Article

The impact of changes in macroeconomic factors on banks' lending behaviour

Mayibongwe Sangweni, Oliver Takawira*

MCom Investment Management, Department of Finance and Investment Management (DFIM), College of Business and Economics (CBE), University of Johannesburg, Johannesburg 2006, South Africa
* **Corresponding author:** Oliver Takawira, otakawira@uj.ac.za

Abstract: Loans are a critical transmission channel for commercial banks as well as an important revenue source. Macroeconomic factors are not within the control of commercial banks, however, select factors are observed to have a direct impact on lending behaviour in studies around the world. This study examined the relationship between macroeconomic variables and the lending behaviour of banks in South Africa for the period ranging from 2001 to 2022. Quarterly time series data was employed using the Autoregressive Distributed Lag Model (ARDL). The empirical results of the paper revealed that there is a long-run relationship between the repurchase rate (repo rate), inflation, the real effective exchange rate (REER) and lending behaviour in South Africa. The REER and inflation were both found to have a positive relationship, whilst the repo rate had a negative relationship. In addition, Gross Domestic Product (GDP), the activity rate and sovereign credit rating (SCR) changes returned insignificant results. Overall, these findings show that select macroeconomic factors do influence lending behaviour in South Africa. Furthermore, the results suggest that monetary policy decisions have a direct influential effect on lending and the South African Reserve Bank (SARB) has implemented their policies effectively.

Keywords: sovereign credit ratings; autoregressive distributed lag; macroeconomics; banking; lending behaviour

1. Introduction

Macroeconomic imbalances in South Africa are dominated by fiscal fragility highlighted by high unemployment (Arndt et al., 2020). The Coronavirus pandemic created a difficult economic environment for South Africa, with the country taking precautionary steps such as the enforced lockdowns to slow the spread of the virus, which resulted in a large supply shock, further worsening the country's fiscal position with the government projecting a 7.2% economic growth decline for 2020 (Burger and Calitz, 2020).

Further to this, there were clear macroeconomic steps taken to combat the economic consequences created by the pandemic such as the repo rate being reduced to 3.75% per annum in October 2020 from highs of 6.5% on 1 January 2020 (South African Reserve Bank, 2020). The problem for financial institutions is that whilst they may have control over their internal factors, they do not exert any control on macroeconomic factors such as reduced interest rates, as an extended period of low monetary rates will have negative outcomes on profits (Altavilla et al., 2018). Bernanke (1983) has previously suggested that a financial crisis disrupts the credit allocation process, thereby leading to a restricted credit supply. This has created a

fascinating relationship between macroeconomics and bank lending behaviour.

Although lending is a critical source of earnings generation for a bank, it involves a remarkable amount of risk which makes it vital to understand the determinants of lending behaviour (Bhattarai, 2019). This is why banks conduct credit assessments before providing loans, to manage credit risk and influence the amount of non-performing loans (NPLs) that are held by the lending institution (Munkhdalai et al., 2019).

Therefore, estimating the potential long-term economic consequences of the macroeconomic shocks, is not an easy process and the question that arises is whether the effects of changes and recessive events will be temporary or persistent. This paper thus aims to assess the long-term effects of the crisis on South African banks by taking a historical view of lending behaviour.

2. South Africa's economic and banking environment

South Africa is Africa's second-largest economy with a GDP of $421 billion in 2021 and a population of 60 million. It is second only to Nigeria whose GDP sits at $440 billion however with a considerably larger population of 211 million (World Bank, 2022). South Africa is seen as the most developed country in Sub-Saharan Africa (SSA) with one of the highest access rates to electricity in the region at an average rate of 86%, including an 85% access rate in rural areas, which is considerably high compared to the SSA average of 35% (Sarkodie and Adams, 2020). However, despite the developed nature of the country, it remains the most unequal country in the world with a Gini coefficient of 0.67 in 2018, making it rank last amongst the 164 countries in the World Bank database. The inequality gap that exists in South Africa creates a dual economy where 10% of the population owns more than 80% of financial assets, and nearly 20% of the population live below the international poverty line, which is almost twice the average for similar countries, the World Bank found.

Prior to the COVID-19 pandemic, the country was already in a weak position after a decade of low economic growth. This is further shown by the continuous ratings downgrades starting with Fitch Ratings (Fitch), Moody's Investors Services (Moody's) and Standard & Poor's (S&P) all downgrading the country's foreign rating in September 2012, according to the South African Reserve Bank (SARB). Over the following years, the rating continued to fall as highlighted by Moody's downgrading South Africa to junk status in November 2017.

The country's financial intermediaries, such as banks, play a fundamental role in the growth of an economy by lending to households and firms, and reallocating capital to its highest value use (Bottero et al., 2015). Due to the systemic importance of banks, there is strong regulatory oversight of the sector with all banks having to be registered with the Prudential Authority (PA) to conduct business in South Africa and are regulated by a range of legislations including the Banks Act, the FSR Act, the Mutual Banks Act, the Co-operative Banks Act and the Co-operatives Act.

The SARB is the central bank of South Africa and is mandated with maintaining price stability and uses the repurchase (repo) rate—the rate at which the SARB lends to commercial banks—as its main policy instrument (Vermeulen, 2020).

Although the largest four banks hold 83% of the industry's deposits, the recent

entrance of new banks is creating competition in the market and fostering more innovation (FSCA, 2022). This, coupled with the increased number of operational banks in the country, (where there are currently 63 operational banks in 2022 compared to the 38 registered banks in 2004) is a reliable gauge of the health of the sector as the increased level of competition will only continue to foster innovation and growth within the industry.

The secure nature of the banking sector is highlighted by the IMF in the 2019 Article IV consultation report commending South Africa for having a strong and resilient financial sector despite weak economic conditions. The COVID-19 pandemic also provided a litmus test of the robustness of banks as it created challenging circumstances for the banks to operate in. Although profitability in 2020 was materially lower for the fiscal year, the banking industry remained well-capitalised throughout the pandemic.

3. Literature review

Understanding the factory that determine the lending behaviour of banks has been a topic that researchers around the glove have focus on. However, the focus has largely centred on the countries in the developed world, compared to those in less economically renowned countries. This may be attributed to the larger and more established banking sectors found in these regions. Hence, in this section of the study, the review will primarily focus on literature available on the African continent, to amplify the research that is less well known.

Kamau and Wainaina (2013) and Onyango (2016) both analysed these effects on commercial banks in Kenya. Kamau and Wainaina's (2013) literature focused primarily on the effects on the agricultural sector where it was determined using an Ordinary Least Squares Regression (OLS) that GDP growth has a positive relationship whilst interest rates, and exchange rate and inflation movement all have a negative relationship. Onyango's (2016) research yielded similar results for the impact of interest rate movements. The study also revealed that the volume of deposits also has a direct positive effect where higher levels of deposits allow for banks to lend more.

Olokoyo (2011) uses the same methodology as Onyango (2016), however with a focus on Nigeria. He determined that the volume of deposits and the investment portfolios of the banks have the greatest positive impact on banks' lending behaviour. GDP is also seen to have a positive impact on banks' lending behaviour. Interestingly, interest rates were seen to have an insignificant effect on lending behaviour. Olokoyo (2011) argues that this could be due to commercial banks having the highest market share of financial institutions in Nigeria, therefore the lack of competition negates the effects of higher interest rates.

In Ghana, Sarpong-Kumankoma et al. (2013) studied the determinants for that country using a Generalised Method of Moments (GMM) System indicator where they determined the effects on lending behaviour (proxied by the total loan portfolio of the bank) by analysing various macroeconomic indicators, bank characteristics and industry characteristics. Sarpong-Kumankoma et al. (2013) found significant results across all three categories where particularly, a high level of bank capital was demonstrated to have the most positive relationship.

