
Bank of Namibia

Macro-Stress Testing NPLs in the Banking Sector in Namibia: A VAR approach

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Abstract

This paper examined the impact of macroeconomic variables, namely real GDP growth, house price growth and changes in the repo rate on the non-performing loan (NPL) ratio in Namibia using data from 2004Q1 to 2020Q1. The study used a vector auto-regressive (VAR) model and impulse response analysis to estimate the impact of changes in macroeconomic conditions on NPLs, and further conducted stress testings on NPL ratio over 4 - 6 quarter horizons. Empirical evidence from this study shows that macroeconomic variables such as real GDP growth rate, the house price growth rate and the repo rate have a statistically significant impact, and material impact on the non-performing loans in the banking sector in Namibia. Largely, a positive growth rate shock in a quarter will reduce NPL ratio by more than half percentage point over two quarters. Similarly, a positive shock of about 4.0 percent in a quarter will reduce NPL ratio by more than 1.2 percentage points over four quarter horizons. Macro-stress-testing results revealed that a deterioration of the GDP growth by more than one standard deviation will increase the NPL ratio from 2.46 to 2.78 over four quarter horizons. Meanwhile, the combined effects of deteriorating GDP growth and falling house prices further exacerbated the vulnerability of the banking sector.

Keywords: `Financial Stability, Macro-stress Testing, Non-Performing Loans, VAR`

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1. Introduction

Since the global financial crisis of 2008–09, both regulators and industry practitioners have integrated stress testing in their regulatory and managerial frameworks for financial stability. According to Bellini (2017), stress testing and 'what-if analysis are cutting-edge tools qualifying a risk management practice operating in a global economy.' For regulators, macro-stress testing tools enable supervisors to detect (ahead of time) the relevant transmission channels of extreme, but still plausible events affecting the stability of the financial system. Thus, the crucial role macro-stress testing techniques cannot be over emphasized, these techniques allow analysts and regulators to conduct and formulate a forward-looking analysis of potential risks to the banking system (Amediku, 2006).

Recent macroeconomic economic conditions in Namibia have deteriorated with large adverse effects on the economic and financial resilience of the domestic banking system. Figure 1 below show the development of selected economic indicators for the past 4 years in Namibia. These macroeconomic indicators have deteriorated with significant impacts on assets quality in the banking sector. This deterioration was largely triggered by various demand and supply shocks that battered the economy as from 2015 to 2020. These shocks include the severe rain drought that was recorded in 2015 to 2017, low commodity demand and low international prices over the same period. As result these economic shocks, Namibia's average real GDP growth slowed into recession and it remained far below growth potential level since 2015. Meanwhile, fiscal policy became unsustainable and public debts increased from 37.2 percent in 2015 to an estimate of 67.5 percent of GDP in 2020, - the later debt ratio is far above the fiscal target of 35 percent GDP. Consequentially, credit to the private sector has slowed down from 15.8 percent in 2015Q1 to 6.5 percent in 2020Q1 and non-performing loans more than quadrupled from 1.0 percent in 2012Q1 to 5.8 percent in 2020Q1, - again this ratio is far above 4.0 percent threshold for NPL ratio in Namibia [1].

Although, historically, the asset quality of the banking sector as measured by NPL has been stable, the recent upsurge in NPLs call for a thorough interrogation of the macro-financial linkages between economic growth, house prices and the banking sector's asset quality in Namibia. The pertinent question is, has the economic slowdown affected the banking

[1] The threshold level of 4.0 percent is set by the Bank of Namibia as point about which the level of NPLs should be deemed a concern to the banking sector.

