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The Impact of Monetary Policy on Economic Growth and Price Stability in Kenya: 1992-2013

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Abstract: *The government of Kenya's economic blueprint dubbed 'Kenya Vision 2030' acknowledges the importance of maintaining a stable macro-economic environment. Despite Kenya implementing monetary policy aimed at achieving stable prices and fostering economic growth, the economy has been reporting low economic growth and high rates of inflation. These implies there is still a point of disconnect between what Central bank of Kenya Pursues and the outcome of the objectives. In this study, structural vector autoregresion (SVAR) model is estimatedto trace the effects of monetary policy shocks on economic growth and prices in Kenya. Three alternative monetary policy instruments were put into use i.e. broad money supply (M_3), interbank lending rate (ILR) and the real effective exchange rate (REER). The study found evidence that monetary policy innovations carried out on the quantity-based nominal anchor (M_3) has modest effects on economic growth and prices with a very fast speed of adjustment. Innovations on the price-based nominal anchors (ILR and REER) have relative and fleeting effects on real GDP. The study recommended that Central Bank of Kenya should place more emphasis on the use of the quantity-based nominal anchor rather than the price-based nominal anchor.*

Key words: *Monetary Policy, Economic Growth, Price Stability*

I. Introduction

1.1 Background to the Study

The principal objective of the Central Bank of Kenya is the formulation and implementation of monetary policy directed at achieving and maintaining stability in the general price level. Monetary policy in Kenya is therefore, designed to support the governments' desired growth in production of goods and services and employment creation through achieving and maintaining a low, stable inflation (Republic of Kenya, 2007 andCBK, 2012).Monetary policy is a critical tool of macroeconomic management. The study was motivated by the fact that a relatively small number of empirical studies have been conducted on the impact of monetary policy on economic growth and prices (Sims, 1991; Bernanke and Mihov, 1998, Starr, 2005; Chuku, 2009 and Asongu, 2013). A large proportion of these studies were not done on the Kenyan economy due to differences in economic behavior from one country to another. This study is important as it sheds light on the impact of monetary policy on economic growth and prices in Kenya. This is important to policy-makers because it enables them to identify the appropriate monetary policy instruments for any monetary action. The study is also relevant as it contributes to the debate on the relevance of monetary policy as presented in Kenya's Vision 2030.

In large industrial economies, changes in monetary policy affect real economic activity in the short run, but only prices in the long run. In transition economies, the question of whether monetary policy affects output in the short run is open for debate (Starr, 2005). The factors that account for real effects in mature developed nations include sticky prices, sticky wages and imperfect competition which is supportive of the idea that monetary policy can be used to counter aggregate shocks (Starr, 2005).Monetary policy implementation in most developing countries face additional challenges that are not present in developed economies such as fiscal dominance and the treat of currency substitution (Agboluaje,Fasanya& Onakoya, 2013). A recent study on the choice of optimal monetary policy instrument in Kenya by Gichuki, Kosimbei and Oduor (2012) indicates that using interest rates and reserve money simultaneously as monetary policy instruments works better than either of the two independently but if used independently interest rate is superior over reserve money. Asongu (2013) documents that effects of monetary policy on real variables is less clear in countries that have experienced high inflation, slack labour markets, and flexible prices and wages because monetary policy changes could pass quickly through prices and have little real effects.

1.2 Structural Interlinkages of the Monetary Policy Framework

The structure of the framework can be summarized using a flowchart, as shown in figure 1.1. The figure shows the structural interlinkages of the monetary policy framework and captures the interaction between the various sectors of the economy (blue boxes). It also shows the interaction between markets,that is, between

the financial market and other markets. The white boxes denote different domestic prices determined in the model (consumer price, exchange rate and domestic interest rates). For instance, the interaction of money demand and money supply determines domestic interest rates. Excess money demand acts as one of the triggers of monetary policy actions (Kamau, Kiptui, Sichei, & Were, 2013).

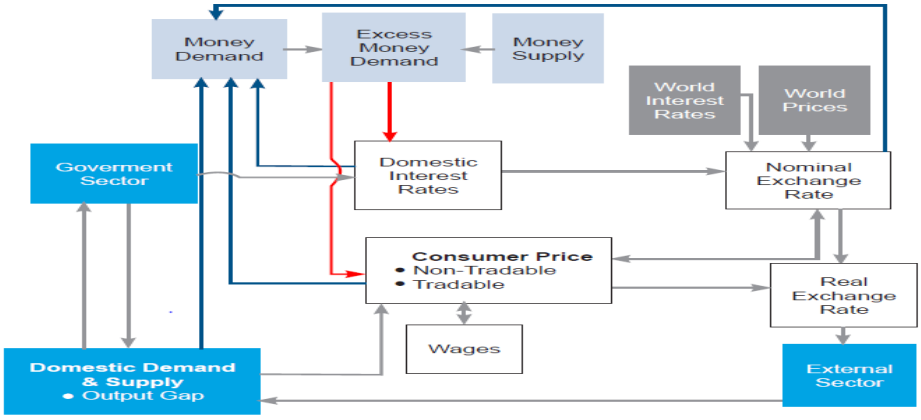


Figure 1.1: Logical framework and structure of the monetary policy framework
Source:Kamau et al., (2013)

The CBK follows the monetary-targeting framework, where it controls quantities (money stock) to affect the prices in the economy. Reserve money is the operating target and is under the CBK's control. Broad money supply is the intermediate target and is related to reserve money through the money multiplier. CBK uses broad money supply, given that it is perceived to contain all the instruments used to influence policy. Actions on the fiscal side have implications on domestic interest rates i.e., through the price effect of crowding out or through the effects on the return to government securities relative to other assets. Aggregate demand, price level, exchange rate and interest rates determine money demand. Other marketsthe external sector and the government/fiscal sectorare represented in the bright blue boxes.

The nominal exchange rate is determined in the foreign exchange market by the differentials between domestic and world interest rates, as well as between the domestic price and world prices. For instance, a rise in domestic interest rates relative to foreign interest rates will lead to an appreciation of the local currency. The real exchange rate follows by definition (i.e., from the nominal exchange rate, the foreign price and the domestic price level). The (real) exchange rate has an impact on the exports and imports of goods and services in the external sector. World price and foreign interest rates are exogenous (gray boxes)(Kamau et al., 2013).

1.3 History of Monetary Policy in Kenya

The first decade after independence the CBK pursued a passive monetary policy owing to the fact that the Kenyan economy had no serious macro-economic problems to contend with (Kinyua, 2001).The first macro-economic imbalance arose in the second decade following the collapse of the Britton woods system of fixed exchange rates in 1971 and the first and second oil crises of 1973 and 1979 respectively (Kinyua,2001). During thesefirst two decades after independence, monetary policy was conducted through direct tools which were cash reserve ratio, liquidity ratio, interest controls and credit ceiling for commercial banks.

