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**EFFECTS OF MACROECONOMIC SHOCKS ON BANKING SECTOR
LOAN QUALITY IN KENYA**

Shammah Wema Oduor

095405

**Submitted in partial fulfilment of the requirements for the Degree of
Bachelor of Business Science in Finance and Applied Economics at
Strathmore University**

Strathmore Institute of Mathematical Sciences

Strathmore University

Nairobi, Kenya

November ,2019

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Shammah Wema [Name of Candidate]

Shammah [Signature]

29th Nov 2019 [Date]

This Research Project has been submitted for examination with my approval as the Supervisor.

Rodgers Ochengi [Name of Supervisor]

Rodgers [Signature]

29/11/2019 [Date]

Strathmore Institute of Mathematical Sciences

Strathmore University

ACKNOWLEDGEMENT

First, I thank God so much for his sufficient grace that has seen me through the tough and good times up to the end of this project. I thank my dad and the rest of my family for the encouragement. I thank Mr. John Kitui and his family so much for their inspiration. I thank Mr. Rodgers Ochenge very much for stirring up in me this interest in Macro-economics when I was just beginning my studies and holding my hands through this journey to the very last minute. A thank you note also to Gillian and Professor Robert Mudida. Finally, to my classmates and friends who have helped me through this journey.

May God Bless you all.

Abstract

This a paper uses two approaches to analyse the link between loan quality and macroeconomic performance. First evaluating the interaction between different macroeconomic factors using panel regressions second applying a panel vector autoregressive model in modelling the same macro-financial interactions. Using panel data from banks 31 banks spanning between 2001 to 2018, results show that money supply is the main macro-economic factor that influences loan quality in Kenya. Impulse response functions are used to how that macro-economic shocks take time reduce or increase loan quality in Kenya.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the study

In this information age that we live in, banks increase in relevance every hour since they keep most of our wealth and the risk of them failing concerns everyone. Banks facilitate storage of wealth, making and receiving of payments, borrowing and lending of wealth and others (Ongore & Kusa, 2013). Banking industry today has become one the most complex sectors since it has been split into many sub-sectors ranging from insurance to portfolio management. All sectors in whichever economy is dependent on banks and hence would be impacted by shocks to the banking sector (CBK, 2017).

The most important role of the bank is its intermediation role which involves generating loans from deposits and issuing them to those with a deficit (Moore, 1989). It is from this role that banks earn most of their profits. The interest earned from these loans have become so useful to banks provoking them to become more innovative. Banks have made loans very lucrative and suitable for individuals, corporates, governments and other organizations. They have packaged these loans into affordable deals for parties of whichever calibre.

Increasing innovations in the banking industry have led to well-structured regulatory bodies who ensure no parties are exploited. Regulators have become more elaborate even as the banking sector grows more and more complex. These organisations have come up with various rules that banks have to abide by (Barth, Caprio, & Levine, 2008). Most of these rules were made having learnt from an occurrence that costed the economy. One of the most important regulation was the requirement of lenders to report on the loans that are not performing well through a metric known as the non-performing loans ratio. Non-performing loans represents the proportion of loans that have not been serviced for a period of 90 days. Non-performing loans is defined the proportion of bad loans in the total loan portfolio of a financial institution (Caprio & Daniela, 2002).

NPL ratios observed in certain banks in Kenya such as of KCB Bank Kenya Ltd in 2017 has raised the alarm in the Kenyan financial sector. In 2017 non-performing loans increased by 23.4% which is about sixty billion Kenya shillings compared to the value in 2016 (CBK, 2017). The root cause of poor loan quality is inefficient insider lending.

The increased amount of bad loans has attracted the attention of the Central Bank and other regulatory bodies. In 2016 the central bank had to come in and put a cap on interest rates so that borrowers could afford credit. This has had many consequences to the economy of Kenya. Although the banking sector has been growing and pioneering in Africa, amongst its main constraints is non-performing loans (Brownbridge, 2010).

The main consequence has been the collapse and stagnation of banks that have costed the economy a fortune according to Gathaiya (2017). In 2015 Dubai Bank worth 2.92 Billion was placed under receivership and eventually liquidated. Imperial bank which 53 Billion worth of deposits was put under receivership in 2016. Also, in 2016, Chase Bank was put under receivership. This was after an asset valuation of 142 Billion in 2015. All these three cases were directly or indirectly as a result of bad loans, specifically insider lending (Gathaiya, 2017).

Regulation of the banks in Kenya has therefore become a contentious issue for the Kenyan government. In 2016, the central bank of Kenya had to intervene and put a cap on interest rates charged by banks. This was aimed at making credit more affordable. (CBK, 2018).

1.2 Stylized facts

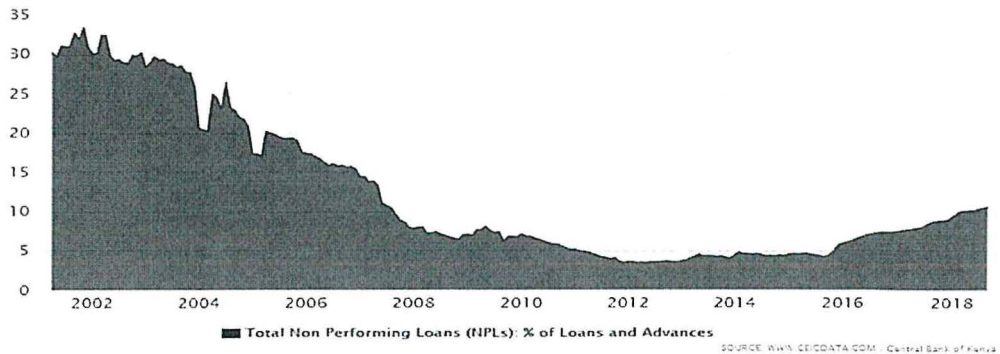


Figure 1 NPL. Source; Central Bank of Kenya

The NPL sample has mixed dynamics since it includes periods of very low loan quality and periods of high loan quality. The lowest quality was in November 2001 where the NPL ratio was at 33.4% while the highest was in May 2012 where the NPL ratio was just 3.5%.

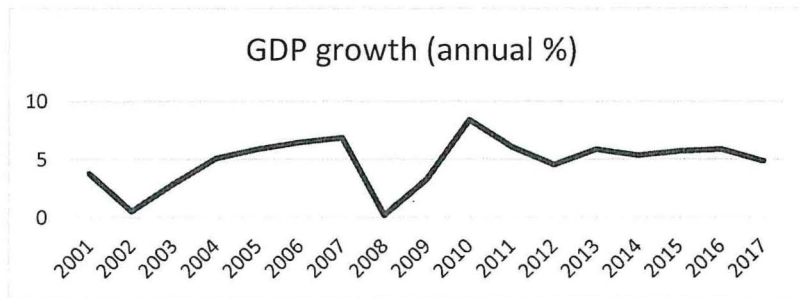


Figure 2 GDP Growth; Source World Bank

According to the graph above, GDP growth has had an upward trend except from the drastic drop in 2008 that was mainly caused by the post-election violence at the time. A summary of the other variables included in the study can be found in Appendix 1.

1.3 Problem statement

According to theory, an economy that is performing well should portray an increasing trend in loan quality (Beck, Jakubik, & Piloiu, 2013). The key argument being that households, corporates and other institutions are well off and can afford to service their financial obligations in a better performing economy. Therefore, an increase in GDP and employment rate corresponds to an increase in loan quality. Also, an increased budget deficit, inflation and weak exchange rates correspond to poor loan quality denoted by increasing NPL ratios (Tracey, 2006).

Data from Kenya is generally consistent with this theory. Most economic variables indicate that overtime the Kenyan economy has been getting better. Data of Kenyan NPL from 2001 to 2013 indicate a decrease of approximately 80% in NPL (WorldBank, DataBank, 2008). After 2014 however loan quality has been gradually decreasing. This trend in non-performing loans does not clearly trace the GDP and other metrics that indicate economic performance.