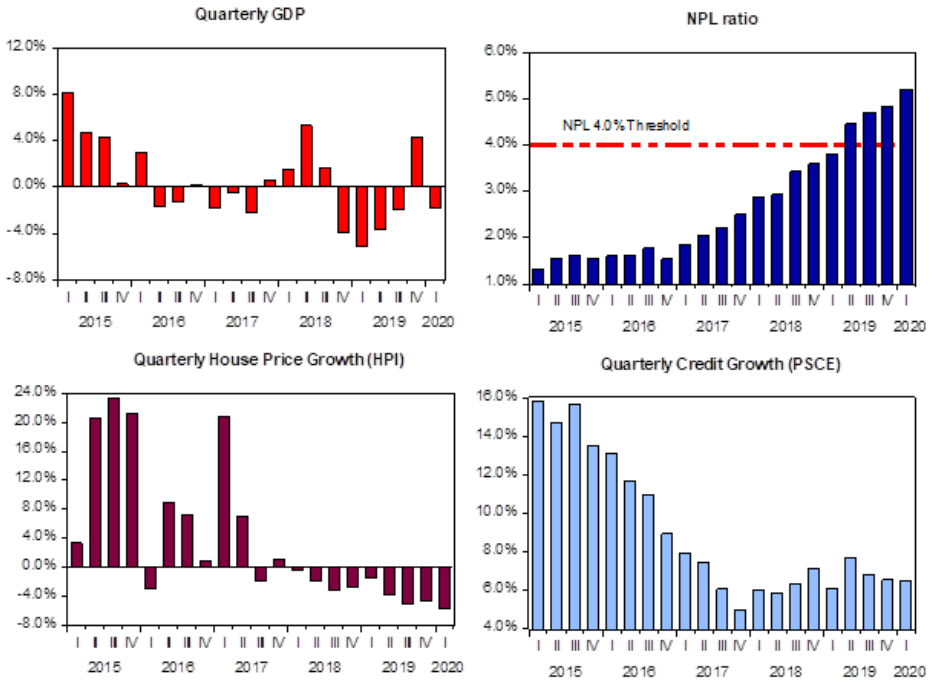


Figure 1: Macroeconomic conditions in Namibia, 2016Q1 - 2020Q1

sector's asset quality in Namibia? Looking ahead, what if the domestic macroeconomic environment is distressed further than what we have observed so far?

In the last decade, Namibia maintained real economic growth above the potential level, and in response NPL ratio slowed to lowest level over same the years; but, this ratio has drastically increased since 2017Q1. The deterioration's of macroeconomics conditions and the acceleration of NPL ratio is a cause for concern for the central Bank of Namibia and the public at large. According to BoN (2020) on the assessment of financial stability, there is high risk as in relation to asset quality in 2019 compared to the level of risk reported in December, 2018. For example, Namibia's NPL ratio has risen by 2.9 percentage points from 1.6 in the second quarter of 2016 to 4.5 percent in the second quarter of 2019. This increase in NPLs could largely be attributed to the continuous depression of real economic activities that have characterised the Namibian economy for the last four years. In addition, the onset of COVID-19 in late 2019 the real economic impact is furthermore expected to continue the erosion of asset quality in the financial sector beyond 2020.

1.1. Objectives of the Study

This study examined the impact of adverse macroeconomic shocks on NPLs in the banking sector in Namibia. Furthermore, it stress tested the NPL ratio by varying the degrees of deterioration's in macroeconomic variables such as real GDP and house price index at four to six quarter horizons. The aim of this stress test scenarios (i.e the "What-if-analyses") were to get insights into the dynamic interactions between NPL ratio and the changes in macroeconomic conditions. This study contribute rare empirical evidence on how asset quality (as measured by NPL ratio) in Namibia responds to varied degree of stresses from macroeconomic indicators such as real economic growth and house prices. Macro-stress results shows that asset quality is resilient to standard shocks or historical averages within one standard deviation size. However, results from varied scenarios showed that NPL ratio increased when macro-stressed with a high deterioration in real growth rate and low house prices of more than 2 standard deviation over 4 quarter horizons. In addition, asset quality deteriorate more when these shocks were combined over the same period.

This paper is organized as follows: Section 2 presents the literature review which summarised the importance of macro stress testing and evidence of stress testing the aggregate NPL ratio - a measure of asset quality in the banking sector. This is followed by the rational of the Vector auto regression (VAR) method used in the empirical analysis, and data sources and descriptive statistics of the elements in data set. The empirical results are reported in Section 4, and the paper concludes with a summary of the empirical findings.

2. MACRO-FINANCIAL STRESS TESTING OF NPLs: A REVIEW

Since the Global Financial Crisis of 2008-09, both regulators and industry practitioners have increased the role of macro stress testing in their regulatory and managerial frameworks for the banking sector. According to (Bellini, 2017) stress testing or 'what-if analysis' are cutting-edge tools qualifying a risk management practice operating in a global economy.' For regulators, stress testing tools enable supervisors to detect (ahead of time) the relevant transmission channels of extreme, but still plausible events affecting the stability of the financial system. For, example, stress testing is exercised in European Union where systematically important banks are expected to participate in the EU-wide stress test exercises annually. Often the ultimate aim of this exercise is to asses the resilience of the financial institutions to adverse financial and economic shocks (ESRB, 2020). According to Claudio et al. (2012) since then, the analytical results from

macro stress has revealed possible potential risks to which financial sectors in various countries are exposed and the nodes of vulnerability in those financial systems.

Macro stress tests are designed to stress the financial system as a whole and commonly, the stress test results are often threefold. Marcelo et al. (2008) pointed out that these include but not limited to: adding value to the internal controls exercised by banks concerning risk management; they serve as a basis for fostering prudential techniques of protection against adverse situations; and they facilitate identification of macro-financial risks, provide early warning and help to mete out the response tasks to deal with these adverse situations. Meanwhile Claudio et al. (2012) summed that this exercise must involve, a *scenarios* (exogenous) shocks that stressed the identified risk exposures (bank's balance sheet), a well defined *model* (VAR or DSGE) that maps those shocks onto an outcome, and finally a measured *outcome* (e.g. NPLs). Stress tests therefore seek to determine the resilience of the banking system to shocks in order to determine the health and stability of the financial system.

