used for this study as the researcher felt that the correlation results were sufficient.

3.7.7.5 Model stability test

The CUSUM test is a statistical technique that detects structural changes or breaks in a regression model over time. It examines whether the cumulative sum of the squared residuals exceeds a critical threshold, indicating a significant departure from the model's stability. The CUSUM test involves calculating the cumulative sum of squared residuals from the beginning of the sample to each observation. If the cumulative sum of residuals moves outside the critical confidence bands (typically set at the 5% significance level), it suggests that the model has experienced a structural change or parameter instability over time. The CUSUM test is useful in identifying shifts in the relationship between variables, changes in coefficients, or variations in error variance over time. It is commonly applied in time series analysis and monitoring the stability of economic or financial models. Brown et al. (1975).

3.8. Chapter Summary

This chapter has outlined the research methodology employed to investigate the impact of monetary policy changes on the performance of South African banks, detailing the correlational and descriptive research design, data sources from the South African Reserve Bank, model specifications, variable definitions, and the ARDL estimation technique. The study uses secondary data from 2019m1 to 2025m4. The chapter also highlights pre- and post-estimation techniques, and these methods include stationarity tests, co-integration analysis, and diagnostic checks for heteroscedasticity, serial correlation, and multi-collinearity. This approach ensures a rigorous analysis of the relationships between monetary policy variables, bank-specific factors, and macroeconomic indicators. The methodology provides a solid foundation for addressing the research objectives and deriving reliable insights into bank performance dynamics. The next chapter presents data analysis and empirical findings, discussing the results of the ARDL model estimations and their implications for the South African banking sector.

CHAPTER 4:
RESEARCH FINDINGS AND ANALYSIS

4.1. Introduction

This chapter presents the empirical findings and detailed analysis of the study investigating the impact of monetary policy changes on aggregate bank performance in South Africa. The results form the basis for the study's conclusions and policy recommendations. The analysis is organised into eight subsections: Section 4.2 presents the descriptive statistics, Section 4.3 outlines the stationarity (unit root) test results, Section 4.4 discusses the determination of optimal lag length, Section 4.5 covers the bounds test for co-integration, Sections 4.6 and 4.7 provide the long-run and short-run ARDL regression estimates, respectively, and Section 4.8 reports the diagnostic tests. These subsections collectively address the research questions and hypotheses, offering insights into the relationships between monetary policy variables and bank performance indicators.

4.2. Descriptive Statistics

This section presents the descriptive statistics of the dataset, covering the period 2019m1 to 2025m5, to provide an overview of the variables' distributional properties and their economic implications for the South African banking sector. Three dependent variables included in this study are Return on Assets (ROA), Return on Equity (ROE), and Net Interest Income to Interest Earning Assets (NIIEA). The independent variables include monetary policy indicators (repo rate, inflation), bank-specific factors (cost-to-income ratio, capital adequacy ratio) and macroeconomic variables (real effective exchange rate, production index, debt). Table 4.1 measures central tendency, dispersion, skewness, kurtosis, and normality.

Table 4.1: Descriptive Statistics

Variable	Mean	Maximum	Minimum	Std. Dev.	Obs.
ROE	13.35	16.69	6.93	2.48	77
ROA	1.01	1.27	0.51	0.19	77
NIIIEA	3.95	4.33	3.66	0.18	77
REPO	6.20	9.36	2.75	2.15	77
CAR	17.17	18.87	12.79	0.64	77
DEBT	13.71	15.32	-0.09	4.36	76
PROD	93.19	103.80	48.10	6.91	77
IAGLA	4.95	6.54	3.73	0.78	77
REER	23.98	112.09	-8.58	45.46	77

Table 4.1 presents the descriptive statistics for the variables used in the study, based on 77 monthly observations from January 2019 to May 2025. Return on equity (ROE) has a higher mean of 13.35% and a standard deviation of 2.48, reflecting greater variability in shareholder returns due to leverage and risk exposure. Return on assets (ROA) averages 1.01% with a standard deviation of 0.19, indicating modest but stable profitability. Net interest income to interest-earning assets (NIIIEA), on the other hand, averages 3.95%, suggesting consistent interest-based profitability. The repo rate averages 6.20%, with moderate dispersion, while the real effective exchange rate (REER) shows high volatility, indicating macroeconomic instability. Debt securities issuance also displays extreme variability and a wide range, suggesting fiscal policy fluctuations.

Bank-specific indicator, capital adequacy ratio (CAR), shows relatively low dispersion (0.64), implying operational consistency across banks. The impaired advances to gross loans (IAGLA) averages 4.95%, indicating varying credit risk profiles. Skewness and kurtosis statistics reveal that several variables deviate from normality. Furthermore, ROA and ROE are negatively skewed and leptokurtic, while REER and the production index (PROD) exhibit high kurtosis, especially PROD, suggesting the presence of outliers. The Jarque-Bera test confirms non-normality for most variables, with significant p-values (ROA and ROE both < 0.001), reinforcing the need for robust econometric techniques.

4.3. Results of Preliminary Test

4.3.1. Multi-collinearity Test

The correlation matrix assessed linear relationships and detected multi-collinearity among variables. The rule of thumb shows that any correlation coefficient greater than 0.8 means the two variables are highly correlated, implying multi-collinearity. This means that one of the two variables needs to be dropped. Table 4.2 shows collinearity between ROE and ROA, NIIIEA and REPO, and NIIIEA and REER. This is largely expected, and none of the dependent variables (ROE, ROA, and NIIIEA) will be dropped since they would not be in the same model (equation). Among the 6 explanatory variables, there seems to be no problem of multi-collinearity, which could inflate standard errors and produce unreliable regression coefficient estimates, thus compromising the model's validity.

Table 4.2: Correlation Matrix

	ROE	ROA	NIIIEA	REPO	CAR	DEBT	PROD	IAGLA	REER
ROE	1.000								
ROA	0.98*	1.00							
NIIEA	0.62*	0.53*	1.00						
REPO	0.65*	0.53*	0.92*	1.00					
CAR	0.28*	0.27*	0.32*	0.21	1.00				
DEBT	-0.22	-0.09	-0.18	-0.29*	-0.03	1.00			
PROD	0.21	0.21	0.04	0.14	0.09	-0.02	1.00		
IAGLA	-0.13	-0.24*	0.64*	0.53*	0.40*	-0.13	-0.14	1.00	
REER	0.20	0.14	0.81*	0.68*	0.28*	0.19	0.01	0.78*	1.00

* Indicates significance at 5%.

4.3.2. Stationarity test

To ensure the validity of the ARDL model, the study conducted the Augmented Dickey-Fuller (ADF) test to assess the stationarity properties of all the time series variables. The ARDL framework is flexible in accommodating variables that are either stationary at level (I(0)) or at first difference (I(1)). However, it cannot be applied to variables integrated of order two (I(2)), as this would lead to spurious regression results. Therefore, confirming that none of the variables is I(2) is a critical prerequisite for model estimation.

The ADF test results, presented in Table 4.3, show that several variables namely Return on Assets (ROA), Return on Equity (ROE), Net Interest Income to Interest Earning Assets (NIIIEA), Capital Adequacy Ratio (CAR), Debt Securities Issuance (DEBT), Impaired Advances to Gross Loans (IAGLA), and the Real Effective Exchange Rate (REER) are non-stationary at levels but become stationary after first differencing. This confirms that they are integrated in order one (I(1)). On the other hand, the Production Index (PROD) is stationary at levels, indicating it is integrated of order zero (I(0)). These results confirm that all variables used in the study meet the integration requirements for ARDL estimation. The presence of both I(0) and I(1) variables further justifies the use of the ARDL approach, which is well-suited for analysing relationships among variables with mixed orders of integration.

Table 4. 3: Unit Root Tests

Variable	**ADF (level)**		**ADF (first difference)**		**Order of integration**
	Statistic	***p-value***	***Statistic***	***p-value***	
ROE	-1.237	0.657	-6.431***	0.000	I(1)
ROA	-1.366	0.599	-7.012***	0.000	I(1)
NIIIEA	2.260	0.999	-4.491***	0.000	I(1)
REPO	-0.802	0.818	-10.165***	0.000	I(1)

Variable	ADF (level)		ADF (first difference)		Order of integration
	Statistic	*p-value*	*Statistic*	*p-value*	
CAR	-2.068	0.258	-10.767***	0.000	I(1)
DEBT	-0.422	0.906	-8.428***	0.000	I(1)
PROD	-4.619***	0.000	-9.845***	0.000	I(0)
IAGLA	0.630	0.988	-4.921***	0.000	I(1)
REER	-0.480	0.896	-9.145***	0.000	I(1)
*[***]/ (**) / * indicates significance at 1%, 5% and 10% respectively.*					

4.3.3. Determination of optimal lag length

The optimal lag length for the ARDL model was determined using three criteria, which are the Akaike Information Criterion (AIC), the Schwarz Bayesian Criterion (SC) and the Hannan-Quinn Criterion (HQ). The lag length was determined using the AIC due to its balance of model fit and parsimony. This analysis indicated an optimal lag length of four. The AIC minimum ensures that the information criterion is minimised compared to other lags, capturing sufficient dynamics without overfitting. Table 4.4 below shows the lag length selection for all variables in the three models.

Table 4.4: Lag Length Selection

Variable	ROE	ROA	NIIIEA	REPO	CAR	DEBT	PROUD	IAGLA	REER
Model 1 (r1)	2			1	1	2	0	0	0
Model 2 (r1)		1		1	0	2	0	0	2
Model 3 (r1)			2	2	0	0	0	0	0

4.3.4. *Co-integration test*

To determine whether a long-run equilibrium relationship exists among the variables in the three ARDL models, the study employed the bounds testing approach to co-integration. The models under consideration include Model 1 (Return on Equity, ROE), Model 2 (Return on Assets, ROA), and Model 3 (Net Interest Income to Interest Earning Assets, NIIIEA). The bounds test evaluates whether the dependent and independent variables in each model are co-integrated, meaning they move together over time despite short-term fluctuations.

Table 4.5: ARDL Bounds Tests (k = 6)

Model	Type of Test	Test Statistic	I (0) Bound 5%	I (1) Bound 5%	Decision
Model 1 (ROE)	F-statistic	6.95	2.45	3.61	F > I(1) ⇒ co-integration
	t-statistic (ECM)	-3.42	-2.86	-4.38	–I (0) ≤ t ≤ –I (1) → Inconclusive
Model 2 (ROA)	F-statistic	8.39	2.45	3.61	F > I(1) ⇒ co-integration
	t-statistic (ECM)	-1.93	-2.86	-4.38	t-stat > I(0) → No co-integration
Model 3 (NIIIEA)	F-statistic	5.67	2.45	3.61	F > I(1) ⇒ co-integration
	t-statistic (ECM)	-4.36	-2.86	-4.38	t-stat < I(1) ⇒ co-integration

The ARDL bounds test confirms the existence of a long-run relationship between REO (Model 1) and the set of six explanatory variables. The computed F-statistic (6.95) exceeds the 5% upper critical bound of 3.61 for k = 6, Pesaran, Shin & Smith (2001), leading to rejection of the null hypothesis of no levels relationship. Although the accompanying t-statistic (–3.42) is inconclusive, the F-statistic provides strong and sufficient evidence of co-integration in the model.

In summary, the results, presented in Table 4.5, show that the computed F-statistics for all three models exceed the critical upper bounds at both the 5% and 10% significance levels. Specifically, the F-statistic for ROE is 6.95, ROA is 8.39, and for NIIIEA is 5.67. These values are all greater than the respective I(1) critical values for six explanatory variables (k = 6). Consequently, the null hypothesis of no co-integration is rejected for each model. These findings confirm the existence of long-run relationships between the dependent variables and their respective explanatory variables, thereby validating the use of the ARDL framework for further analysis. The presence of co-integration implies that any short-term deviations from equilibrium will eventually adjust over time, reinforcing the robustness of the model specifications.

Following the confirmation of long-run relationships among variables in the three ARDL models, the study estimates the long-run and short-run ARDL Error Correction equations. The long-run estimates, presented in Section 4.6, quantify the equilibrium relationships between the dependent and explanatory variables, while the short-run estimates, presented in Section 4.7, capture dynamic adjustments toward equilibrium.

4.4. Main Estimation Results

4.4.1. Long-run estimates

4.4.1.1. Model 1: return on equity

The results in Table 4.6 show that the long-run coefficients for REPO, CAR, DEBT and IAGLA are significant at the 5% level. A one-unit increase in the REPO, for example, raises ROE by 0.630. Furthermore, a one-unit increase in CAR, all other things being equal, increases ROE by 3.249. This suggests that stronger capital (CAR) buffers enhance banks' ability to generate equity returns by supporting financial stability and absorbing risk. The results further show that debt securities issuance (DEBT) has a complex effect on ROE. A one-unit increase in DEBT reduces ROE in the current period by 0.191. The results further show that a one-unit increase in the production index (PROD) raises ROE by 0.113, though the coefficient is not significant, just like the one for the real effective exchange rate (REER).