Most literature on Kenyan credit risks focuses on finding the determinants of credit risk. This research is however aimed at establishing the nature of shocks of macro-economic factors on loan quality. To arrive at these results of interest, a Panel VAR framework is adopted to capture these interactions and explain the NPL values witnessed in Kenya. This research will be useful to lenders to Kenyan borrowers, in modelling their loan portfolio quality.

1.4 Objective

The objective of this study is to investigate the interactions between the macro economy and the loan quality. More specifically the study intends to examine the effects of macroeconomic shocks on non-performing loans of commercial banks in Kenya. Finding out the extent to which macroeconomic shocks affect the bad loans taking note of the feedback effects and how they persist in the long run, if they do.

CHAPTER TWO

LITERATURE REVIEW

2.1 Theoretical literature

Theoretical business cycles models have become a useful tool in modelling macroeconomic seasonality. Especially regarding credit. Williamson (1985) uses a general equilibrium model and business cycles to explain how bad loans have the potential to trigger business cycles and that they also depict a cyclical nature (Williamson, 1985). He uses a two-period model with a countable infinite number of agents in play. There are two types of agents who are described comprehensively in the paper. The main distinctive characteristic is that type one agents consume in the second period only through acquiring fiat money or lending to type two agents. Type 2 agents only consume in the second period and have access to investment opportunities whose monitoring costs are zero. This key difference enables Williamson (1985) to model intermediation and bring out the cyclical nature of bad loans and its interaction with the economy. This analogy has been approved of in many following papers e.g. Allen and Gale (2004).

By testing the relationship between financial stability and credit risk, Allen and Gale (2004) show that widespread default may be the most influential cause of a crisis. Their model includes time 0, 1 and 2. At time 0 all agents are issued one unit of investment and zero in the subsequent periods. To increase wealth an agent must invest bringing about intermediation. Allen and Gale (2004) build a model that splits intermediation into complete and incomplete contracts. His main example of incomplete contracts, also referred to as contingent contracts is bank deposits since they are vulnerable to bank runs. Their model proves that whenever there exist incomplete contracts in a market, the possibility of default should be allowed for in a model. This in turn increases the chances of a financial crisis (Allen & Gale, 2004).

Diamond (1984) appreciates the essence of maintaining a good loan quality by developing a financial intermediation model that minimizes the costs of obtaining information of the borrowing and lending process. His main proposition of reducing monitoring cost is diversification. Diamond (1984) uses his model to extensively

explore two kinds of diversification. These methods are first, diversification by subdivision and second diversification by adding risks. By reducing this cost, firms have the incentive to ensure that all the loans issued are given to borrowers who are credit worthy thus maintaining a healthy loan quality portfolio (Diamond, 1984).

2.2 Empirical literature

Empirical results of most researchers have been consistent with expected theory. We will look at these results in three segments. The first chain of literature aims at explaining difference in NPL across banks and countries using macroeconomic indicators and briefly on the idiosyncratic factors that influence NPL. In their analysis of micro and macro factors that affect banks loans, Ahlem and Faith (2013) use a sample of 85 banks in three countries; Spain, Greece and Italy. Their panel data spans from 2004-2008. Since their research was interested in both macro and micro factors, they include both macroeconomic variables such as unemployment and microeconomic variables such as return on assets.

They find that problem loans vary negatively with the growth rate of GDP. Unemployment rate was however found to be significantly positively related to non-performing loans. According to their analysis, an increase in interest rates would significantly increase bad loans for banks especially for floating rate loans. They explain this relationship further by mentioning how a borrower's ability to finance obligations decrease as interest rate increase (Ahlem & Faith, 2013). The choice of countries was justified since these are economies that have experienced volatile macroeconomic conditions. However, a study of the reactions of loan quality to macroeconomic shocks would have been a more captivating research given the economies studied. These results are consistent with Dimitrios, Helen and Tsionas (2016).

Dimitrios, Helen and Tsionas (2016) use country and bank specific variables that influence NPL. They study fifteen countries in the Eurozone over a period between 1990 and 2015. Applying the generalized method of moments (GMM), they first study macroeconomic variables. Secondly, they study the bank specific factors. Finally, they include both macroeconomic and bank specific factors in modelling bad loans. They employed the GMM framework and focused on the Eurozone. The effects of GDP

growth, inflation, unemployment and budget deficits were all consistent with previous studies. Income tax was estimated to exert a strong (at 1%) positive influence on bad loans (Dimitrios, Helen, & Tsionas, 2016).

The second chain of literature puts emphasis on the predicting power of bad loans on crisis. Bock and Demyanets (2012) carry out a study of the bank asset quality in twenty five emerging markets. They use data that spans between 1996 and 2010. They first use dynamic panel regressions to determine the factors relevant to modelling loan quality. Having established these factors, they use a structural panel VAR to estimate the feedback effects from the financial sector (Bock & Demyanets, 2012). They find out that NPL is inversely related to macro factors associated with economic growth. A unique aspect of their findings was the sharp decline in loan quality given an injection of foreign direct investment (FDI) specifically bank related inflows and foreign portfolio flows. These two inflows were also found to dominate most FDIs in emerging markets.

In contrast, Nkusu (2011) uses data from 26 developed economies spanning from 1998 to 2009 to study nonperforming loans and macro financial vulnerabilities in advanced economies. He uses a panel VAR and also carries out elaborate impulse response tests to find out that an abrupt increase in NPL provokes persisting tail-wind that etiolates macroeconomic performance from various sides (Nkusu, 2011). Among the factors found to have the strongest correlation to bad loans are GDP growth and unemployment. This is consistent with Louzis, Vouldis & Metaxas' (2010) findings in which employment was the leading explanatory variable to consumer NPL.

The third chain of literature investigates predicting aggregate NPL that is at nationwide level. Louzis, Vouldis and Metaxas (2010) investigate the determinants on non-performing loans in one of the most volatile macro-environments in Europe; Greece. According to their dynamic panel data methods, they found out that GDP has a strong negative correlation with NPL especially for business loans. Mortgage loans and consumer loans also had a negative relationship with NPL, but mortgage loans were least affected by GDP and other macro variables. This was explained as a result of a greater incentive to avoid default of a mortgage loan. Unemployment effect on NPLs was also found significant but only with one lag. They explained that this could be because of institutions cut labour costs before credit problems are succumbed to. Also,

just as anticipated, unemployment was found to be the leading explanatory variable to consumer NPL (Louzis, Vouldis, & Metaxas, 2010).

Using reserves as a proxy for loan quality, Love and Ariss (2013) carry out a panel analysis of economic shocks and loan portfolio quality in Egypt. Love and Ariss (2013) use data from forty-one banks for a period extending between 1993-2010. Analyses of variance decomposition further suggested that macroeconomic variables have a large explanatory power for reserves compared to other bank-level variables such as loan growth and profitability (Love & Ariss, 2013).

They find out that GDP growth triggers a negative response in reserves. Also, a lending rate increase, results in higher reserves (lower portfolio quality) over time. There impulse response approximations suggested that between capital inflows, GDP growth rate and the lending rate, the shock from the lending rate had the largest magnitude while the rest had fairly the same magnitude.

Makri, Tsagkanos, and Bellas (2014) using data from fourteen countries between the period 2000 and 2008, find out that there exists a positive correlation between public debt and non-performing loans in the eurozone. They also discover that GDP has a decisive negative influence on the NPL index in the Eurozone. To their surprise, budget deficit and inflation did not have any significant influence on bad loans.

Moving to the Asian banking market, Ekanayake and Azeez (2015), use a panel data regression model to investigate the determinants of non-performing loans. They use data from nine domestic banks between 1999 and 2012. According to their study, GDP had the largest impact on Non-performing loans. Inflation followed but with a negative impact on bad loans. This was attributed to banks becoming more selective of high-quality borrowers during high inflation period. Another interesting finding was that unemployment did not have a significant effect on NPL ratio.