Mufandaedza (2017) employed the random effects model to analyse the drivers in a post-dollarization Zimbabwe. The author discovered that the main determinants in the country are total deposits, cash-required reserves, capital and NPLs. Other variables such as liquidity and interest income failed to produce significant results. The only macroeconomic variables used by Mufandaedza (2017) were GDP and inflation, which surprisingly, were both computed as insignificant.

In the South African context, Tabila (2016) investigated several factors that determine commercial banks' lending behaviour. The author examined the loans to total assets ratio as the dependent variable, whilst using GDP growth, credit risk (loan loss reserve to gross loans ratio), liquidity risk (liquid assets to customer deposits and short-term borrowed funds ratio), equity risk (total equity to total assets ratio) and management efficiency (cost to income ratio) as the explanatory variables. The results from the fixed panel regression that was used suggested that the equity ratio, liquidity ratio and GDP growth were the most significant variables in influencing lending behaviour, with GDP growth and liquidity risk both having an adverse impact and the remaining variables having a favourable impact.

The GDP growth rate has a negative relationship to lending behaviour which the author argues could be due to the consequences of deflation, as well as the current level of consumer confidence.

Coetzee and Genukile (2020) also examined the drivers of lending behaviour in South Africa. They considered the volume of deposits for commercial banks, the cash reserve ratio, the bank size (total assets), the effective exchange rate, GDP, M3 broad money supply, liquidity ratio (liquid assets to short-term liabilities) and the investment portfolios of the commercial banks as the explanatory variables for bank lending behaviour, which would be proxied by the total loans and advances (LOA).

Using an Autoregressive Distributed Lag (ARDL) model, the results of the study suggest that in the long-run, GDP is the sole variable to have a positive influence on the LOA. Coetzee and Genukile (2020) also note that a macroeconomic environment favourable to fostering economic growth is critical in explaining the banks' behaviour.

From the above literature, it is clear to see that there is no universal consensus on the expected relationships between the variables as different studies produce varying results. This is highlighted by Olokoyo (2011) finding a positive relationship with GDP, whilst Tabila (2016) noted a negative relationship. This is an indication that regions behave differently in response to macroeconomic changes and thus thoroughly understanding the drivers behind a select country is imperative.

It is evident to note that it is a trend for researchers to focus on internal bank factors to analyse lending behaviour and from a macroeconomic perspective, the most common factors used are GDP, exchange rates, interest rates and inflation. However, it can be noted that there is the potential that other factors, beyond those mentioned, may also have an influence. Hence, this study also includes sovereign credit ratings (SCR) and unemployment to widen the research literature. Athari (2023) found that SCRs positively impact cross-border banking flows.

From a theoretical perspective, the Credit Creation Theory can also be used to explain the relationship. As the theory suggests that banks are not required to collect deposits first before lending (Freimanis and Šenfelde, 2019). Instead, individual banks can essentially create money by not only lending out the deposits they've collected,

but rather by generating deposits as a ramification of bank lending (Starkley, 2018).

As the theory suggests, banks not being required to gain deposits in order to originate loans, creates a situation where they are effectively creating money out of nothing every time they originate a loan, as the banks' balance sheet will grow with the additional loan assets over time, whilst there is no counterweight on the balance sheet, as there is no re-allocation of funds (Werner, 2016).

What empowers banks to create credit, is their monopoly in accepting deposits and granting loans concurrently, without any regulatory requirements to segregate the money of clients (Nabilou and Prum, 2018). Werner (2016) proves in a case study of Credit Suisse, during the 2008 GFC, that banks can conjure up any level of capital required, therefore indicating that the capital adequacy requirements are irrelevant. Credit Suisse raised over £7 billion from predominately Qatari investors, in a preference share raise to avoid bankruptcy; yet at the same time the bank offered to extend the money to the investors to ensure they did not have to fund the liquidity themselves. This in effect, allowed the bank to raise equity capital out of nothing.

4. Methodology

4.1. Model specification

This paper adopts an approach used by authors Olokoyo (2011), Coetzee and Genukile (2020) and Assefa (2014) to uncover the relationship between the variables. This approach uses time-series data over the selected period to evaluate the determinants of the lending behaviour of South African commercial banks.

The model assumes that there is an underlying relationship between the explanatory variables used in the model (expressed in a functional form) and the overall loan book of a bank (Olokoyo, 2011). Therefore, the empirical results collected in the literature review are a critical point of reference as they provide evidence of the relationship and are necessary for the model to be accurately applied. The explanatory factors that are not expressed in the model will be captured by the error term.

Another key assumption made in the model is that bank lending behaviour in the present is explained by past lending experience. Therefore, all the variables are tested for the optimal lag length to ensure the model is expressed correctly.

The model is expressed as follows:

$$\text{LOANS}_t = \beta_0 + \beta_1 \text{REPO}_t + \beta_2 \text{HCPI}_t + \beta_3 \text{REER}_t + \beta_4 \text{GDP}_t + \beta_5 \text{ACTI}_t + \beta_6 \text{SCRI}_t + \mu_t$$

- Where LOANS_t indicates lending behaviour.
- REPO_t represent the repurchase rate.
- HCPI_t denotes the inflation rate.
- REER_t is the real effective exchange rate.
- GDP_t represents Gross Domestic Product.
- ACTI_t constitutes the activity rate.
- SCRI_t is the sovereign credit rating index.
- μ_t is the error term.

4.2. Data

This paper makes use of quarterly time-series data. The data used to represent the

banks is an aggregated figure of the SARB member banks. The observation period is a 21-year period, ranging from 2001–2022. This period has been selected because 2001 is when the prime lending rate became fixed at 350bps over the repo rate (Greenwood-Nimmo et al., 2022). It therefore, is an appropriate time to begin this analysis, as we can accurately account for the monetary policy transmission through the lending channel.

Data for this paper has been sourced from the Quantec, Federal Reserve Economic Data (FRED), Trading Economics, and SARB databases. The paper uses the log of the bank lending behaviour, which will be proxied by the total loan portfolio for the bank at a given point in time, as the dependent variable. This proxy has been chosen in line with Sarpong-Kumankoma et al. (2013) as it is considered appropriate in representing the loan books of banks.

Table 1 below is a description of the independent variables used in conducting the quantitative research tests. It also represents authors who have used these metrics in prior studies.

Table 1. Description of the independent variables.

Variable	Short Form	Description	Research Precedent
Lending rate	REPO	Log (South African repurchase rate)	Panagopoulos and Spiliotis (1998), Onyango (2016)
Inflation Rate	HCPI	Log (Headline Consumer Price Index)	Bhattarai (2019), Timsina (2016)
Exchange rate	REER	Log (Real Effective Exchange rate)	Coetzee and Genukile (2020), Bhattarai (2019)
Growth Domestic Product	GDP	Log (National Accounts: GDP by Expenditure)	Timsina (2016), Tabila (2016)
Unemployment	ACTI	Log (Activity rate)	Avdjiev et al. (2019)
Sovereign Credit Rating	SCRI	Log (SCRI)	Adelino and Ferreira (2016)

Source: Author's Computation, 2024.

To understand the monetary policy implication in South Africa directly, the repo rate will be analysed to see the effect on lending behaviour. A negative relationship is expected as the SARB raises this rate to curb inflationary pressure, which makes it more expensive for banks to borrow money (Matemilola et al., 2015). This is therefore, expected to lead to lower lending activities.

Price stability is a major policy objective for most central banks as it has been well-studied that inflation, above a certain threshold, is detrimental to the economy (Garriga and Rodriguez, 2020). Therefore, to achieve this the central bank amends the repo rate accordingly, this causes banks to amend their lending rates in line with the repo rate change and thus it is expected that an increase in inflation would have an inverse relationship with banks' lending books.