The key objectives of a macroeconomic based stress testing exercise are to establish the links between macroeconomic variables and the financial system under adverse conditions. Stress testing exercise entails assessing the stability of groups of financial institutions by evaluating the responses of some aggregate sector's indicators such as the financial stability index or non-performing assets to adverse shocks. Further this constitutes identifying the main risk drivers and possible sources of vulnerabilities that have the potential risks to generate financial sector instability. Generally, there are important variables for macro-stress testing exercises, and these include: real GDP, inflation, equity prices, market volatility, real estate prices and interest rates. Furthermore, important gap measures such as private sector credit gap, real effective exchange rate gap and interest rate spread gap have been used to detect ahead of time the built up of bubbles in the financial sector.

On the relationship between macroeconomic conditions and NPLs, numerous studies have advanced to explain main drives of non-performing loans overtime. According to BIS (2016) definition, loans become non-performing when a borrower no long services the debt for a determined time period, usually a delinquency status (90 days past due) or the unlikeliness of repayment. Scanning the literature there is no common variance factor on what drives NPLs, because of differential initial conditions that prelude the pass through from the real sector side of the the economy to the banking sector. The set of drivers that have been identified in various literature

seem to evolve from region to region overtime. Hence, it is imperative to revisit the questions: What are the drivers of NPLs and what are the theoretical underpinnings of NPLs within the banking sector? How do macro-financial risks impact the bank's asset quality before they become a systemic problem? Further, why is there a prevalence of NPL's during certain times compared to other times?

Deterioration of macroeconomic variables such as output gap, economic growth and inflation affects the performance of the banking sector. Literature shows that this channel is bi-directional rather than uni-directional, because consensus prevail that high NPLs have negative impacts on bank lending to the real sector economy. As argued by ECB (2017) and Mustafa et al. (2019) in most cases deterioration of banks' balance sheets, coupled with low profitability ratio constrains the capacity to lend thereby further reinforcing economic slowdown. Using quarterly data for the period 1995-2005, Amediku (2006) estimated the impact of changes in some macroeconomic variables on the NPL ratio of the Ghanaian banking system through a VAR model. The study found that the banks' NPL ratio increased following an adverse shock to output as well as an increase in inflation. This result was supported by the impulse response functions indicating that the NPL ratio increased after eight quarters following an unexpected increase in the output gap, whereas it increased after nine quarters as a result of an unexpected increase in inflation (Amediku, 2006). In addition, Amediku (2006) found that an unexpected increase in the prime lending rate led to a significant increase in the NPL ratio, at maximum six quarters post the prime lending rate shock.

Dovern & Vilsmeier (2008) indicated that monetary policy shocks strongly increase distress in the banking sector in Germany. The study used data which stretched over 36 years, including four complete business cycles, with the main indicator being the write-off ratio. The study employed a structural VAR on macroeconomic variables such as real GDP, inflation and the 3-months interest rate. The study identified and assumed the following: a negative monetary policy shock, a negative demand shock and a negative supply shock. Dovern & Vilsmeier (2008) found that a tightening monetary policy shock significantly worsens the soundness of the banking sector which is reflected in a strong increase in write-offs and a considerable decrease in return on equity. On the contrary, both the demand and supply shocks caused limited and less severe declines in return on equity and did not cause remarkable changes in the level of write-offs. The results therefore suggest that monetary policy decisions are of utmost importance for financial stability in the banking sector.

Banerjee & Murali (2015) analysed the soundness of banks in India through the identi-

fication of factors that adversely influence banks' non-performing assets (NPA). In this study, the authors examined the response of banks NPA to unexpected shocks from external and domestic macroeconomic factors namely, interest rate, GDP output gap, inflation rate, deposits Cash Reserve Ratio (CRR) exchange rate and net foreign institutional investors (FII) inflow. Banerjee & Murali (2015) found that interest rate significantly impairs asset quality for all banks in a two-way causality. In the case of public banks, the NPA was found to be Granger caused mainly by the exchange rate, net FII flow and deposits. For old private and foreign banks NPA was Granger caused by the GDP gap (Banerjee & Murali, 2015).

Morakinyo et al. (2018) investigated the role of non-performing loans in the Nigerian banking system and the macroeconomy. The study used a structural auto-regressive model with quarterly data over the period 1998 to 2014. Morakinyo et al. (2018) found that there is a long-run impact on NPLs from the macroeconomic shocks in Nigeria. Furthermore, the study showed that exchange rate did not have significant impact on NPL ratio, however NPLs rose significantly in response to a shock from GDP growth rate, bank liquidity ratio, return on assets, lending rate and the bank total credit to the private sector. From the variance decomposition results, Morakinyo's results show that the NPL ratio explained about 5 percent variations in the bank liquidity ratio, 5 percent in the return on assets and exchange rate.