In Kenya, some studies have been carried out to understand how NPL interacts with macro-economic variables. Muriithi (2011) uses data spanning from 2008 to 2012 from 43 banks to investigate the causes of non-performing loans in Kenya. Muriithi (2011) found out that NPL is strongly correlated with inflation rate. Muriithi (2011) also found a negative relationship between non-performing loans and real interest rate. An interesting finding was that non-performing loans were found to be negatively

related to growth rate in loans. In this study a simple OLS regression was used despite the few observations included in the data set (Muriithi, 2013).

Dynamic Panel models are the most commonly used models in micro financial analysis since most of the variables of interest have serial correlation. The idea of using instrumental variables in the analysis to capture the partial adjustment mechanism of most of these variables was first introduced by (Anderson & Hsiao, 1981). They were later modified into two of the most commonly used dynamic models by (Arellano & Bond, 1991) which was later developed into (Arellano & Bover, 1995). These models have been applied by many recent researchers including (Love & Aris, 2013) who use it to analyse Loan quality in Egypt as mentioned above.

VAR has become a trendy tool in macro-economic modelling. The VAR model was first used in macro-econometrics modelling (Sims, 1980). One of the reasons why the use of VAR models has become common is, they clearly capture the feedback effects of variables among each other (Love & Ariss, 2013; Nkusu, 2011). In most recent papers, Panel VAR has been used to analyse the reactions of NPL and macroeconomic factors to each other especially through the use of Impulse Response Functions. Panel VAR allows for inter-country analysis among developed economies such as in (Nkusu, 2011), who uses PVAR across 26 advanced economies and establishes the key role of bad loans in ensuring a healthy economy. Another advantage of Panel VAR is that it allows for the analysis of the interactions between banks and the economy across banks at the same time (Love & Ariss, 2013). Panel VAR can also be used to analyse interactions across various countries (Espinoza & Prasad, 2010)

CHAPTER THREE

METHODOLOGY

Introduction

Stemming from the literature, we use four methods of estimation to arrive at our objectives. First, we check which variables have the most impact on non-performing loans using static models. Then we use two dynamic panel models. Thirdly, we use a Panel VAR to generate impulse response functions and then use a Panel Vector Error Correction Model to assess the long -term relationships between loan quality and the Macro economic variables having our micro variables are controls. Finally a Vector Error Correction Model is used to establish the ling run relationship between these variables.

3.1 Data

Panel Data on bank specific NPL between 2001 and 2017 were obtained from bank supervision report of 2018, the Banking Survey of 2013 and from bank specific financial statements. 31 banks in total are included in the analysis out 44 which was the total number of banks in Kenya as at 2016 (CBK, 2017). This is therefore a good sample of the banking industry. Annual data was used in the analysis. The nature of the data set is a strongly balanced panel data. Macroeconomic data for the same period is collected through a Rifinitive terminal from a variety of sources including; Central Bank, World Bank and the Kenya National Bureau of Statistics. Micro-factor data was obtained from the financial statements of the banks included in the analysis through the help of my very able supervisor.

3.2 Research design

The general research design adopted in this study is the Quasi-experimental research design. This is a quantitative research design that targets to explain the effects of macro-economic variables on non-performing loan. The use of panel data will however borrow some aspects of longitudinal research design in which a certain sample is tracked over time. This research design permits the measurement of differences or change in a variable from one period to another and facilitates prediction and forecasting (Ployhart & Vandenberg, 2010). On the other hand, this research design

involves a significant number of assumptions about the population observed over the specified duration.

3.3 Variable definition

The focus of this study is the relationship between loan quality and the macro-economy. NPL ratios will be used as the proxies for loan quality. NPL has been mainly used as a proxy for estimation of loan quality in most of literature. However, reserves have been used by Love and Ariss (2013) in their study in Egypt in place of NPL ratios since they could not access enough NPL ratio data.

3.4 Macroeconomic variables

Macroeconomic variables that will be included in this research can be grouped into three. The first group contains; Gross Domestic Product growth, unemployment, inflation (CPI). These are key in indicating general macroeconomic performance. According to literature from both theoretical and empirical studies, poor loan quality is associated with poor economic performance. This withholding, a negative correlation between GDP growth and loan quality and a positive correlation between interest, unemployment and poor loan quality is expected.

The second lot contains; growth rate of real money, public debt, government budget deficit. Growth of real money represents the financial ability of households while public debt and government budget deficit represents the ability of the government to finance its financial obligations. Growth in real money is expected be negatively correlated to poor loan quality. Public debt and government deficit are however expected to be positively correlated with poor loan quality.

The third lot contains the real effective exchange rate. The variable is an indication of the interaction of the Kenyan banking industry with other economies. It also represents the impact of the loan quality in an economy especially, developed economies, that many times have significant impact on emerging economies

The real effective exchange rate is also expected to have a negative relationship with the poor loan quality. A stronger currency implies the demand for a countries export is rising and thus a well performing economy. Foreign direct investment, net-capital flows and foreign portfolio flows are all expected to have a positive relationship with

loan quality. This is because increased foreign direct investment increases the money supply in the economy, thus increasing the ability of an economy to finance its financial obligations.

An aspect of interest would be to investigate how these macroeconomic variables shock loan quality and the converse, in an emerging market such as Kenya. This would enable policy makers better defend their recommendations.

3.5 Micro economic variables

Loan growth increases non-performing loans risk mainly if the increase in supply of loans is caused by the less vigorous credit worthiness test or the rates charged for borrowing drops. However if the demand for loans increases triggers loan growth in the books of a firm, then Non-performing loan ratio is not expected to change significantly (Keeton, 1999).

A bank that has assets large enough to be considered huge are assumed to be well established. This implies that they enjoy elaborate risk management units that work round the clock to assess, forecast and manage risk. This means that we expect a negative relationship between bank size and Non-performing loans ratio. (Alhassan, Kyereboah-Coleman, & Andoh, 2014).

Interest income was used as a proxy for income diversification. It would be interesting to study how a bank that enjoys very high income from loans manage their non-performing loans. This relationship varies across different countries. However, banks that have properly diversified their income have a reduced risk exposure.

3.6 Panel Estimation

In this section, as simple panel estimation is going will be carried out. Before estimation the Fisher Unit Root test will be used to test for stationarity of included variables. In doing this both Fisher Phillips-Perron (PP) and Fisher Augmented Dickey-Fuller (ADF) units root tests will be done, and the results compared. The results from Fisher DF will be more weighted since it has been found to be most suitable for panel data (Maddala & Wu, 1999).

Variable		Augmented Dickey-Fuller (ADF)		Im-Pesaran-Shin (IPS)	
		Z score	P value	Z score	P value
Non-Performing loans	Level	-4.0621	0.0000	-2.7452	0.0030
	Differenced	-17.808	0.0000	-9.2152	0.0000
Loan Growth	Level	-0.3762	0.3534	0.7065	0.7601
	Differenced	-17.808	0.0000	-9.2152	0.0000
Bank Size	Level	-2.4888	0.0064	-0.4007	0.3443
	Differenced	-14.792	0.0000	-8.2712	0.0000
Interest income	Level	6.3270	1.0000	7.4811	1.0000
	Differenced	-12.142	0.0000	-7.1894	0.0000
GDP growth	Level	-15.187	0.0000	-9.9310	0.0000
	Differenced	-13.289	0.0000	-9.1451	0.0000
Unemployment	Level	-4.2657	0.0000	-4.1538	0.0000
	Differenced	-13.289	0.0000	-9.1451	0.0000
Inflation	Level	16.9252	1.0000	24.0266	1.0000
	Differenced	-13.289	0.0000	-9.1451	0.0000
Public debt	Level	-	-	33.0147	1.0000
	Differenced	-	-	-4.2779	0.0000
Money supply	Level	-	-	27.7932	1.0000
	Differenced	-	-	-3.3114	0.0005
Real effective exchange rate	Level	8.4986	1.0000	8.3605	1.0000
	Differenced	-13.199	0.0000	-9.1060	0.0000

Table 1; Stationarity tests results

3.6.1 Dynamic Panel Model

Bank non-performing loans are persistent through time as observed from the data. The value today of the total non-performing loans of a specific bank is highly dependent of the value in the preceding period. Dynamic Panel methods also deal with the problem of serial autocorrelation thus increasing the accuracy of the model. This observed phenomenon calls for the introduction of a dynamic panel model that includes a lag variable to capture the partial adjustment mechanism. Using dynamic panel techniques however introduces the problem of endogeneity since taking first differences to removes unobserved heterogeneity causes the lagged term to have a significant correlation with the error term. To counter this, Anderson Hsiao 1981 introduced instrumental variables (Anderson & Hsiao, 1981). This has been improved by Many authors including the two most famous models developed by (Arellano & Bond, 1991) and (Arellano & Bover, 1995). The instrumental variable in my model is the NPL variable lagged to the 3rd order since it was the most correlated to my variables and uncorrelated to the error term. Below is a representation of the Arellano-bond/blundell.