Given the dominance of the US Dollar exchange rate in trade invoicing, official reserve holding and asset issuances, and that it is an important transmission channel globally, changes in the US economy will have spillover effects onto the rest of the world, including South Africa (Bernoth et al., 2023). The weakening of a currency can lead to more expensive debt repayments as well as more difficulty in combating inflation (Gopinth and Gourinchas, 2022). This would therefore lead to an expected positive relationship, as a strengthening Rand position in relation to its trading partners, would have the opposite effect.

Broadly, an improvement in GDP can be conveyed as a positive indicator for an economy, whereas the opposite holds for a shrinking GDP. Generally, in times of growth, employment is likely to be increasing with individuals having more income to spend, whilst in times of contraction it can lead to recession (defined as two consecutive quarters during which output declined) and job loss (Callen, 2020). An increasing GDP would theoretically boost banks' willingness to lend to borrowers as they are more likely to meet their debt obligations. Therefore, a positive relationship is anticipated between changes in GDP and bank lending behaviour in South Africa.

Growth and unemployment can be seen as highly correlated and can be thought of as two aspects of a shared reality, as unemployment is reliant on economic activity since when economic activity increases, there is an uptick in production and more people are required in the creation of goods and services. The reverse is true in times of lower economic activity (making unemployment countercyclical) (Oner, 2010). However, the unemployment rate is not the only method used to estimate the economic health of the labour force. According to the International Labour Organization (2015) the activity rate (also known as the labour force participation rate) measures the proportion of a country's working age population, (which is 15 to 64 years in South Africa), that actively engages in the labour market (it includes those both currently employed and looking for employment). Increased participation in the labour market is critical for achieving employment targets and therefore requires favourable macroeconomic conditions (Council of the European Union, 2002). The expectation in this study is that the activity rate will have a positive relationship with lending behaviour, because an increasing labour force would suggest a larger borrower base that has the financial means to repay their debt obligations.

Sovereign Credit Ratings (SCRs) are a vital tool for a country to enter the international capital markets as this is a measurement of the likelihood of default by a country (Reinhart, 2002). Major credit ratings agencies such as S&P, Fitch and Moody's are commonly used by private creditors in making investment decisions, such as in their pricing calculations and in decisions to invest (or sell) their securities (Bhatia, 2002). Therefore, credit ratings are an important tool for countries to maintain. An increase in sovereign risk also pushes up the cost of funding for a commercial bank and adversely affects the funding composition of the bank's book, as a bank's creditworthiness usually deteriorates in line with the country (Panetta et al., 2011). Therefore, an inverse relationship is anticipated between SCR and bank lending, as the anticipated increased cost of funding for a bank means that they cannot provide the same volume of loans at the current price and must pass on the cost of funding to the borrower, which will alienate consumers who cannot afford the increased financing costs.

4.3. The autoregressive distributed lag (ARDL) model cointegration test

This study utilised the ARDL model, which is also commonly referred to as the bounds-testing approach in achieving the objectives of the study. The technique was initially established by Pesaran and Shin (1998). It has also been developed further over the years by Pesaran et al. (2001).

However, before running the model, the data underwent various formal and

informal tests to ascertain the properties of the data. It must also be noted that in the ARDL model variables can be a mix between stationary and non-stationary (Shrestha and Bhatta, 2018).

This model has been used for several years to establish the relationship between economic variables in a time series setup characterized by a solitary equation and its popularity stems from the fact that the cointegration of nonstationary variables is analogous to an error correction process (Kripfganz and Schneider, 2018).

There are a number of advantages of this model in contrast to other techniques for cointegration tests, such as Johansen's approach and the Engle and Granger cointegration approach. Specifically, because the underlying variables stand as a sole equation, endogeneity is not a pressing matter for the technique as it is free from residual correlation (Nkoro and Uko, 2016). It is also noted by Chetty (2018) that the ARDL technique is better equipped to address the dynamic influence of variables through its distributed lag efficiency. The technique also benefits from its capacity to calculate short and long-run parameters concurrently (Khan et al., 2019).

This study determines whether macroeconomic factors influence bank lending behaviour using the general ARDL $(p, q_1, …, q_k)$ equation. Which is stated as follows:

$$y_t = a_0 + a_1 t + \sum_{i=1}^{p} \psi_i y_{t-1} + \sum_{j=1}^{k} \sum_{l_j=0}^{q_j} \beta_{j,l_j} x_{j,t-l_j} + \epsilon_t$$

where:
- ϵ_t are the usual innovations.
- a_0 is a constant term.
- ψ coefficient of the lagged values of bank's lending.
- y_{t-1} are the lagged values of bank's lending proxies.
- x_j are the macroeconomic indicators.

Thus, $a_1, \psi_i, \beta_{j,l_j}$ are all, respectively, the coefficient associated with a linear trend and the lags of y_t and the lags of the k regressors $x_{j,t}$ for $j = 1, …, k$.

5. Empirical results

This section illustrates the findings of this study showing the lag length, ARDL results. Descriptive results, unit root tests, correlation results are shown in the Appendix section.

5.1. Lag length criteria

As the order of integration has been established, the following step involved determining the optimal lag length to be implemented in the regression. **Table 2** indicates the different tests used to understand the appropriate lag length.

The AIC and HQ outputs both indicate that eight lags are optimal, whilst the SC output indicates that one lag is appropriate. Given that the AIC has the smallest *R*-squared figure and is in the majority, the optimal lag length for each variable has been selected in line with this. This result is expected as Wooldridge (2018) notes that with quarterly data, the number of lags to include is typically one to eight, given sufficient data points.

Table 2. Lag length determination.

Lag	LogL	AIC	SC	HQ
0	383.5788	−9.298243	−9.091315	−9.215221
1	1091.231	−25.56125	−23.90583*	−24.89707
2	1160.976	−26.07347	−22.96956	−24.82814
3	1205.298	−25.95798	−21.40557	−24.13150
4	1263.440	−26.18370	−20.18280	−23.77606
5	1352.359	−27.16936	−19.71996	−24.18056
6	1493.754	−29.45072	−20.55283	−25.88077
7	1575.876	−30.26853	−19.92215	−26.11743
8	1719.526	−32.60559*	−20.81071	−27.87333*

Source: Author's Computation, 2024.
*Indicates optimal lag length.

5.2. ARDL bounds cointegration test results

Table 3 shows the results of the unrestricted VAR model and indicates the calculated *F*-statistic associated with various levels of significance.

Table 3. ARDL bounds cointegration test results.

F-Bounds Test	Null Hypothesis: No levels relationship			
Test Statistic	**Value**	**Signif.**	**I(0)**	**I(1)**
F-statistic	8.982181	10%	1.99	2.94
K	6	5%	2.27	3.28
		2.5%	2.55	3.61
		1%	2.88	3.99

Source: Author's Computation, 2024.

Table 3 shows the *F*-statistic is 8.98 which is above the upper bound I(1) at all four levels of significance computed in the table. Thus, we can reject the null hypothesis of no cointegration and confirm that there is cointegration. This implies that there is a long-run relationship between lending behaviour and the selected macroeconomic variables used in the study.

The empirical results of the regression are presented in **Table 4** and indicate which variables have a significant long- run relationship with lending behaviour. Looking firstly at the results of the repo rate, the variable is shown to have a statistically significant negative relationship with lending behaviour. This is in line with expectation as the SARB raises the repo rate to control inflation and stifle consumer and investment spending (Vermeulen, 2020), since theoretically, the higher interest rates stretch the capacity of borrowers to repay debt and therefore discourage them from taking on additional debt (Adrian, 2023). Thus, raising the rate deters individuals and corporates from using lending channels.