The deregulation of economic activities in early 1990s where interest rate controls were removed and exchange rate made flexible was a major milestone in the conduct of monetary policy (Kathanje, Maana & Rotich, 2007). The Central Bank of Kenya Act was amended in 1996 to allow greater operational autonomy in the conduct of monetary policy while at the same time limiting its role to formulation and implementation of monetary policy directed to achieving and maintaining stability in the general price level.While the CBK's monetary policy strategy continued to be that of targeting monetary aggregates, there was a shift from direct to indirect instruments of monetary control with clearly defined objectives and greater operational autonomy (Kathanje et al., 2007).

To this end,CBK has been operating under a monetary targeting policy framework until the introduction of the Central Bank rate. Monetary targeting policy framework is effective when a stable demand for money exists. Kamau and Sichei (2012) indicate that demand for money in Kenya is unstable challenging the effectiveness of monetary targeting policy framework under implementation by CBK. Currently, Kenya exercises greater monetary discipline in light of globalization and financial innovation in order to achieve the set monetary targets as well as achieve the government objectives(CBK, 2012).

1.4 Kenya's Economic Performance and Inflation Levels since Independence

The summary of Kenya economic performance and trend in inflation levels is summarized in figure 1.2. The first decade of independence (1963-1972), Kenya's gross domestic product grew at an average of 6.7 per cent while inflation averaged at 3.4 per cent. During this period, the Kenyan economy had no serious macro-economic challenges to contend with (Kinyua, 2001). The first major macro-economic imbalance arose in the second decade after independence in the form of 1973 and 1979 oil crises where economic growth averaged at 4.2 per cent while inflation averaged at 13.4 as shown in figure 1.2. Despite the poor performance of the economy during the second decade after independence, the economy reported slight improvements on account of higher incomes from tea and coffee in 1976 and 1977 (Kabubo &Ngugi, 1998).

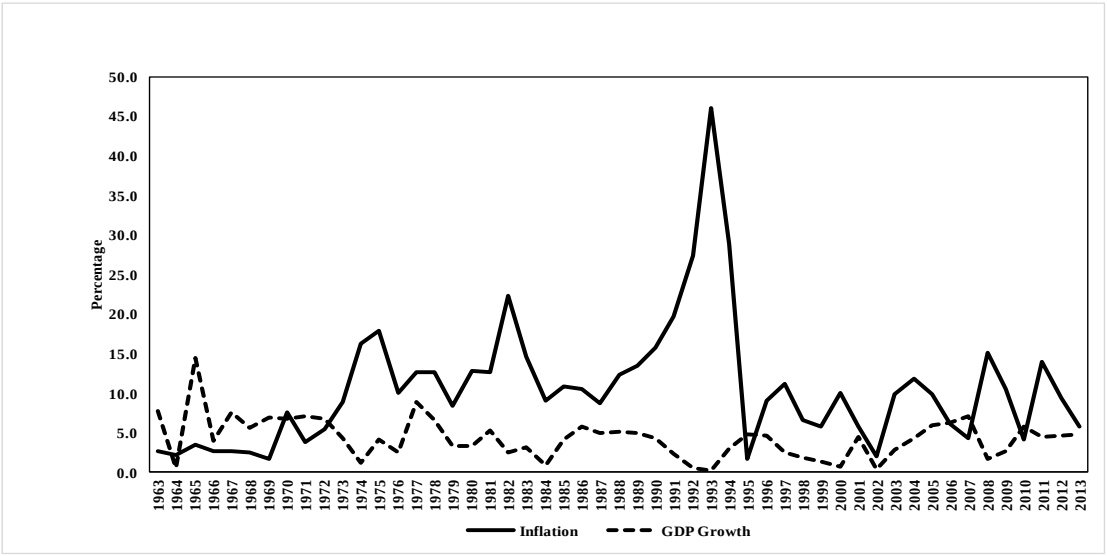


Figure 1.2: Kenya's economic performance and inflation since independence

Source of data: Economic surveys(Various issues), Republic of Kenya.

Figure 1.2 denotes that the period between1983 to2002 economic growth averaged at 3per centwhile annual inflation averaged at13.5per cent. Poor performance of the economy during this period is attributed to poor management of both fiscal and monetary policy. Highinflation was attributed to several factors which include; increased money supply in excess of the targeted level, depreciation of the Kenya shilling, erratic weather conditions, price decontrols, and the activities of the multi-party election in 1992. Government deficit also worsened during this period despite tight fiscal policy. The re-emerging deficit was mainly attributed to the significant proportion of the government budget spent during the 1992/93 multi-party elections(Kabubo & Ngugi, 1998).

In the period 2003-2012, the economy reported positive improvement as shown in figure 1.2 where the economy grew at an average of 4.6per cent while inflation eased to an average of 9.5per cent. The structural reforms undertaken during the period 1993-2002 is among the reasons for the positive outlook of the economy (Kinyua, 2001). Among the main reasons given for Kenya's loss of competitiveness after independence include; choice of inappropriate development strategies, unstable macro-economic environment, uncertain institutional and political environment,poorly managed policy transition anddecline in regional markets especially after the collapse of the East African Community (IEA, 2000).

1.5 Statement of the Problem

The government of Kenya's economic blueprint dubbed Kenya Vision 2030 laid down the macro-economic framework that was intended to move the economy up the value chain (Republic of Kenya, 2007). Maintaining low and stable inflation is critical for long-term economic and social prosperity. Kenya's Vision 2030 laid down the monetary policy to be pursued by CBK that aimed at maintaining a low rate of inflation of below 5 per cent and sustain economic growth at 10 per cent annually. Some of the benefits outlined by the Vision 2030 of maintaining low and stable inflation are; stable levels of growth, employment creation and poverty reduction (Republic of Kenya, 2007).

Recent studies in Kenya indicate that demand for money is unstable. These implies CBK does not have control of the money supply process making it difficult to steer the reserve money with a view to creating monetary conditions that are consistent with the ultimate objective of price stability (Kamau & Sichei, 2012). In addition, the inability of monetary policy to effectively maximize its objectives is as a result of the

shortcomings of monetary instruments used in most developing countries (Agboluaje et al., 2013 and Gichuki et al., 2012).

Despite Kenya implementing monetary policy aimed at achieving stable prices and fostering economic growth, the Kenyan economy has been reporting low economic growth and high rates of inflation. These indicate that there is still a point of disconnect between the various objectives that the Central Bank pursues and the outcome of the policy objectives. Lack of an efficient monetary policy framework implies that the public cannot make rational decisions on communications from CBK. Preceding from such background, this study finds it significantto inform policy-makers the impact of monetary policy on economic growth and prices and the speed of adjustment aftershocks.This would be instrumental in guiding the choice of monetary policy instruments applied, their overall effectiveness and thus generate information which may assist the Central Bank of Kenya (CBK) in meeting its policy goals of low inflation and sustainable economic growth.