Model used;

$$\begin{aligned} NPL_{it} = & \beta_1 NPL_{it-k} + \beta_1 BnkSZ_{it} + \beta_2 Gdpgrth_{it} \mu_t + \beta_3 Unemplmnt_{it} \\ & + \beta_4 \Delta Infltn_{it} + \beta_5 \Delta Pblcdbl_{it} + \beta_6 \Delta Mnspply_{it} + \beta_7 \Delta REER_{it} \\ & + \beta_8 \Delta Lngrwth_{it} + \beta_9 \Delta Intrstincm_{it} + \mu_t + \varepsilon_{it} \end{aligned}$$

With $i=1\dots, N(N=31)$, and $t=1\dots, T(T=16)$

Where NPL_{it} is the dependent variable Non-performing loans for each of the 31 banks over the 16 years. NPL_{it-k} is the lagged variable that introduces the dynamic properties into the model to capture persistence in loan quality. Larger values of NPL_{it} imply a low quality of loans since it signals that bad loans are growing faster than the good once. K represents the number of lags included in the model. The remaining independent variables represent GDP growth, unemployment growth, inflation, change in public debt, change in money supply change in real effective exchange rate change in loan growth and change in interest income respectively. μ_t represents the

firm specific characteristics. ε_{it} represents the error term. Lagged independent variables are also included in both the Arellano Bond and Arellano Blundell/Bover Bond models.

Both Arellano Bond and Arellano Blundell/Bover Bond models are included to check which model best fits the data. Both models use a GMM and are therefore useful in dealing with homogeneity. However, Arellano Blundell/Bover Bond is more efficient in modelling unobserved heterogeneity for unlike Arellano bond that takes first differences. Arellano Blundell/Bover Bond uses Forward Orthogonal Deviations that minimizes Nickel Bias. A variation of the Arellano Blundell/Bover Bond model is included where both the one step and two step models are included. This also to vary the model and test for the fitness of the models used.

3.6.3 Panel Vector Autoregression

As a compliment to the multivariate analysis, a Panel Vector Autoregressive model is be used to identify and analyse the transmissions of macroeconomic shocks. This methodology allows for individual heterogeneity in the variables at level form by modelling for fixed effects. It was first done by Love and Zicchino (2006).

The model to be estimated is given by:

$$y_{it} = \alpha_i + B_1(L)y_{it} + \gamma_t + \varepsilon_{it}$$

With $i=1\dots, N(N=31)$, and $t=1\dots, T(T=16)$

This represents the reduced form of the model. y_{it} is a vector of macroeconomic and microeconomic variables of interest and the loan quality variable. α_i models the firm specific properties and γ_t removes the firm time specific properties. $B(L)$ is the polynomial of the lag operator. ε_{it} represents the residuals assumed to have a mean equal to zero and a covariance matrix of Σ_ε . This model used generalized method of moments (GMM) in its estimation. Helmert transformation (forward orthogonal deviation) is used to deal with unobserved heterogeneity (Abrigo & Love, 2016).

A Cholesky decomposition was used to order the variables. However, the recursive ordering will be adjusted to conform to economic theory. This is because Cholesky decomposition is a mathematical model which imposes restrictions based on mathematical concepts and not economic theory. Economic theory assumptions were used to order each the variables in each PVAR estimation.

Sensitivity analysis will be carried out to understand the interactions between the loan quality and macroeconomic variables. This will be captured using Impulse Response Functions (IRFs) and Variance decomposition.

Since the model has many variables, the number of parameters is likely to be very high. Therefore, the number of lags is a critical restriction. Too many lags would consume most degrees of freedom thus causing a biased estimation. This is because a higher number of degrees of freedom imply a larger sample thus a more accurate estimation. The following techniques could have been used will be used to arrive at the appropriate number of lags: The likelihood ratio (LR) test, the Schwartz Bayesian Criterion (SBC) in conjunction with the Akaike Information Criterion (AIC). But since our model uses GMM, techniques relying on maximum likelihood could not be applied however their GMM equivalents (consistent moment and model selection criteria (MMSC)) introduced by Andrews and Lu (2001) will do the job (Andrews & Lu, 2001).

Panel VAR models have the rare capability to efficiently estimate the shocks of the variables on themselves (Abrigo & Love, 2016). In addition to this benefit, the fact that it barely requires any priori information on the relationships between variables makes it useful. Especially in estimating coefficients of variables that do not have a straightforward relationship. The major drawback of this model is that the ordering of variables and the restrictions put the coefficients corresponding to contemporaneous interactions are only based on the researcher's judgement.

To check for long run co-movements, Westerlunds test, Pedroni test and Kao tests were used. A long run relationship was evident both with the macro and micro variables included in the analysis. The PVAR estimation included was still very necessary since it facilitated the analysis of the impulse response functions and Variance decomposition. To establish the lag length viable a standard vector autoregressive model was run before the Vector Error Correcting model was used. The

vector error correcting model also uses GMM to counter the endogeneity problem that comes in due to many variables included in the analysis.

CHAPTER FOUR

RESULTS

Introduction

In this chapter the findings of the various estimation models included in this study (Random Effects Model, Arellano Bond Model, Arellano-Bond/Blundell, Panel Vector Autoregressive Model and Vector Error Correction Model) are presented. However, before showing the results, below is a table of a pairwise correlation so us to find out which variables could cause a multicollinearity problem.

	npl	loangr-h	banksi-s	interest	gdpgro-h	unempl-t	change-n	change-t	change-y	change-r
npl	1.0000									
loangr-h	-0.0229	1.0000								
banksi-s	-0.3813	0.0468	1.0000							
interest	-0.2142	0.0513	0.6057	1.0000						
gdpgro-h	-0.0255	0.0782	0.1102	0.0680	1.0000					
unemployment	0.0491	0.0246	-0.1311	-0.0688	0.2121	1.0000				
changein-n	0.0718	-0.0586	-0.1122	-0.1209	-0.6048	-0.5519	1.0000			
changeinput	-0.1470	-0.0267	0.2637	0.2922	-0.1851	0.0167	-0.1278	1.0000		
changeinmry	-0.1369	0.1111	-0.0122	-0.1521	0.2344	-0.0794	-0.1222	-0.1759	1.0000	
changeinreer	-0.1200	0.0094	0.1603	0.1056	-0.1166	0.1558	-0.0835	0.7691	0.0593	1.0000

Table 2; Test for collinearity

4.1 Summary statistics.

Variable	Observations	Mean	Standard Deviation
<i>Non-performing loans ratio</i>	496	.1061469	.1221094
<i>Loan growth</i>	495	2.484845	50.60739
<i>Bank size</i>	496	16.88529	1.921928
<i>interest income</i>	496	5930027	9274360
<i>GDP growth</i>	496	5.217531	1.796884
<i>Unemployment</i>	496	9.577688	.2985827
<i>Inflation</i>	496	110.2534	45.7042
<i>Real Money supply</i>	496	1316.599	786.2315
<i>Real effective exchange rate</i>	496	84.22734	11.44626
<i>Public debt</i>	496	972.3465	701.551

Table 3; Summary Statistics

4.2 Dynamic and static model results

Variable	Model 1	Model 2	Model 3
Constant	-	-0.8015079	.0643311
NPL (lagged)	.5189331***	.8361878***	
Bank Size	.0078526***	.0067794***	-.0102248***
Lag 1	-.0365826***	-.0268702***	
GDP growth	.0076584	.0041649***	.0074685
Change in Money Supply			-.5419824***
Change in Money Supply (Lag 1)	-.4752044***	.2217488	
Change in REER	.2216913***	.6325837	.0915623

Table 4; Dynamic and Static model results.