Table 4. Long-run model estimates.

Levels Equation				
Case 2: Restricted Constant and No Trend				
Variable	**Coefficient**	**Std. Error**	***t*-Statistic**	**Prob.**
LNREPO	−1.225097	0.276306	−4.433844	0.0001
LNHCPI	0.904535	0.361191	2.504310	0.0168
LNREER	3.784680	0.703933	5.376480	0.0000
LNGDP	−0.790128	0.728543	−1.084533	0.2851
LNACTI	−1.741801	2.327439	−0.748377	0.4590
LNSCRI	0.107086	0.582981	0.183687	0.8553
C	5.624958	7.610651	0.739090	0.4645

EC = LNLOANS − (−1.2251 × LNREPO + 0.9045 × LNHCPI + 3.7847 × LNREER − 0.7901 × LNGDP − 1.7418 × LNACTI + 0.1071 × LNSCRI + 5.6250)

Source: Author's Computation, 2024.

The GDP results show negative relationship because during a fall in GDP, firms delay investments, and consumers reduce borrowing because of low confidence in the banking system stability or future earnings which diminishes overall demand for loans. These results are in contrast with Coetzee and Genukile (2020) who obtained a positive long-run relationship between interest rates and lending behaviour in South Africa. However, these results were insignificant. Panagopoulos and Spiliotis's (1998) estimations also found an insignificant relationship in the Greek market, which the authors suggested is an indication of the authorities' power to influence the volume of credit in the market, being considerably weak. We can therefore deduce that the opposite is true of the SARB, as the significant results indicate that the monetary policy implementations that are part of the SARB's inflation targeting framework are working as intended and having their desired effects on consumers.

Headline CPI returned a significant positive relationship, which is a surprising result because the positive relationship is theoretically incorrect as higher inflation leads to a reduction in the purchasing power of money (Omondi, 2014). Therefore, it leads to consumers being unable to afford additional debt as the inflationary environment impedes financial development as it inhibits debtors from external financing (Le et al., 2022). However, some research suggests that rising inflation and the rising expectation of inflation lead to more consumer spending (Olusola et al., 2022). This is because moderate inflation increases are associated with economic growth which leads to increased demand (PIMCO, 2022). Thus, the positive relationship could be a result of consumers taking advantage of debt facilities and continuing their consumption before interest rate hikes- in response to inflation- are implemented.

Secondly, it can be noted that individual units of investment financed by bank credit are likely to be created even in an inflationary environment (Dorrance, 1963). This positive relationship is therefore plausible, however authors such as Bhattarai (2019) and Timsina (2016) both found insignificant negative relationships, indicating that the results found in this study are an anomaly.

The real effective exchange rate proved to have a positive significant relationship.

This is in line with the research conducted by Bhattarai (2019) who also found a positive relationship; however, the results of that study were insignificant. A possible reason for the positive relationship is that the exchange rate shock will affect a bank's loan supply if they have foreign currency exposure on their balance sheet that is not perfectly hedged (Beck et al., 2022). The increased valuation of the foreign currency would give the bank a bigger asset base to lend from. A second reason is that when a home currency appreciates, firms which hold foreign currency debt and local currency assets observe a higher net worth, thus allowing the firms to borrow more (Shim, Kalemli-Ozcan and Liu, 2020).

GDP returned an insignificant relationship. As South Africa's economic outlook continues to look uncertain with structural challenges such as the weak management of state-owned enterprises (World Bank, 2023) continuing to leave many South Africans having limited confidence in the country, the insignificant relationship is understandable, as many potential borrowers may still be averse to taking up debt opportunities in times of economic boom due to their distrust of the state of the country. However, this is in contrast with Timsina (2017) who suggests that if an economy is in a boom and GDP growth is impressive, then it is likely for lending behaviour to increase.

Although, the outcome of the regression is in line with Tabila (2016) who found similar results in South Africa and argues that this could be a result of deflation and consumer confidence levels. The activity rate indicates an insignificant negative relationship with lending behaviour, which is not in line with expectation, as an increasing economically active population would suggest there is more market activity which would theoretically result in more lending activity.

This is also an indication that unemployment is not a significant factor in South Africa's lending environment which is in contrast with Avdjiev et al.'s (2019) study which found that lending increases when unemployment decreases. A potential reason why the relationship is insignificant is that the regulatory framework put in place has been successful, and the credit modelling is robust enough to ensure that those who pose a higher risk of increasing NPLs do not receive the requested funding.

A secondary reason is potentially that South Africa's unemployment rate has historically been above 20% since before the observation period of this study, because the inequality in the country is not a new phenomenon. The higher unemployment has thus already been taken into account by the market and no longer has significant implications, as South African banks would have had sufficient time to alter their target market and risk metrics to ensure that higher unemployment is not a significant influence.

The SCRI results indicate an insignificant positive relationship with bank lending, which suggests that credit rating changes by agencies such as Fitch, Moody's and S&P do not have a significant effect on lending behaviour. The direction of the relationship is theoretically correct as investors in the South African market are sensitive to ratings downgrades (Mutize and Nkhalamba, 2020). Thus, a decrease in the SCR would lead to lending behaviour lowering.

However, the insignificance of the variable was not the expected result. This is because the deterioration of credit ratings affects the ability of banks to access funding and public debt markets for various reasons (Adelino and Ferriera, 2016). It would

thus impact the banks' ability to fund the loan requests from their client base. However, the insignificance of this statistic suggests that South African banks have alternative means of funding themselves, that mitigate the foreign counterparts who were no longer allowed to invest in South Africa. Development Finance Institutions (DFIs), such as the International Finance Corporation (IFC), could be seen to be part of that mitigation strategy, as they have been increasing loans to the country over the years to fund certain projects (SARB, n.d.).

Given that cointegration was established, the next step was conducting the error correction model (ECM) to analyse the error correction term. The results are presented in the Appendix section. It is expected that for the short-run error to be corrected in the long-run, the coefficient of the error correction term should be negative and significant. The results shown in Appendix indicate that the ECM term (CointEq (−1)) is indeed negative and significant. Therefore, it suggests that in the event of disequilibrium, the variables will correct to the long-run equilibrium at an adjustment rate of approximately 4.3% per period.

6. Conclusion

Based on the empirical evidence provided in this paper, select macroeconomic variables are indeed seen to have a significant influence on lending behaviour. Namely, the real effective exchange rate and Headline CPI both have found significant positive relationships with lending behaviour in South Africa, whilst the repo rate found a significant negative relationship. The activity rate, GDP and the SCRI were found to have an insignificant negative relationship.

The result of this study is also an indicator that South Africa's experience does not reflect that of other African countries, highlighted in the literature review, and that there is merit in seeing these countries differently as banks on the continent have differing responses to macroeconomic changes.

Another point of interest is that as monetary policy works largely through indirect channels, such as influencing interest rates (Bernanke, 2004) an important option the SARB possesses is increasing the repo rate to deflate consumer demand as raising interest rates is a key ingredient in inflation stabilisation programs around the world (Calvo and Vegh, 1995). The results of this regression suggest that this is an effective tool as the significant negative relationship with bank lending behaviour found in this paper indicates that the increased repo rate does indeed hamper consumer spending.

As lending remains a key source of profit for banks, some considerations can be taken into account to ensure the continued profitability of the product. Namely:

- If commercial banks feel that the profit fluctuation is too significant when the SARB changes the repo rate, it may be worthwhile to investigate expanding the use of other base rates that account for international market conditions, instead of the local conditions. This can be especially looked at for international corporates who aren't exposed to South African market conditions. Although lending rates such as SOFR are still relatively new in their mainstream adoption, it would be a worthwhile investigation to understand the profitability difference using this rate compared to JIBAR or the prime lending rate.
- Commercial banks could consider selling down bigger portions of their loan

books in order to mitigate some of the risks of NPLs that come with borrowers being under strain in difficult economic conditions. In doing so they will not be exposed to the same level of risk as they currently are when the markets turn as they will not be holding that risk. This could also lead to the banks being able to write more business as their balance sheet could support it.

