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Monetary Policy Transmission Mechanism in East Africa: A Comparative Study of Tanzania, Kenya And Uganda

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Abstract

This study makes a comparative analysis of the channels and effectiveness of the transmission mechanisms of monetary policy in three East African countries. The study applies time series data that is analysed using a Recursive Vector Autoregressive technique. The results suggest that exchange rate is the dominant monetary policy transmission channel in Tanzania and Uganda; and the bank credit channel is found to be the most dominant mechanism in Kenya. Further, the results suggest the existence of good potential for targeting inflation or interest rate rather than monetary aggregates, especially for Tanzania and Kenya, since Uganda has already embarked on inflation targeting lite, and is currently faring well.

Keywords: *monetary policy, reserve money, interest rate, inflation*

JEL Classification: E31, E37

1. Introduction

Member countries of the East African Community (EAC) have an agreement to establish a monetary union; and that they will adhere to a common macroeconomic policy framework that will lead to the achievement of macroeconomic stability, economic growth, and good balance of payments (EAC, 2013; MU Protocol, Article 7: 10). The monetary union has not been established yet, and one of key reasons is the mismatch in convergence criteria across the EAC countries. Among the convergence criteria are variables associated with the monetary phenomenon of the region, which can be achieved through sound implementation of monetary policy; including inflation rate and balance of payments, among others.

The envisaged establishment of a monetary union supportive to the attainment of fundamental macroeconomic goals presupposes the existence of good understanding of the channels of monetary policy transmission and their effectiveness. There are some country-specific studies that attempt to understand this subject. However, these have not focused on the conduct of monetary policy in an integrated economic block of the EAC that is in quest for monetary union (see Nannyonjo (2001) and Mugume (2011) for the case of Uganda; Cheng (2007), Misati

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et al. (2010) and Buigut (2010) for Kenya; and Aikaeli (2006), Mbowe (2008), Minja and Magina (2009), and Montiel et al. (2012) for Tanzania). Therefore, scanty literature exists on monetary policy transmission mechanisms in the EAC, and the existing studies like Davood et al. (2013) look only into whether changes in monetary policy do affect prices and output.

The main objective of this paper is to establish empirically the most relevant and effective channels of monetary policy transmission in each of the three EAC countries by using time series data for 1967-2016. The focus on Kenya, Tanzania and Uganda has been dictated by the availability of long-term series of data; and the corresponding experiences of the trio countries in conducting monetary policy in the region. The results of this paper can contribute to the design of country-specific monetary policies; and, in that regard, inform potentials that exists for a common monetary policy framework, as well as the strategic actions for achievement of macroeconomic stability across EAC as one the regional convergence criteria.

2. Historical Overview of Monetary Policy Regimes in the EAC

The history of development of monetary sector in East Africa starts from 1903 when the British colonial government established the East African Currency Board (EACB). The EACB operated as a 'money changer', that is, only to ensure the existence of a stable convertibility of the East African shilling and the British Pound Sterling. EACB did not use the most of conventional instruments of monetary control, including Open Market Operations (OMO), discount rate, and reserve requirement, *inter alia* (Kasekende & Atingi, 2008). The development and growth of nationalism since the 1950s apparently prompted some artificial changes in the monetary framework of the EACB. In 1955, the EACB started to lend to the governments in East Africa, a development that loosened the link between changes in money supply and balance of payments outcomes.

The attainment of political independence by the three EAC countries in the early1960s, together with the crave for rapid economic growth and development by the young post-colonial governments could not be met by the 'rule-based' EACB. In this regard, the role of the EACB was irreconcilable with the development vigour of the post-colonial nationalistic governments. The national governments lacked discretion over credit expansion to support rapid economic growth and development. Endeavours to reform the EACB to make it more active in promoting economic growth and development in East Africa failed. A three-tier central bank for East Africa proposed by Blumenthol report and similarly by the Newlyn report was rejected in favour of independent central bank for each country.[1] Consequently, the EACB was replaced by independent central banks that became established and operational in Tanzania, Uganda, and Kenya in 1966.

[1] According to Ndung'u (2008) the demise of the EACB robbed the East Africa union the chance to develop a monetary union.

The charters of each of the three central banks carried conventional central bank roles, i.e., the use of traditional indirect instruments of monetary policy to achieve price stability. However, the operationalization of monetary policy changed thereafter in each country. In Tanzania, the *Ujamaa and Self-Reliance Policy* of the Arusha Declaration of 1967 required the Bank of Tanzania to regulate and promote economic growth. On this account, and by fiat, the conduct of monetary policy drifted away from the indirect to direct instruments that included pegged interest and exchange rates, and credit rationing that directed credit allocations in favour of key designated financial institutions and/or sectors of the economy. In Uganda, credit rationing and credit ceiling assumed importance in the conduct of monetary policy (Mugume, 2011). In Kenya, the government used instruments of direct monetary control, mainly credit controls by selective instruments on bank lending, licensing of foreign trade and control on interest rates (Ndung'u, 2008; Ngugi & Kabubo, 1998).