Model 1; Arellano Bond, Model 2; Arellano Blundell.

Non-performing loans ratio is the ratio between Loans that are not performing well and the total loans. A high non-performing ratio indicate that the loan quality is low. First, GDP growth has a positive coefficient for all model although it is only significant in the Arellano Blundell/Bover Bond model. This implies that as GDP grows in Kenya, non-performing loans have also been growing. This is inconsistent with economic theory that expects the relationship to be inverse.

Secondly, the previous values of non-performing loans significantly impact the current. This implies that a shock on non-performing loans would be persistent through various periods. According to the results, more than half of previous non-performing loan values are carried forward to the next year.

Third, banks size is also found to have a significant relationship with loan quality. According to the results. Larger banks are not found to have lower non-performing loans. This could imply that although they are large and have better loan recovery systems, more stringent credit-worthy assessments, efficiently running risk management functions and other advantages that stem from the size, they are not able to reduce loan quality in the same period by these mechanisms. However, from the coefficient of the lagged variable, the fruits of these mechanisms are evident as from the next period. If the bank size increases, loan quality is expected to drop in the

following year. In as much as bank size is significant, the coefficient is very small in most of the included models. Concluding from the random effects model that assumes that loan quality has no serial correlation across banks, then the relationship is negative and significant.

Fourth, in two out of the three models, money supply is found to significantly interact with loan quality. Money supply was found to change the loan quality by about fifty percent. This is consistent since with more money circulating in the economy, debtors can service their financial obligations thus increasing the loan quality of the banks' portfolios.

Fifth, according to Arellano Bond model, a positive change in the real effective exchange rate has a positive impact on the loan quality. This implies that when the currency is strong, loan quality increases.

4.3 Panel VAR results

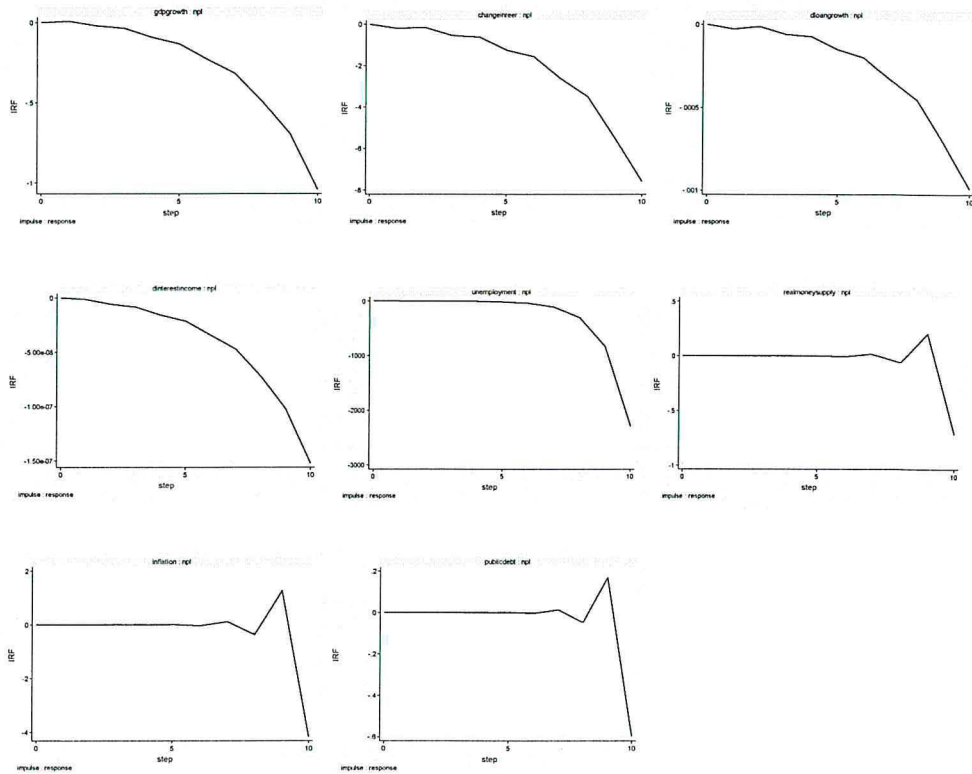
This model had the main goal of exploring how macro-economic and micro-economic factors shock loan quality.

4.3.1 PVAR Coefficients

Variable	Coef.	Std. Err.	z	p> z
NPL L1	1.210843	0.0510046	23.74	0.000
<i>Change in Loan growth L1</i>	-.0000267	4.01e-06	-6.66	0.000
<i>Change in Interest income L1</i>	-1.73e-09	8.27e-10	-2.09	0.037
GDP growth L1	-0.0183	0.0009477	-9.31	0.000
Change in REER L1	-0.190 589	0.0247117	-7.71	0.000
Money supply L1	0.0000319	2.95e-06	10.82	0.000
Unemployment L1	-0.1627039	0.0101855	-5.97	0.000
Inflation L1	0.0004996	0.0000473	10.56	0.000
Public Debt L1	0.0000247	3.52e-06	7.01	0.000

Table 5 Panel VAR results

4.3.2 Impulse response functions



The first graph, just like the rest, shows how NPL would respond over a span of ten years given a unit change in GDP growth. We observe that the impact of a unit change in GDP growth today would escalate as the years go by and be felt most after ten years. This shows how persistent this shock would be. This is consistent with the results in dynamic panel analysis. Loan quality in Kenya is so low that even an increase in GDP would take a long time to negatively influence the NPL.

As observed for GDP, a positive change in Real effective exchange rate would reduce non-performing loans, and this impact increases with time. Unlike GDP however this change would be faster observing from the Y-axis of the impulse response graph.

Loan growth and interest income also increase loan quality as time passes after the shock. These and the results above reinforce the inference made before on the persistence of non-performing loans across time.

Unemployment shocks do not influence loan quality up to about the fourth year that even a decrease in unemployment decreases loan quality. Afterwards, the impact of the shock is amplified. This means that even unemployment decline on its own is not strong enough to be used as a tool to increase loan quality in Kenya. This is inconsistent with theory, but it can be observed in the Kenyan economy given the severe level of loan quality in.

Real money supply shocks loan quality after six years, and in a mean reverting way before maintaining a negative impact on loan quality as the ten-year mark is approached. Inflation and public debt also impact loan quality after the same period. However, inflation has a larger negative impact on loan quality compared public debt and money supply after the mean reverting period.

CHAPTER FIVE

CONCLUSION

The objective of this study is to examine the relationship between the macro economy and the loan quality in Kenya. Results have showed which factors influence loan quality the most and the extent to which micro economic and macroeconomic shocks affect the bad loans taking note of the feedback effects and how they persist in the long run.

According to the results of the dynamic model that aimed at achieving the first objective, money supply seems to be the largest contributor to loan quality in Kenya. This implies that best short at reducing Loan quality in Kenya is through monetary policy. This study therefore backs up the central banks move in November 2019 to lower interest rates.

Unemployment may not be an easy factor for the government to shock in Kenya. However, the government and banks should be aware that in the long run, high unemployment rates have dire consequences to loan quality.

To conclude this section, it is important for banks to expect these shocks from the economy since loan quality is a huge fraction of their value proposition today and in the forecastable future. Using the forecasts for macro-economic variables, banks should rebalance their books and brace for the impact of macro-economic shocks. This is because when they see a dangerous credit boom, they would be prepared to a certain extent.

Further study should be done on the Long run relationship between macro-economic factors and loan quality. In addition to this, it would be interesting to investigate the loan quality East Africa as a whole. Especially in this time when our governments are working to remove trade barriers and remove the impact of borders. Recently, more banks have also expanded their services into other East Africa countries.