- If commercial banks are not willing to distribute their risk, then it's possible to expand their use of insurance products. Although insurance is not a new concept in the banking industry, new fintech-based insurance companies are providing innovative solutions in the industry which could be further explored. This could be in the form of AI and machine learning capabilities being developed that ensure more efficient risk mitigation.

- The foreign exchange risk posed to banks in South Africa- since the Rand has declined over the years in relation to major currencies around the world- may make banks look to finding solutions to expanding their deposit base of foreign currencies, as the appreciation of the foreign currency against the Rand would influence the banks' balance sheet. This could be facilitated through the interbank market by gaining foreign deposits from overseas-based banks in exchange for the use of domestic payments rails that the foreign-banks would need access to.

Lastly, based on the finding of this study, there are various key areas that would be of interest to research further. Namely, to see a qualitative study of decision-makers within banks to understand their psyche and responses when the macroeconomy changes. Secondly, it can also be recommended that a comparative study is done using the same data points for different African countries to identify the exact differences in the regions. Future studies should apply machine learning techniques forecast and augment the modelling or analysis the impact of macroeconomic variables on bank's lending behaviour.

Author contributions: Conceptualization, MS and OT; methodology, MS and OT; software, MS; validation, MS and OT; formal analysis MS and OT; investigation, MS; resources, OT; data curation, MS and OT; writing—original draft preparation, MS and OT; writing—review and editing, MS and OT; visualization, MS; supervision, OT; project administration, OT. All authors have read and agreed to the published version of the manuscript.

Conflict of interest: The authors declare no conflict of interest.

References

Adelino, M., & Ferreira, M. A. (2016). Bank Ratings and Lending Supply: Evidence from Sovereign Downgrades. Review of Financial Studies, 29(7), 1709–1746. https://doi.org/10.1093/rfs/hhw004

Adrian, T. (2023). Higher-for-Longer Interest Rate Environment is Squeezing More Borrowers. Available online: https://www.imf.org/en/Blogs/Articles/2023/10/10/higher-for-longer-interest-rate-environment-is-squeezing-more-borrowers (accessed on 2 June 2023).

Akinboade, O. A., & Makina, D. (2009). Bank Lending and Business Cycles: South African Evidence. African Development Review, 21(3), 476–498. https://doi.org/10.1111/j.1467-8268.2009.00219.x

Ali, S., Shahzad, S. J. H., Raza, N., et al. (2018b). Stock market efficiency: A comparative analysis of Islamic and conventional stock markets. Physica A: Statistical Mechanics and its Applications, 503,139–153. https://doi.org/10.1016/j.physa.2018.02.169

Altavilla, C., Boucinha, M., & Peydró, J. L. (2018). Monetary Policy and Bank Profitability in a Low-Interest Rate Environment. Economic Policy. https://doi.org/10.1093/epolic/eiy013

Arndt, C., Davies, R., Gabriel, S., et al. (2020). Impact of COVID-19 on the South African economy an initial analysis. SA-TIED Working Paper, 111.

Assefa, M. (2014). Determinants of Growth in Bank Credit to the Private Sector in Ethiopia: A Supply Side Approach. Research Journal of Finance and Accounting, 5(17), 90.

Athari, S. A. (2023). Does a Country's Sovereign Credit Rating Drive Capital Inflows into Emerging European Markets? Evidence From Balkan Region. The Economics and Finance Letter, 174, 185.

Avdjiev, S., Aysun, U., & Hepp, R. (2019). What drives local lending by global banks? Journal of International Money and Finance, 90, 54–75. https://doi.org/10.1016/j.jimonfin.2018.09.005

Bansal, A. (2019). An Analysis of Basel I, Basel II and Basel III and Its Impact on Profitability of Banks in Kingdom of Bahrain. International Journal of Innovative Technology and Exploring Engineering (IJITEE), 8(8), 2278–3075.

Bassett, W. F., Chosak, M. B., Driscoll, J. C., et al. (2014). Changes in bank lending standards and the macroeconomy. Journal of Monetary Economics, 62, 23–40. https://doi.org/10.1016/j.jmoneco.2013.12.005

Beck, T., Bednarek, P., te Kaat, D., et al. (2022). Real Effects of Exchange Rate Depreciation: The Roles of Bank Loan Supply and Interbank Markets. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.4282877

Bernanke, B. (2004). Ben S Bernanke: The logic of monetary policy * * *. Available online: https://www.bis.org/review/r041206e.pdf (accessed on 12 January 2024).

Bernoth, K., Herwartz, H., & Trienens, L. (2023). The Impacts of Global Risk and US Monetary Policy on US Dollar Exchange Rates and Excess Currency Returns. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.4455143

Bhatia, A. V. (2002). Sovereign Credit Ratings Methodology: An Evaluation. IMF Working Papers, 02(170), 1. https://doi.org/10.5089/9781451858433.001

Bhattarai, B. P. (2019). Determinants of Commercial Banks' Lending Behavior in Nepal. International Journal of Accounting & Finance Review, 4(1), 51–60. https://doi.org/10.46281/ijafr.v4i1.338

Blinder, A. (2018). Keynesian Economics. Available online: https://www.econlib.org/library/Enc/KeynesianEconomics.html (accessed on 12 January 2024).

Bottero, M., Lenzu, S., & Mezzanotti, F. (2015). Sovereign Debt Exposure and the Bank Lending Channel: Impact on Credit Supply and the Real Economy. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.2686226

Brester, G. W., & Watts, M. J. (2019). The Basel accords, capital reserves, and agricultural lending. Agricultural Finance Review, 79(1), 27–47. https://doi.org/10.1108/afr-04-2017-0025

Burger, P., Calitz, E. (2020). COVID-19, Economic Growth and South African Fiscal Policy. South African Journal of Economics, 89(1), 3–24. https://doi.org/10.1111/saje.12270

Callen, T. (2020). Gross Domestic Product: An Economy's All. International Monetary Fund.

Calvo, G. A., & Vegh, C. A. (1995). Fighting Inflation with High Interest Rates: The Small Open Economy Case under Flexible Prices. Journal of Money, Credit and Banking, 27(1), 49. https://doi.org/10.2307/2077850

Caulker, S. (2020). Banking Regulations-Understanding the Dodd-Frank Act and the Basel Accord. International Journal of Finance.

Chanetsa, C. K. (2019). Securities and Capital Markets Regulation in South Africa. Brill Research Perspectives in International Banking and Securities Law, 3(1), 1–99. https://doi.org/10.1163/24056936-12340007

Chetty, P. (2018). Auto regressive distributed lag model (ARDL) and its advantages. Available online: https://www.projectguru.in/auto-regressive-distributed-lag-model-ardl/ (accessed on 12 January 2024).

Coetzee, J., & Genukile, L. (2020). The short- and long-run drivers of lending behaviour by South African banks. African Journal of Economic and Management Studies, 11(4), 639–651. https://doi.org/10.1108/ajems-08-2019-0316

Council of the European Union. (2002). Increasing labour force participation and promoting active ageing. Economic Policy Committee.