The use of direct monetary policy instruments to achieve mostly conflicting multiple objectives of central banks largely undermined the effectiveness and transmission of monetary policy in East Africa (Ndung'u, 2008). Apparently, corrective actions to restore effective monetary policy were embedded in economic reforms, particularly the liberalization of the financial sector since the mid-1980s. In Tanzania, the Banking and Financial Institution Act (BFIA) was enacted in 1991 to liberalize the financial sector. In tandem and among others, the government liberalized foreign exchange market by enacting the Foreign Exchange Act in 1992;[2] and also provided for the establishment and development of a stock exchange market.

To better provide supportive environment to the conduct of monetary policy were 'secondary reforms' in the legal and regulatory framework of the banking system. The three East African countries enacted central bank charters that declared the attainment of price stability as the prime objective of monetary policy (Bank of Tanzania Act of 1995; Central Bank of Kenya Act No. 9 of 1995; Bank of Uganda Act of 2000). In practice, the 'drive to price stability' rested on reserve money programming for which broad monetary aggregate is used as the intermediate target of monetary policy, seemingly the open market operations (OMO). Other instruments used include change in reserve requirement, foreign exchange operations, moral suasion, and gentlemen's agreements.[3]

The change in monetary policy regime from the use of direct to indirect monetary policy instruments to achieve price stability since the mid-1980s was not smooth: the growth rates of money supply in all the three East African countries remained higher than planned;[4] and inflation remained high since the mid-1980s through the 1990s. It appears the high rates of growth in money supply were not solely responsible for the

[2]Post reform period witnessed East African economies shifting from fixed to a relatively flexible exchange rate regime. This followed the introduction of interbank foreign exchange market (IFEM) in 1993 in Uganda and Kenya, and in 1994 in Tanzania.

[3]The central banks, however, occasionally intervened the foreign exchange market to mitigate any excessive instability (volatility) in the foreign exchange market.

[4] The situation raises a question on the practicability of the Reserve Money Programming (RMP) as the monetary policy framework applied in these economies, which require *inter alia*, the setting of the target for money growth consistent with the planned rate of economic growth.

undesired double-digit inflation rates recorded in all the three countries during the period. In Kenya, where inflation was slightly lower than in Tanzania, its behaviour was not strongly owing to growth in money supply. In fact, except for the period 1992 to 1994, the growth rate of money supply in Kenya was almost constant. However, some sharp spikes in inflation were experienced during 2008 due to Kenya's post-election violence in 2007/08 that adversely affected supply and distribution of food in the country (Muthama, 2018). Before 2012 the EAC countries had set inflation target of 5 percent, but like Kenya, headline inflation remained volatile in all countries, and above the target. The inflation target was adjusted upward to 8 percent in 2012, which has generally been possible to achieve in the three EAC countries.

3. Theoretical and Empirical Perspectives

The theory on monetary transmission mechanism is characterized by four main views on how monetary policy impulses are transmitted to real economic activity and inflation. First, one of the traditional views shared by both Keynesian and Monetarist schools suggests that the transmission of monetary policy impulses works through interest rate, hence the so-called interest rate transmission channel. However, while the Keynesians maintain that the transmission mechanism work through interest rate (Taylor, 1995), the monetarists maintain that the transmission mechanism works through prices of multiple assets that are imperfect substitutes for money balances (Mishkin, 2007; Meltzer, 1995). In this view, which is also referred to as interest rate or asset prices channel, monetary policy actions influence output through their effect on cost of borrowing.

The adequacy of the interest rate channel of monetary policy transmission is challenged from different angles. First, Bernanke and Gertler (1995) argue that the monetary policy effect on interest rate is susceptible to external finance premium, that is, the spread between cost of retained earnings and the cost of external sources of finance – e.g., debt or equity financing, which is affected by market imperfections. On one hand, the effect of external finance premium on the cost of funds in what is referred to as balance sheet channel of the monetary policy transmission affects the asset value and consequently the net worth of potential borrowers. This in turn, affects their credit worthiness and consequently investment and output. On the other hand, in what is referred to as credit channel of the monetary policy transmission, it is argued that monetary actions on interest rate increase or decrease cost of searching for non-bank alternative sources of loans. The consequent rise or fall in external finance premium causes a change in the volume of loans demanded, and accordingly on funds borrowed for investment and economic activity. It is noteworthy that in both balance sheet and credit channels, monetary policy actions affect output and prices through the external premium that affects bank lending for investment and consequently output.[5] In general, there are two caveats of interest in balance sheet channel of monetary

[5] Asset prices channel is criticized because the equilibrating nature of the credit market is non-existent because markets do not clear due to existence of asymmetric information between borrowers and lenders that lead to principal agent (PA) problem. The PA problem thwarts transmission mechanism of monetary policy (Bernanke and Gertler, 1995).

policy. One is that the transmission of monetary policy shocks to key macroeconomic variables works through the nominal rather than real interest rate as argued by the Keynesian view. Second, it is short-term rather than long-term interest rate on debt instruments that plays a critical role in the transmission mechanism of monetary policy because it exerts a great impact on cash flows of firms, particularly small ones.