Table 4.6 Estimated Long Run Coefficients for Model 1

ROE: Dependent Variable	**ARDL results**	
Variable	**Coefficient**	**P-value**
Constant	-5.270***	0.001
ECT (-1)	-0.123***	0.008
Long-run (LR)		
REPO	0.630**	0.020
CAR	3.249***	0.000
DEBT	-0.191*	0.096
PROD	0.113	0.154
IAGLA	-2.408**	0.014
REER	0.012	0.551

*Notes: [***]/ (**) / * indicates significance at 1%, 5% and 10%, respectively.*

4.4.1.2. Model 1: Return on assets

The results in Table 4.7 show that a one-unit increase in the capital adequacy ratio (CAR) raises ROA by 3.495, confirming that stronger capital buffers enhance banks' ability to generate equity returns by supporting financial stability and absorbing risk. The other significant result (at 10%) is for IAGLA, which shows an inverse relationship between IAGLA and ROA. The coefficients for REPO, DEBT, PROD and REER, though showing expected signs, are insignificant even at the 10% level.

Table 4. 7 Estimated Long Run coefficients for Model 2

ROA: Dependent Variable	**ARDL long-run results**	
Variable	**Coefficient**	**P-value**
Constant	-0.846***	0.000
ECT (-1)	-0.139*	0.063
Long-run (LR)		
REPO	0.047	0.155
CAR	3.495**	0.010
DEBT	0.005	0.727
PROD	0.018	0.193
IAGLA	-0.198*	0.093
REER	0.000	0.894

*Notes: [***]/ (**) / * indicates significance at 1%, 5% and 10%, respectively.*

4.4.1.3. Model 3: Net interest income to interest-earning assets

The long run results in Table 5.8 show that a one-unit increase in the REPO and CAR increases the NIIIEA by 0.069 and 0.135, respectively. The coefficients for DEBT, PROD, IAGLA and REER are insignificant, suggesting that they don't have an influence on NIIIEA in the long run.

Table 4.8 Estimated Long Run coefficients for Model 3

NIIIEA: Dependent Variable	**ARDL long-run results**	
Variable	**Coefficient**	**P-value**
Constant	0.128	0.300
ECT (-1)	-0.097***	0.001
Long-run (LR)		
REPO	0.069***	0.000
CAR	0.135***	0.003
DEBT	-0.005	0.357
PROD	-0001	0.766
IAGLA	0.004	0.935
REER	0.012	0.247

*Notes: [***]/ (**) / * indicates significance at 1%, 5% and 10%, respectively.*

4.4.2. Short-run estimates

This section presents the short-run estimates from the ARDL Error Correction equations. These estimates capture the dynamic adjustments of the dependent variables toward their long-run equilibrium in response to short-term changes in explanatory variables.

4.4.2.1. Model 1: Return on equity

The results in Table 4.9 show that the error correction term (ECT (-1)) is negative and statistically significant (–0.123). This confirms the existence of a long-run relationship between the variables in the model and indicates that deviations from the long-run equilibrium are corrected at a speed of 12.3% per month. In practical terms, this means that around 12% of any disequilibrium in return on equity (ROE) is adjusted in the following month, reinforcing the model's stability and convergence toward long-run equilibrium. The short-run dynamics reveal several significant relationships. The lagged value of ROE itself is positive and statistically significant. The significance of the lagged value of ROE suggests strong momentum in equity returns, where past performance continues to influence current profitability.

Table 4.9 Estimated Short Run Coefficients for Model 1

ROE: Dependent Variable	**ARDL short-run results**	
Variable	**Coefficient**	**P-value**
Constant	-5.270***	0.001
ECT (-1)	-0.123***	0.008
Short run (LR)		
ROE(LD)	0.312***	0.001
REPO (D1)	-0.092	0.174
CAR (D1)	-0.207	0.156
DEBT (D1)	-0.128***	0.000
DEBT (D2)	0.175***	0.000

*Notes: [***]/ (**) / * indicates significance at 1%, 5% and 10%, respectively.*

The only significant short-run coefficient is for the debt securities issuance (DEBT), which shows a strong short-run impact. In the first lag (D1), DEBT reduces ROE, while the second lag (D2) increases it. This alternating pattern suggests that fiscal borrowing may initially crowd out bank equity returns but could stimulate performance in the following period, depending on how the funds are deployed.

4.4.2.2. Model 2: Return on assets

The results in Table 4.10 show the error correction term (ECT (-1)), which is negative and statistically significant. This confirms the presence of long-run causality and indicates that deviations from the long-run equilibrium are corrected at a speed of approximately 14% per month. In other words, if return on assets (ROA) deviates from its long-run path due to short-term shocks, approximately 14% of that deviation is adjusted in the following month, restoring equilibrium over time.

The short-run dynamics reveal several significant relationships. A one-unit increase in the second lag of the REPO raises ROA by 0.029, suggesting that an increase in interest improves the bank's profitability in the short run.

Table 4.10 Estimated Short Run Coefficients for Model 2

ROE: Dependent Variable	**ARDL short-run results**	
Variable	**Coefficient**	**P-value**
Constant	-0.846***	0.000
ECT (-1)	-0.139*	0.063
Short run (LR)		
REPO (D1)	0.029***	0.001

*Notes: [***]/ (**) / * indicates significance at 1%, 5% and 10%, respectively.*

4.4.2.3. Model 3: Net interest income to interest-earning assets

The results in Table 5.11 begin with the error correction term (ECT (-1)), which is negative and statistically significant. This confirms the existence of a long-run relationship between the variables in the model and Net Interest Income to Interest-Earning Assets (NIIIEA). The coefficient indicates that approximately 9% of any deviation from the long-run equilibrium is corrected each month. Although the adjustment speed is slower compared to the other models, it still reflects a gradual convergence toward equilibrium over time. The short-run dynamics show that the lagged value of NIIIEA itself is positive and statistically significant at the 5% level.

Table 4.11: Estimated Short Run Coefficients for Model 3

ROE: Dependent Variable	**ARDL short-run results**	
Variable	***Coefficient***	***P-value***
Constant	0.128	0.300
ECT (-1)	-0.097***	0.001
Short run (LR)		
NIIIEA(LD)	0.241**	0.034

*Notes: [***]/ (**) / * indicates significance at 1%, 5% and 10%, respectively.*

4.5. Discussion of Results

The empirical findings of this study provide an understanding of how monetary policy and macro-financial variables influence aggregate bank performance in South Africa. Using ARDL models to estimate both long-run and short-run relationships, the analysis focused on three key performance indicators: Return on Equity (ROE), Return on Assets (ROA), and Net Interest Income to Interest-Earning Assets (NIIIEA). The confirmation of co-integration across all models through the bounds test validates the existence of stable long-run relationships between bank performance and the selected explanatory variables, consistent with the findings of Kayabaş et al. (2017) and Shirya et al. (2023), who emphasized the enduring impact of monetary policy on financial institutions in emerging markets.

Table 4.12 Summary of Estimated ARDL Results (Model 1-3)

Variable	Model 1 (ROE	Model 2 (ROA)	Model 3 (NIIIEA)
Constant	-5.27***	-0.85***	0.13
ECT (-1)	-0.12***	-0.14*	-0.10***
Long-run (LR)			
REPO	0.63**	0.05	0.07***
CAR	3.25***	0.35**	0.14***
DEBT	-0.19*	0.004	-0.004
PROD	0.11	0.02	-0.001
IAGLA	-2.41***	-0.20*	0.004
REER	0.01	0.00	0.001
Short run (LR)			
ROE (LD)	0.33***		
ROA (LD)			
NIIIEA (LD)			0.24**
REPO (D1)		-0.03***	
CAR (D1)			
DEBT (D1)	-0.13***		
DEBT (D2)	0.18***		

*Notes: [***]/ (**) / * indicates significance at 1%, 5% and 10%, respectively.*

As shown in Table 4.10 above, for the ROE Model, the long-run results highlight the importance of REPO, CAR, DEBT, and IAGLA. CAR continues to play a stabilising role, enhancing equity returns through improved risk absorption and regulatory compliance Allen, 2024). Debt securities issuance (DEBT) exhibits alternating effects, suggesting that fiscal activity can both crowd out and stimulate bank equity performance depending on timing and macroeconomic conditions Olofinlade et al. (2020).

The results for Model 2 (ROA) reveal that in the long run, the capital adequacy ratio (CAR) and IAGLA were statistically significant in influencing bank profitability. This supports the view that well-capitalised banks are more resilient and capable of sustaining lending activities during economic fluctuations Kumar et al. (2020). Economic output, proxied by PROD, enhances ROA by stimulating credit demand and improving borrower repayment capacity, aligning with Rahman and Ahmed (2022), who found similar effects in Ghana. Conversely, the real effective exchange rate (REER) positively affects ROA, suggesting that currency appreciation may enhance export competitiveness and improve the financial position of export-oriented borrowers English & Sack (2024).

In the NIIIEA model, REPO and CAR contribute positively to interest income in the long run, confirming that strong capital and liquidity positions enable banks to sustain lending and manage funding risks. DEBT and PROD are negative and insignificant, while IAGLA and REER are positive but insignificant. Theoretically, PROD also enhance NIIIEA. IAGLA positively influences NIIIEA, indicating that effective credit risk management can support short-term returns. In the short run, only previous levels of NIIIEA enhance NIIIEA.

4.6. Diagnostic Test Results

This section presents the diagnostic tests conducted to evaluate the robustness and reliability of the three ARDL models, including the absence of heteroscedasticity, the Breusch-Godfrey Serial Correlation LM test, and the stability test.

4.6.1. Diagnostic Test Results for Model 1 (ROE)

4.6.1.1. Heteroscedasticity test results

The Breusch-Pagan Test for heteroscedasticity in the ROE model results in a t-statistic of 0.10 with a p-value of 0.755. As shown in Table 4.13, this is a very high p-value (0.755 > 0.05). We clearly fail to reject the null hypothesis, that residuals are homoscedastic (constant variance). We therefore conclude that Model 1 (ROE) exhibits homoscedasticity. The lack of heteroscedasticity confirms that the residuals' variance is constant across the range of explanatory variables, ensuring that the standard errors of the ARDL model estimates are unbiased and the regression coefficients are reliable.

Table 4.13: Diagnostic Test Results for Model 1 (ROE)

Diagnosis & Null Hypothesis	Tests	p-Value	Inference
Normality H_0: Residuals are normally distributed	Residual Test (5.36)	0.068	Fail to Reject H_0 at 5%; the residuals are normally distributed.
Heteroscedasticity H_0: Residuals are homoscedastic.	Breusch-Pagan (0.10)	0.755	The variance of the residuals isconstant (Homoskedasticity).
Serial correlation H_0: No serial correlation	Breusch-Godfrey (0.199)	0.820	Fail to Reject H_0; There is no serial correlation up to the 2^{nd} lag.

4.6.1.2. Serial correlation test results

Table 4.13 above also shows the serial correlation (Breusch-Godfrey) test results. This is arguably the most important test for time series data. It checks if the current error term is correlated with previous error terms. If serial correlation (autocorrelation) exists in an ARDL model, the estimates are biased and inconsistent. The test results show a very high p-value ($0.820 > 0.05$). We strongly fail to reject the null hypothesis and conclude that there is no serial correlation. This indicates that you have likely included enough lags in Model 1 (ROE) to adequately capture the dynamic nature of the data.