Jiang et al. (2019) found a significant relationship between macroeconomic variables and NPLs in China. The study adopted a VAR approach to stress test the NPL ratio using key macroeconomic factors over the period 2000Q1 to 2013Q3. Jiang's study analysed macroeconomic factors such as real GDP growth, the unemployment rate, fixed investment, real estate price indexes, the money supply, interest rates, the exchange rate and the retail price index (RPI). Multivariate scenarios were mapped against potential risks in order to assess the overall loan portfolio and mortgage exposures of the banks in China. For scenarios design, these authors applied different types of macroeconomic shocks to replicate historical shocks that occurred in past financial crises. The analysis indicates that there is a significant negative relationship between the NPL ratio, and GDP growth, the unemployment rate, interest rate and the exchange rate.

A study by Sheefeni (2015) found that the macroeconomic environment in Namibia is critical for the performance of its non-performing loans. The study analysed the impact of macroeconomic determinants on NPLs in Namibia using quarterly data over the period 2001: Q1 to 2014:Q2 with main variables such as NPLs, GDP, interest rate and the inflation rate. The results

from impulse response functions revealed that in the long run NPL is significantly influenced by real GDP, inflation and interest rate; however, in the short run, this is only true for the log of GDP and exchange rate. Sheefeni (2015) posits that the macroeconomic environment is therefore critical for the performance of NPLs and should continue to be monitored given that it has a bearing on the performance of many economic sectors as well as the banking sector.

In summary, this literature review revealed that there is a bi-directional relationship between changes in macroeconomic conditions and non-performing loan. There is a significant link between changes in macroeconomic conditions and the financial system stability. When real growth in the domestic economy contract these changes increase financial system vulnerability. Further, the effects of economic slowdown are manifested in the decrease of credit supply, contraction of monetary conditions and a prolonged economic recession. In addition, the loop-back effects shows up in low profitability and inadequacy capital ratios, further constrained lending and the heightened level of financial instability. And thus, it is essential to carry out macro-stress testing exercises so as to identify the main areas at risk from the worsening macroeconomic environment in the domestic economy. Stress testing exercises dates back many years, and stress testing methods have evolved from value-at-risk approach to regression based techniques such as vector auto-regressive models[2].

3. METHODOLOGY: VAR MODEL SET-UP, DATA AND ESTIMATION

This study used the Vector Auto-regression (VAR) model to estimate the dynamic system for deriving the macroeconomics impacts on NPLs. Furthermore, we applied varied degrees of stress on NPL ratio within the VAR system to examine how NPL ratio responds to deterioration in real GDP and house price growth shocks. Procedurally, a VAR representation aims to capture interrelations and produce significant joint dynamics among a set of variables of interest in the analysis. Thus, the VAR model is appropriate technique to examine dynamic relationships were the estimated effects runs both ways among variables of interest. One important condition to estimate the VAR model is that such a model should be representative; - that is, the VAR must adequately describes the data generating processes of the endogenous variables involved in the system. Working with an adequate system is essential in VAR analysis, because a representative

[2]There are studies that provide a chronological genesis and introduction of stress testing in the field of financial stability. These studies discussed stress-testing nature and its purpose (e.g., Blaschke and others, 2001; Jones, Hilbers, and Slack, 2004; and Čihák, 2007).

system will produce good conditional and unconditional forecasts. This property is particularly very important when the estimated VAR system is used in the stress testing exercise. In terms of deploying this modelling technique in the macro-stress testing analyses, a VAR model is an appropriate method, because it allows for clear exogenous interventions such as the 'What if analysis' illustrated in (Bellini, 2017). A VAR(p) with p-th lag length is a representation for a set of variables $y_{1t}, \ldots, y_{mt}$ grouped in the m×1 *vector* : $y_t = (y_{1t}, \ldots, y_{mt})^{'}$ is stated as follows:

$$y_t = \mu + \psi_1 y_{t-1} + + \psi_p y_{t-p} + \epsilon_t \tag{1}$$

whereby μ is $m \times 1$ vector of intercept, ϵ_t is $m \times 1$ column vector of error terms grouped into $\epsilon_t = (\epsilon_{1t}, \ldots, \epsilon_{mt})^{'}$. Generally, ϵ_t is assumed to be a white noise process, where $\sum$ stands for variance-co-variance matrix. Therefore, with mild conditions of ϵ_t, y_t is stationary VAR(p) can be written in moving average (MA) form as follows:

$$y_t = \psi^{-1}(L)\epsilon_t = \theta(L)\epsilon_t, \epsilon_t \; WN(0, \sum). \tag{2}$$

Since, $\sum$ is a positive definite, there exist a non-singular matrix P such that $P \sum P^{'} = I$. Using, this identity we can therefore write equation (Eq.2) as:

$$y_t = \theta(L)P^{-1}P\epsilon_t = \psi(L)\upsilon_t \tag{3}$$

note:

$$\upsilon_t = P\upsilon_t \tag{4}$$

$$E(\upsilon_t) = 0, E(\upsilon_t \upsilon_t^{'}) = P \sum P^{'} = I. \tag{5}$$

The orthogonal errors in matrix υ_t represent the economic shocks in the VAR model and largely depend on matrix P which is not unique . Typically, P matrix is chosen as some triangular matrix, which in this study took a lower triangular form. The impulse response of variable k to the shock j which shows how the variables within the system under analysis react to economic shocks is given by impulse response function (IRF)

$$\frac{\partial y_{k,t+i}}{\partial \upsilon_{j,t+1}}. \tag{6}$$

Specifications: the VAR model main specification includes variables such as real GDP growth rate, house price growth rate, non-performing loans ratio, and repo rate measured at quarterly frequency.