Regarding the exchange rate channel of monetary policy transmission, it is argued that given a flexible exchange rate and some degree of price stickiness with perfect capital mobility in a small open economy, the monetary policy actions on interest rate (*cost of funds*) affect net capital inflows. This effect is through an influence on deposits denominated in domestic currency, i.e., the exchange rate appreciates or depreciates to cause changes in net exports; exports-oriented investment; and subsequently national output (Mangani, 2012).

There are several empirical studies on the channels of the transmission mechanism of monetary policy in sub-Saharan Africa (SSA) countries.[6] Most of the studies are characterized by estimation of Recursive Vector Autoregressive (VAR) models using high frequency data; with varying order of lag structure; and are implemented by tests for Granger causality, impulse responses and variance decomposition. Empirical results suggest that effective channels of monetary policy transmission are variable across the SSA countries. Some studies – e.g., by Al-Mashat and Billmeir (2007) – found that interest rate was a weak channel of monetary policy transmission in Egypt. However, a study on Malawi by Mangani (2012) and on Zambia by Simantele (2004) noted that exchange rate is the only effective channel of transmitting monetary policy impulses to prices.[7] This means that it is difficult to establish effective channel of monetary policy transmission mechanism for a set of countries together unless country-specific studies are done. While some studies have established interest rate as the most effective channel of monetary policy transmission (Cheng, 2007), others – notably by Al-Mashat and Billmeir (2007) for Egypt, and Kovanen (2011) for Ghana – have found interest rate channel ineffective.

In East Africa region, some studies have found credit or bank lending the most effective channel of monetary policy transmission (see, e.g., Buigut (2010) in a study on Kenya). However, while Nannyonjo (2001) found the credit channel ineffective in Uganda, another study on Uganda by Mugume (2011) found that all the three (interest rate, exchange rate, and credit) channels of monetary policy transmission ineffective. Similarly, the study by Montiel *et al.* (2012) on financial architecture and monetary transmission in Tanzania concludes that both exchange rate and bank lending channels were weak and, specifically, that monetary policy effect on the real output was neither statistically significant nor economically meaningful.

[6]The survey excludes studies on the rest of developed and developing countries to serve space.
[7] According to Mangani (2012) the key message drawn from the findings was that imported inflation was the main cause of demand pull-inflation that made the exchange rate policy more relevant in controlling inflation in Malawi than monetary policy.

In the specific case of Tanzania, available empirical evidence is inconclusive on the effective channel of monetary policy transmission. A study by Minja and Magina (2009) used quarterly time series data for 1995–2007 to investigate the existence of a significant relationship between monetary policy and bank lending in Tanzania. The study concludes that Treasury bills, in both volume and yield, had a significant crowding out effect on bank lending. Moreover, the findings reveal that the level of financial development was explained by development in banks competition that seemed to lower lending rate, but the decline in inflation to a single digit did not seem to play a significant role in bank lending rate as it failed to make loans cheaper.

Study by Mbowe (2008), which applied the VAR method to time series data shows that there were positive shocks on reserve money and broad money that accelerated inflation and output growth, while shocks to interest rates (as indicated by the Treasury bill rate) reduced inflation and output. Moreover, a study by Aikaeli (2007), which applied generalized auto regression conditional heteroskedastic (GARCH), indicates that the current change in money supply would affect inflation significantly seven months ahead; and that the impact of money supply on inflation was not a sort of one time-strike on inflation but a persistent shock. Both studies (Mbowe and Aikaeli) show that there is policy transmission, but they do not clearly establish the specific transmission mechanisms. Therefore, this current study seeks to bridge that gap.

The literature in this area shows there are three main channels of monetary policy transmission: interest rate, exchange rate, and credit channel. These channels have been subjected to empirical analyses. Almost all studies on the monetary policy transmission mechanisms are based on vector autoregression (VAR) framework and Granger causality tests with a varying number of endogenous variables and estimation of both variance decomposition and impulse response functions. The results are diverse: most of the studies point to interest rate as a weak channel of policy transmission in SSA countries. They also reveal exchange rate and/or bank lending as the most effective channels of monetary policy transmission in SSA countries. However, we note that studies on monetary policy transmission in SSA so far have excluded the other asset prices (e.g., equity prices), balance sheet, and expectation channels for Africa, largely because of their restrictive assumptions and data problem on the sub-continent.