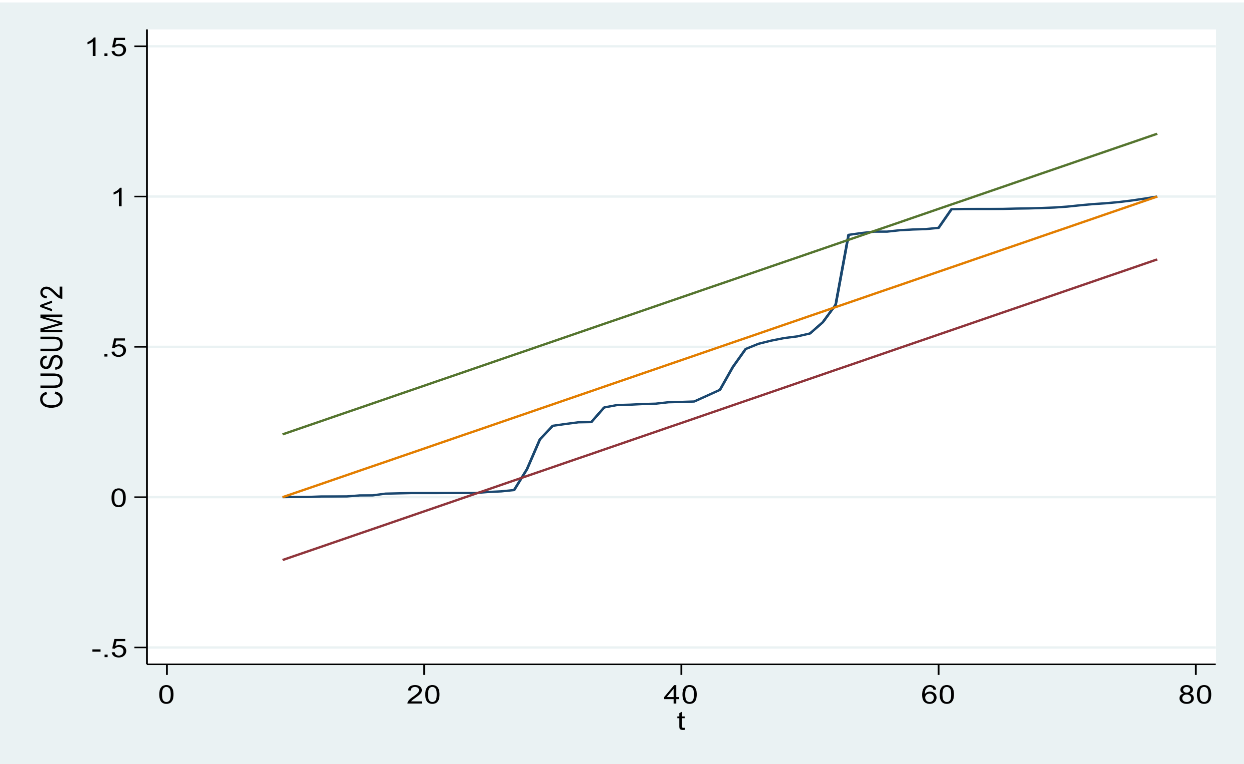
4.6.1.3. Normality test results

The normality (residual) test checks if the error terms (residuals) of the model follow a normal "bell curve" distribution. This is required to ensure that t-statistics and F-statistics are valid for hypothesis testing. As shown in Table 4.13, the p-value is 0.068, which is greater (>) than 0.05. It is therefore concluded that the residuals follow a normal distribution. Although it is somewhat close to the 0.05 threshold, it is statistically acceptable.

4.6.1.4. Stability test results

The cumulative sum of squared (CUSUMSQ stability test for the ROE model, as shown in Figure 4.1, demonstrates that the CUSUMSQ residuals generally stay within the 5% critical bounds throughout the sample period. The graph, however, shows the blue line briefly crosses (or at least touches) the red (lower) and green (upper) lines. However, taken together with other diagnostic tests, it was concluded that the model is generally stable. The stability of the ROE model supports its suitability for analysing the long-term and short-term effects of monetary policy variables on bank equity performance in South Africa.

Figure 4. 1: Stability Test for Model 2



4.6.2. Diagnostic Test Results for Model 2 (ROA)

Table 4.14 below shows the diagnostic test results for Model 2 (ROA) in terms of normality, heteroscedasticity and serial correlation.

Table 4.14: Diagnostic Test Results for Model 2 (ROA

Diagnosis & Null Hypothesis	Tests	p-Value	Inference
Normality H_0: Residuals are normally distributed	Residual Test (9.46)	0.009	Reject H_0; The residuals are not normally distributed.
Heteroscedasticity H_0: Residuals are homoscedastic.	Breusch-Pagan (0.09)	0.770	The variance of the residuals is constant (Homoskedasticity).
Serial correlation H_0: No serial correlation	Breusch-Godfrey (0.296)	0.745	Fail to Reject H_0; There is no serial correlation up to the 2^{nd} lag.

4.6.2.1. Heteroscedasticity test results

As shown in Table 4.14 above, the heteroscedasticity (Breusch-Pagan test) result gives a p-value of 0.770. This p-value is significantly greater than 0.05. We fail to reject the null hypothesis. This suggests that the residuals of the ROA model exhibit constant variance, confirming the absence of heteroscedasticity. The lack of heteroscedasticity ensures that the standard errors of the regression coefficients are reliable, supporting the validity of the long-run and short-run estimates for analysing the impact of monetary policy variables on ROA.

4.6.2.2. Serial correlation test results

The Breusch-Godfrey Serial Correlation LM test for the ROA model p-values (0.745) exceed the 0.05 significance level, leading to a failure to reject the null hypothesis of no serial correlation. This indicates that the residuals of the ROA model are not auto correlated, meaning there is no systematic pattern in the errors over time. This further confirms that the dynamic structure of the ARDL model has been correctly specified.

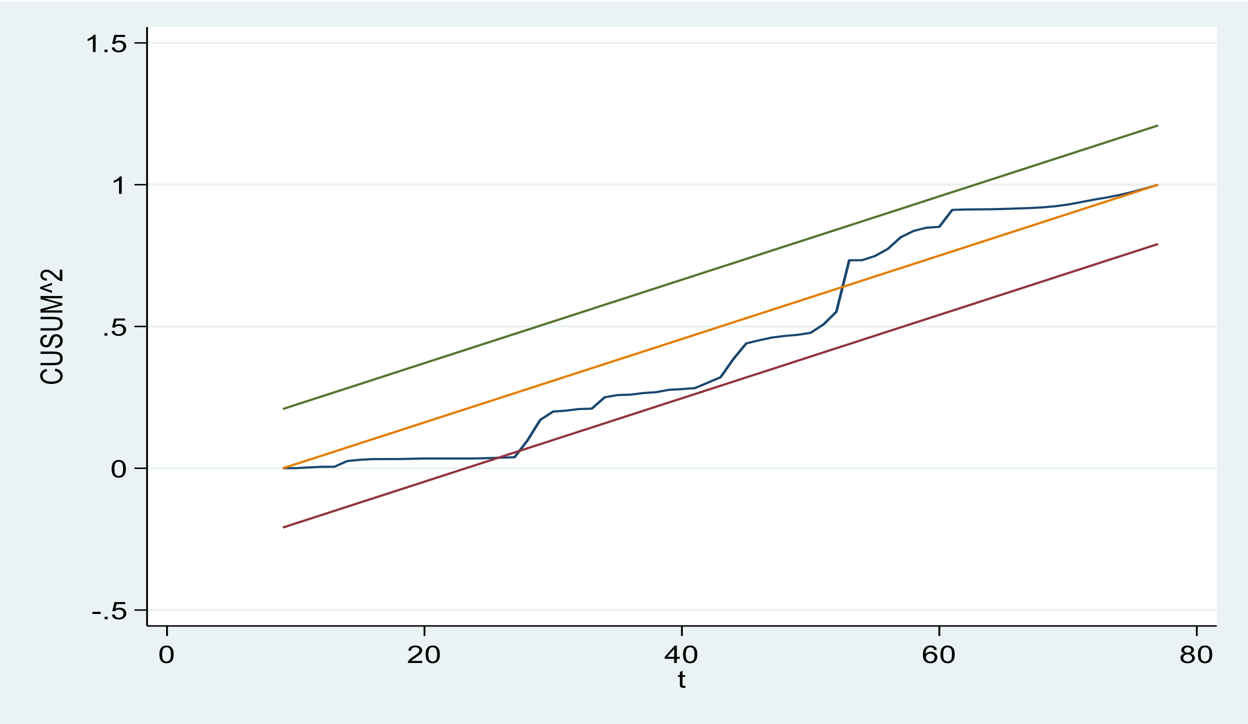
4.6.2.3. Normality test results

As shown in Table 4.14 above, the p-value (0.009) is less than the conventional 5% significance level. Consequently, the null hypothesis of normally distributed residuals is rejected. This implies that residuals of Model 2 (ROA) are not normally distributed. While a violation of normality does not bias the estimated coefficients, it invalidates the standard t-statistics and F-statistics. This means the inferences regarding the significance of individual variables, or the overall model, may be unreliable.

4.6.2.4. Stability test results

Figure 4.2 shows the stability test for the ROA model. The CUSUMSQ residuals generally remain within the critical bounds. The stability of the model confirms its suitability for analysing the long-term and short-term effects of monetary policy on bank performance.

Figure 4.2: Stability Test for Model 1



4.6.3. Diagnostic test results for Model 3 (NIIIEA)

Table 4.15 below shows the diagnostic test results for Model 3 (NIIIEA) in terms of normality, heteroscedasticity and serial correlation.

Table 4.15: Diagnostic Test Results for Model 3 (NIIIEA)

Diagnosis & Null Hypothesis	Tests	p-Value	Inference
Normality H_0: Residuals are normally distributed	Residual Test (2.38)	0.008	Reject H_0; The residuals are not normally distributed.
Heteroscedasticity H_0: Residuals are homoscedastic.	Breusch-Pagan (3.79)	0.052	The variance of the residuals is constant (Homoskedasticity).
Serial correlation H_0: No serial correlation	Breusch-Godfrey (0.377)	0.688	Fail to Reject H_0; There is no serial correlation up to the 2^{nd} lag.

4.6.3.1. Heteroscedasticity test results

The Breusch-Pagan test p-value (0.052) slightly exceeds the 5% significance level, indicating that the null hypothesis of homoscedasticity cannot be rejected. This result confirms that the residuals exhibit constant variance across different levels of the explanatory variables, ensuring that the standard errors of the ARDL model estimates are reliable and the regression coefficients are unbiased.

4.6.3.2. Serial correlation test results

As shown in Table 4.15, the Breusch-Godfrey p-value (0.688) is well above the 5% significance threshold, leading to a failure to reject the null hypothesis of no serial correlation in the residuals. The lack of serial correlation indicates that the residuals are not systematically correlated over time, confirming that the model adequately captures the dynamic relationships between NIIIEA and explanatory variables.

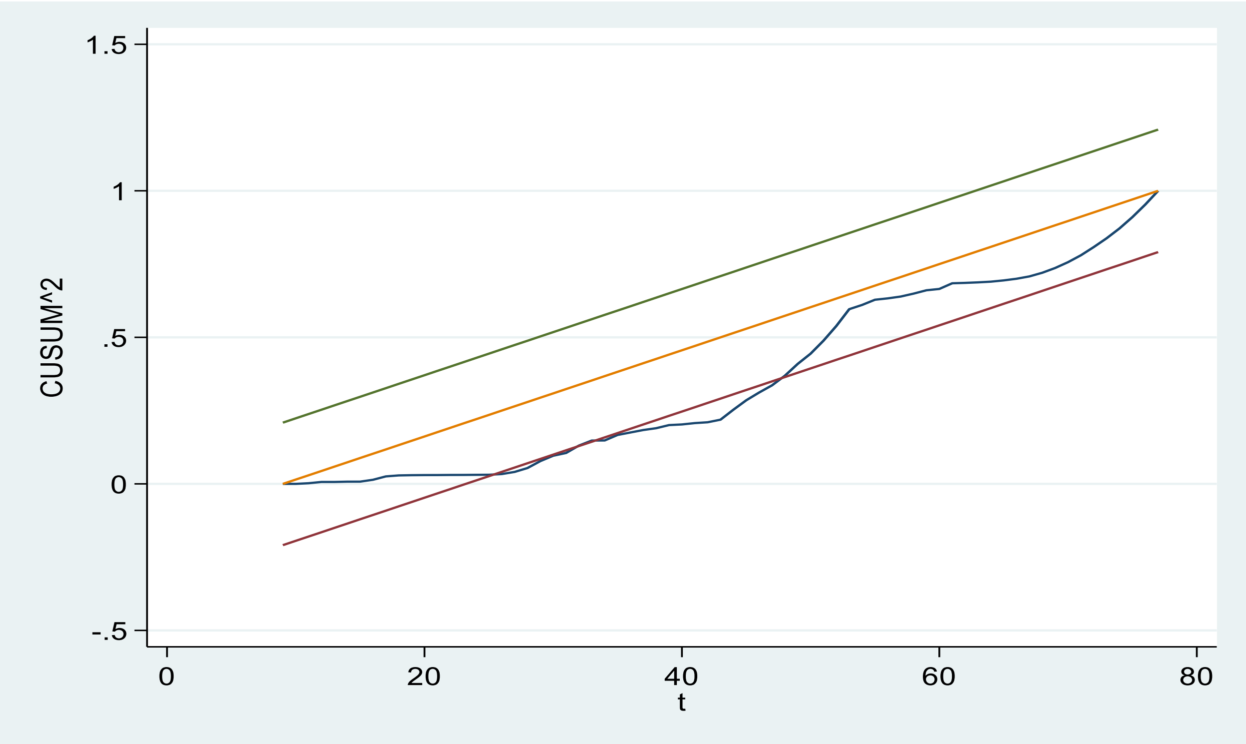
4.6.3.3. Normality test results

As shown in Table 4.15 above, the p-value (0.008) is less than the conventional 5% significance level. Consequently, the null hypothesis of normally distributed residuals is rejected. This implies that residuals of Model 3 (NIIIEA) are not normally distributed. While a violation of normality does not bias the estimated coefficients, it invalidates the standard t-statistics and F-statistics. This means the inferences regarding the significance of individual variables or the overall model may be unreliable.