II. Literature Review

2.1 Theoretical Literature

Theoretically,the conduct of monetary policyis well explained by the quantity theory of money. The theory lays down the foundation upon which the monetary policy is to be implemented as proposed by the classical economists. This study limits its focus on competing theories that explain the conduct of monetary policy that gave rise to several empirical studies attempting to assess the impact of monetary policy on economic growth and price stability, with most of them showing mixed results in support of one theory or the other. Some of these empirical finding are as follows:

2.2 Empirical Literature

Chow and Shen (2004) sought to establish the relationship between money, price level and output for the Chinese Macro Economy. The study used annual data for the period covering 1954 to 2002 employing a VAR model in the analysis. The study was motivated by Friedman proposition which states that output reacts to money shocks first, and prices later. The results of the impulse response function revealed that in the first year after expansionary monetary shock, most of the impact is on real output,which die down quickly while in the second year, price die out over a long horizon thus confirming Friedman findings.

Kandil (2004) analyzed the effects of exchange rate fluctuations on real output growth and price inflation in a sample of 22 developing countries. The study utilized rational expectation model that decomposes movements in exchange rates into anticipated and unanticipated component. The study analyzed annual time series data covering the period 1955-1995 of real output, price level, real energy price, short-term interest rates, government spending, money supply and real effective exchange rates. The findings revealed that, exchange rate depreciation both anticipated and unanticipated decrease real output growth and increases inflation confirming the negative effects of currency depreciation on economic performance in developing countries. The study recommendsminimizing unanticipated currency fluctuations to insulate economic performance from the adverse effects of this variability in developing countries.

Starr (2005),in an investigation to establish theeffects of monetary policy on output and prices in four CIS countries (Russia, Ukraine, Kazakhstan and Belarus),employed Vector Auto Regression (VAR) on quarterly data covering the period 1995 to 2003. Variables used in the model include; M1, M2, CBR, real exchange rate, real gross domestic product (RGDP) and consumer price index (CPI). The results of impulse response functions revealed that the real effects of monetary policy are relatively modest in these four countries because; prices and wages are flexible, monetization is low, credit markets are thin and domestic interest cannot be determined independently of the world capital markets. The study further reveals that monetary policy is effective in large, relatively closed economy like Russia than in small, relatively open ones.

Shokoofeh (2006)investigated theeffectiveness of monetary policy in the USA during the period 1990 to 2004.The study employed multiple regression model on monetary aggregates (M1 and M2), consumerexpectation and mortgage rates. Consumer expectation was used in the analysis because it captures the overall state of the macro economy than single variables such as inflation rate, short and long-terminterest rates and it avoids the problem of multi-collinearity. The study established that changes in money supply have no impact on mortgage interest rates. The new development necessitates further analysis to establish whether it holds for developing countries.

Cheng (2006) sought to investigate the monetary transmission mechanism in Kenya by investigating how the Central Bank's REPO rate affectsreal output, prices and nominal effective exchange rate. The study usedVAR technique to analyze monthly data during the period 1997 to 2005. The study observed that an exogenous increase in CBK repo rate is followed by a decline in prices and the appreciation of nominal exchange rate but insignificant impact on output. The sluggish response of output to a monetary shock is that the Kenyan financial system is plagued with structural weakness, thereby hampering the monetary transmission to the real sector.

Chuku (2009) investigated the effects of monetary policy innovations in Nigeria employing Structural Vector Auto regression (VAR) on quarterly data covering the period 1986 to 2008. Variables used in the model include; broad money supply, minimum rediscount rate, real effective exchange rate, real gross domestic product (RGDP) and consumer price index (CPI). The results of impulse response functions revealed that monetary policy innovations have both real and nominal effects on economic parameter depending on the policy variable selected. The study also revealed that price-based nominal anchors (MRR and REER) do not have a significant influence on real economic activity. Whereas, innovations in the quantity-based nominal anchor (M2), affects economic activities modestly. It therefore, follows that monetary policy shocks have been a modest driver of business cycle fluctuations in Nigeria.

Gichuki et al. (2012) sought to determine the optimal monetary instruments for Kenya, employing stochastic IS-LM model. The study sought toestablishthe optimal instrument between interest rates and reserve money in influencing the conduct of monetary policy in Kenya and further establish whether a combination policy mix of both instruments was a better policy than using either of them independently. Variables used in the model include gross domestic product, M_3, and CBK overdraft interest rate. The study used quarterly data covering the period 1994 to 2010. The study establishedthat theinterest rate is a superior policy instrumentover reserve money in meeting Kenya's monetary policy objectives.The study further revealed that a combination policy mix performs better than the two instruments working independently.

Asongu (2013)assessed the long-run and short-run effects of monetary policy on output and prices on annual data in a sample of 10 African countries experiencing high inflation rates. The study employed vector autoregressive, vector error correction and granger causality econometrictechniques.Variables used in the model include; financial depth (M2/GDP), credit efficiency (Credit/deposits) and size (deposits/total assets). The study established that permanent changes in financial depth, efficiency, credit and size affect prices in the long-run but in cases of disequilibrium; only financial depth and size adjust inflation to the cointegration relations. The study further established that monetary policy does not affect prices in the short–run.

III. Methodology

3.1 Model Specification

The study followed the approach initially developed by Sims (1980), refined by Christiano, Eichenbaum and Evans (1999) and implemented by Starr (2005). To observe the effects of monetary policy in Kenya, the study adopted the Structural Vector Auto regression (SVAR) approach because it captures complex dynamic interrelationships among macro-economic variables quite well, and because it is the common model used in the literature for identifying the impact of monetary policy shock (Coric, Perovic & Simic, 2012).Consider the model with;

$$Y_t = \sum_{i=0}^{k} B_i Y_{t-i} + \sum_{i=1}^{k} C_i P_{t-i} + A^y v_t^y \quad \text{..... (7)}$$

$$P_t = \sum_{i=0}^{k} D_i Y_{t-i} + \sum_{i=0}^{k} G_i P_{t-i} + A^p v_t^p \quad \text{..... (8)}$$

Where; $Y_t = [\, rgdp_t \quad GDPdef_t \,]$ and $P_t = [\, M3_t \quad ILR_t \quad REER_t \,]$

Yt= vector of macro-economic variables which include; real Gross Domestic Product, Gross Domestic Product deflator and

Pt= Monetary policy variables which include; broad money supply (M_3), interbank lending rate (ILR), Real effective exchange rate (REER).

The vector of policy indicators have information about policy but also affected by macro variables:'P' depends on current and lagged values of 'Y' and 'P' and disturbances, one of them being money supplyshockrepresented by 'v^s'. 'Y' depends on its current and lagged values and on lagged values of 'P'. Note that there is a block exogeneity assumption, in the sense that 'P' does not enter 'Y' during the same period, while 'Y'and 'P' does enter 'P' during the period. This means that innovations to policy variables do not feedback to the economy contemporaneously (Bernanke & Mihov, 1998). The output shock denoted 'v^y'and price shock denoted by 'v^p' are the unobservable, structural shocks, which the study sought to retrieve and they wereserially uncorrelated disturbances that had zero mean and variance co-variance matrix $\sum \varepsilon$ and 'i' is the number of lags.