In general, we should note that the effectiveness of monetary policy in developing countries is faced by several challenges: nascent and inefficient markets for products, services, and financial assets; low degree or sheer inexistence of central bank independence; and, economic agents that are poor or less sensitive to policy interventions. This implies that the effectiveness of the channels of policy transmission can be undermined by the existence of inelasticities in the real and monetary sectors that render the Mundell-Flemming (1963) interest rate effect (Baksh & Craigwell, 1997).

Unlike studies done elsewhere, studies on East Africa countries are mostly country-specific and non-comparative: they are largely on specific (single) channels of monetary policy transmission. Unlike previous studies on the EAC countries, this study first analyses and compares the relative strength of all the three channels of monetary policy transmission in Kenya, Tanzania, and Uganda. Second, it specifically focuses on the main target of monetary policy – i.e., core inflation – which excludes food inflation from the headline inflation since it is affected by non-monetary factors. Third, the analysis is based on monthly rather than quarterly or annual time series, which entail only medium to long-term memories that may not easily capture the short-run nature of monetary policy dynamics.

4. Methodology

This study employs the vector autoregression (VAR) method to analyse monetary policy transmission mechanisms. This method has been used in various studies (see, e.g., Bernanke and Blinder (1992); Christiano et al., 1994; Suzuki, 2004; Bjϕrnland, 2008; Al-Mashat and Billmeir, 2007; Mangani, 2010; Kovanen 2011; and Davood *et al*., 2013). The VAR method has been used to discriminate between alternative theoretical models of the economy, and also to capture key properties of the time series of money and output, while allowing us to impose minimum restrictions to identify policy changes (Simatele, 2004; Sderlind, 1999; Baglioano & Favero, 1998). Assuming that the economy is operating systematically using certain form of policy rules, the VAR approach focus on deviations from these policy rules. Such deviations account for either changing the systematic component of monetary policy or from exogenous shocks. These deviations then form the basis for observing the response of the economy to unexpected monetary shocks.

Let y_t be a measure of macroeconomic indicator such as GDP or inflation; and x_t be the monetary policy variable. Then a VAR model is specified as,

$$\begin{bmatrix} y_t \\ x_t \end{bmatrix} = A_0 + A[L]\begin{bmatrix} y_{t-1} \\ x_{t-1} \end{bmatrix} + \begin{bmatrix} \mu_{yt} \\ \mu_{xt} \end{bmatrix} \qquad (1)$$

where, A_0 is a vector of constants, *A [L]* is a 2 × 2 matrix polynomial in the lag operator L, and μ_{it} are *serially* independent errors for variable i.

The structural equations for the system above can be written as,

$$\begin{aligned} y_t &= b_{10} - b_{12}x_t + b_{12}y_{t-1} + b_{13}x_{t-1} + \mu_{yt} \\ x_t &= b_{20} - b_{21}y_t + b_{22}y_{t-1} + b_{23}x_{t-1} + \mu_{xt} \qquad (2) \end{aligned}$$

This system is rearranged and written in matrix form as:

$$\begin{pmatrix} 1 & b_{12} \\ b_{21} & 1 \end{pmatrix}\begin{pmatrix} y_t \\ x_t \end{pmatrix} = \begin{pmatrix} b_{10} \\ b_{20} \end{pmatrix} + \begin{pmatrix} b_{11} & b_{13} \\ b_{22} & a_{23} \end{pmatrix}\begin{pmatrix} y_{t-1} \\ x_{t-1} \end{pmatrix} + \begin{pmatrix} \mu_{yt} \\ \mu_{xt} \end{pmatrix}.$$

Let $B = \begin{pmatrix} 1 & b_{12} \\ b_{21} & 1 \end{pmatrix}, X = \begin{pmatrix} y_t \\ x_t \end{pmatrix}, \prod_0 = \begin{pmatrix} b_{10} \\ b_{20} \end{pmatrix}, \prod_1 = \begin{pmatrix} b_{11} & b_{13} \\ b_{22} & a_{23} \end{pmatrix}$ and $\mu_t = \begin{pmatrix} \mu_{yt} \\ \mu_{xt} \end{pmatrix}$; and then present it in compact form as:

$$BX_t = \prod_0 + \prod_1 X_{t-1} + \mu_t \qquad (3)$$

Assume matrix B is invertible and pre-multiply B^{-1} on both sides to get,

$$X_t = A_0 + A_1 X_{t-1} + \varepsilon_t, \qquad (4)$$

where,

$A_0 = B^{-1}\prod_0, A_1 = B^{-1}\prod_1$ and $\varepsilon_t = B^{-1}\mu_{it}$.