4.6.3.4. Stability test results

The CUSUMSQ stability test for the NIIIEA model, Figure 4.3, shows that the cumulative sum of squared residuals generally remains within the 5% critical bounds throughout the sample period, though there are periods it crosses the lower boundary line. Model 3 (NIIIEA) shows signs of instability, which may be a result of structural breaks.

Figure 4.3: Stability Test for Model 3



4.7. Chapter Summary

This chapter provided data analysis and interpretation. The stationarity tests confirmed the suitability of the ARDL model, which is further validated by the bounds test establishing long-run relationships among variables. Long-run and short-run estimates highlighted the significant roles of capital adequacy ratio, repo rate, and production index in driving bank performance, with dynamic adjustments toward equilibrium underscored by significant error correction terms. Diagnostic tests affirmed the robustness of the models, showing no evidence of heteroscedasticity, serial correlation, or structural instability. The next chapter is the conclusion and recommendations of the study.

The findings presented in this chapter are supported by the evidence obtained from the analysis. The results justify the use of the ARDL model and confirm the presence of long-run relationships among the variables. Both the long-run and short-run estimates show that the capital adequacy ratio, repo rate, and production index play an important role in influencing bank performance. The significance of the error correction terms indicates that short-term changes adjust back toward the long-run equilibrium over time. In addition, the diagnostic tests show that the model is reliable and free from major econometric problems, which strengthens the overall interpretation of the results.

CHAPTER 5
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter synthesises the findings of the study, which examined the impact of monetary policy changes on aggregate bank performance in South Africa using monthly data from January 2019 to May 2025. Utilising the Autoregressive Distributed Lag (ARDL) model, the study assessed the relationships between monetary policy variables and macroeconomic indicators on three key bank performance indicators: Return on Equity (ROE), Return on Assets (ROA), and Net Interest Income to Interest Earning Assets (NIIIEA). The conclusions section addresses each of the three hypotheses tested, structured to outline the hypothesis, findings, and conclusions clearly. Subsequently, recommendations are provided for the South African Reserve Bank (SARB), commercial banks, policymakers, and other stakeholders to enhance banking sector resilience. Finally, areas for future research are proposed to address limitations and extend the study's contributions, ensuring actionable insights for academic and practical applications.

5.2 Summary of Findings

This study examined the impact of monetary policy changes on aggregate bank performance in South Africa using monthly data from January 2019 to May 2025. The Autoregressive Distributed Lag (ARDL) model was employed to estimate both long-run and short-run relationships between monetary policy indicators (such as the repo rate), bank-specific factors (including the capital adequacy ratio [CAR], and macroeconomic variables (such as the production index (PROD), debt securities issuance (DEBT), and the real effective exchange rate (REER). The study focused on three key performance indicators: Return on Equity (ROE), Return on Assets (ROA), and Net Interest Income to Interest Earning Assets (NIIIEA).

The results confirmed the existence of statistically significant long-run and short-run relationships. In the long run, CAR consistently enhanced ROE, ROA, and NIIIEA, indicating that strong capital buffers support bank profitability. An increase in REPO also enhances bank profitability, even though it's not statistically significant in the ROA model. IADLA had a negative and statistically significant long-run effect on ROE and ROA, while REER and PROD had a positive but statistically insignificant long-run relationship with ROE, ROA and NIIIEA.

In the short run, of all six explanatory variables, only DEBT had a significant effect on ROE. DEBT exhibited alternating effects across lags, implying that fiscal borrowing can both stimulate and crowd out bank performance depending on timing. The significance of the error term and lagged coefficients of dependent variables confirms that the models were correctly specified and evidence of persistence, respectively.

5.3 Conclusion

The study tested three hypotheses to investigate the nature, impact, and asymmetry of monetary policy's effects on aggregate bank performance in South Africa.

5.3.1. Hypothesis 1: Association between monetary policy variables and bank performance

The first hypothesis tested whether trends in monetary policy variables exhibit a statistically significant association with aggregate bank performance indicators in South Africa. The study focused on the repo rate as the primary monetary policy instrument and examined its relationship with three key performance indicators: Return on Equity (ROE), Return on Assets (ROA), and Net Interest Income to Interest Earning Assets (NIIIEA). The bounds test for co-integration confirmed the existence of long-run relationships across all three models, validating the use of the ARDL framework. In the long run, an increase in the repo rate significantly enhanced NIIIEA, indicating that tighter monetary policy improves banks' net interest margins. The capital adequacy ratio (CAR) showed consistent positive associations with ROA, ROE, and NIIIEA, suggesting that strong capital buffers support bank profitability and resilience.

The REPO rate demonstrated a positive effect on bank profitability. Based on these findings, the study concludes that monetary policy variables, particularly the repo rate, are significantly associated with aggregate bank performance indicators in South Africa. The South African Reserve Bank's monetary policy decisions play a pivotal role in shaping bank profitability, interest income, and operational efficiency, necessitating strategic alignment by banks to respond effectively to policy shifts.

5.3.2 Hypothesis 2: Impact of monetary policy easing and tightening

The second hypothesis tested whether monetary policy easing and tightening exert a statistically significant impact on aggregate bank performance indicators in South Africa. The study focused on the repo rate as the primary monetary policy instrument, assessing its effects on Return on Assets (ROA), Return on Equity (ROE), and Net Interest Income to Interest Earning Assets (NIIIEA). The results confirmed that changes in the repo rate, whether increases (tightening) or decreases (easing), significantly influence bank performance. In the long run, an increase in the repo rate was found to enhance ROE and NIIIEA, suggesting that tighter monetary policy improves banks' net interest margins by allowing them to adjust lending rates more aggressively than deposit rates.

Based on these findings, the study concludes that monetary policy easing and tightening have a statistically significant and differentiated impact on aggregate bank performance in South Africa. The timing and magnitude of repo rate adjustments play a critical role in shaping profitability, interest income, and operational efficiency, with short-run constraints and long-run benefits requiring careful policy calibration by the South African Reserve Bank and strategic responses from commercial banks.

5.3.3 Hypothesis 3: Asymmetry of monetary policy pass-through

The third hypothesis examined whether changes in monetary policy exhibit symmetrical or asymmetrical effects on aggregate bank performance in South Africa. The study found clear evidence of asymmetry in the pass-through effects of monetary policy, particularly in relation to the repo rate, especially in the long run. However, the effect of the real effective exchange rate (REER) was insignificant. It was also shown that DEBT reduced ROE in the current period but increased it in the next lag. These fluctuations suggest that fiscal policy interactions with monetary policy can produce delayed and sometimes contradictory outcomes.

Based on these findings, the study concludes that monetary policy changes—particularly adjustments in the repo rate exhibit asymmetrical impacts on aggregate bank performance in South Africa. The non-linear and time-dependent nature of these effects underscores the need for banks and policymakers to differentiate between immediate and lagged responses when designing strategies to manage profitability, lending behaviour, and financial stability.

5.4 Recommendations

The empirical findings provide a basis for actionable recommendations to enhance the resilience and performance of South Africa's banking sector amidst monetary policy changes. These recommendations target the South African Reserve Bank, commercial banks, policymakers, regulators, and other stakeholders.

5.4.1 For the South African Reserve Bank (SARB)

The study highlights the significant and asymmetrical effects of monetary policy, particularly repo rate adjustments, on aggregate bank performance. SARB should adopt a cautious and gradual approach to changing the repo rate, avoiding abrupt shifts that could destabilise banks' lending strategies and compress short-term profitability. Incremental adjustments of 25–50 basis points, as reflected in SARB's recent policy actions (e.g., the 2024 rate cut), allow banks to recalibrate loan pricing and deposit rates more effectively, thereby maintaining credit supply and financial stability.

To improve transparency and reduce uncertainty, SARB should strengthen its forward guidance during Monetary Policy Committee (MPC) announcements. This could include publishing indicative rate paths, scenario analyses, or macroeconomic projections to help banks anticipate and prepare for future policy shifts. Enhanced communication would align market expectations and reduce volatility in lending and investment decisions. Given the study's findings that repo rate changes have both immediate and lagged effects on bank performance, particularly on Net Interest Income to Interest Earning Assets (NIIIEA), SARB should monitor the cumulative impact of rate adjustments over time. This includes assessing delayed effects on loan demand and interest margins, which may not be immediately visible in short-run indicators.

For the South African Reserve Bank, the main focus should be on the repo rate and the real effective exchange rate. The repo rate has been fairly stable, which gives some room for careful policy decisions. In contrast, the exchange rate shows large swings, which point to economic uncertainty. This means SARB needs to stay flexible and ready to respond to sudden changes. Interest rate decisions should not only control inflation but also help reduce pressure from exchange rate movements. Close and regular monitoring of these trends will support better and faster decisions.

SARB should also facilitate regular engagement with commercial banks through platforms such as the Financial Stability Committee or dedicated monetary policy workshops. These forums can serve as feedback mechanisms to evaluate the real-time impact of policy decisions on bank operations and credit conditions. Such collaboration would help SARB balance its inflation-targeting mandate with the need to sustain systemic liquidity and banking sector profitability.

5.4.2 For Commercial Banks

Commercial banks are directly affected by monetary policy changes. To bolster resilience, banks should prioritise strengthening their capital and liquidity buffers, targeting CAR levels well above the Basel III minimum of 10.5% (for example, 12%–14%), as practised by leading South African banks like Standard Bank. This can be achieved through retained earnings, prudent dividend policies, or selective capital raises, ensuring banks remain well-capitalised during tightening cycles when loan demand may decline. Similarly, maintaining LCR above the regulatory minimum of 100%, potentially targeting 120%, can safeguard liquidity, enabling banks to meet obligations during periods of monetary tightening or economic volatility. Regular stress-testing of capital and liquidity positions against scenarios like a 200-basis-point rate hike or a 5% inflation surge can further enhance preparedness. To counteract the negative short-run impact of repo rate increases on ROA, banks should diversify revenue streams to reduce reliance on interest income.

Commercial banks in South Africa should pay close attention to return on equity, return on assets, capital adequacy, and impaired loans. The strong changes in return on equity show that profits are tied to higher risk and borrowing. Banks should avoid taking on too much risk just to increase returns. The steady pattern in return on assets suggests that focusing on efficiency can support stable profits. Capital levels appear consistent, but banks should still keep enough buffers to stay safe. The level of impaired loans shows that credit risk remains a concern, so better screening and monitoring of borrowers is important.

5.4.3 For Policymakers and Regulators

Policymakers should prioritise coordinating monetary and fiscal policies to minimise such distortions, particularly during economic recovery phases when government borrowing tends to rise. For instance, reducing reliance on domestic bond issuance by diversifying funding sources, such as multilateral loans from the World Bank or public-private partnerships, can alleviate pressure on domestic capital markets, freeing up resources for bank lending and equity performance. The National Treasury could adopt a fiscal rule capping debt-to-GDP growth during recoveries, similar to frameworks in Chile or New Zealand, to ensure sustainable borrowing that complements SARB's monetary objectives.

Regulators, particularly the Prudential Authority under the SARB, should strengthen oversight of banks' operational efficiency, given the mixed impact of the cost-to-income ratio on performance indicators. High cost-to-income ratios, often exceeding 50% in South African banks, erode profitability, especially during tightening cycles when margins are squeezed. Regulators should enforce efficiency benchmarks, such as maintaining cost-to-income ratios below 45%, through regular audits and compliance reviews. To support this, incentives like tax breaks or grants for adopting cost-effective technologies, such as artificial intelligence for fraud detection, block chain for transaction processing, or robotic process automation for back-office operations, can drive efficiency gains. For example, Nedbank's AI-driven customer service platforms have reduced operational costs by 10%, offering a scalable model. Additionally, regulators should promote financial inclusion by encouraging banks to extend credit to underserved sectors, such as small and medium enterprises (SMES) or rural communities. Initiatives like subsidised loan guarantees or partnerships with development finance institutions can incentivise inclusive lending, fostering equitable growth while enhancing bank performance.

For policymakers in South Africa, the key issues are debt issuance and the production index. The large changes in debt levels suggest that fiscal policy is not always stable. There is a need for better planning and more control over borrowing. This will help reduce uncertainty in the economy. The production index also shows uneven patterns, which means economic activity is not consistent. Policies should aim to support steady growth across different sectors.

5.4.4 For Other Stakeholders

To enhance understanding and trust, banks should invest in comprehensive financial literacy programs tailored to diverse audiences, such as retail borrowers, SMES, and institutional investors. These programs could include workshops, online tutorials, or mobile app-based tools explaining how policy changes affect loan rates, deposit returns, or investment yields. For instance, a campaign illustrating how a 1% repo rate hike increases mortgage payments by ZAR 500 monthly for a ZAR 1 million loan can empower clients to make informed financial decisions. Community outreach initiatives, partnered with local NGOS or schools, can further extend literacy efforts to underserved populations, fostering inclusive financial engagement.