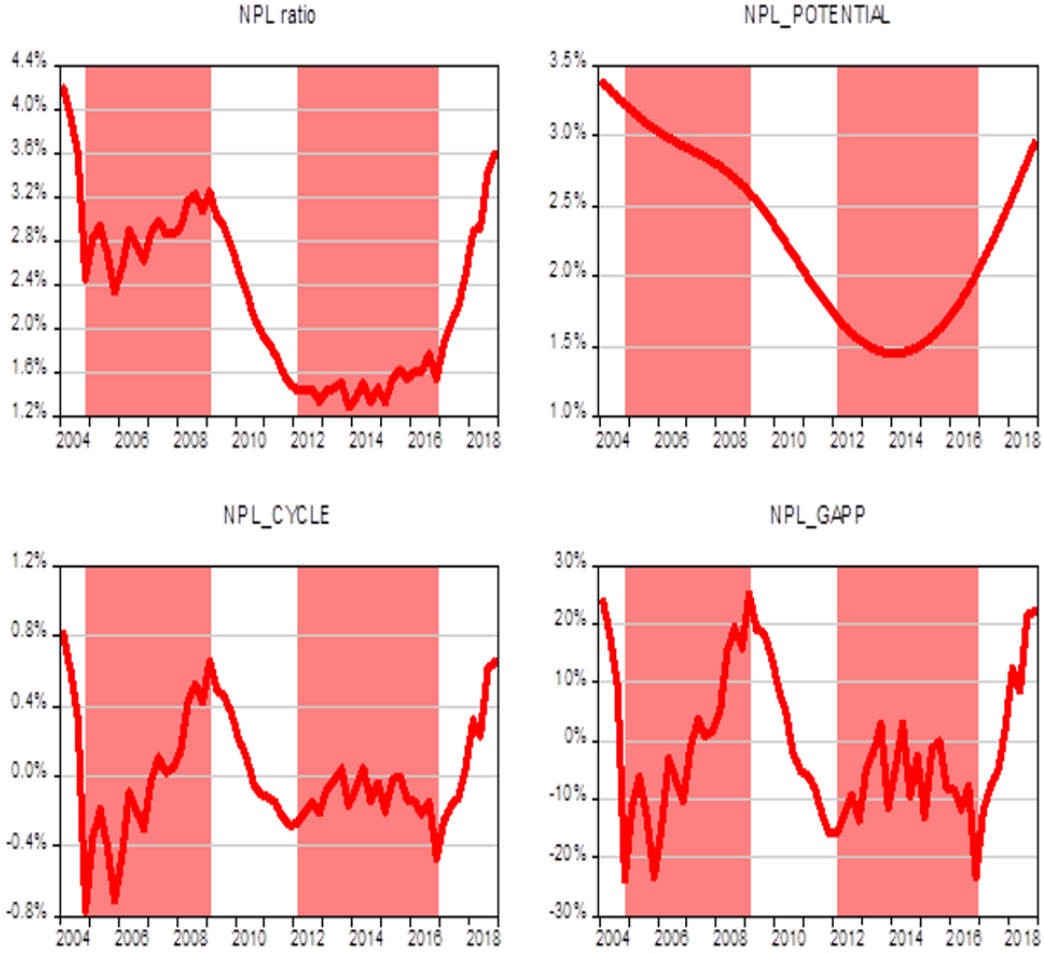
The real GDP growth rate represent the aggregate demand environment, and this influence the banking sector with a lag thus ordered first in the VAR model. Next, house price growth rate is an indicator which captures the housing sector dynamics, and it responds to macroeconomic changes from real growth rate but affects the banking sector with a lag. House price growth rate variable was ordered before NPL in the VAR model. Meanwhile, repo rate and Non-performing loans are high frequency variables hence, no preference on which variable enter before the other in the system. The deterministic component includes constant and seasonal dummy variables for Q1, Q2, and Q3. Furthermore, two structural dummy variables were included to capture significant structural breaks at 2009Q2 and 2016Q1 periods; and these exogenous variables stabilised the estimated dynamic system as observed from the residuals plots.