Given that a_{ij} is the element of the i^{th} row and j^{th} column, then the VAR can be written as,

$$\begin{aligned} y_t &= a_{10} + a_{11}y_{t-1} + a_{12}x_{t-1} + \varepsilon_{yt} \\ x_t &= a_{20} + a_{21}y_{t-1} + a_{22}x_{t-1} + \varepsilon_{xt} \qquad (5) \end{aligned}$$

It should be noted that the errors are a composite of μ_{yt} and μ_{xt} since $\varepsilon_t = B^{-1}\mu_{it}$, that is,

$$\begin{pmatrix} \varepsilon_{yt} \\ \varepsilon_{xt} \end{pmatrix} = \begin{pmatrix} 1 & b_{12} \\ b_{21} & 1 \end{pmatrix}^{-1} \begin{pmatrix} \mu_{yt} \\ \mu_{xt} \end{pmatrix},$$

which makes,

$$\varepsilon_{yt} = \frac{\mu_{yt} - b_{12}\mu_{xt}}{1 - b_{12}b_{21}}$$

$$\varepsilon_{xt} = \frac{\mu_{xt} - b_{12}\mu_{yt}}{1 - b_{12}b_{21}}$$

Since μ_{it}s are a white noise, ε_ts are also a white noise.

The two results from VARs that are useful for analysing transmission mechanisms are impulse response functions, and forecast error variance decompositions. The impulse responses tell us how macro-variables respond to shocks in policy variables, while the variance decompositions show the magnitude of the variations in the macro-variables due to changes in policy variables. If we have stable system, we can iterate (5) backwards and let n approach infinity, and then solve it to obtain,

$$X_t = \eta + \sum_{i-0}^{\infty} A_1^i \varepsilon_{t-i}, \qquad (6)$$

ηs are the means of y_t and x_t.

We use equation (6) to write,

$$\begin{pmatrix} y_t \\ x_t \end{pmatrix} = \begin{pmatrix} \eta_y \\ \eta_x \end{pmatrix} + \frac{1}{1 - b_{12}b_{21}} \sum_{i=0}^{\infty} \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix} \begin{pmatrix} 1 & -b_{12} \\ -b_{21} & 1 \end{pmatrix} \begin{pmatrix} \mu_{yt} \\ \mu_{xt} \end{pmatrix} \qquad (7)$$

We define the 2 × 2 matrix as $\varphi(i)$ with elements $\varphi_{jk}(i)$, such that

$$\varphi(i) = \frac{A_1^i}{1-b_{12}b_{21}}\begin{pmatrix} 1 & b_{12} \\ b_{21} & 1 \end{pmatrix}.$$

This can be written in the reduced form of moving average form as,

$$X_t = \eta + \sum_{i=0}^{\infty} \varphi(i)\, \mu_{t-i} \ , \qquad (8)$$

where, $\varphi_{jk}(i)$ are the impulse response functions.

As we vary i we get a function describing the response of variable j to an impulse in variable k. To derive the forecast error variance, we use equation (8) to make a forecast of x_{t+1}. One step ahead forecast error is $\varphi\mu_{t+1}$, and in general the n-period forecast error $X_{t+n} - E_t X_{t+n}$ is written as,

$$X_{t+n} - EX_{t+n} = \sum_{i=0}^{\infty} \varphi(i)\mu_{t+n-i} \ . \qquad (9)$$

The mean square error (MSE) is given by,

$$(X_{t+n} - EX_{t+n})^2 = \delta_x^2 \ , \qquad (10)$$

where δ_x^2 is the variance of x_{t+n}.

From this theoretical model, we see a description of a simple two endogenous variables VAR model, and a maximum lag order of a unit. The general form of a reduced-VAR model that includes j endogenous variables and lag order p, which explains each variable as a linear function of own past value and the past value of all other variable is,

$$X_t = AZ_t + \beta_1 X_{t-1} + \ldots\ldots + \beta_i X_{t-i} + \ldots\ldots + \beta_p X_{t-p} + \varepsilon_t \ , \qquad (11)$$

where, X_t is an $(n \times 1)$ vector of all endogenous variables, in which X_{jt} (j = 1, 2, 3, ..., n) is a j^{th}variable included in the model. A and β_i are matrices of the coefficients to be estimated, Z_t is $(n \times 1)$ vector of deterministic variables that can either be constant or trend of seasonal term, and ε_t is $(n \times 1)$ vector of error terms.

Therefore, equation (11) is the empirical estimation model for our case.

The three categories in our estimations are:

(a) A category of instruments of monetary policy – i.e., policy variables – namely, interbank interest rate (INTR), Treasury bills rate (TBR), and reserve money (M0), which in theory, are close to the instruments of monetary policy but are far from the goal of monetary policy.

(b) A category of intermediate targets of monetary policy, including lending rate (LEDR), nominal exchange rate (EXCR) and money supply (MS).
(c) A category of inflation only, which is the ultimate goal of monetary policy.