Investors, particularly those holding bank stocks or bonds, should be educated on the asymmetrical impacts of policy changes. Banks could host quarterly investor webinars or publish policy impact reports, detailing how monetary tightening or easing affects dividends, share prices, or bond yields. Industry associations, such as the Banking Association South Africa (BASA), should take a proactive role in advocating for policies that support banks' adaptation to monetary policy shifts. This could include lobbying for tax incentives for digital banking investments or regulatory sandboxes to test innovative financial products, ensuring the sector remains competitive and growth-oriented. BASA could also organise annual stakeholder forums, bringing together banks, regulators, clients, and policymakers to collaboratively address policy challenges, such as balancing credit access with risk management during tightening cycles.

Other stakeholders, such as investors and analysts in South Africa, should focus on net interest income and the overall risk patterns in the data. The stable nature of interest income is a good sign and suggests a reliable source of earnings. At the same time, the data shows unusual patterns and extreme values, which means risks may be higher than expected. It is important to be cautious and to use better tools when making financial decisions.

5.5 Limitations and Areas for Future Research

Future research should conduct disaggregated analyses at the individual bank level to uncover varied responses to monetary policy, particularly across different bank sizes, ownership structures, and risk profiles. Incorporating emerging variables such as technological adoption, digital banking penetration, or environmental, social, and governance (ESG) metrics could provide deeper insights into evolving performance drivers. Comparative studies with other emerging market economies may reveal structural differences in monetary transmission and inform policy benchmarking. Additionally, qualitative methods such as interviews with bank executives could complement econometric findings by capturing strategic responses to policy shifts. Finally, the use of non-linear models, including threshold ARDL or quantile regressions, would allow for a more nuanced investigation of the asymmetrical and time-varying effects of monetary policy identified in this study.

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APPENDIX A: ESTIMATION (STATA) OUTPUT

```
. summarize ROA ROE NIIIEA REPO CAR LDEBT PROD IAGLA REER
```

Variable	Obs	Mean	Std. Dev.	Min	Max
ROA	77	1.013726	.1932325	.51	1.27
ROE	77	13.3465	2.477517	6.93	16.69
NIIIEA	77	3.954791	.1804364	3.66	4.326398
REPO	77	6.204528	2.146288	2.75	9.355099
CAR	77	17.16821	.6448725	15.79	18.87
LDEBT	76	13.70621	4.360952	-.0944287	15.31864
PROD	77	93.18693	6.910252	48.1	103.8
IAGLA	77	4.945179	.7834652	3.73	6.539669
REER	77	23.98261	45.46552	-8.579215	112.0946

```
. pwcorr ROA ROE NIIIEA REPO CAR LDEBT PROD IAGLA REER, sig
```

	ROA	ROE	NIIIEA	REPO	CAR	LDEBT	PROD
ROA	1.0000						
ROE	0.9752	1.0000					
	0.0000						
NIIIEA	0.5288	0.6201	1.0000				
	0.0000	0.0000					
REPO	0.5320	0.6499	0.9179	1.0000			
	0.0000	0.0000	0.0000				
CAR	0.2651	0.2760	0.3154	0.2125	1.0000		
	0.0198	0.0151	0.0052	0.0635			
LDEBT	-0.0863	-0.2248	-0.1868	-0.2945	-0.0312	1.0000	
	0.4585	0.0509	0.1062	0.0098	0.7894		
PROD	0.2087	0.2137	0.0402	0.1445	0.0890	-0.0154	1.0000
	0.0685	0.0620	0.7283	0.2100	0.4415	0.8951	
IAGLA	-0.2416	-0.1331	0.6351	0.5260	0.4037	-0.1276	-0.1405
	0.0343	0.2485	0.0000	0.0000	0.0003	0.2719	0.2229
REER	0.1354	0.1975	0.8088	0.6761	0.2804	0.1873	0.0085
	0.2405	0.0852	0.0000	0.0000	0.0135	0.1051	0.9413

	IAGLA	REER
IAGLA	1.0000	
REER	0.7816	1.0000
	0.0000	

.

```
. dfuller ROE

Dickey-Fuller test for unit root                   Number of obs   =        76

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -1.237            -3.544            -2.909            -2.590
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.6573

.
. dfuller d.ROE

Dickey-Fuller test for unit root                   Number of obs   =        75

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -6.431            -3.545            -2.910            -2.590
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

.
```

```
. dfuller ROA

Dickey-Fuller test for unit root                   Number of obs   =        76

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -1.366            -3.544            -2.909            -2.590
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.5985

.
. dfuller d.ROA

Dickey-Fuller test for unit root                   Number of obs   =        75

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -7.012            -3.545            -2.910            -2.590
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

.
```

```
. dfuller NIIIEA

Dickey-Fuller test for unit root                   Number of obs   =        76

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)              2.260            -3.544            -2.909            -2.590
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.9989

.
. dfuller d.NIIIEA

Dickey-Fuller test for unit root                   Number of obs   =        75

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -4.491            -3.545            -2.910            -2.590
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0002

.
```

```
. dfuller REPO

Dickey-Fuller test for unit root                   Number of obs   =        76

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -0.802            -3.544            -2.909            -2.590
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.8184

.
. dfuller d.REPO

Dickey-Fuller test for unit root                   Number of obs   =        75

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)            -10.165            -3.545            -2.910            -2.590
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000
```

```
. dfuller CAR

Dickey-Fuller test for unit root                   Number of obs   =        76

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -2.068            -3.544            -2.909            -2.590
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.2575

.
. dfuller d.CAR

Dickey-Fuller test for unit root                   Number of obs   =        75

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)            -10.767            -3.545            -2.910            -2.590
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

.
```

```
. dfuller LDEBT

Dickey-Fuller test for unit root                   Number of obs   =        74

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -0.422            -3.546            -2.911            -2.590
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.9063

.
. dfuller d.LDEBT

Dickey-Fuller test for unit root                   Number of obs   =        72

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -8.428            -3.549            -2.912            -2.591
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000
```

```
. dfuller PROD

Dickey-Fuller test for unit root                   Number of obs   =        76

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -4.619            -3.544            -2.909            -2.590
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0001

.
. dfuller d.PROD

Dickey-Fuller test for unit root                   Number of obs   =        75

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -9.845            -3.545            -2.910            -2.590
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000
```

```
. dfuller IAGLA

Dickey-Fuller test for unit root                   Number of obs   =        76

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)              0.630            -3.544            -2.909            -2.590
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.9883

.
. dfuller d.IAGLA

Dickey-Fuller test for unit root                   Number of obs   =        75

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -4.921            -3.545            -2.910            -2.590
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000
```

```
. dfuller REER

Dickey-Fuller test for unit root                   Number of obs   =        76

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -0.480            -3.544            -2.909            -2.590
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.8959

.
. dfuller d.REER

Dickey-Fuller test for unit root                   Number of obs   =        75

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -9.145            -3.545            -2.910            -2.590
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000
```

```
. pperron ROE

Phillips-Perron test for unit root                 Number of obs   =        76
                                                   Newey-West lags =         3

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(rho)           -4.278           -19.368           -13.508           -10.856
 Z(t)             -1.552            -3.544            -2.909            -2.590
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.5074

.
. pperron d.ROE

Phillips-Perron test for unit root                 Number of obs   =        75
                                                   Newey-West lags =         3

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(rho)          -62.036           -19.350           -13.500           -10.850
 Z(t)             -6.656            -3.545            -2.910            -2.590
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000
```

```
. pperron REPO

Phillips-Perron test for unit root                Number of obs   =        76
                                                  Newey-West lags =         3

                               ——————— Interpolated Dickey-Fuller ———————
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
——————————————————————————————————————————————————————————————————————————————
 Z(rho)           -1.124           -19.368           -13.508           -10.856
 Z(t)             -0.525            -3.544            -2.909            -2.590
——————————————————————————————————————————————————————————————————————————————
MacKinnon approximate p-value for Z(t) = 0.8871

.
. pperron d.REPO

Phillips-Perron test for unit root                Number of obs   =        75
                                                  Newey-West lags =         3

                               ——————— Interpolated Dickey-Fuller ———————
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
——————————————————————————————————————————————————————————————————————————————
 Z(rho)          -77.780           -19.350           -13.500           -10.850
 Z(t)            -10.517            -3.545            -2.910            -2.590
——————————————————————————————————————————————————————————————————————————————
MacKinnon approximate p-value for Z(t) = 0.0000
```

```
. pperron LDEBT

Phillips-Perron test for unit root                Number of obs   =        74
                                                  Newey-West lags =         3

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(rho)           -1.752           -19.332           -13.492           -10.844
 Z(t)             -0.465            -3.546            -2.911            -2.590
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.8986

.
. pperron d.LDEBT

Phillips-Perron test for unit root                Number of obs   =        72
                                                  Newey-West lags =         3

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(rho)          -71.830           -19.296           -13.476           -10.832
 Z(t)             -8.427            -3.549            -2.912            -2.591
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000


. pperron PROD

Phillips-Perron test for unit root                Number of obs   =        76
                                                  Newey-West lags =         3

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(rho)          -32.190           -19.368           -13.508           -10.856
 Z(t)             -4.557            -3.544            -2.909            -2.590
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0002

.
. pperron d.PROD

Phillips-Perron test for unit root                Number of obs   =        75
                                                  Newey-West lags =         3

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(rho)          -71.723           -19.350           -13.500           -10.850
 Z(t)            -10.425            -3.545            -2.910            -2.590
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000
```

```
. ardl ROE REPO CAR LDEBT PROD IAGLA REER, maxlag(2) aic

ARDL(2,1,1,2,0,0,0) regression

Sample:         3 -        77, but with a gap   Number of obs     =         72
                                                F(  12,      59)  =     451.55
                                                Prob > F          =     0.0000
                                                R-squared         =     0.9892
                                                Adj R-squared     =     0.9870
Log likelihood =  -4.783355                     Root MSE          =     0.2857

------------------------------------------------------------------------------
         ROE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         ROE |
         L1. |   1.144822   .1018401    11.24   0.000       .94104    1.348603
         L2. |  -.3117852   .0846646    -3.68   0.001    -.4811988   -.1423717
             |
        REPO |
         --. |   .0285105    .064755     0.44   0.661     -.101064    .1580849
         L1. |   .0917359   .0667104     1.38   0.174    -.0417513    .2252231
             |
         CAR |
         --. |   .2939355   .1540677     1.91   0.061    -.0143532    .6022242
         L1. |   .2065439   .1436702     1.44   0.156    -.0809395    .4940272
             |
       LDEBT |
         --. |  -.1550473   .0216638    -7.16   0.000    -.1983965    -.111698
         L1. |   .3034143   .0300782    10.09   0.000      .243228    .3636006
         L2. |  -.1754103   .0250976    -6.99   0.000    -.2256304   -.1251902
             |
        PROD |   .0127145   .0061257     2.08   0.042     .0004571    .0249719
       IAGLA |  -.4449235   .2073203    -2.15   0.036    -.8597704   -.0300766
        REER |   .0023467   .0027543     0.85   0.398    -.0031647    .0078581
       _cons |   -5.78864   1.507587    -3.84   0.000    -8.805315   -2.771964
------------------------------------------------------------------------------

.
. matrix list e(lags)

e(lags)[1,7]
      ROE   REPO    CAR  LDEBT   PROD  IAGLA   REER
r1      2      1      1      2      0      0      0

.
```

```
. ardl ROE REPO CAR LDEBT PROD IAGLA REER, lags(2,1,1,2,0,0,0) ec

ARDL(2,1,1,2,0,0,0) regression

Sample:         3 -        77, but with a gap   Number of obs     =         72
                                                R-squared         =     0.7987
                                                Adj R-squared     =     0.7577
Log likelihood =  -4.783355                     Root MSE          =     0.2857

------------------------------------------------------------------------------
       D.ROE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
ADJ          |
         ROE |
         L1. |  -.1669636   .0487975    -3.42   0.001    -.2646072   -.0693201
-------------+----------------------------------------------------------------
LR           |
        REPO |    .720195   .2030492     3.55   0.001     .3138945    1.126496
         CAR |   2.997535   .5951869     5.04   0.000     1.806569    4.188501
       LDEBT |  -.1619711   .0851069    -1.90   0.062    -.3322695    .0083273
        PROD |   .0761515   .0511005     1.49   0.141    -.0261003    .1784033
       IAGLA |  -2.664793   .6635093    -4.02   0.000    -3.992472   -1.337114
        REER |   .0140552   .0147475     0.95   0.344    -.0154545    .0435648
-------------+----------------------------------------------------------------
SR           |
         ROE |
         LD. |   .3117852   .0846646     3.68   0.001     .1423717    .4811988
             |
        REPO |
         D1. |  -.0917359   .0667104    -1.38   0.174    -.2252231    .0417513
             |
         CAR |
         D1. |  -.2065439   .1436702    -1.44   0.156    -.4940272    .0809395
             |
       LDEBT |
         D1. |   -.128004    .020794    -6.16   0.000    -.1696127   -.0863953
         LD. |   .1754103   .0250976     6.99   0.000     .1251902    .2256304
             |
       _cons |   -5.78864   1.507587    -3.84   0.000    -8.805315   -2.771964
------------------------------------------------------------------------------
```

```
. estat btest

note: estat btest has been superseded by estat ectest
      as the prime procedure to test for a levels relationship.
      (click to run)
```