The study assumed that the Central Bank cannot respond instantaneously to developments in the real economy. This assumption imposed a recursive restriction on the reduced form disturbance. This restriction helped to identify and interpret the relationship between the residuals of the SVAR model and the underlying innovations

in monetary policy variables. It is only when the innovations have been correctly identified that the estimated SVAR can be used to generate impulse response functions that describe the time-dynamic effects of monetary innovations on the non-policy variables. This process is usually referred to as the Cholesky decomposition(Christiano et al.,1999). Specifically, this assumption implies that monetary policy innovations are determined based on knowledge of contemporary and past values of the non-policy variables, whereas, the non-policy variables respond to changes in the policy variables with a lag and not vice-versa.

Since the study was not sure which policy variable(s) was related to economic growth and prices, the study included all the three measures of monetary policy in the SVAR model. The money supplywas measured by M_3, the study employed M_3 because itis highly correlated with output and prices (Starr, 2005); the key policy interest rate was taken to be the inter-bank lending rate. The study also included the real effective exchange ratesas it acts as a "pass-through" channel, that is, a component of the cost of imported items and helps to capture the traditional interest rate paradigm, where monetary policy has the immediate effect of changing the returns on assets denominated in other currencies. Economic growth was measured by real GDP while GDP deflator (GDPdef) measured general price level. Real GDP and the GDP deflator were chosen because they are better indicators of broad macro-economic conditions than the more conventional monthly indicators like industrial production and the CPI (Bernanke & Mihov, 1998).

Policy variables were ordered in the SVAR after the non-policy variables with real GDP coming first, based on the assumption that it adjusts most sluggishly. The ordering technique deviated from the usual ordering used for developed economies where prices are assumed to be the most sluggish, and hence, entering first (Starr, 2005). Nonetheless, reversing this order was likely to be more appropriate for Kenya where prices are relatively flexible and the rigidity of production techniques makes output more inelastic.Within the policy related block, the study followed Starr (2005) in ordering the variables thus; money supply came first, followed by the Interbank-lending Rate and lastly the real effective exchange rate to reflect their respective likely degrees of endogeneity.

3.2 Definition and Measurement of Variables

As guided by empirical literature output and input of monetary policy is easily defined by considering its objectives; prices stability and economic growth. Based on these roles table 3.1 summarizes the definition and measurement of variables used in the study.

Table 3.1: Measurement of variables

Variable name	Definition
Real gross domestic product (RGDP)	Real GDP, at annual rate, expressed in constant units of local currency (Kes).
Gross domestic product deflator(GDPdef)	Gross domestic product deflator, 2000=100.
Broad money supply (M3)	Includes M2 plus longer-term time deposits and money market funds with more than 24-hour maturity.
Real effective exchange rate(REER)	Real effective exchange rate: Units of local currency per US dollar, adjusting for differential rates of inflation.
Interbank lending rate(ILR)	This is the rate of Interbank transaction fixed by Monetary policy committee.

Source: Author

3.3 Data Types and Sources

Theresearch usedquarterly secondary data for the period 1992 to 2013 to analyze the impact of monetary policy on economic growth and prices. Data were obtained from government official documents such as Economic Surveys, Central Bank of Kenya publications and other sources including International Financial Statistics. All nominal variables were converted to real variables measured in constant (2000) Kenya shillings. The year 2000 was chosen as a base year because most macro-economic variables showed normal performance during this period. Apart from being a more recent year, it was during this timethat few changes were experienced in the economy (Kosimbei, 2009). GDP deflator was chosen because it's a better indicator of broad macro-economic conditions than the more conventional monthly indicators like industrial production and the CPI (Bernanke & Mihov, 1998).

IV. Empirical Findings

4.1 Time Series Properties

Before the effects were identified using impulse response functions and variance decomposition analysis, the data series had to be tested for stationarity. The Augmented Dickey Fuller (ADF) and Phillip Peron (PP) tests results are presented in table 4.1.With the exception of real gross domestic product, all other variables were non-stationary and became only stationary after being transformed to their first differences. For real GDP, the study obtained inconsistent stationarity results. The ADF test did not reject the hypothesis of the presence of a unit root in the levels. However, the PP tests gave results that suggested non-stationarity at the series level.

The inconsistent results for real GDP were not surprising, given the known computational difficulties of distinguishing between non-stationary and stationary data sets with short-time spans (Maddala & Kim, 1998).

Table 4.1: Unit root tests results

Variables	Test at Levels	Unit Root Test			
		ADF test		PP test	
		t-statistic	Critical Value (5%)	t-statistic	Critical Value (5%)
Real GDP	Constant	-3.149	-2.896	-2.034	-2.895
	Constant and Trend	-3.708	-3.463	-2.424	-3.462
GDPdef	Constant	1.695	-2.896	3.315	-2.895
	Constant and Trend	0.228	-3.463	1.938	-3.462
Broad money supply	Constant	3.507	-2.895	11.04	-2.895
	Constant and Trend	1.139	-3.463	5.00	-3.462
Interbank lending rate	Constant	-2.972	-2.896	-2.267	-2.895
	Constant and Trend	-3.796	-3.464	-2.739	-3.462
Real effective exchange rate	Constant	-1.641	-2.896	-1.072	-2.895
	Constant and Trend	-1.393	-3.158	-0.638	-3.462

Source: Constructed from study data

Following the above results in table 4.1; GDPdeflator, money supply, interbank bank lending rate and real effective exchange rate were fed into the model at their first differences, while real GDP entered at its levels.

4.2 VAR Diagnostic Tests

Diagnostic tests were performed to check the appropriateness of the estimated VAR. The results are presented in table 4.2.

Table 4.2: VAR diagnostic statistics

VAR Condition	**Statistic**	**Conclusion**
Stability condition	Roots of the polynomial are within unit cycle. Highest is 0.765	VAR is stable
Lag exclusion test	Wald test for 2 lags, 25 df, Chi-square = 30.264, p-value = 0.0000	2 lagsare important
Residual serial correlation	LM test statistic =14.875, P-Value = 0.944	Shows serial correlation at lag order 1 hence lag 2 is used

Source: Constructed from study data

Based onADF, PP, Lr tests and final predication error two lags were found to beoptimal. The diagnostic tests indicated that the VAR model was stable since the roots of the polynomials were within the unit cycle. The lag exclusion test indicated that 2 lags were acceptable in the VAR model. The VAR model was, therefore, found to be appropriate. The residual serial correlation test indicated absence of serial correlation in the residuals.

4.3 Structural VAR Model

The study used Sims' 1986 structural VAR approach. Using Sims approach, therefore, implied that the structural VAR estimated the structural coefficients by imposing contemporaneous structural restrictions based on economic theory. This approach imposes restriction on the primitive system such that some coefficients equal zero (Enders, 2004).