The A and β_i in equation (11) are matrices of parameters for estimation. *A priori*, the interbank rate is expected to have a positive effect on the lending rate and the Treasury bills rate; and monetary aggregate (reserve money and broad money) are expected to bear a direct positive impact on the general price level, regardless of how it is measured.

Definitions of the estimation variables are as follows. The INTR is measured by monthly average inter commercial banks cash borrowing rate; and the TBR is a weighted average Treasury bill rates of different maturities. Reserve money (M0) is measured as the sum of currency in circulation and reserves of commercial banks held with the central bank in each country. The lending rate (LEDR) is a weighted average monthly lending rate of commercial banks; and the exchange rate (EXCR) is measured by the nominal official exchange rate, i.e., domestic currencies of each country for a unit of the USD. Money supply (MS) is measured by the broad measure (M2), which aggregates currency in circulation, demand deposits, saving deposits and time deposits of each country. Inflation is measured by the consumer prices index (CPI) for each country. Note that core CPI, which excludes food and fuel (CPIN), is the more useful measure of the effectiveness of monetary policy. For the purpose of this study, inflation (ΔP) is derived as changes in the logarithm of CPI. The non-core CPI defined as CPIF or CPIO, includes food or energy prices, respectively.

Data Type and Source

Analysis is based on time series data for Kenya, Tanzania, and Uganda for the period 1967–2016. The two main data sources for Kenya were Statistical Bulletins (various issues) and Statistical Abstracts that are published by the Central Bank of Kenya (CBK) and the Kenya National Bureau of Statistics (KNBS), respectively. The data for Tanzania and Uganda were obtained from quarterly and annual reports of the Bank of Tanzania (BoT) and the Bank of Uganda (BoU). The data in levels are used to estimate the VAR models for each country by using the ordinary least squares (OLS) method. Note that, as in most previous studies, the estimation of the model by using data in levels has one advantage: it keeps intact the required statistical properties in data for efficient parameters and establishment of the causal relationships among the variables of the estimation model that are usually lost if differencing (Bacchetta & Ballabriga, 2000; Mangani, 2012; Ender, 1996). Nonetheless, the data in levels are *a priori* subjected to unit root test using the ADF method.

The order of lag length is determined by Akaike Information Criteria (AIC) which is known to be efficient. The LR suggests a higher order of lag length than the other criteria. To ensure robustness of the results, a test for VAR stability is done using the characteristic root AR Polynomial. The results show that all the roots are within the unit circle, thus suggesting that the VAR model is stable.

5. Estimation Results

5.1 Granger Causality/Block Exogeneity Tests

A Granger causality/block exogeneity test investigates the nature of the interrelationship between variables and is carried out within the equations in the VAR system. While Granger causality seeks to establish the joint significance of the lagged value of a single variable (in which one variable is a regressand), a block exogeneity test accesses the statistical significance of the lagged values of all variables. The variables in the first row of the results tables are regressand, and the same variables arranged in the first column are interpreted as dependent variables. 'ALL' represent the block exogeneity significance level. The first three models (model 1, 2 & 3) for each country are such that the interbank interest rate is the policy rate. In models 4, 5 & 6; and model 7, 8 & 9 the Treasury bills rate and reserve money are, respectively, the policy variables (see Tables A1, A2 and A3).

For *Tanzania,* the exchange rate is significant in explaining the policy rates (interbank and Treasury bills rate). Since the exchange rate has directly influenced movement in prices, it becomes the most dominant channel of monetary policy transmission in Tanzania. The effect is strongest for core inflation, which is in tandem with our earlier argument that monetary policy effectiveness can be better measured when the core part of CPI is the focus of analysis (see Table A1).

Interest rate channel links market interest rate (lending channel) to policy variables, and hence directly or indirectly to goal variables (the CPI). Little evidence for the existence of interest rate channel is ascertained and this for non-core inflation. It is only in the food inflation model (7) where monetary aggregates seem to significantly granger caused price. So, the dominance of the exchange rate channel is vivid for Tanzania. The existence of a weak interest rate channel is also established. The monetary aggregate (M0) models (7, 8 and 9) suggest a significant relationship between M0 and M2 as expected, but not strongly linked to CPI. This raises a question as to whether the BoT should continue to target monetary aggregates, or shift to inflation targeting instead.

In the case of *Kenya*, the policy rates (interbank and Treasury bills rate) are generally significant in explaining the movement in the market rate. The market interest rate responds well to policy interventions in Kenya, and hence the bank lending channel is quite effective in monetary policy transmission. This is consistent with the fact that Kenya has a relatively well-developed financial sector when compared with the other two EA countries. This is evident as policy rates effect filters well even to non-food inflation model 2 (see Table A2).