Dorrance, G. S. (1963). The Effect of Inflation on Economic Development. IMF Staff Papers. https://doi.org/10.5089/9781451956023.024.A001

Dymski, G. A. (1988). A Keynesian Theory of Bank Behavior. Journal of Post Keynesian Economics, 10(4), 499–526. https://doi.org/10.1080/01603477.1988.11489704

Emami-Langroodi, F. (2017). SchumpeterrS Theory of Economic Development: A Study of the Creative Destruction and

Entrepreneurship Effects on the Economic Growth. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.3153744

ESKOM. (2023). Medium-Term System Adequacy Outlook 2024–2028. Available online: https://www.eskom.co.za/wp-content/uploads/2023/11/Medium_Term_System_Adequacy_Outlook_2024-2028.pdf (accessed on 7 January 2024).

Eyraud, L., Bunda, I., Jack, J., et al. (2021). Resolving Nonperforming Loans in Sub-Saharan Africa in the Aftermath of the COVID-19 Crisis. Available online: https://books.google.co.za/books?hl=en&lr=&id=uPI_EAAAQBAJ&oi=fnd&pg=PR9&dq=bunda+2021+imf+&ots=AwcNiBbrY9&sig=3VQ3opNgn6a0tXN6-MP8hHCOn6U&redir_esc=y#v=onepage&q=bunda%202021%20imf&f=false (accessed on 7 January 2024).

Fama, E. F. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. The Journal of Finance, 25(2), 383. https://doi.org/10.2307/2325486

Freimanis, K., & Šenfelde, M. (2019). Credit creation theory and financial intermediation theory: different insights on banks' operations. In: Proceedings of 6th International Scientific Conference Contemporary Issues in Business, Management and Economics Engineering 2019. https://doi.org/10.3846/cibmee.2019.033

Fsca.co.za. (2019). Vision and Mission. Available online: https://www.fsca.co.za/Pages/Vision-and-Mission.aspx (accessed on 7 January 2024).

Garriga, A. C., & Rodriguez, C. M. (2020). More effective than we thought: Central bank independence and inflation in developing countries. Economic Modelling, 85, 87–105. https://doi.org/10.1016/j.econmod.2019.05.009

Gopinath, G., & Gourinchas, P. O. (2022). How Countries Should Respond to the Strong Dollar. Available online: https://www.imf.org/en/Blogs/Articles/2022/10/14/how-countries-should-respond-to-the-strong-dollar (accessed on 2 June 2023).

Greenwood-Nimmo, M., Steenkamp, D., & Van Jaarsveld, R. (2022). South African Reserve Bank Working Paper Series WP/22/06 A bank-level analysis of interest rate pass-through in South Africa. Available online: https://www.resbank.co.za/content/dam/sarb/publications/working-papers/2022/WP%202206.pdf (accessed on 2 June 2023).

Heymans, A., & Santana, L. (2018). South African Journal of Economic and Management Sciences. ISSN. https://doi.org/10.4102/sajems

Hull, J.C. (2018). Risk Management and Financial Institutions. John Wiley & Sons.

IMF. (2019). South Africa: 2019 Article IV Consultation-Press Release; and Staff Report; and Statement by the Executive Director for South Africa. Available online: https://www.imf.org/en/Publications/CR/Issues/2020/01/29/South-Africa-2019-Article-IV-Consultation-Press-Release-and-Staff-Report-and-Statement-by-49003#:~:text=Summary%3A (accessed on 7 January 2024).

IMF. (2023). IMF Executive Board Concludes 2023 Article IV Consultation with South Africa. Available online: https://www.imf.org/en/News/Articles/2023/06/05/pr23198-south-africa-imf-executive-board-concludes-2023-article-iv-consultation-with-south-africa (accessed on 7 January 2024).

Industrial Development Corporation. (2019). Economic overview: Recent developments in the global and South African economies. Available online: https://www.idc.co.za/wp-content/uploads/2019/02/IDC-RI-publication-Economic-Overview-External-19-February-2019.pdf (accessed on 7 January 2024).

Iyke, B. N., & Ho, S. Y. (2017). Nonlinear effects of exchange rate changes on the South African bilateral trade balance. The Journal of International Trade & Economic Development, 27(3), 350–363. https://doi.org/10.1080/09638199.2017.1378916

Jahan, S., Saber Mahmud, A., & Papageorgiou, C. (2014). What Is Keynesian Economics? Available online: https://www.imf.org/external/pubs/ft/fandd/2014/09/basics.htm (accessed on 7 January 2024).

Jing, E. (2020). Impact of high non-performing loan ratios on bank lending trends and profitability. International Journal Financial Stud, 8.

Kamau, G., & Wainaina. (2013). Effect Of Macroeconomic Factors on Commercial Banks Lending to Agricultural Sector in Kenya [PhD thesis]. University of Nairobi.

Khan, M. K., Teng, J. Z. and Khan, M.I. (2019). Cointegration between macroeconomic factors and the exchange rate USD/CNY. Financial Innovation, 5(1). https://doi.org/10.1186/s40854-018-0117-x

Koulischer, F., & Roy, P.V. (2017). Using bank loans as collateral in Europe: The role of liquidity and funding purposes. Working Paper Research. Available online: https://ideas.repec.org/p/nbb/reswpp/201703-318.html (accessed on 7 January 2024).

Kripfganz, S., & Schneider, D. (2018). Ardl: Estimating autoregressive distributed lag and equilibrium correction models. Available online: https://econpapers.repec.org/paper/bocusug18/09.htm (accessed on 7 January 2024).

Le, H. N. Q., Nguyen, T. V. H., & Schinckus, C. (2022). Bank lending behaviour and macroeconomic factors: A study from strategic interaction perspective. Heliyon, 8(11), e11906. https://doi.org/10.1016/j.heliyon.2022.e11906

Matemilola, B. T., Bany-Ariffin, A. N., & Muhtar, F. E. (2015). The impact of monetary policy on bank lending rate in South Africa. Borsa Istanbul Review, 15(1), 53–59. https://doi.org/10.1016/j.bir.2014.09.003

Mee, S., & Sophister, S. (n.d.). Joseph Schumpeter And the Business Cycle: An Historical Synthesis. Available online: https://www.tcd.ie/Economics/assets/pdf/SER/2009/simon_mee.pdf (accessed on 2 June 2023).

Mills, K. G. (2018). Fintech, Small Business & the American Dream. Springer International Publishing. https://doi.org/10.1007/978-3-030-03620-1

Mufandaedza, S. (2017). Determinants of Commercial Bank Lending Behaviour in Zimbabwe: An Empirical Investigation of the Post Dollarization Era. ResearchGate.

Munkhdalai, L., Munkhdalai, T., Namsrai, O. E., et al. (2019). An Empirical Comparison of Machine-Learning Methods on Bank Client Credit Assessments. Sustainability, 11(3), 699. https://doi.org/10.3390/su11030699

Mutarindwa, S., Schäfer, D., & Stephan, A. (2021). Differences in African Banking Systems: Causes and Consequences. Journal of Institutional Economics, 17(4), 561–581. https://doi.org/10.1017/s174413742100014x

Mutize, M., & Nkhalamba, M. M. (2020). The impact of sovereign credit rating changes on government bond yields in South Africa. International Journal of Sustainable Economy, 12(1), 81. https://doi.org/10.1504/ijse.2020.107860

Nabilou, H., & Prrm, A. (2018). Ignorance, Debt and Cryptocurrencies: The Old and the New in the Law and Economics of Concurrent Currencies. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.3121918

Nkoro, E., & Uko, A. K. (2016). Autoregressive Distributed Lag (ARDL) cointegration technique: application and interpretation. Journal of Statistical and Econometric Methods, 5(4).