For the purpose of stress testing, the variables of interest in this exercise were real GDP and house price growth rates. After estimating the impulse response functions, the study used the same model to stress test the NPL ratio by varying the conditions of real GDP and house price growth rates over the four to six quarter horizons. This model was used to examined how the banking sector asset quality (NPL) variable responds to different stresses applied through changing conditions of real GDP and house prices individually, and combined at some predetermined sequence. The NPL ratio was put under stress beyond 2-3 standard deviations or alternatively, the highest historical shock observed over the sample period, as a negative growth rate for real GDP and house prices over the forecast horizon. These scenarios are reasonable and plausible given the sample size as well as the historical developments of real GDP, house price growth rate since 2004Q1 and the sluggish responses of NPL ratio over the sample period.

3.1. Data and Descriptive Analysis

The main data set consist of the following variables: Quarterly GDP (QGDP), Quarterly House Price Index (HPI), non-performing loans (NPL) ratio, repo rate, output gap, NPL gap, NPL cycle and NPL trend. Theoretically, increases in QGDP, HPI, and positive output gap are expected to reduce the NPL ratio. Meanwhile, the negative output gap and rising repo rate are expected to increase the NPL ratio other things being equal. The estimation sample starts from 2004Q1 to 2017Q4, meanwhile the prediction sample was from 2018Q1 to 2019Q4. All non-observable and observable variables (output gap and NPL gap) and real GDP growth rate and house price growth rate gravitate around the mean zero over time which seem to suggest that these variables are stable over the sample period. Figure 2 below show the time series of NPL ratio, and

Figure 2: Actual NPL ratio, NPL-Potential (HP filtered trend), NPL-GAPP and NPL cycle from HP filter



NPL cycle, NPL gap and NPL trend -these are non-observable variables derived from NPL ratio. As can be seen in Figure 1, NPL ratio seem to have gone through different regimes since 2004Q1 to 2018Q4.

3.2. Results: VAR (4) Impulse Responses Analysis

In most multivariate time series analysis the dynamic interaction among key variables as estimated by impulse response functions is the major results of interest. Hence, in this section we discussed the (IFRs) with the special focus to the objective of this paper. Figure 3 below show the dynamic responses represented by a solid line within one standard deviation bands over the forecast horizon.

Figure 3 shows the main results of the impulse responses of the NPL ratio to an economic growth shock, house price shock and interest rate shock. The IRFs from the VAR (4), has NPL response to QGDP shock, NPL impulse response to a repo rate shock, second row impulse response for NPL to a house price shock, then house price growth rate impulse response to a QGDP shock, house price growth impulse response to a repo rate shock and finally, house price response to its own shock.

A positive demand and house price shocks both reduce NPL ratio. As expected, better macroeconomic conditions and robust housing demand are inversely related to the NPL ratio in Namibia. Thus, a one standard deviation of increase in real economic growth and house prices in Namibia will reduce the non-performing loans by 0.6 percentage points and would raise house prices by 4.0 percentage points over a 4 quarter horizon. The latter reduces non-performing loans by more than 1.2 percentage points over the four quarter horizon. This implies that positive macroeconomic conditions have significant effects to the banking sector. These results are similar to other empirical studies such as (Hoggarth et al., 2005) who found that an increase in real economic growth over consumers income levels, improves the financial capacity of borrowers with a significant spin-off effect on the banking sector. However, recessions lead to unemployment and financial difficulties for borrowers and ultimately impact on the banking sector.

4. Macro-Stress testing Scenarios

Before turning to the macro-stress testing results, it is important to note that the macro-stress simulations are illustrative of the "what if analysis" such as: a deterioration in real GDP and housing price index. How could such deviations affect asset quality in the banking sector, but of course these results are subject to limitations because we cannot completely reproduce reality. Stress testings based on VAR models nevertheless provide important insights into complex transmission of shocks and the dynamic behavior of macro-financial variables in response to changes in macroeconomic conditions. For example, when macroeconomic environment changes, there are not distinct periods about when each of these deterioration's start and ends as assumed in the combined scenario. Therefore, these results represent the most likely path that will prevail when the Namibian banking sector is put under stress from real economic activity and the housing sector. Turning to the scenario designs followed in this study, the quarterly real GDP growth rate has varied between -6.7 percent and 15.2 percent, with an average of 3.8 percent over the sample period. Meanwhile, the quarterly growth rate of house prices varied widely between -8.8 percent and