To identify the structural model from an estimated VAR, it was necessary to impose $(n^2-n)/2$ restrictions on the structural model (Enders, 2004). Imposing restrictions must be supported by theoretical foundation otherwise the model will be improperly identified and as such, the impulse responses and variance decompositions resulting from this improper identification can be quite misleading (Enders, 2004).The restrictions were placed using theoretical underpinnings shown in table 4.3.

Table 4.3: Theoretical underpinnings for variables in the system

Variable	**Determinants**	**Theoretical Basis**
Economic growth	Human capital, government expenditure, net exports, capital stock, inflation	Barro (1991)
GDP deflator	Exchange rates, money supply, interest rates,	Monetary policy
Interbank lending rate	Inflation, government debt, economic growth	Monetary policy
Broad money supply (m3)	Interest rates	Monetary policy
Real effective exchange rate	Inflation, interest rates, net exports.	Monetary policy

Based on theory as indicated in table 4.3, the 'A' matrix used in the structural VAR model was specified as follows:

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ \alpha_{21} & 1 & 0 & 0 & 0 \\ \alpha_{31} & \alpha_{32} & 1 & 0 & 0 \\ \alpha_{41} & \alpha_{42} & \alpha_{43} & 1 & 0 \\ 0 & 0 & \alpha_{53} & \alpha_{54} & 1 \end{pmatrix} \quad \begin{pmatrix} RGDP \\ GDPdef \\ M3 \\ ILR \\ REER \end{pmatrix}$$

The B matrix is a diagonal matrix with constants at its principal diagonal. As pointed out by Enders (2004), the aim of a structural VAR is to use economic theory to recover the structural innovations from the residuals. Restricting some variables to zero implies their shocks do not have contemporaneous effects on targeted variables. Notice that there are 12 zero restrictions on the 'A' matrix: the system is over identified; with five variables, exact identification requires only $(5^2-5)/2=10$ restrictions. Any restriction in the SVAR model has to be supported by theoretical reasoning as done in table 4.3; otherwise the underlying shocks will be improperly identified.

Using the identified restrictions,the study estimated the relation 'Ae_t'='Bu_t' as a set of equations identifying each element of the 'e_t'and 'u_t' vectors. Elements of the 'A' and 'B' matrices estimated were specified as elements of a coefficient vector. 'A' and'B'matrices were estimated using maximum likelihood, assuming the innovations are multivariate normal. The log likelihood was estimated by the method of scoring. The structural innovations were orthonormal (i.e. E $(e_te_t) = I_{n)}$ implyingthere was no contemporaneous correlation between shocks.

The SVAR estimates are not easy to interpret. Impulse response functions offer useful representation of the models as they are easy to understand and interpret. Identified shocks were imposed on SVAR residuals from which the impulse response functions were generated and interpreted in the next section.

4.4 Estimation Results of Impulse Responses

The impulse response function traced the effects of a one-standard deviation shock to the innovation on current and future values of all the endogenous variable of the system. A shock to the i^{th} variable directly affected thei^{th} variable and was also transmitted to the entire endogenous variable through the dynamic structure of the VAR (Enders, 2004).

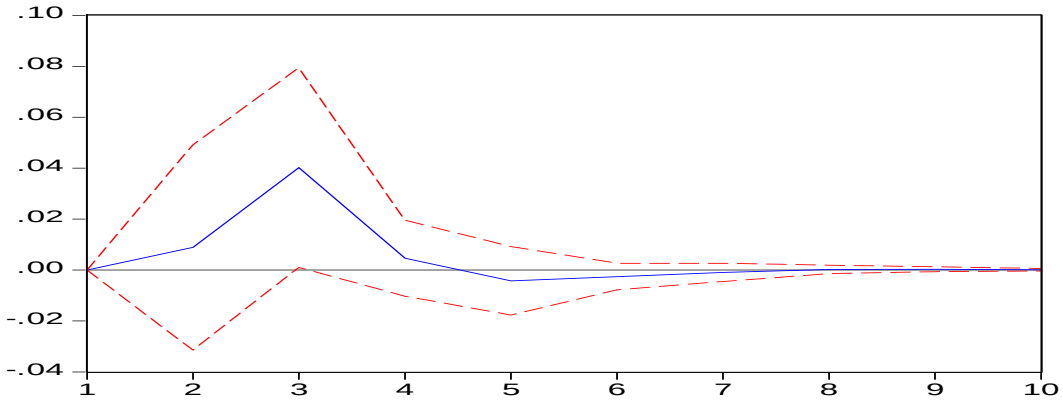
Policy variables were ordered in the SVAR after the non-policy variables with real GDP coming first, based on the assumption that it adjusts most sluggishly. The ordering technique deviated from the usual ordering used for developed economies where prices are assumed to be the most sluggish, and hence, entering first (Starr, 2005). Nonetheless, reversing this order was likely to be more appropriate for Kenya where prices are relatively flexible and the rigidity of production techniques makes real GDP more inelastic.

Within the policy-related block, the study followed Starr (2005) in ordering the variables thus; money supply came first, followed by the interbank lending rate and lastly, the real effective exchange rate to reflect their respective likely degrees of endogeneity. The study utilized the SVAR residuals to generate impulse responses for each variable. The plots and impulse responses that follow summarize the results of the shock evaluation, indicating the responses of each variable over the ten periodhorizons to the initial one-standard deviation positive shock to each of the five variables.

4.4.1. Impact of Monetary Policy on Real GDP in Kenya

The first objective of the study was to examine the effects of the monetary policy on real GDP. This was done by the estimation of the Structural Vector Auto Regression model and the subsequent use of its residuals to generate impulse responses and variance decomposition analysis. Figure 4.1 presents the impact of broad money supply (M_3) on real GDP.

Figure 4.1: Impact of broad money supply on real GDP



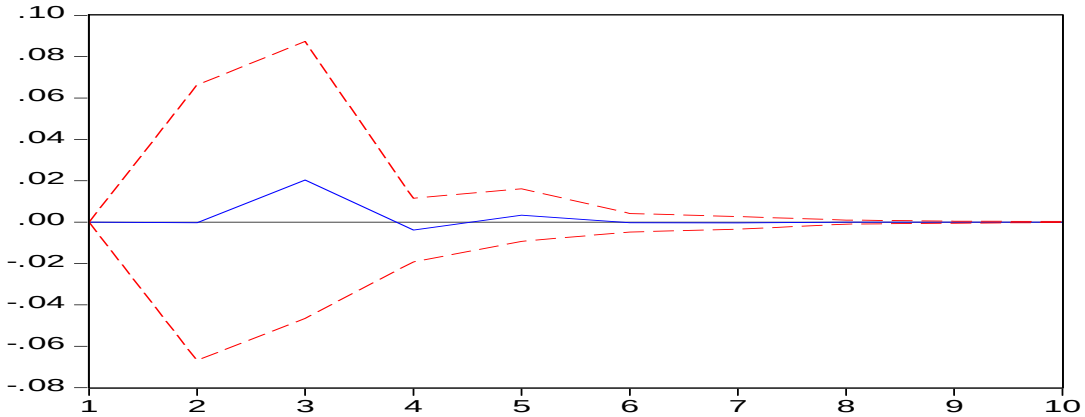
Source: Derived from data

The response to onestandard deviation shocktobroad money supply results in a stable time path, which declines to zero with respect to economic growth as shown in figure 4.1. This effect lasted for sevenperiodsbefore fizzling out.The effect of a onestandard deviation shock on money supply affects real GDP positively in the firstthree and a half periods, then moved to negative territory for three and a half periods after which it returns to its natural path. This suggests that money supply positively affects real GDP because the effect takes longer in the positive territory. The positive effect could be as a result of increase in aggregate demand through the multiplier effect.