Olokoyo, F. O. (2011). Determinants of Commercial Banks' Lending Behavior in Nigeria. International Journal of Financial Research, 2(2). https://doi.org/10.5430/ijfr.v2n2p61

Olusola, B. E., Chimezie, M. E., Shuuya, S. M., et al. (2022). The Impact of Inflation Rate on Private Consumption Expenditure and Economic Growth—Evidence from Ghana. Open Journal of Business and Management, 10(04), 1601–1646. https://doi.org/10.4236/ojbm.2022.104084

Omondi, G. (2014). Effects Of Inflation on Commercial Banks' Lending: A Case of Kenya Commercial Bank Limited. Available online: https://erepo.usiu.ac.ke/bitstream/handle/11732/139/GEORGE%20OMONDI%20OPUODHO%20.pdf?isAllowed=y&sequence=1 (accessed on 2 June 2023).

Oner, C. (2010). Back to Basics: What Is Inflation? International Monetary Fund.

Onyango, J. (2016). Determinants of Lending Behaviour in Selected Commercial Banks in Kenya. International Journal of Economics, Commerce and Management, 14(9), 767-782.

Panagopoulos, Y., & Spiliotis, A. (1998). The Determinants of Commercial Banks' Lending Behavior: Some Evidence for Greece. Journal of Post Keynesian Economics, 20(4), 649–672. https://doi.org/10.1080/01603477.1998.11490172

Panetta, F., Vespro, C., Wieland, M., et al. (2011). Committee on the Global Financial System The impact of sovereign credit risk on bank funding conditions. Available online: https://www.bis.org/publ/cgfs43.pdf (accessed on 2 June 2023).

Pesaran, H., & Shin, Y. (1998). Generalized impulse response analysis in linear multivariate models. Economics Letters, 58(1), 17–29. https://doi.org/10.1016/s0165-1765(97)00214-0

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics, 16(3), 289–326. https://doi.org/10.1002/jae.616

PIMCO (2022). Understanding Inflation|PIMCO. Pacific Investment Management Company LLC.

Reinhart, C. M. (2002). Default, Currency Crises, and Sovereign Credit Ratings. The World Bank Economic Review, 16(2), 151–170. https://doi.org/10.1093/wber/16.2.151

RisCura. (2020). AUM—RisCura. Available online: https://brightafrica.riscura.com/sources-of-capital-on-the-continent/banks/aum/ (accessed on 24 August 2023).

Rodano, G., Serrano-Velarde, N. A. B., & Tarantino, E. (2015). Lending Standards Over the Credit Cycle. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.2699553

Romer, C. (2019). Business Cycles—Econlib. Available online: https://www.econlib.org/library/Enc/BusinessCycles.html (accessed on 2 June 2023).

Rossi, M., & Gunardi, A. (2018). Efficient Market Hypothesis and Stock Market Anomalies: Empirical Evidence in Four

European Countries. Journal of Applied Business Research (JABR), 34(1), 183–192. https://doi.org/10.19030/jabr.v34i1.10111

Sarı Aksakal, B. (2020). World Bank and Keynesian Economics. Business and Economics Research Journal, 10(1), 77–94. https://doi.org/10.20409/berj.2019.156

Sarkodie, S. A., & Adams, S. (2020). Electricity access and income inequality in South Africa: Evidence from Bayesian and NARDL analyses. Energy Strategy Reviews, 29, 100480. https://doi.org/10.1016/j.esr.2020.100480

Sarpong-Kumankoma, E., Osei, K., & Ladime, J. (2013). Determinants of Bank Lending Behaviour in Ghana. Journal of Economics and Sustainable Development, 4(17).

Schmulow, A. (2020). Consumer financial well-being in South Africa's Twin Peaks regulatory regime: from measurement, to confidence in outcomes The International Review of Financial Consumers, (2).

Schoenmaker, D., Véron N., Gehrig, T.P., et al. (2016). European banking supervision the first eighteen months. Available online: https://www.bruegel.org/sites/default/files/private/wp_attachments/Blueprint-XXV-web.pdf (accessed on 2 June 2023).

Shim, I., Kalemli-Ozcan, S., Liu, X. (2020). Exchange Rate Fluctuations and Firm Leverage. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.3772488

Shrestha, M. B., Bhatta, G. R. (2018). Selecting appropriate methodological framework for time series data analysis. The Journal of Finance and Data Science, 4(2), 71–89. https://doi.org/10.1016/j.jfds.2017.11.001

Sinha, S., & Getachew, M. (2024). (Blog) As Africa's Population Crosses 1.5 billion, The Demographic Window Is Opening; Getting the Dividend Requires More Time and Stronger Effort. Available online: https://www.uneca.org/stories/%28blog%29-as-africa%E2%80%99s-population-crosses-1.5-billion%2C-the-demographic-window-is-opening-getting (accessed on 24 August 2023).

South African Reserve Bank Prudential Authority. (2022). Prudential Authority Annual Report 2021/22. Available online: https://www.resbank.co.za/content/dam/sarb/publications/reports/pa-annual-reports/2022/Prudential%20Authority%20Annual%20Report%202021%202022.pdf (accessed on 7 January 2024).

South African Reserve Bank. (2020). Monetary Policy Review. Available online: https://www.resbank.co.za/content/dam/sarb/publications/reviews/monetary-policy-review/2020/10299/Monetary-Policy-Review---October-2020.pdf (accessed on 7 January 2024).

South African Reserve Bank. (n.d.). The international banking crisis and domestic financial intermediation in emerging market economies: issues for South Africa. Available online: https://www.bis.org/publ/bppdf/bispap54w.pdf (accessed on 2 June 2023).

Starkey, M. (2018). Credit creation theory of banking. Available online: https://shura.shu.ac.uk/23013/1/Starkey-CreditCreationTheory%28VoR%29.pdf (accessed on 7 January 2024).

Statista. (2023). Topic: Bank lending during recessions. Available online: https://www.statista.com/topics/9883/bank-lending-during-recessions/#topicOverview (accessed on 7 January 2024).

Tabila, N. (2016). Determinants of Commercial Banks' Lending Behavior in South Africa [Master's thesis]. Eastern Mediterranean University.

The Executive Director for South Africa. (2023). South Africa 2023 Article Iv Consultation-Press Release; Staff Report. Available online: https://www.imf.org/-/media/Files/Publications/CR/2023/English/1ZAFEA2023001.ashx (accessed on 2 June 2023).

Timsina, N. (2016). Determinants of Bank Lending in Nepal. NRB Economic Review, 28(2), 19–42. https://doi.org/10.3126/nrber.v28i2.52532

Ţiţan, A. G. (2015). The Efficient Market Hypothesis: Review of Specialized Literature and Empirical Research. Procedia Economics and Finance, 32, 442–449. https://doi.org/10.1016/s2212-5671(15)01416-1

Vermeulen, C. (2020). On the mandate, ownership and independence of the South African Reserve Bank. South African Journal of Economic and management Sciences, 23(1). https://doi.org/10.4102/sajems.v23i1.3416

Werner, R. A. (2016). A lost century in economics: Three theories of banking and the conclusive evidence. International Review of Financial Analysis, 46, 361–379. https://doi.org/10.1016/j.irfa.2015.08.014

World Bank. (2023). Overview. Available online: https://www.worldbank.org/en/country/southafrica/overview#:~:text=The%20unemployment%20rate%20is%20highest (accessed on 2 June 2023).

Appendix

Descriptive statistics

Table A1. Descriptive statistics.