Exchange rate significantly explains the market rate and money supply, which shows the existence of exchange rate channel too. Its movement has also been influenced by movement in interbank rates in the first three models. Exchange rate channel is not strongly effective to Kenya. Unlike the case of Tanzania, money supply in Kenya significantly explain the movement in the price level (see models 1, 3 and 6) for food and oil price inflation rates. The exchange rate channel is weak in the transmission of monetary policy in Kenya. The monetary aggregates (models

7, 8 and 9), in which reserve money is a policy variable, have no significant relationships among themselves; and so, monetary targeting may not be appropriate for the country, i.e., this supports Kenya's shift to inflation targeting.

In *Uganda*–and like in Kenya–policy rates significantly influence movements in the market rate, thus supporting the lending channel. This, however, has only been the case in model 1 through model 3 where interbank is the policy variable. Exchange rate has significantly influenced movement in policy rates and money supply. The policy rate has in turn significantly determined the exchange rate movement. Therefore, the exchange rate channel of monetary policy transmission in Uganda is quite strong (see Table A3).

Interesting results are observed when reserve money is set as a policy variable (models 7, 8 and 9), in which only one direction of causality is observed: M2 granger causes M0, and not otherwise. In the theory, M0 was also expected to granger cause M2. The two were as well expected to granger cause prices, which is not the case. That means M0 and M2 did not have any influence in all measured prices. This observation leaves a question to BoU as to whether monetary targeting is useful, and supports a shift from monetary framework to inflation targeting lite in Uganda.

5.2 Impulse Response Functions Results

The response of one variable to an impulse or innovation in other variables in the system is ascertained by the impulse response function (IRF), which traces the dynamic interactions among the variables included in the VAR model. The IRF results for Tanzania, Kenya and Uganda are succinctly explained below.

The case of *Tanzania* shows that a positive 1 standard deviation shock to interbank rate causes an exchange rate appreciation and is statistically significant. This is the case for the first 7 months in food and non-food policy rates' models (1 and 2). A positive standard deviation shock to exchange rate (*depreciation*) is followed by an increase in money supply (M2), but is only statistically significant in food policy rate model 2 after the first 3 months, and its impacts dies out 5 months later (in the 8^{th} month). Innovations in M2 also impacts positively and significantly on the movement in price regardless of how it is measured (Figure 1). If the interbank rate is a policy instrument and consistent with the granger causality results, this implies the effectiveness of exchange rate policy transmission channel.

Innovation in Treasury bill rates has impacted positively the movement in exchange rate (*appreciation*), especially for the non-food price model 5 in the first 8 months, and the oil price model 6 in the first 3 months. The Treasury bills rate also responds to innovations in exchange rate and is statistically significant. Innovation in exchange rate has impacted movement in M2, and the impact is statistically significant within 7 months of food price (model 4), and the first 10 months for non-food (model 5). The response is, however, not statistically significant for the oil price. There is no significant influence of M2 to movement in general price level. This implies the existence—but weak—exchange rate channel if Treasury bills rate is a policy instrument.