This response was consistent with the traditional Keynesian IS-LM model and the Mundell-Fleming-Dornbusch model (Dornbusch, Fischer & Startz, 2008). However, the time dynamics were startling, considering the rigid nature of the production techniques used in the economy. Normally, economic agents are expected to adjust their spending and investment habits moderately and gradually in response to the increased supply of funds rather than immediately. Therefore, it follows that this response may not reflect the usual marginal adjustment to the policy innovation. Rather, it measures the concurrence of significant changes in output during the period preceding the monetary innovation.

The results are similar to those found by Starr (2005) in CIS countries where real effects of monetary policy are relative modest because prices and wages are relatively flexible, monetization is low, credit markets are thin and domestic prices cannot be determined independently of world capital markets. The current study reaffirmed that real effects of monetary policy are fast and fleeting.The results are also similar to those found by Bernanke and Mihov (1998) and Asongu (2013) that positive shocks to monetary policy variables positively affect real GDP.The next figure presents the impulse response graph for real GDP on interbank lending rates.

Figure 4.2: The impact of interbank lending rate on real GDP

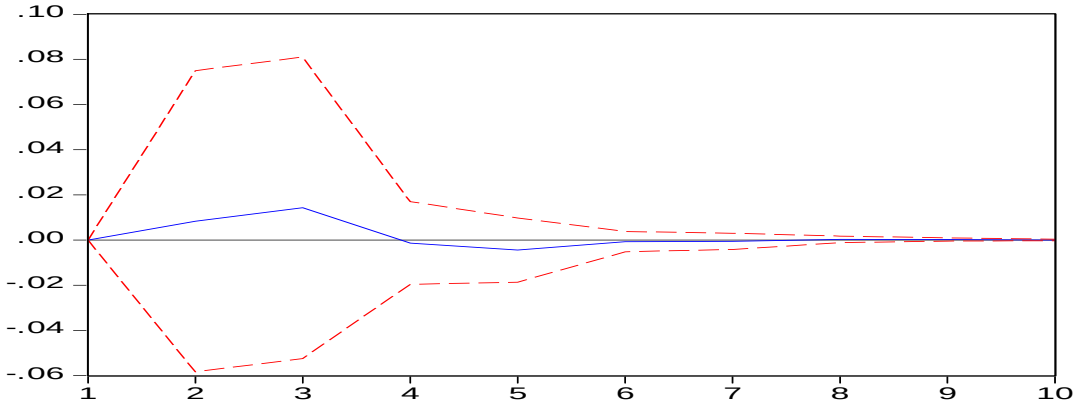


Source :Derived from data

As shown in figure 4.2, it will take fiveperiods for the effect on real GDP due to a one standard deviation shock on interbank lending rates to fizzle out.

The results show mixed effects of one standard deviation shock on interbank lending rate. In the first period, the effect is neutral, then on the positive territory for the next two periods, then negative for one period after which it returns to positive territory for one period before stabilizing at the new level. The direction ofthis effect is consistent with expectations but the speed of adjustment is surprising becausebusiness people and consumers are expected to adjust their spending moderately andgradually to changes in returns to saving and in the costs of investment, rather than substantiallyand immediately. A probable explanation is that the estimated effect does notreflect a usual marginal adjustment to a marginal policy change, but rather it measures theconcurrence of dramatic changes in real GDP and interest rates during the period. This result is in support of Chuku (2009) and Starr (2005), who foundsimilar results that a positive shock on interest rates has positive effect on real GDP in the earlier periods before fizzling out and returning to its natural path.The next figure presents the impulse response graph for real GDP on real effective exchange rate.

Figure 4.3: The impact of real effective exchange rate on real GDP



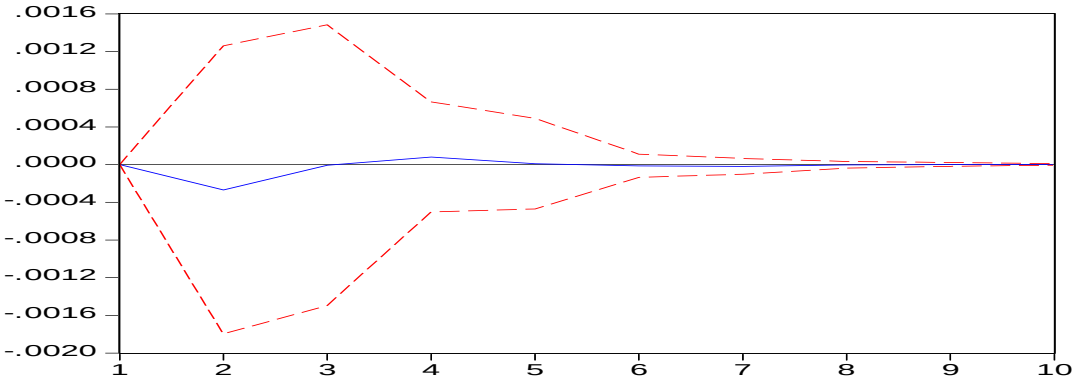
Source: Derived from data

The response to one standard deviation innovation to real effective exchange rate results in a stable time pathwhich declines to zero with respect to real GDP as shown in figure 4.3.This effect lasted for fiveperiods before fizzling out.The effect was initially positive for three periods then moved to negative territory for two periods after which it returns to its natural path.Practically, this is true because depreciation of the real exchange rate makes local tradable goods more competitive globally and hence increases the demand for the local commoditiesimpacting real GDP positively.Chuku (2009) and Starr (2005) found similar results that real exchange depreciation impactsreal GDPpositively but petering out and returning to its natural path after a short period.This response is theoretically consistent especially for an open economy with many trading partners like Kenya.

4.4.2. Impact of Monetary Policy on Prices in Kenya

The second objective of the study was to examine the effects of the various components of monetary policy on prices (inflation). This was done by the estimation of the Structural Vector Auto Regression model and the subsequent use of its residuals to generate impulse responses and variance decomposition analysis. Figure 4.4 presents the impact of broad money supply (M_3) on prices.