Pesaran/Shin/Smith (2001) ARDL Bounds Test

```
H0: no levels relationship           F =  6.951
                                     t = -3.422
```

Critical Values (0.1-0.01), **F-statistic**, Case 3

	[I_0] L_1	[I_1] L_1	[I_0] L_05	[I_1] L_05	[I_0] L_025	[I_1] L_025	[I_0] L_01	[I_1] L_01
k_6	2.12	3.23	2.45	3.61	2.75	3.99	3.15	4.43

```
accept if F < critical value for I(0) regressors
reject if F > critical value for I(1) regressors
```

Critical Values (0.1-0.01), **t-statistic**, Case 3

	[I_0] L_1	[I_1] L_1	[I_0] L_05	[I_1] L_05	[I_0] L_025	[I_1] L_025	[I_0] L_01	[I_1] L_01
k_6	-2.57	-4.04	-2.86	-4.38	-3.13	-4.66	-3.43	-4.99

```
accept if t > critical value for I(0) regressors
reject if t < critical value for I(1) regressors

k: # of non-deterministic regressors in long-run relationship
Critical values from Pesaran/Shin/Smith (2001)
```

```
. estat ectest

Pesaran, Shin, and Smith (2001) bounds test

H0: no level relationship                                     F =     6.951
Case 3                                                        t =    -3.422

Finite sample (6 variables, 72 observations, 5 short-run coefficients)

Kripfganz and Schneider (2020) critical values and approximate p-values

   | 10%               | 5%                | 1%                | p-value
   |    I(0)      I(1) |    I(0)      I(1) |    I(0)      I(1) |    I(0)      I(1)
---+-------------------+-------------------+-------------------+------------------
 F |   2.217     3.434 |   2.607     3.943 |   3.487     5.074 |   0.000     0.001
 t |  -2.519    -4.011 |  -2.849    -4.397 |  -3.504    -5.151 |   0.012     0.237

do not reject H0 if
    either F or t are closer to zero than critical values for I(0) variables
      (if either p-value  > desired level for I(0) variables)
reject H0 if
    both F and t are more extreme than critical values for I(1) variables
      (if both   p-values < desired level for I(1) variables)

decision: no rejection (.a), inconclusive (.), or rejection (.r) at levels:

             |       10%         5%         1%
-------------+---------------------------------
    decision |         .          .         .a

.
```

```
. ardl ROA REPO CAR LDEBT PROD IAGLA REER, lags(1,1,0,2,0,0,2) ec

ARDL(1,1,0,2,0,0,2) regression

Sample:         3 -        77, but with a gap   Number of obs     =         72
                                                R-squared         =     0.5731
                                                Adj R-squared     =     0.4863
Log likelihood =  145.22171                     Root MSE          =     0.0356

------------------------------------------------------------------------------
       D.ROA |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
ADJ          |
         ROA |
         L1. |  -.1312984   .0681621    -1.93   0.059    -.2676906    .0050937
-------------+----------------------------------------------------------------
LR           |
        REPO |    .034416   .0358344     0.96   0.341    -.0372885    .1061206
         CAR |   .3597803   .1337421     2.69   0.009     .0921629    .6273977
       LDEBT |   -.005414   .0130949    -0.41   0.681    -.0316168    .0207889
        PROD |   .0197548   .0143918     1.37   0.175    -.0090431    .0485528
       IAGLA |   -.206632   .1113536    -1.86   0.069    -.4294501     .016186
        REER |   .0012149   .0023101     0.53   0.601    -.0034077    .0058375
-------------+----------------------------------------------------------------
SR           |
        REPO |
         D1. |  -.0251969   .0082348    -3.06   0.003    -.0416747    -.008719
             |
       LDEBT |
         D1. |  -.0010447   .0025964    -0.40   0.689    -.0062402    .0041508
         LD. |   .0065616   .0026176     2.51   0.015     .0013237    .0117995
             |
        REER |
         D1. |  -.0029752   .0014948    -1.99   0.051    -.0059664    .0000159
         LD. |  -.0033037   .0014121    -2.34   0.023    -.0061293   -.0004782
             |
       _cons |  -.8084094   .1582387    -5.11   0.000    -1.125044   -.4917745
------------------------------------------------------------------------------

.
. estat btest

note: estat btest has been superseded by estat ectest
      as the prime procedure to test for a levels relationship.
      (click to run)

Pesaran/Shin/Smith (2001) ARDL Bounds Test
H0: no levels relationship            F =  8.388
                                      t = -1.926

Critical Values (0.1-0.01), F-statistic, Case 3

      | [I_0]   [I_1] | [I_0]   [I_1] | [I_0]   [I_1] | [I_0]   [I_1]
      |   L_1     L_1 |  L_05    L_05 | L_025   L_025 |  L_01    L_01
------+---------------+---------------+---------------+--------------
  k_6 |  2.12    3.23 |  2.45    3.61 |  2.75    3.99 |  3.15    4.43
accept if F < critical value for I(0) regressors
reject if F > critical value for I(1) regressors

Critical Values (0.1-0.01), t-statistic, Case 3

      | [I_0]   [I_1] | [I_0]   [I_1] | [I_0]   [I_1] | [I_0]   [I_1]
      |   L_1     L_1 |  L_05    L_05 | L_025   L_025 |  L_01    L_01
------+---------------+---------------+---------------+--------------
  k_6 | -2.57   -4.04 | -2.86   -4.38 | -3.13   -4.66 | -3.43   -4.99
accept if t > critical value for I(0) regressors
reject if t < critical value for I(1) regressors

k: # of non-deterministic regressors in long-run relationship
Critical values from Pesaran/Shin/Smith (2001)

.
. estat ectest

Pesaran, Shin, and Smith (2001) bounds test

H0: no level relationship                                   F =      8.388
Case 3                                                      t =     -1.926

Finite sample (6 variables, 72 observations, 5 short-run coefficients)

Kripfganz and Schneider (2020) critical values and approximate p-values

   | 10%              | 5%               | 1%               | p-value
   |    I(0)     I(1) |    I(0)     I(1) |    I(0)     I(1) |    I(0)     I(1)
---+------------------+------------------+------------------+-----------------
 F |   2.217    3.434 |   2.607    3.943 |   3.487    5.074 |   0.000    0.000
 t |  -2.519   -4.011 |  -2.849   -4.397 |  -3.504   -5.151 |   0.275    0.769

do not reject H0 if
    either F or t are closer to zero than critical values for I(0) variables
      (if either p-value  > desired level for I(0) variables)
reject H0 if
    both F and t are more extreme than critical values for I(1) variables
      (if both   p-values < desired level for I(1) variables)

decision: no rejection (.a), inconclusive (.), or rejection (.r) at levels:

-------------+-----------------------------------
             |       10%         5%         1%
-------------+-----------------------------------
    decision |        .a         .a         .a
-------------+-----------------------------------

.
```

```
. ardl NIIIEA REPO CAR LDEBT PROD IAGLA REER, lags(2,2,0,0,0,0,0) ec

ARDL(2,2,0,0,0,0,0) regression

Sample:         3 -        77, but with a gap   Number of obs     =         74
                                                R-squared         =     0.6474
                                                Adj R-squared     =     0.5914
Log likelihood =  233.79112                     Root MSE          =     0.0111

------------------------------------------------------------------------------
    D.NIIIEA |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
ADJ          |
      NIIIEA |
         L1. |   -.128476   .0294684    -4.36   0.000     -.187364   -.0695881
-------------+----------------------------------------------------------------
LR           |
        REPO |   .0727499    .011343     6.41   0.000     .0500826    .0954172
         CAR |   .1265977   .0301952     4.19   0.000     .0662574    .1869379
       LDEBT |   -.002554   .0039305    -0.65   0.518    -.0104084    .0053005
        PROD |  -.0000821   .0016795    -0.05   0.961    -.0034384    .0032742
       IAGLA |   .0034381   .0306934     0.11   0.911    -.0578977     .064774
        REER |   .0009804   .0007394     1.33   0.190    -.0004973    .0024581
-------------+----------------------------------------------------------------
SR           |
      NIIIEA |
         LD. |   .2061656   .1096292     1.88   0.065    -.0129108     .425242
             |
        REPO |
         D1. |  -.0031465   .0029584    -1.06   0.292    -.0090584    .0027655
         LD. |  -.0070094   .0025761    -2.72   0.008    -.0121574   -.0018614
             |
       _cons |   .1744212   .1120531     1.56   0.125    -.0494991    .3983415
------------------------------------------------------------------------------

.
. estat btest

note: estat btest has been superseded by estat ectest
      as the prime procedure to test for a levels relationship.
      (click to run)

Pesaran/Shin/Smith (2001) ARDL Bounds Test
H0: no levels relationship            F =  5.673
                                      t = -4.360

Critical Values (0.1-0.01), F-statistic, Case 3

       | [I_0]   [I_1] | [I_0]   [I_1] | [I_0]   [I_1] | [I_0]   [I_1]
       |   L_1     L_1 |  L_05    L_05 | L_025   L_025 |  L_01    L_01
-------+---------------+---------------+---------------+---------------
   k_6 |  2.12    3.23 |  2.45    3.61 |  2.75    3.99 |  3.15    4.43
accept if F < critical value for I(0) regressors
reject if F > critical value for I(1) regressors

Critical Values (0.1-0.01), t-statistic, Case 3

       | [I_0]   [I_1] | [I_0]   [I_1] | [I_0]   [I_1] | [I_0]   [I_1]
       |   L_1     L_1 |  L_05    L_05 | L_025   L_025 |  L_01    L_01
-------+---------------+---------------+---------------+---------------
   k_6 | -2.57   -4.04 | -2.86   -4.38 | -3.13   -4.66 | -3.43   -4.99
accept if t > critical value for I(0) regressors
reject if t < critical value for I(1) regressors

k: # of non-deterministic regressors in long-run relationship
Critical values from Pesaran/Shin/Smith (2001)

.
. estat ectest

Pesaran, Shin, and Smith (2001) bounds test

H0: no level relationship                                   F =      5.673
Case 3                                                      t =     -4.360

Finite sample (6 variables, 74 observations, 3 short-run coefficients)

Kripfganz and Schneider (2020) critical values and approximate p-values

   | 10%               | 5%                | 1%                | p-value
   |    I(0)      I(1) |    I(0)      I(1) |    I(0)      I(1) |    I(0)      I(1)
---+-------------------+-------------------+-------------------+-------------------
 F |   2.226     3.419 |   2.614     3.919 |   3.487     5.025 |   0.000     0.004
 t |  -2.533    -4.032 |  -2.860    -4.413 |  -3.508    -5.155 |   0.001     0.055

do not reject H0 if
    either F or t are closer to zero than critical values for I(0) variables
      (if either p-value  > desired level for I(0) variables)
reject H0 if
    both F and t are more extreme than critical values for I(1) variables
      (if both   p-values < desired level for I(1) variables)

decision: no rejection (.a), inconclusive (.), or rejection (.r) at levels:

             |      10%        5%        1%
-------------+-------------------------------
    decision |       .r         .         .

.
```

```
. reg ROE REPO CAR LDEBT PROD IAGLA REER

      Source |       SS           df       MS      Number of obs   =        76
-------------+----------------------------------   F(6, 69)        =    110.38
       Model |  420.965693         6  70.1609489   Prob > F        =    0.0000
    Residual |  43.8600819        69   .63565336   R-squared       =    0.9056
-------------+----------------------------------   Adj R-squared   =    0.8974
       Total |  464.825775        75    6.197677   Root MSE        =    .79728

------------------------------------------------------------------------------
         ROE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        REPO |   .8549433   .0832924    10.26   0.000     .6887795    1.021107
         CAR |      1.689   .1588893    10.63   0.000     1.372025    2.005976
       LDEBT |  -.1421996   .0338671    -4.20   0.000    -.2097626   -.0746366
        PROD |  -.0380949   .0141035    -2.70   0.009    -.0662307   -.0099591
       IAGLA |  -3.735428   .2604214   -14.34   0.000    -4.254954   -3.215901
        REER |   .0299258   .0059634     5.02   0.000     .0180291    .0418225
       _cons |   2.276997   3.011687     0.76   0.452    -3.731154    8.285149
------------------------------------------------------------------------------

.
. reg ROA REPO CAR LDEBT PROD IAGLA REER

      Source |       SS           df       MS      Number of obs   =        76
-------------+----------------------------------   F(6, 69)        =     77.73
       Model |  2.46544979         6  .410908299   Prob > F        =    0.0000
    Residual |  .364759194        69  .005286365   R-squared       =    0.8711
-------------+----------------------------------   Adj R-squared   =    0.8599
       Total |  2.83020899        75   .03773612   Root MSE        =    .07271

------------------------------------------------------------------------------
         ROA |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        REPO |    .060929   .0075958     8.02   0.000     .0457758    .0760823
         CAR |   .1439497   .0144898     9.93   0.000     .1150433    .1728561
       LDEBT |  -.0066703   .0030885    -2.16   0.034    -.0128316   -.0005089
        PROD |  -.0033576   .0012862    -2.61   0.011    -.0059234   -.0007917
       IAGLA |  -.3188585    .023749   -13.43   0.000    -.3662365   -.2714806
        REER |   .0024994   .0005438     4.60   0.000     .0014145    .0035843
       _cons |   .0836727   .2746491     0.30   0.762    -.4642373    .6315828
------------------------------------------------------------------------------

.
. reg NIIIEA REPO CAR LDEBT PROD IAGLA REER

      Source |       SS           df       MS      Number of obs   =        76
-------------+----------------------------------   F(6, 69)        =    156.85
       Model |  2.28542792         6  .380904653   Prob > F        =    0.0000
    Residual |  .167562285        69  .002428439   R-squared       =    0.9317
-------------+----------------------------------   Adj R-squared   =    0.9258
       Total |   2.4529902        75  .032706536   Root MSE        =    .04928

------------------------------------------------------------------------------
      NIIIEA |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        REPO |    .046092   .0051482     8.95   0.000     .0358216    .0563625
         CAR |   .0317523   .0098208     3.23   0.002     .0121603    .0513443
       LDEBT |   -.006908   .0020933    -3.30   0.002     -.011084    -.002732
        PROD |  -.0022676   .0008717    -2.60   0.011    -.0040067   -.0005286
       IAGLA |  -.0502457   .0160965    -3.12   0.003    -.0823572   -.0181342
        REER |   .0024373   .0003686     6.61   0.000     .0017019    .0031726
       _cons |   3.617995   .1861501    19.44   0.000     3.246635    3.989354
------------------------------------------------------------------------------

.
```

```
. ardl ROE REPO CAR LDEBT PROD IAGLA REER, maxlag(2) ec

ARDL(2,0,0,2,0,0,0) regression

Sample:         3 -        77, but with a gap   Number of obs     =         72
                                                R-squared         =     0.7844
                                                Adj R-squared     =     0.7490
Log likelihood = -7.2524134                     Root MSE          =     0.2907

------------------------------------------------------------------------------
       D.ROE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
ADJ          |
         ROE |
         L1. |  -.1231768   .0445791    -2.76   0.008    -.2123182   -.0340354
-------------+----------------------------------------------------------------
LR           |
        REPO |    .630413   .2647502     2.38   0.020     .1010123    1.159814
         CAR |   3.248832   .8776021     3.70   0.000     1.493958    5.003706
       LDEBT |  -.1905215   .1126926    -1.69   0.096    -.4158643    .0348212
        PROD |   .1133747   .0786072     1.44   0.154    -.0438101    .2705595
       IAGLA |  -2.407833   .9509568    -2.53   0.014    -4.309388    -.506277
        REER |    .011948   .0199314     0.60   0.551    -.0279073    .0518033
-------------+----------------------------------------------------------------
SR           |
         ROE |
         LD. |   .3279902   .0853095     3.84   0.000     .1574033    .4985772
             |
       LDEBT |
         D1. |  -.1263804   .0210759    -6.00   0.000    -.1685244   -.0842364
         LD. |   .1843097   .0251562     7.33   0.000     .1340067    .2346126
             |
       _cons |  -5.269886   1.473294    -3.58   0.001     -8.21592   -2.323852
------------------------------------------------------------------------------


. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of D.ROE

         chi2(1)      =     0.10
         Prob > chi2  =   0.7553
```

```
. estat bgodfrey, lags(1/2) small

Number of gaps in sample:  1

Breusch-Godfrey LM test for autocorrelation
```