References

- Abrigo, & Love. (2016). Estimation of Panel Vector Autoregression in Stata: a Package of Programs. *The Stata Journal*, 16(3).
- Ahlem, & Faith. (2013). Micro and Macro Determinants of Non-performing Loans. *International Journal of Economics and Financial Issues*, 852-860.
- Alhassan, A. L., Kyereboah-Coleman, A., & Andoh, C. (2014). Asset quality in a crisis period: An empirical examination of Ghanaian banks. *Review of Development Finance*, 50-62.
- Allen, & Gale. (2004). Financial Intermediaries and Markets. *Econometrica*, 1023-1061.
- Anderson, & Hsiao. (1981). Estimation of Dynamic Models with Error Components. *Journal of the American Statistical Association*, 598-606.
- Andews, & Lu. (2001). Consistent model and moment selection procedures for GMM estimation with application to dynamic panel data models. *Journal of Econometrics*, 123-164.
- Arellano, M., & Bond, S. (1991). Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. *Review of Economic Studies*, 277-297.
- Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, 29-51.
- Baltagi. (2008). *Econometric Analysis of Panel Data*. Chichester: John Wiley and Sons.
- Barth, Caprio, & Levine. (2008). Bank Regulations are Changing: For Better or Worse? *Comparative Economic Studies*, 537-563.
- Beck, R., Jakubik, P., & Piloju, A. (2013). *Non-performing loans, What matters in addition to the economic cycle?* Frankfurt am Main: European Central Bank.
- Bock, R. D., & Demyanets, A. (2012). Bank Asset Quality in Emerging Markets: Determinants and Spill Overs. *IMF Working Paper*.

- Brooks, C. (2008). *Introductory Econometrics for Finance*. Cambridge: Cambridge University Press.
- Brownbridge. (2010). *The Causes of Financial Distress in Local Banks in Africa and Implications for Prudential Policy*. UNCTAD.
- Caprio, & Daniela. (2002). Episodes of Systemic and Borderline Financial. *The World Bank (Unpublished)*.
- CBK. (2017). *Bank supervision annual report*. Nairobi: Central Bank of Kenya.
- CBK. (2018). *The Impact of Interest Rate Capping on the Kenyan Economy* . Nairobi: Central Bank of Kenya.
- Diamond. (1984). Financial Intermediation and Delegated Monitoring. *The Review of Economic Studies*, 393-414.
- Dimitrios, A., Helen, L., & Tsionas. (2016). Determinants of non-performing loans: Evidence from Euro-area countries. *Finance Research Letters*, 116-119.
- Ekanayake, & Azeez. (2015). Determinants of Non-Performing Loans in Licensed Commercial Banks: Evidence From Sri Lanka. *Asian Economic and Financial Review*, 868-882.
- Espinoza, & Prasad. (2010). Nonperforming Loans in the GCC Banking Systems and their Macroeconomic Effects. *IMF Working Paper*, 10/224.
- Gathaiya, R. (2017). Analysis of Issues Affecting Collapsed Banks in Kenya From Year 2015 to 2016. *JMBS*.
- Kao, c. (1999). Spurious regression and residual-based tests for cointegration in panel data. *Journal of Econometrics*, 1-44.
- Keeton. (1999). Does faster loan growth lead to higher loan losses? Federal Reserve Bank of Kansas City.
- Louzis, Vouldis, & Metaxas. (2010). Macroeconomic and Bank-Specific Determinants of Non-Performing Loans. *The Bank of Greece*.
- Love, I., & Ariss, R. T. (2013). A Panel Analysis of Economic Shocks and Loan Portfolio Quality. *IMF Working Paper*, WP/13/271.

- Love, I., & Zicchino, L. (2006). Financial development and dynamic investment behavior: Evidence from panel VAR. *The Quarterly Review of Economics and Finance*, 190-210.
- Maddala, & Wu. (1999). A Comparative Study of Unit Root Tests with Panel Data and a New Simple Test. *Oxford Bulletin of Economics and Statistics*, 631-683.
- Makri, V., Tsagkanos, A., & Bellas, A. (2014). Determinants of Non-Performing Loans: The Case of Eurozone. *PANOECONOMICUS*, 193-206.
- Moore, B. (1989). A Simple Model of Bank Intermediation. *Journal of Post Keynesian Economics*, 10-28.
- Muriithi, M. (2013). The Causes of Non-performing Loans in Commercial Banks in Kenya. *Uon repository*.
- Nkusu, M. (2011). Nonperforming Loans and Macro financial Vulnerabilities in Advanced Economies. *IMF Working Paper*.
- Ongore, & Kusa. (2013). Determinants of Financial Performance of Commercial Banks in Kenya. *International Journal of Economics and Financial Issues*, 237-252.
- Ployhart, & Vandenberg. (2010). Longitudinal Research. *Journal of Management*, 94-120.
- Sims. (1980). Macroeconomics and reality. *Econometrica*, 1-48.
- Tracey, M. (2006). A VAR Analysis of the Effects of Macroeconomic Shocks on Banking Sector Loan Quality in Jamaica.
- TradingEconomics. (n.d.). *Trading Economics*. Retrieved from Kenya Unemployment Rate: <https://tradingeconomics.com/kenya/unemployment-rate>
- Williamson. (1985). Financial Intermediation, Business Failures, and Real Business Cycles. *Journal of Political Economy*, 1196–1216.
- Wooldridge. (2002). *Econometric Analysis of Cross-Section and Panel Data*. Massachusetts: MIT Press.

WorldBank. (2008). Retrieved from DataBank:

<https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=KE>

WorldBank. (n.d.). *The World Bank*. Retrieved from Databank:

<https://data.worldbank.org/indicator/FB.AST.NPER.ZS?locations=KE>

Appendix

1. CPI

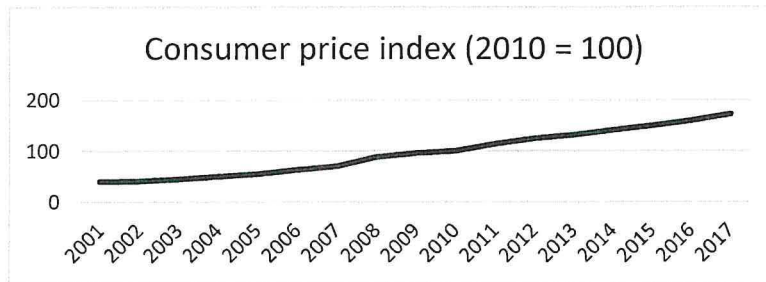


Figure 3. CPI source World Bank

Inflation on the other hand has maintained an upward trend and seems to be maintaining its gradual course.

2. Unemployment rate

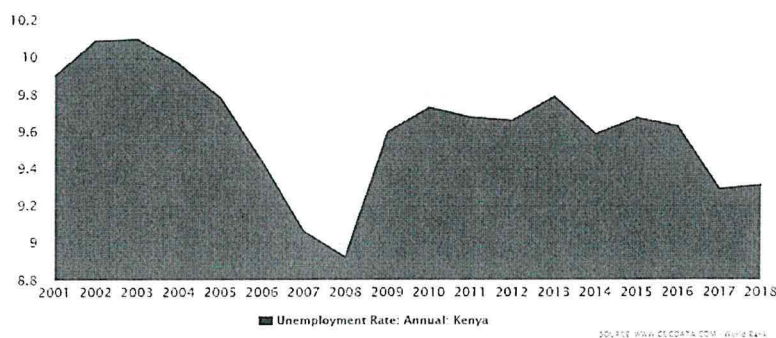


Figure 4. Unemployment rate. Source World Bank

Unemployment has been gradually increasing over the years; however, it was on the rise after the post-election violence.