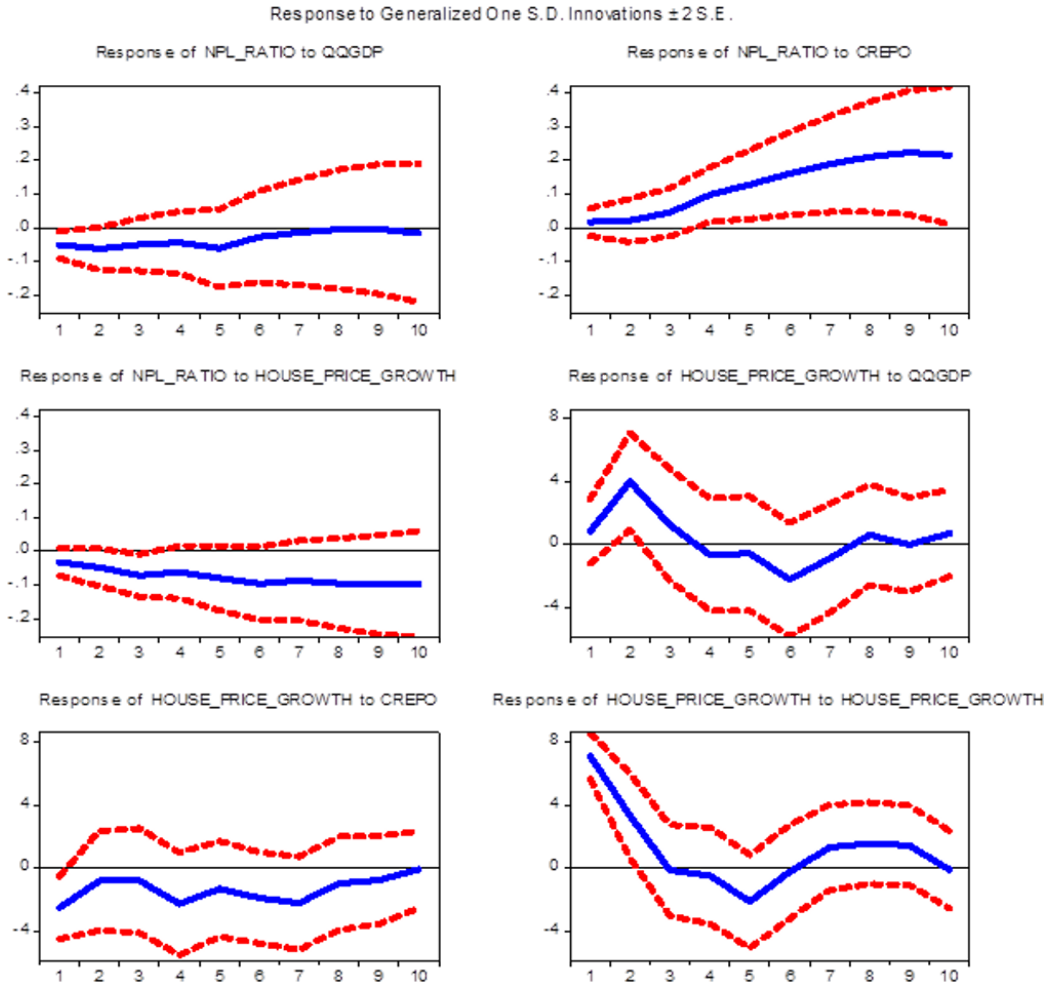


Figure 3: Impulse Response from VAR (4) model with ordering (real QGDP, HPL, NPL, Changes in the repo rate (Repo)

33.5 percent, thereby averaging 11.8 percent over the sample period. Hence, the first and second scenario were set with a contraction of 1 to 3 standard deviations in the quarterly real GDP and house price index over 4 quarters horizon i.e. a year.

Variable	Obs	Mean	Std. Dev.	Min	Max
RGDP	56	3.77	5.07	-6.72	15.21
NPL	56	2.21	0.69	1.28	3.59
HPGrowth	56	11.81	10.01	-8.82	33.58
Repo	56	7.10	1.44	5.5	10.5

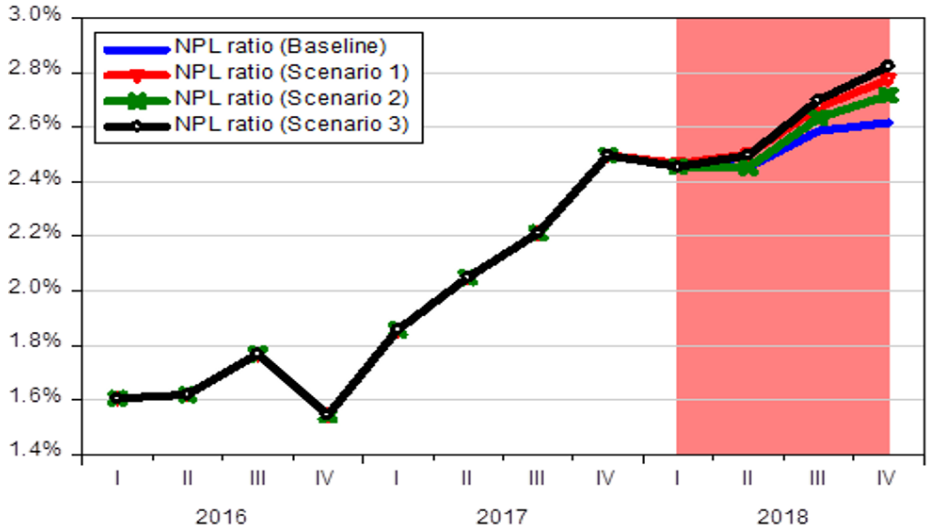
Table 1: Descriptive Statistics of macroeconomic variables, sample 2004Q1 – 2018Q4