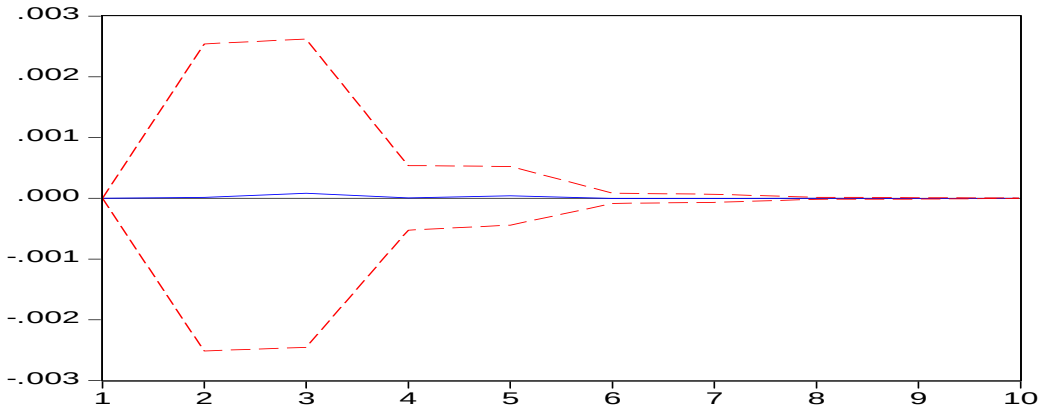
Figure 4.4:The impact of broad money supply on prices



Source: Derived from data

The response to one standard deviation innovation to broad money supply results in a stable time path which declines to zero with respect to prices as shown in figure 4.4. The effect of a one standard deviation shock on money supply on prices would last for seven periods, after which it reduces to zero. The effect was initially negative for two periods, then on positive territory for two periods before returning to a stable path for one period, and then moved to negative territory for two periods before finally returning to its natural path.This suggests that money supply has mixed results on prices. The quick response suggests that prices are relatively flexible; hence the sticky price assumption for the basic Keynesian IS-LM model may not be effective in Kenya. Bernanke and Mihov (1998) found similar mixed results but petering out and returning to its natural path after a short period.The next figure presents the impulse response graph for prices on interbank lending rates.

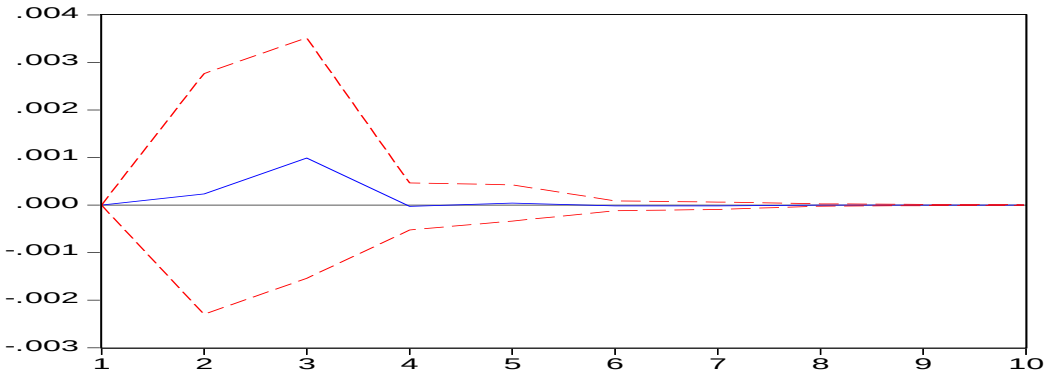
Figure 4.5: The impact of interbank lending rates on prices



Source: Derived from the data

The response of prices to one standard deviation innovation to interbank lending rate resulted in a stable time path that declined to zero as shown in figure 4.5. The effect of a one standard deviation shock on interbank lending rate on prices would last for five periods, after which it reduces to zero. The effect had mixed results over the period. The effect was neutral for one period, then on the positive territory for two periodsbefore returning to stable path for one period, and then moved to positive territory for one period before finally returning to a stable time path. This impliesthat unanticipated shock to interbank lending rate has insignificant effectson prices. This evidence rules out the existence of the price puzzle in Kenya. The results of this study are consistent with results from Chuku (2009), Starr (2005);Bernanke and Mihov (1998) but different from Sims (1991) for OECD countries and Christiano et al. (1999) where evidence suggested the existence of the prize puzzle. Although explanations of the price puzzle vary, the effects disappear once commodity prices are included in the model, probably because commodity prices contain information about future inflation that policy-makers considered at the time they raised the interest rates (Starr, 2005). The insignificant effect of the interest rate shock on prices is simply a confirmation of the thin nature of the credit markets in the economy.The next figure presents the impulse response graph for prices on interbank lending rates.

Figure 4.6: The impact of real effective exchange rate on Prices



Source: Derived from data

As shown in figure 4.6, it would take five periods for the effect on prices due to fizzle out if one standard deviation shock on real effective exchange rate is affected. The effect was on thepositive territory for three periods, then slightly on the negative territoryand then to the positive territory for two periodsbefore finallystabilizing. This suggests that a one standard deviation shock to exchange rate affects prices positively because the magnitude of the effect lasted for five periods. Theoretically and practically, this is true because depreciation of the real exchange rate makes local tradable goods more competitive globally and hence increases the demand for the local commodities. This increased demand puts an upward pressure on prices eventually leading to higher prices in the next period.Bernanke and Mihov (1998) found similar results that an expansionary monetary policy affects prices positively but petering out and returning to its natural path after a short period.

4.5 Variance DecompositionAnalysis

This was an alternative method to the impulse response functions for examining the effects of shocks to real GDP and prices. This technique determined how much of the forecast error variance for any variable in a system was explained by innovations to each explanatory variable over a series of time horizons (Enders, 2004). The own series shocks explained most of the error variance, although the shock also affected other variables in the system. It was also important to consider the ordering of the variables when conducting VDA. This was because in practice, the error terms of the equations in VAR were correlated, so that the result depended on the order in which the equations were estimated in the model. The plots of variance decomposition are presented in the following tables.

Table 4.4: The Results of variance decomposition of real gross domestic product

Period	S.E.	RGDP	GDPDEF	M3	ILR	REER
1	0.291	100.000	0.000	0.000	0.000	0.000
2	0.293	99.826	0.001	0.092	0.000	0.081
3	0.297	97.262	0.034	1.921	0.472	0.310
4	0.297	97.211	0.046	1.942	0.488	0.312
5	0.297	97.097	0.108	1.960	0.501	0.334
6	0.297	97.089	0.108	1.967	0.501	0.334
7	0.297	97.088	0.108	1.968	0.501	0.335
8	0.297	97.088	0.108	1.968	0.501	0.335
9	0.297	97.087	0.109	1.969	0.501	0.335
10	0.297	97.087	0.109	1.969	0.501	0.335

Source: Derived from data

The results presented on Table 4.4 show that all variations in growth of real gross domestic product were due to its own shock at 100 per cent in the first period. The variation of own shocks in growth of real GDP reduced to 99.826 per cent in the second period and even to a lower level as the forecast horizon increased. It was further noted that the variations in the growth of real GDP shock in the first period brought about by other variables was zero , implying that on impact, the variation of growth in real GDP were totally own shocks.