3. Growth rate of real money

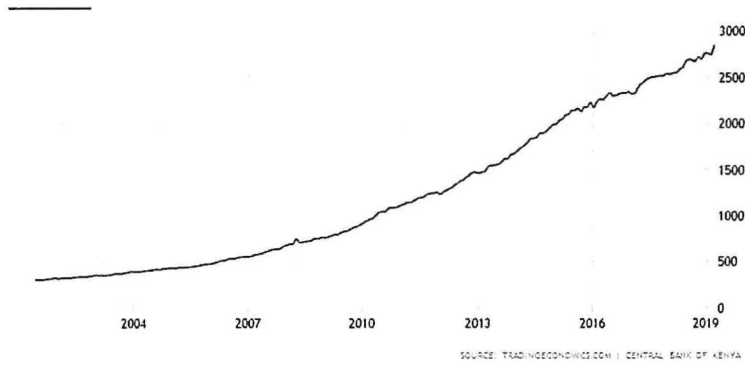


Figure 5. Growth of real Money. Central Bank of Kenya

Money supply has been steadily increasing tracking the inflation rate that has been on an upward trend.

4. Public debt

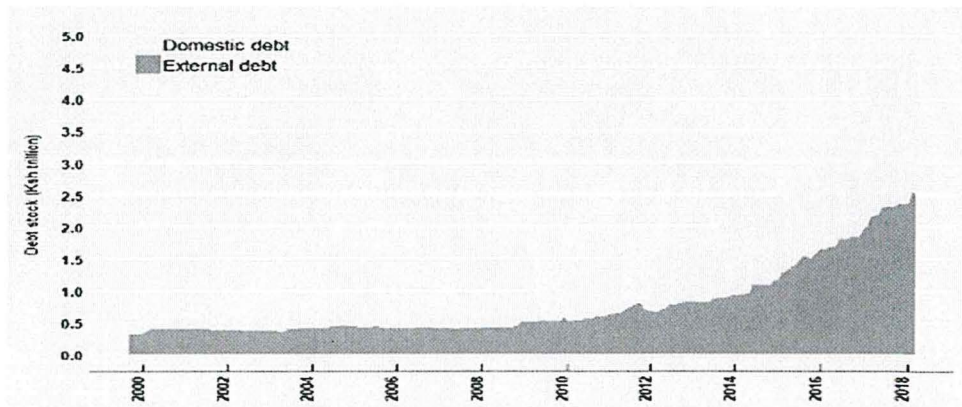


Figure 6. Public debt. Source: Central Bank of Kenya

Public debt has been on the rise and has attracted the attention.