Scenario 1: ***Deterioration of real GDP growth rate by one standard deviation = 5.1 percentage points over the 4 quarters.*** Past historical descriptions of the macroeconomic environment concerning real GDP was used to show the following: that quarterly growth over the sample averaged 3.5 percent, with a minimum of -6.7 percent decline in a quarter, and a maximum growth of 15.0 percent in a quarter, with a standard deviation of about 5.1 percent.[3] The study therefore, assumes a plausible one standard deviation shock every quarter over the forecast horizon. A deterioration of one standard deviation will lead to the NPL ratio rising from 2.47 percent ratio to 2.78 percent over the four quarter's horizon (Table 2). Figure 3 shows that a deterioration in macroeconomic conditions increases the NPL ratio, as illustrated by the impulse response function as a result of a shock in real GDP. This means that real growth first impacts the housing sector which in turn leads to a decline in house prices and feedback effects from the housing sector to the banking sector.

Scenario 2: ***Deterioration of house price growth rate by one standard deviation = 10.0 percentage points over the 4 quarters.*** Over the sample period, house prices growth has been volatile, with the minimum and maximum rate ranging between -8.8 percent and 33.6 percentage points. The maximum growth rate in house prices of 33.6 percent occurred during the second quarter of 2011 underpinned by robust GDP growth, while the lowest rate was recorded in second quarter of 2018 owing to depressed economic activities. In this scenario, house price growth deteriorated

[3]This represent a cumulative effect of approximately 20 percentage points deviation below the average growth level over the sample period.

Figure 4: Macro Stress Testing Scenarios baseline, scenario 1, Scenario 2, and scenario 3 results



by 10.1 percent over the four-quarter horizon. This is about one standard deviation in a quarter and cumulatively 3 quarters over the forecast horizon. In response to the stressing conditions from the housing sector, the real growth in GDP will fall and the NPL ratio will rise significantly from 2.47 percent to 2.72 over the four-quarter horizon. These results show that a decline in house prices create macro-financial risks that will negatively affect the banking sector significantly.

Scenario 3: ***Combining the deterioration of real GDP growth, followed by a decline in the house price growth rate by one standard deviation over the 4 quarters.*** In scenario 3, the simultaneous deterioration of the real GDP growth and the house price growth rate of one standard deviation over the four-quarter horizon, would increase the NPL ratio from 2.46 percent to 2.82 percent. This macro stress testing scenario is essential given that a macro-financial feedback loop could intensify the effect of shocks between macroeconomic conditions and developments in the banking sector. According to the International-Monetary-Fund (2019) due to macro-financial linkages lower credit to the private sector could potentially lead to lower real GDP growth and further contractions in real house price growth and faster increases in NPLs; and thus, ultimately overall deterioration in asset quality in the banking sector. Therefore, we believe that house price growth deceleration, coupled with a contracting economy as observed in the recent past provides a strong explanation as to why the NPL ratio has picked up. Furthermore, this drastic increase in NPL ratio is a manifestation of the response to sustained macroeconomic shocks in the domestic economy (Basarir, 2016). In summary, the macro stress results showed a sizeable effect on the NPL

ratio, therefore, there is a need to monitor and continuously assess macro-financial risks through macro-prudential analyses.

5. CONCLUSION

Empirical evidence concerning the effects of changes in macroeconomic conditions on the banking sector in Namibia are very rare. Although, historically, the asset quality of the banking sector as measured by the NPL has been stable, the recent drastic increase in NPLs called for a thorough interrogation of the macro-financial linkages between economic growth and the banking sector's asset quality.

The empirical evidence from this study showed that macroeconomic variables such as real GDP growth, house price growth rate and the benchmark interest rates have a significant impact on banking sector non-performing loans. This study revealed that a random positive shock to the real growth in GDP tend to decrease the NPL ratio by 0.6 percentage points and increasing house prices by 4.0 percentage points. On the contrary, the macro stress testing results revealed that a deterioration of the GDP growth by more than one standard deviation tend to increase the NPL ratio from 2.46 to 2.78. Meanwhile, the combined effects of deteriorating GDP growth and falling house prices further exacerbated the vulnerability of the banking sector. The stress testing results are consistent with the findings of other studies, which found that changes in macroeconomic conditions strongly influence developments in the banking sector. Although there are few historical lessons and events to guide stress testing in Namibia, the macro stress test scenarios applied in this study are deemed adequate to determine the effect on the banking sector as a result of changes in macroeconomic conditions. Presently, macro-prudential policy in Namibia through the LTV regulation seems to be adequate in moderating house prices. Going forward, macro-prudential regulation need to be enhanced through well designed effective macro-prudential tool kit for Namibia's financial sector. Further, macroeconomic stabilization should maintain real growth close potential level, this will limit persistent negative output gap on financial stability. Meanwhile, the impact from persistent positive output gap, must also receive continuous monitoring and where necessary appropriate macro-prudential tools need to be employed to tame its impact on real estate prices.

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