lags(p)	F	df	Prob > F
1	0.288	(1, 60)	0.5932
2	0.199	(2, 59)	0.8202

```
                        H0: no serial correlation

.
```

```
. sktest resid_ardl

Skewness and kurtosis tests for normality
```

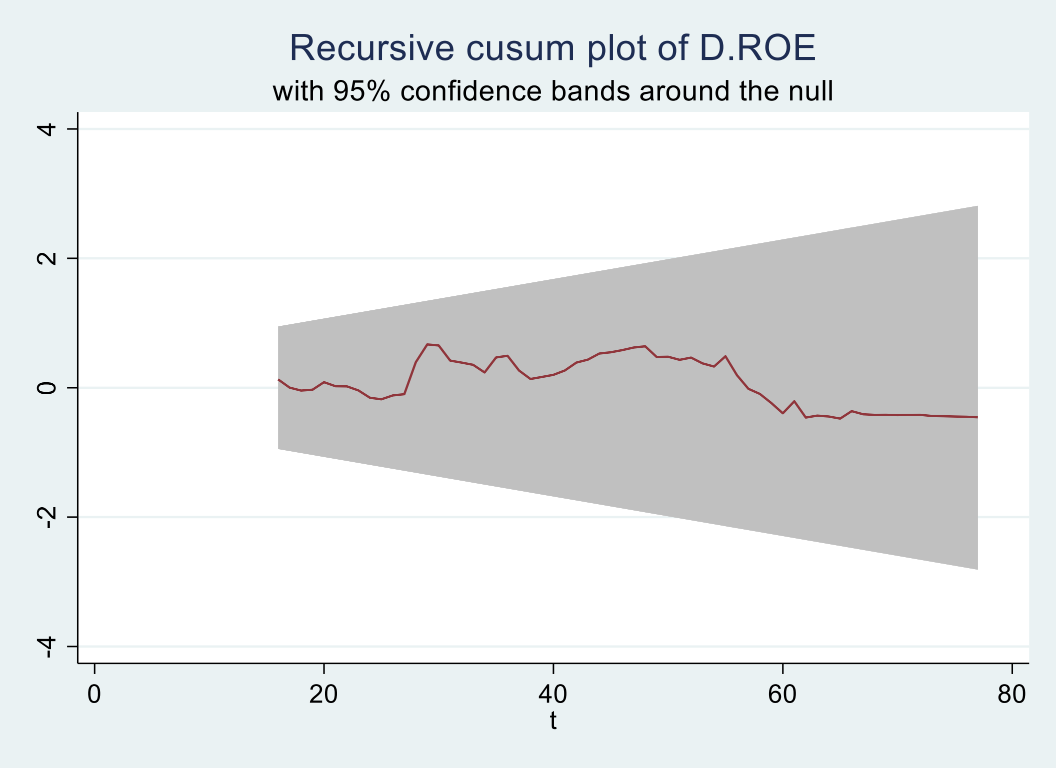
				Joint test	
Variable	Obs	Pr(skewness)	Pr(kurtosis)	Adj chi2(2)	Prob>chi2
resid_ardl	72	0.3601	0.0303	5.36	0.0687

```
.
```

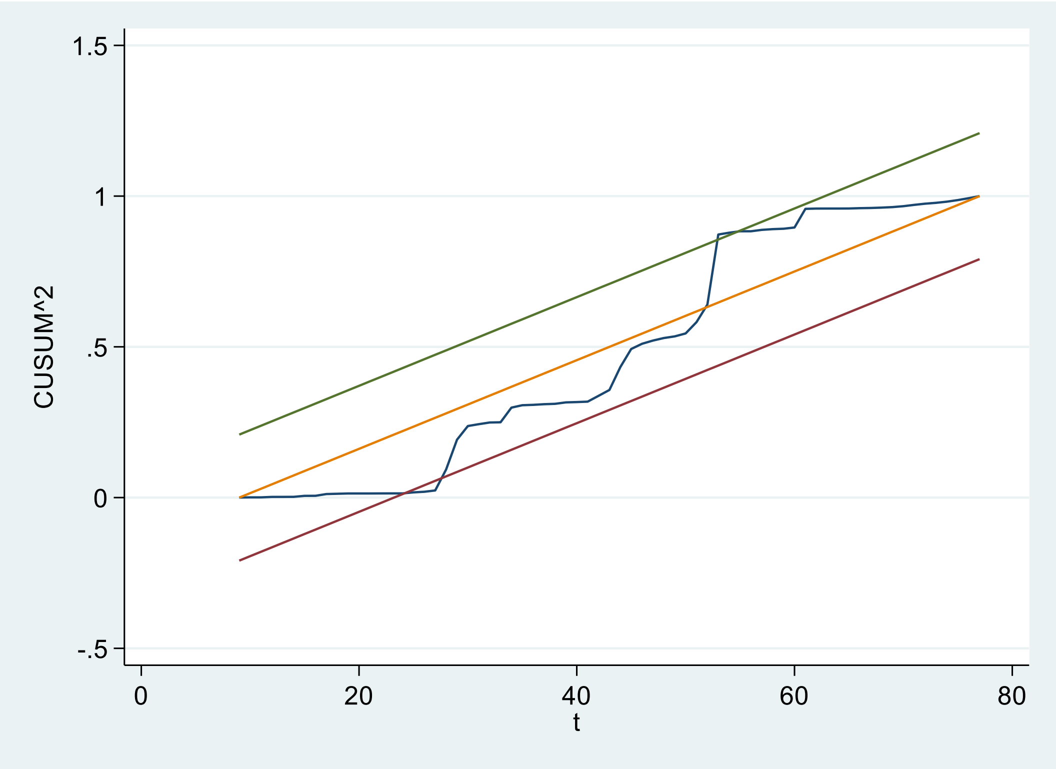
```
. estat sbcusum, name(mycusum, replace)

Cumulative sum test for parameter stability

Sample: 3 - 77                                   Number of obs =         75
Ho: No structural break
```

Statistic	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
recursive	0.4615	1.1430	0.9479	0.850

```
.
```



Recursive cusum plot of D.ROE
with 95% confidence bands around the null
4
2
0
-2
-4
0
20
40
60
80
t



1.5
1
.5
0
-.5
CUSUM^2
0
20
40
60
80
t

MODEL II (ROA)

```
. ardl ROA REPO CAR LDEBT PROD IAGLA REER, maxlag(2) ec

ARDL(1,1,0,0,0,0,0) regression

Sample:          3 -        77, but with a gap   Number of obs     =         72
                                                 R-squared         =     0.4667
                                                 Adj R-squared     =     0.3990
Log likelihood =  137.21342                      Root MSE          =     0.0385

------------------------------------------------------------------------------
       D.ROA |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
ADJ          |
         ROA |
         L1. |  -.1385382   .0732841    -1.89   0.063    -.2849848    .0079084
-------------+----------------------------------------------------------------
LR           |
        REPO |   .0474916   .0329599     1.44   0.155    -.0183736    .1133567
         CAR |    .349488   .1317255     2.65   0.010     .0862557    .6127204
       LDEBT |   .0047445   .0135395     0.35   0.727    -.0223121    .0318011
        PROD |   .0183835   .0139726     1.32   0.193    -.0095385    .0463055
       IAGLA |  -.1975325   .1157507    -1.71   0.093    -.4288418    .0337768
        REER |   .0003347    .002491     0.13   0.894    -.0046432    .0053125
-------------+----------------------------------------------------------------
SR           |
        REPO |
         D1. |  -.0289986   .0084211    -3.44   0.001    -.0458268   -.0121703
             |
       _cons |  -.8461024   .1664428    -5.08   0.000    -1.178712   -.5134931
------------------------------------------------------------------------------

.
```

```
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of D.ROA

         chi2(1)      =     0.09
         Prob > chi2  =   0.7795
```

```
. estat bgodfrey, lags(1/2) small

Number of gaps in sample:  1

Breusch-Godfrey LM test for autocorrelation
```

lags(p)	F	df	Prob > F
1	0.520	(1, 62)	0.4737
2	0.296	(2, 61)	0.7451

```
                        H0: no serial correlation
```

```
. sktest resid_ardlroa

Skewness and kurtosis tests for normality
```