	LOANS	REPO	HCPI	REER	GDP	ACTI	SCRI
Mean	7,889,852	7.268210	70.58759	108.6777	22.27327	57.53806	12.56180
Median	7,465,005	6.833333	67.46667	108.3767	22.36663	57.74629	13.00000
Maximum	14,954,424	13.50000	109.4667	129.9500	39.12405	60.79079	14.33333
Minimum	1,906,258.	3.500000	43.79554	84.04333	3.363507	47.60366	9.333333
Std. Dev.	3,821,841	2.490791	18.08025	10.17891	3.440431	1.906329	1.568789
Skewness	0.040671	0.816657	0.510599	−0.002542	−0.688538	−1.504769	−0.789038
Kurtosis	1.809246	3.019073	2.231429	2.523581	17.68276	9.466049	2.614193
Jarque-Bera	5.282564	9.894125	6.057735	0.841795	806.4879	188.6322	9.786915
Probability	0.071270	0.007104	0.048370	0.656458	0.000000	0.000000	0.007495
Sum	$7.02 \times 10^{+08}$	646.8707	6282.295	9672.317	1982.321	5120.887	1118.000
Sum Sq. Dev.	$1.29 \times 10^{+15}$	545.9557	28,766.80	9117.695	1041.618	319.7998	216.5768
Observations	89	89	89	89	89	89	89

Source: Author's Computation, 2024.

Table A1 indicates the characteristics of the variables and allows a view of the distribution and normality of the data. In analysing the Jarque-Bera *p*-value of the metrics, it is noted that the repo rate, inflation, GDP, activity rate and the SCRI all have *p*-values below 0.05 and demonstrate signs of non-normality. Given that the features of the data employed in this study show signs of non-normality, the logarithmic transformation of variables has been used as a means to reduce the noise.

Correlation matrix

Table A2 presents the correlation matrix of the selected independent variables. Highly correlated coefficients among the variables can be an indication of multicollinearity and result in a spurious regression. However, each variable will perfectly correlate with itself, therefore the correlation coefficient of 1.00 for these variables will not be considered.

Table A2. Correlation matrix.

Probability	LNREPO	LNHCPI	LNREER	LNNAGDP	LNACTI	LNSCRI
LNREPO	1.000000					
	-					
LNHCPI	−0.489452	1.000000				
	0.0000	-				
LNREER	−0.103700	−0.188286	1.000000			
	0.3335	0.0772	-			
LNNAGDP	0.289486	−0.236763	0.206092	1.000000		
	0.0059	0.0255	0.0527	-		
LNACTI	0.431605	0.115134	−0.320973	0.482739	1.000000	
	0.0000	0.2826	0.0022	0.0000	-	
LNSCRI	0.395807	−0.092772	0.363370	0.229682	−0.112555	1.000000
	0.0001	0.3872	0.0005	0.0304	0.2936	-

Source: Author's Computation, 2024.

The output in **Table A2** shows the level of correlation between selected macroeconomic factors of lending behaviour.

Unit root test

Table A3 presents the results of the ADF and the PP test at a level series whilst **Table A4** presents the same tests at a first difference series.

Table A3. Unit root test (level).

Variable	ADF			PP		
	Intercept	Trend and Intercept	None	Intercept	Trend and Intercept	None
lnLOANS	−3.256929**	−2.934496	1.916378	−3.200608**	−1.639728	5.143943
lnREPO	−2.471318	−3.154511	−0.584224	−2.224529	−2.369830	−0.777308
lnHCPI	−1.617086	−2.013323	0.189582	−1.771648	−0.408587	0.523022
lnREER	−2.558757*	−2.607728	−0.013997	−2.742272*	−2.794729	−0.013997
lnGDP	−3.375393**	−5.609354***	−0.215583	−6.880826***	−7.443314***	−0.351142
lnACTI	−5.317128***	−5.311383***	−0.064629	−5.300174***	−5.280340***	−0.194682
lnSCRI	0.664721	−1.439903	−1.104891	0.885310	−1.243546	−1.175893

Source: Author's Computation, 2024* Statistically significant at a 10% level confidence level.
** Statistically significant at a 5% confidence level.
*** Statistically significant at a 1% confidence level.

This paper employs both the ADF and PP tests to test for stationarity to ensure the results are robust. **Table A4** shows the results are mixed between stationarity and non-stationarity, as a fair amount of the variables fail to reject the null hypothesis at various levels of significance, indicating that they exhibit non-stationarity. After first differencing, all the variables become stationary.

Short-run model (ECM)

Table A4. Short-run model (ECM).

ECM Regression				
Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
D(LNLOANS(−1))	−0.192379	0.102094	−1.884342	0.0674
D(LNLOANS(−2))	0.182381	0.095086	1.918060	0.0628
D(LNLOANS(−3))	0.173722	0.102717	1.691266	0.0992
D(LNLOANS(−4))	0.514063	0.105093	4.891513	0.0000
D(LNLOANS(−5))	0.347136	0.094503	3.673297	0.0008
D(LNLOANS(−6))	0.130366	0.073668	1.769655	0.0850
D(LNREPO)	−0.016894	0.018086	−0.934089	0.3563
D(LNREPO(−1))	0.098492	0.021182	4.649783	0.0000
D(LNREPO(−2))	0.080178	0.024944	3.214308	0.0027
D(LNREPO(−3))	0.086767	0.024436	3.550754	0.0011
D(LNREPO(−4))	0.096029	0.023947	4.010115	0.0003

Table A4. (*Continued*).

ECM Regression				
Case 2: Restricted Constant and No Trend				
Variable	**Coefficient**	**Std. Error**	***t*−Statistic**	**Prob.**
D(LNHCPI)	0.006214	0.022792	0.272651	0.7866
D(LNHCPI(−1))	−0.105883	0.022637	−4.677360	0.0000
D(LNHCPI(−2))	−0.056785	0.021657	−2.622050	0.0126
D(LNREER)	−0.027461	0.027154	−1.011328	0.3184
D(LNREER(−1))	−0.001640	0.027599	−0.059424	0.9529
D(LNREER(−2))	0.096819	0.026870	3.603208	0.0009
D(LNREER(−3))	0.114917	0.029386	3.910570	0.0004
D(LNREER(−4))	0.122427	0.027731	4.414773	0.0001
D(LNREER(−5))	0.114020	0.025414	4.486438	0.0001
D(LNGDP)	−0.006431	0.006120	−1.050898	0.3001
D(LNGDP(−1))	0.000680	0.008813	0.077156	0.9389
D(LNGDP(−2))	−0.027555	0.010512	−2.621294	0.0126
D(LNGDP(−3))	−0.039130	0.010435	−3.749936	0.0006
D(LNGDP(−4))	−0.052317	0.008822	−5.930031	0.0000
D(LNGDP(−5))	−0.038236	0.008485	−4.506153	0.0001
D(LNGDP(−6))	−0.030418	0.008400	−3.621174	0.0009
D(LNGDP(−7))	−0.013837	0.006293	−2.198846	0.0342
D(LNSCRI)	0.168135	0.069171	2.430710	0.0200
D(LNSCRI(−1))	−0.019343	0.072835	−0.265568	0.7920
D(LNSCRI(−2))	0.063583	0.072228	0.880318	0.3844
D(LNSCRI(−3))	−0.044112	0.073378	−0.601165	0.5514
D(LNSCRI(−4))	−0.241427	0.069900	−3.453890	0.0014
D(LNSCRI(−5))	−0.239816	0.075515	−3.175729	0.0030
D(LNSCRI(−6))	−0.379263	0.081777	−4.637791	0.0000
D(LNSCRI(−7))	−0.408106	0.088841	−4.593677	0.0000
CointEq(−1)*	−0.043031	0.004655	−9.244031	0.0000
R-squared	0.917089	Mean dependent var		0.021837
Adjusted *R*-squared	0.849252	S.D. dependent var		0.019784
S.E. of regression	0.007681	Akaike info criterion		−6.596728
Sum squared resid	0.002596	Schwarz criterion		−5.502967
Log-likelihood	304.1675	Hannan-Quinn criter		−6.157897
Durbin-Watson stat	2.382010			

Source: Author's Computation, 2024.
* *p*-value incompatible with *t*-Bounds distribution.