5. Government budget deficit

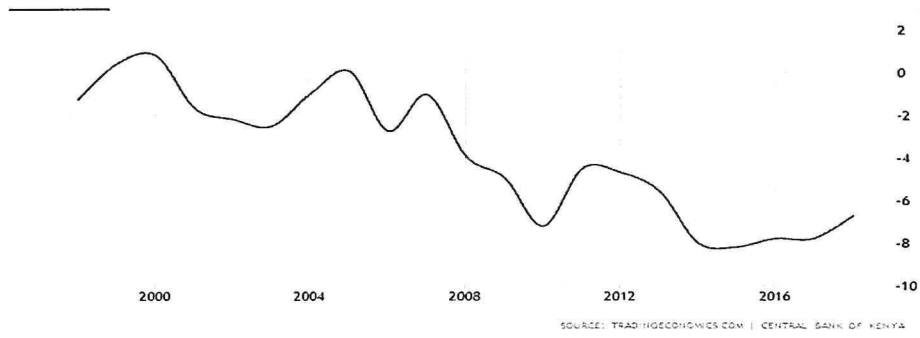


Figure 7. Government deficit. Central Bank of Kenya

6. Real effective exchange rate

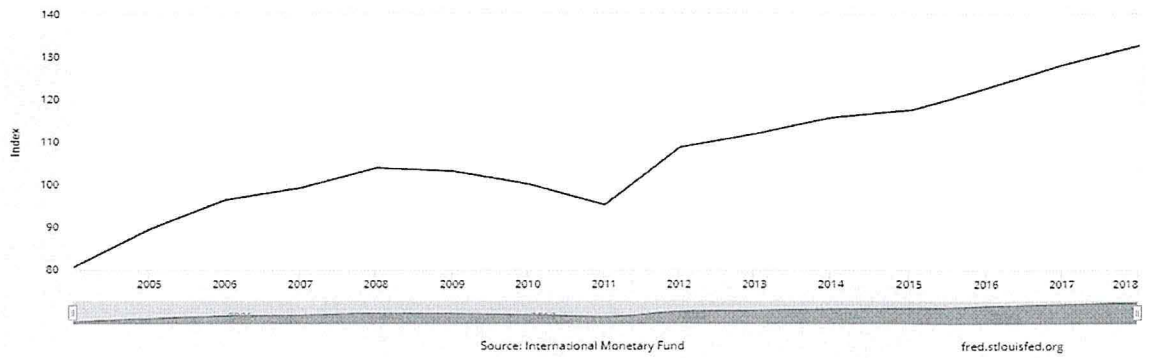


Figure 8. Real Effective exchange rate. Source IMF

7. Impulse response graphs

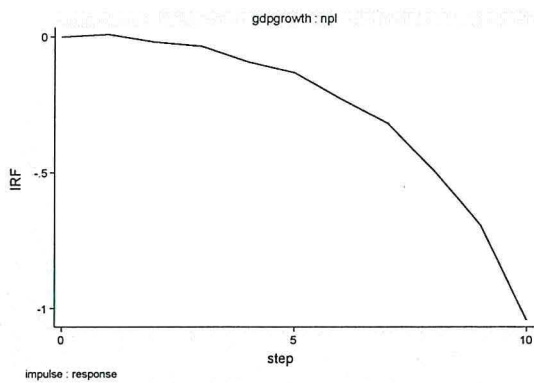


Figure 9

Figure 12

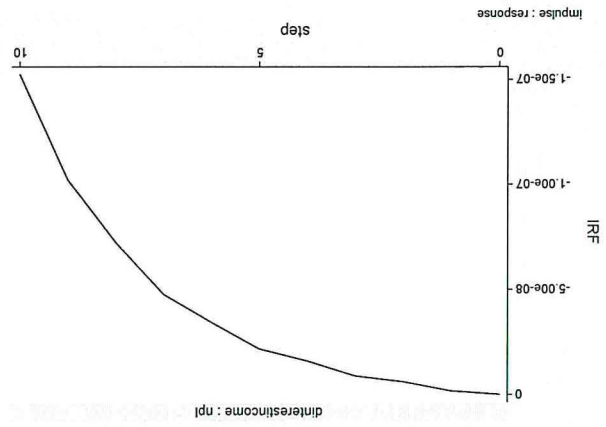


Figure 11

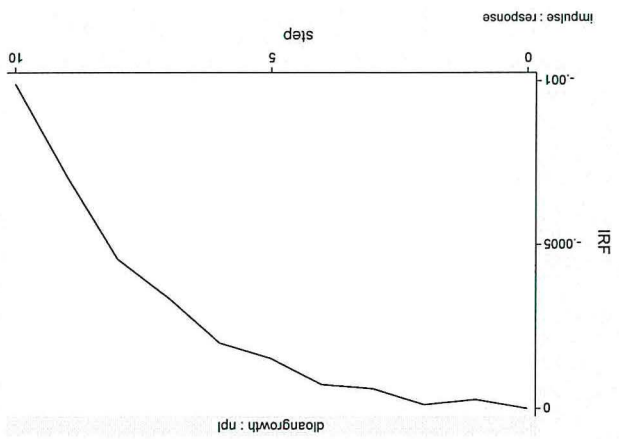


Figure 10

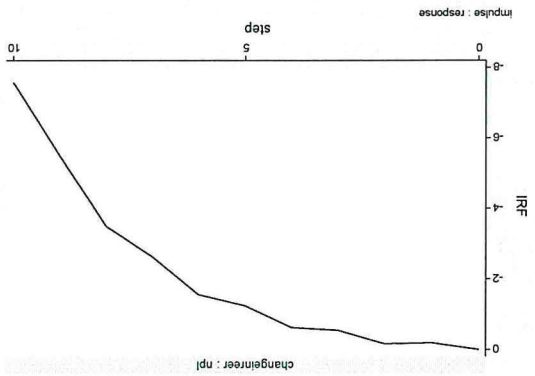


Figure 15

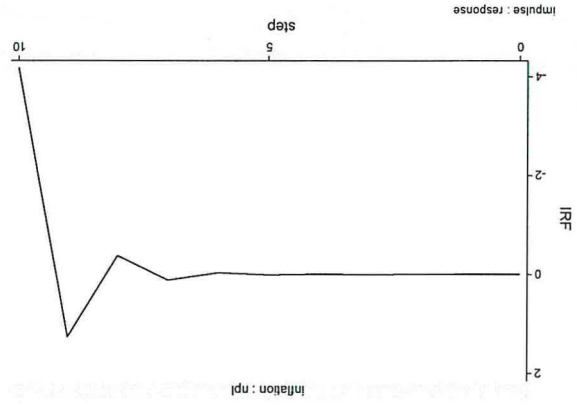


Figure 14

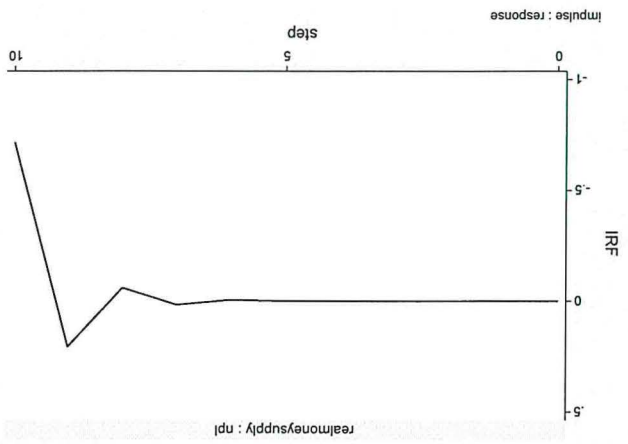
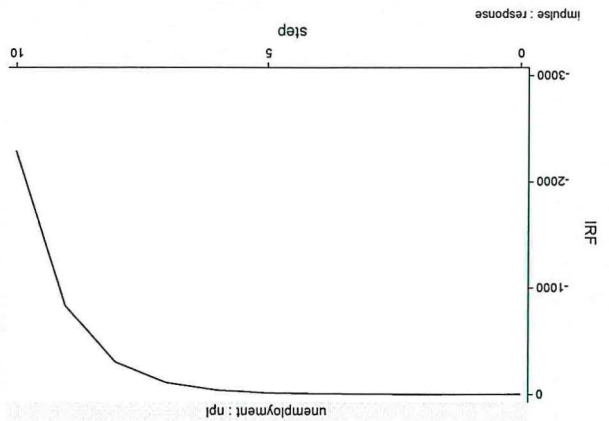


Figure 13



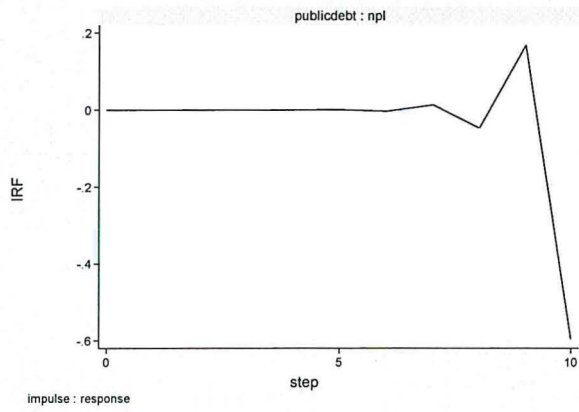


Figure 16

8. Summary of variables statistics

Variable	Mean	Std. Dev.	Min	Max	Observations
gdpgr0-h overall	5.217531	1.796884	.232283	8.4057	N = 496
between		0	5.217531	5.217531	n = 31
within		1.796884	.232283	8.4057	T = 16
unempl-t overall	9.577688	.2985827	8.926	10.099	N = 496
between		0	9.577688	9.577688	n = 31
within		.2985827	8.926	10.099	T = 16
inflat-n overall	110.2534	45.70424	45.09414	201.78	N = 496
between		0	110.2534	110.2534	n = 31
within		45.70424	45.09414	201.78	T = 16
realmo-y overall	1316.599	786.2315	376.0153	2707.591	N = 496
between		0	1316.599	1316.599	n = 31
within		786.2315	376.0153	2707.591	T = 16
reer overall	84.22734	11.44626	67.31917	103.4117	N = 496
between		0	84.22734	84.22734	n = 31
within		11.44626	67.31917	103.4117	T = 16
publicdt overall	972.3465	701.551	404.0559	2629.756	N = 496
between		0	972.3465	972.3465	n = 31
within		701.551	404.0559	2629.756	T = 16

Figure 17; Summary statistics 1

Variable		Mean	Std. Dev.	Min	Max	Observations
npl	overall	.1061469	.1221094	0	.832472	N = 496
	between		.0786999	.0060961	.2999452	n = 31
	within		.0943648	-.1753301	.6386736	T = 16
loangrth	overall	2.484845	50.60739	-1	1125.15	N = 496
	between		12.5893	.0010247	70.25924	n = 31
	within		49.06242	-68.77345	1057.376	T-bar = 15.9677
banksivs	overall	16.88529	1.921928	0	20.248	N = 496
	between		1.371126	13.2197	19.16805	n = 31
	within		1.367768	-.4811826	20.30139	T = 16
interest	overall	5930027	9274360	0	5.70e+07	N = 496
	between		6741205	419011.1	2.68e+07	n = 31
	within		6476649	-1.70e+07	3.61e+07	T = 16

Figure 18; Summary statistics 2

9. Variance Decomposition

Variance
Decompos
ition of
NPL:

Period	S.E.	NPL	INFLATION _CPI_	PUBLIC_D EBT	REAL_EFF ECTIVE_E XCHANGE _RATE	REAL_MO NEY_SUPPYMENT LY	UNEMPLO _
1	0.067723	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.096166	99.80394	0.001388	0.115769	0.000139	0.059072	0.019692
3	0.118245	99.50121	0.003532	0.294525	0.000354	0.150283	0.050098
4	0.137026	99.17832	0.005819	0.485181	0.000583	0.247567	0.082529
5	0.153675	98.87311	0.007980	0.665403	0.000800	0.339527	0.113185
6	0.168790	98.59966	0.009917	0.826868	0.000994	0.421916	0.140650
7	0.182724	98.36095	0.011607	0.967816	0.001164	0.493835	0.164625
8	0.195713	98.15512	0.013065	1.089355	0.001310	0.555851	0.185299
9	0.207920	97.97846	0.014316	1.193670	0.001435	0.609079	0.203042
10	0.219469	97.82687	0.015389	1.283181	0.001543	0.654753	0.218268

Table 6; Variance Decomposition

Table 7, VECM full results

Figure 20; Pedroni test results

```

Pedroni test for cointegration
Not: No cointegration
Yes: All panels are cointegrated

Number of panels = 31
Avg. number of periods = 15

Cointegrating vector: Panel specific
Panel means: Included
Time trend: Included
LR parameter: Panel specific
Kernel: Bartlett
Lags: 2.00 (Newey-West)
Augmented lags: 1
P-Value
-----
Modified Phillips-Perron a 7.8790 0.0000
Phillips-Perron a -15.7940 0.0000
Augmented Dickey-Fuller a -12.1373 0.0000
    
```

Figure 19; Kao test results

```

Kao test for cointegration
Not: No cointegration
Yes: All panels are cointegrated

Number of panels = 31
Avg. number of periods = 12.963

Cointegrating vector: Same
Panel means: Included
Time trend: Not included
LR parameter: Same
Kernel: Bartlett
Lags: 1.68 (Newey-West)
Augmented lags: 1
P-Value
-----
Modified Dickey-Fuller a -2.1692 0.0150
Dickey-Fuller a -4.0165 0.0000
Augmented Dickey-Fuller a -2.9815 0.0014
Unadjusted modified Dickey-Fuller a -4.0213 0.0000
Unadjusted Dickey-Fuller a -4.9266 0.0000
    
```