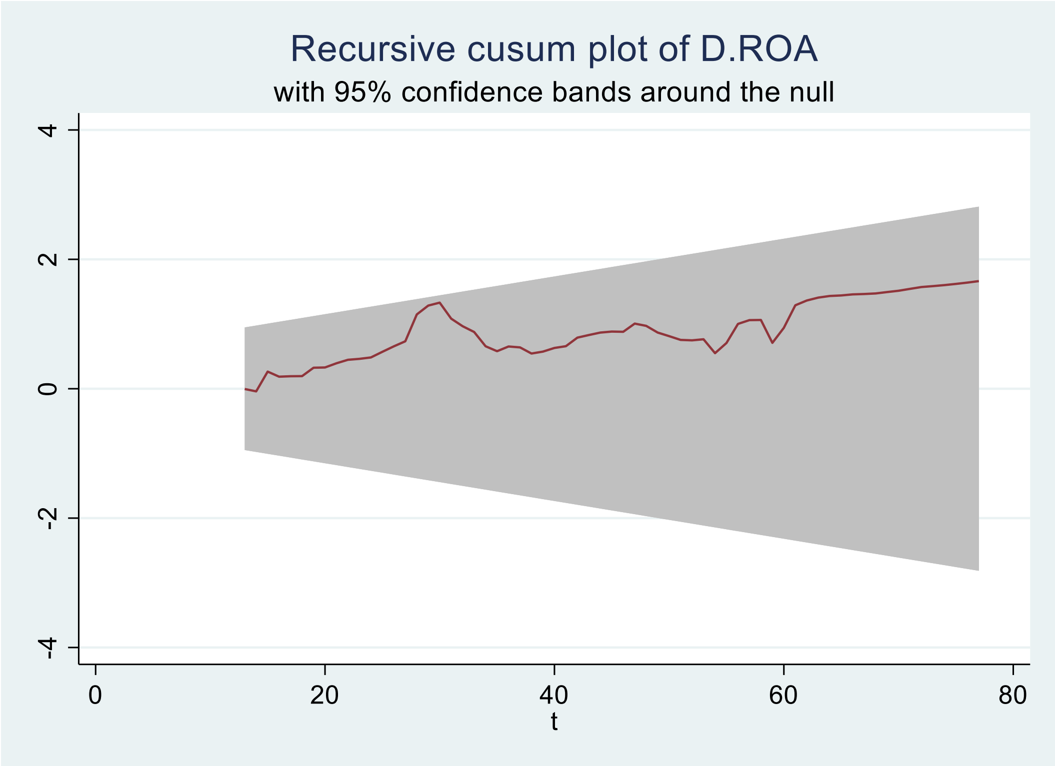
Variable	Obs	Pr(skewness)	Pr(kurtosis)	Joint test Adj chi2(2)	Joint test Prob>chi2
resid_ardlroa	75	0.5592	0.0011	9.46	0.0088

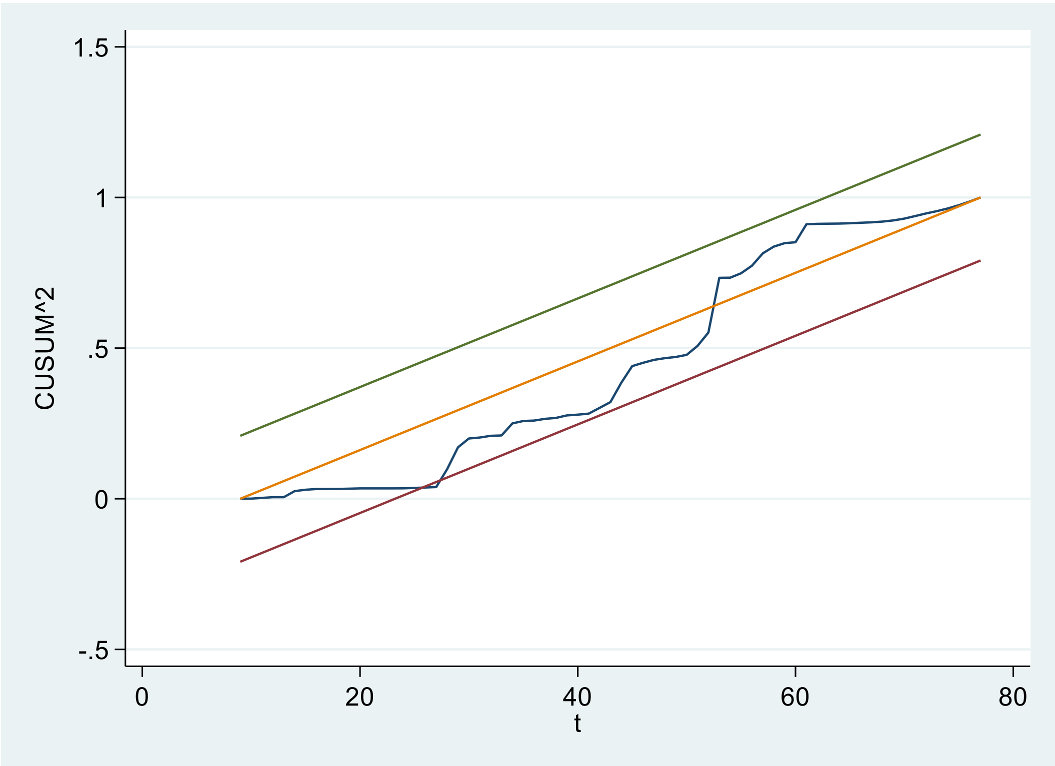
```
.

. swilk ec_residuals

                   Shapiro-Wilk W test for normal data
```

Variable	Obs	W	V	z	Prob>z
ec_residuals	72	0.95260	2.985	2.382	0.00861

```
.

. estat sbcusum, name(mycusum, replace)

Cumulative sum test for parameter stability

Sample: 3 - 77                                 Number of obs =        75
Ho: No structural break
```

Statistic	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
recursive	0.8564	1.1430	0.9479	0.850





MODEL III (NIIIEA)

```
. ardl NIIIEA REPO CAR LDEBT PROD IAGLA REER, maxlag(2) ec

ARDL(2,0,0,0,0,0,0) regression

Sample:         3 -        77, but with a gap   Number of obs     =         72
                                                R-squared         =     0.6089
                                                Adj R-squared     =     0.5592
Log likelihood =  223.95915                     Root MSE          =     0.0115

------------------------------------------------------------------------------
    D.NIIIEA |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
ADJ          |
      NIIIEA |
         L1. |  -.0971488   .0286231    -3.39   0.001    -.1543475   -.0399501
-------------+----------------------------------------------------------------
LR           |
        REPO |   .0686973   .0151301     4.54   0.000     .0384622    .0989324
         CAR |   .1351843    .044543     3.03   0.003     .0461722    .2241965
       LDEBT |  -.0047859   .0051565    -0.93   0.357    -.0150904    .0055185
        PROD |  -.0006684   .0022361    -0.30   0.766    -.0051369       .0038
       IAGLA |    .003597   .0437045     0.08   0.935    -.0837395    .0909335
        REER |   .0012087   .0010344     1.17   0.247    -.0008584    .0032758
-------------+----------------------------------------------------------------
SR           |
      NIIIEA |
         LD. |   .2408341   .1111537     2.17   0.034     .0187112     .462957
             |
       _cons |    .128024   .1224076     1.05   0.300     -.116588    .3726361
------------------------------------------------------------------------------

.


. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of D.NIIIEA

         chi2(1)      =     3.79
         Prob > chi2  =   0.0516
```

```
. estat imtest, white

White's test for Ho: homoskedasticity
         against Ha: unrestricted heteroskedasticity

         chi2(44)     =     47.68
         Prob > chi2  =    0.3253

Cameron & Trivedi's decomposition of IM-test
```

Source	chi2	df	p
Heteroskedasticity	47.68	44	0.3253
Skewness	11.71	8	0.1645
Kurtosis	0.69	1	0.4067
Total	60.08	53	0.2347

```
. estat bgodfrey, lags(1/2) small

Number of gaps in sample:  1

Breusch-Godfrey LM test for autocorrelation
```

lags(*p*)	F	df	Prob > F
1	0.582	(1, 62)	0.4485
2	0.377	(2, 61)	0.6876

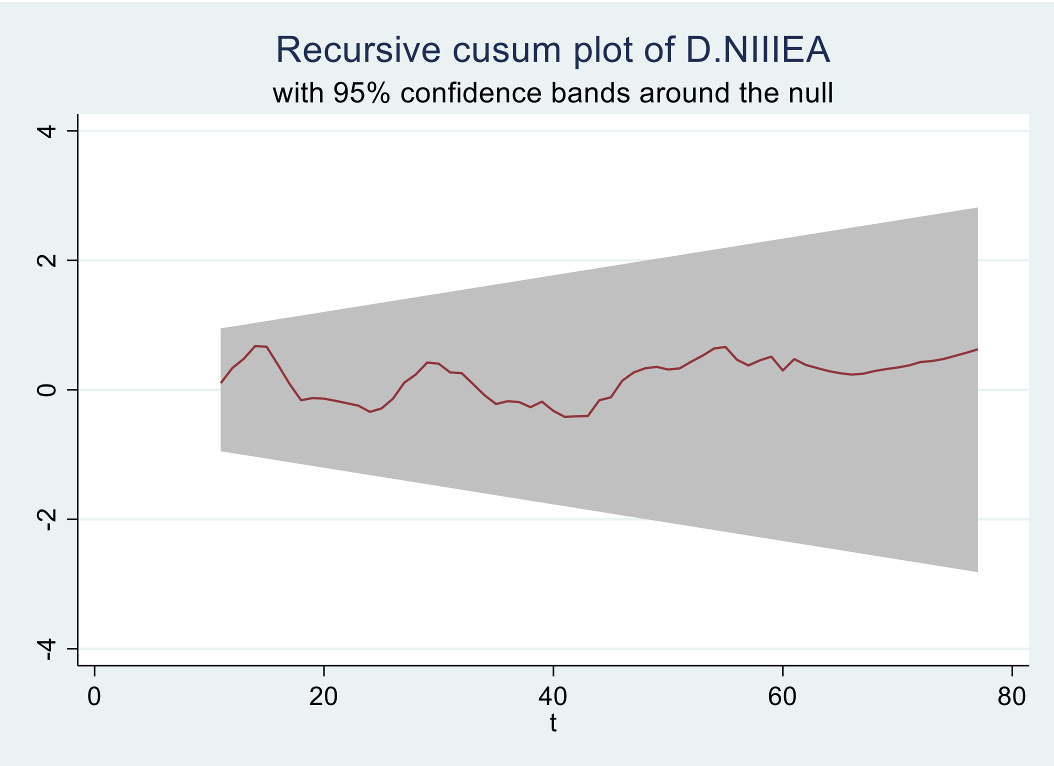
```
                        H0: no serial correlation
```

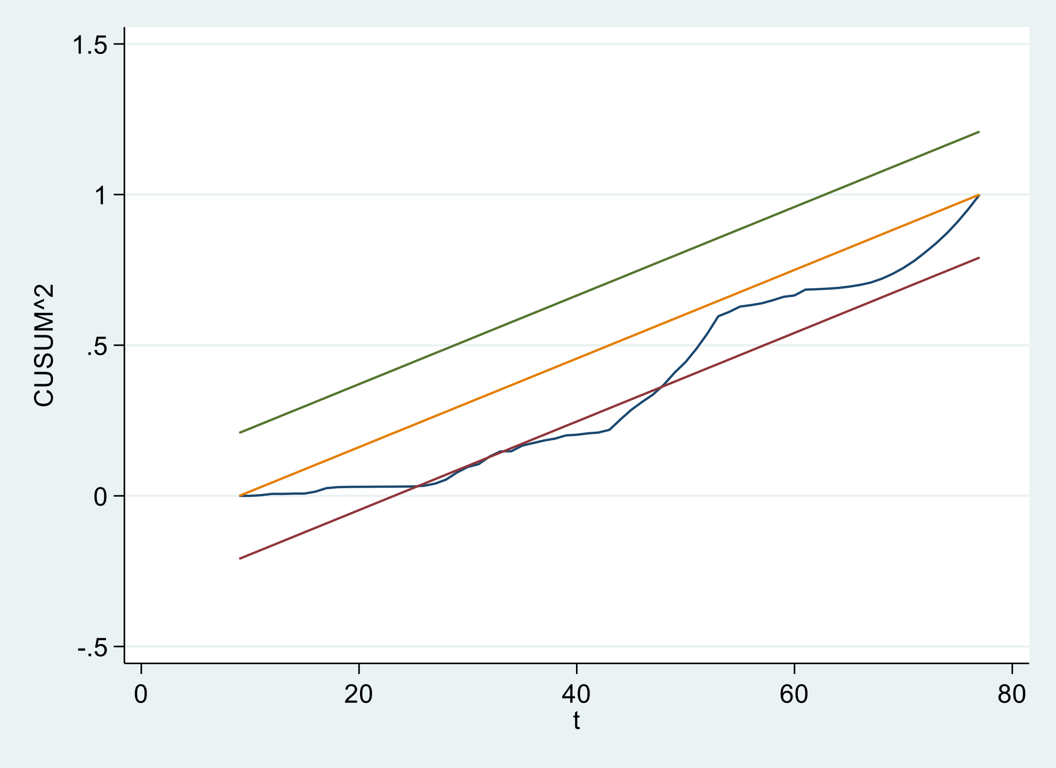
```
. swilk ec_residuals

                   Shapiro-Wilk W test for normal data
```

Variable	Obs	W	V	z	Prob>z
ec_residuals	72	0.95260	2.985	2.382	0.00861

```
.
```

```
. estat sbcusum, name(mycusum, replace)

Cumulative sum test for parameter stability

Sample: 3 - 77                                    Number of obs =         75
Ho: No structural break

                                 1% Critical      5% Critical      10% Critical
 Statistic     Test Statistic       Value            Value            Value
-------------------------------------------------------------------------------
 recursive        0.6044           1.1430           0.9479            0.850
-------------------------------------------------------------------------------
```




1.5
1
.5
0
-.5
CUSUM^2
0
20
40
60
80
t