A further observation of the results in Table 4.4 reveals that the effects of other variables apart from real GDP in the system increase with the increase in forecast period. This implies that real GDP had feedback effects with variables in the system and the effects were multidirectional. The VDA results in the table further support the findings of this study that real GDP has a significant effect on macro-economicrudiments.

Table 4.5: The results of variance decomposition of prices

Period	S.E.	RGDP	GDPDEF	M3	ILR	REER
1	0.291	0.022	99.978	0.000	0.000	0.000
2	0.293	0.217	99.679	0.059	0.000	0.045
3	0.297	0.423	98.684	0.058	0.006	0.829
4	0.297	0.432	98.670	0.063	0.006	0.830
5	0.297	0.434	98.664	0.063	0.007	0.831
6	0.297	0.434	98.664	0.063	0.007	0.831
7	0.297	0.434	98.664	0.064	0.007	0.831
8	0.297	0.435	98.664	0.064	0.007	0.831
9	0.297	0.435	98.664	0.064	0.007	0.831
10	0.297	0.435	98.664	0.064	0.007	0.831

Source: Derived from data

The results presented on Table 4.5 show that variations in growth of prices were due to its own shock at 99.978per cent in the first period. The variation of own shocks in growth of pricesreduced to 99.679per cent in the second period and even to a lower level as the forecast horizon increased. It was further observed that the variations in the growth of pricewas brought about by real GDP at 0.022per cent ,but money supply, interbank lending rate and real effective exchange rate did not contribute to the variations , implying that on impact, the variation of growth in prices were notentirely own shocks.

A further observation of the results in Table 4.5 reveals that the effects of other variables apart from interbank pricesin the system increase with the increase in forecast period. This implies that priceshad feedback effects with variables in the system and the effects were multidirectional. The VDA table further supports the findings of this study that prices have a significant effect on macro-economic rudiments.

This section reveals that policy variable defined by broad money supply, interbank lending rate and real effective exchange rate have an effect on real gross domestic product and prices, which lasts for more than fourperiods. The impulse response functions and the VDA have shown that the effects of policy variables are far reaching in the economy but their effect are felt for short periods of time.

V. Summary, Conclusion And Policy Implication

5.1. Summary

The overall objective of this study was to determine the impact of monetary policy variables on economic growth and prices. The present study is important because it contributes to the debate on rationalization of monetary policy as presented in Kenya's Vision 2030, by establishing the precise quantitative nature of the impact of monetary policy on real GDP and prices.

The first objective of the study was to determine the impact of monetary policy on economic growth in Kenya. Since it was not possible to directly estimate the impact between the selected policy variables onreal GDP using ordinary least squares technique (OLS), it prompted the use of Structural Vector Autoregression.The SVAR method captured the evolution of the interdependencies between multiple time series, generalizing the univariate autoregressive (AR) models. However, the SVAR estimates are not easy to interpret. Impulse response functions offer useful representation of the models as they are easy to understand and interpret. Identified shocks were imposed on SVAR residuals from which the impulse response functions and variance decomposition analysis were generated which suggested that monetary policy variables have significant effect on real GDP that lasted for more thanfour periods.The study found that overall, CBK's monetary policies play crucial role in influencing the level of productivity in the country. This result gives weight to the place of Central Bank in the national development process of a nation.

The second objective was to analyze the impact of monetary policy on prices. The SVAR analysis revealed that the adoption of various monetary policy measures by the Central Bank of Kenya have no significant impact on the inflation rate in the country. The results suggested that the problem of inflation in Kenyan is not a monetary phenomenon but is rather attributable to the structural rigidity in the country.

5.2. Conclusion

The study employed SVAR approach to trace the effects of monetary policy shocks on real GDP and prices in Kenya. The study assumed that Central Bank cannot observe unexpected changes in real GDP and prices within the same period. These placed a recursive restriction on the disturbances of the SVAR which generated impulse response functions that tracked the effects of monetary policy innovations on real GDP and prices. Overall, the study established that monetary policy innovations have both real and nominal effects on real GDP and prices parameters depending on the policy variable selected. The studyrevealed that price-based nominal anchors i.e. interbank lending rate and real effective exchange rate do not have significant influence on real economic activity. Whereas innovations in the quantity-based nominal anchor broad money supply

affectreal GDP and prices modestly, it therefore follows that monetary policy shocks have been a modest driver of business cycle fluctuations in Kenya.

In summary, the contributions of this study to the knowledge include: the study found a multi-directional effect between monetary policy and real GDP and prices. This indicated that there was a feedback effect between monetary policy variables and real GDP and prices. Finally, the study established that a shock in selected monetary policy parametersis unlikely to lead to a shock in real GDP and prices instantaneously, but rather the effect was gradual and even fizzle out after a short period.

5.3. Policy Implications

In light of these research findings, Kenya's monetary policy has been characterized by both internal and external shocks which have impacted onmacro-economic performance. Therefore, several policy implications can be drawn to remedy the situation.The Central Bank of Kenya and the government to place more emphasis on quantity based nominal anchors such as money supply since it has significant effects on real GDP and prices. These will ensure that the economy is not adversely affected.

For effective monetary policy management, the Central Bank of Kenya should focus on manipulating instruments like the liquidity ratio, reserve ratio, and transaction on Treasury Bills and REPOs which directly affects the money supply and eventually through transmission mechanism impact on real GDP and prices. Little emphasis should be placed on the use of interest rates and exchange rates to manage the economy. This is because they have insignificant effects on real GDP and prices.

The Central Bank of Kenya should maintain an independent monetary policy, not so much to fine-tune frequent shocks to real GDP and prices, but as a safety valve for dealing with sudden shifts in underlying conditions.To address challenges of inflation in the country, the Central Bank of Kenya and the government should address the structural rigidity in the country as the problem of inflation in Kenya is not a monetary phenomenon as revealed by the study findings. Since Kenya is operating far below full employment equilibrium, the government should ensure increase in GDP translates to improved purchasing power and reduced poverty index.The Central Bank of Kenya and the government should concentrate on creating public awareness, improving operations of the financial market, enhancing the depth and breadth of the market and building regulatory capacity so as to appropriately position the market to face the challenges ahead.

The Central Bank of Kenya should be more vigilant on thecyclical behaviour of the economy. Full knowledge of the business cycle will go along way in assisting monetary policy to be responsive to the business cycle. Thus,an accurate business cycle mechanism should be in place to monitor the events in theeconomy.

5.4. Areas for FurtherResearch

This study was limited to monetary policy instruments namely broad money supply, interbank lending rates and real effective exchange rate. This limitation creates a need for further research for inclusion of other monetary policy instruments that will impact on economic growth positively and lead to price stability. The study further noted that monetary policy implementation in developing countries like Kenya face additional challenges that are not present in developed economies; such as fiscal dominance. Therefore, to better understand the impact of monetary policy shocks on real GDP and prices, thereis need for a further study that would include fiscal policy variables as dependent variables in the analysis.

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