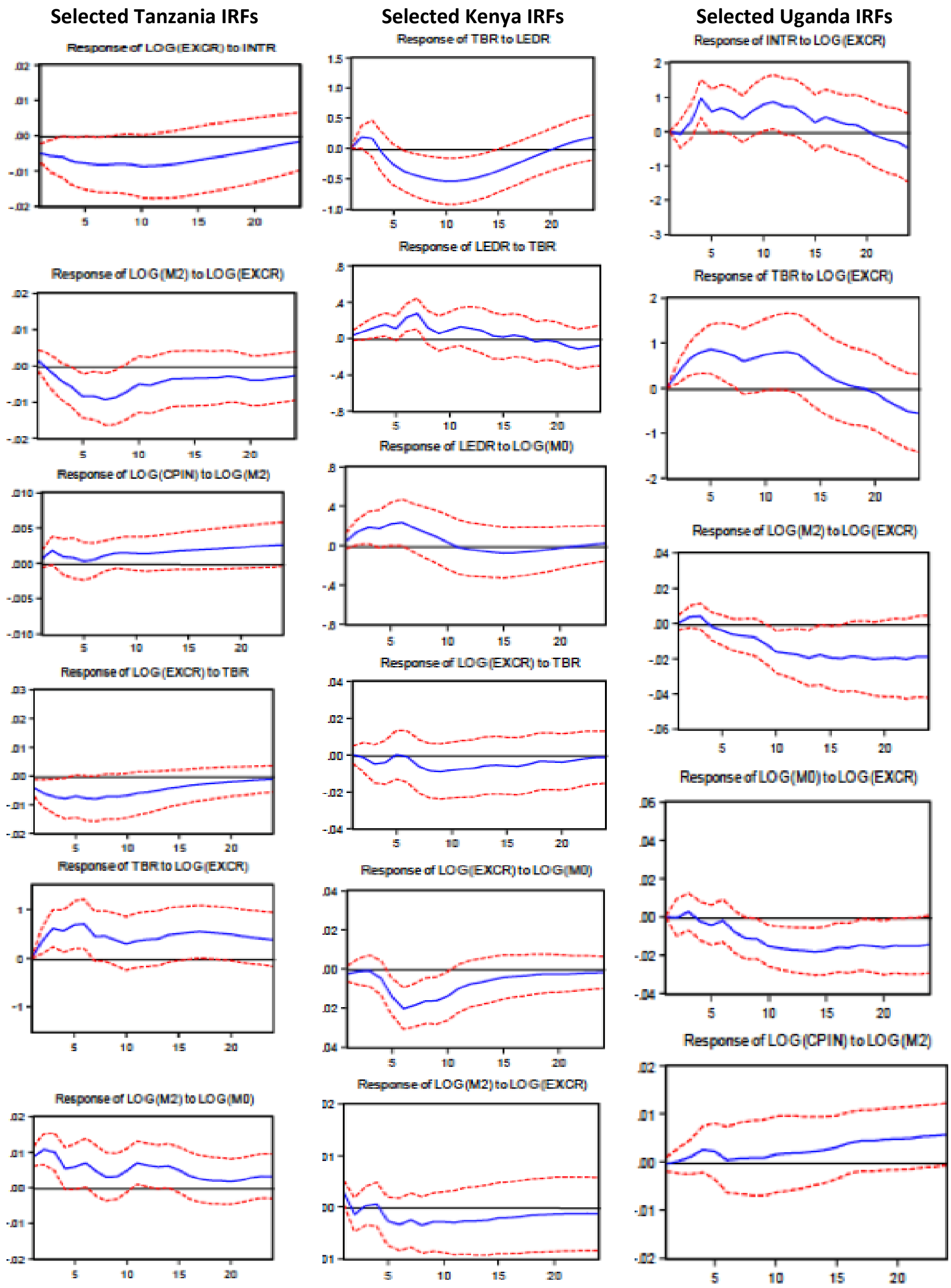

Figure 1: ***Impulse Response Functions***

The impulses response functions in models where reserve money (M0) is placed as a policy variable have a positive 1 standard deviation shock to M0. Initially leading to exchange rate depreciation, this impact is for six months and then dissipates. This is a remarkable result is the relationship between M0 and M2. In all cases, M0 is positively and statistically significant in determining movement in M2; and the existence of exchange rate transmission channel when M0 was the policy variable is also confirmed.

The IRF results for *Kenya* show statistically significant response to policy rate (interbank rate) ranging from the first 3 to 10 months after a shock. The policy rate also responds significantly to shocks in the lending rate. This confirms the lending rate channel, as long as the policy variable is interbank rate in Kenya. The same results are observed when Treasury bills rate is a policy rate. Lending rate positively responded to shocks in the TBR, and is statistically significant within 2 to 12 months after a shock (Figure 1). In the monetary aggregate model, the lending rate responds to movements in M0, and is statistically significant. Since the response between money supply and the lending rate has not been significant, it raises a question on the existence of a lending channel when we place M0 as a policy variable. The exchange rate responds positively to 1 standard deviation shock to interbank rate, and is significant within 3 to 7 months. The reversal causality is not statistically significant.

In models where M0 is a policy variable, the exchange rate significantly responds to innovations in reserve money. The 1 positive standard deviation shock to reserve money has resulted in exchange rate appreciation. However, exchange rate does not influence movement in M2 for the case of Kenya, which would be expected to have influence on prices. Therefore, these results—like in the causality test—confirm a weak exchange rate channel in Kenya.

Uganda's IRF results in indicate 1 standard deviation shock to exchange rate, which causes impact in all the policy rates (the interbank rate and Treasury bills rate). This impact occurs with a lag and is statistically significant within 3 to 7 months (Figure 1). It has also impacted the movement in M2, i.e., depreciation in the exchange rate is associated with decline in M2. The exchange rate influences the movement in a M0 after a lag, i.e. the intermediate variables usually impacts policy variables (M0) after a time lag. This is also a case for the M2, which impacts the movement in the core part of CPI (in the first 7 months). These results confirm the exchange rate channel when INTR, TBR, and M0 are evaluated to signal the monetary policy stance in Uganda.

There is, however, no statistical significance observation of interest channel in all estimated models. In all other cases, it is neither M2 nor M0 that impacts on the movement of one another. This again, gives a justification for the BoU to shift from RMP as a monetary policy framework to inflation targeting lite.

5.3 Variance Decomposition

In various forecasting horizons, the error variance decomposition for a given variable measures the proportions of its total variations due to a shock in the variable itself, and due to some shocks of all variables in the VAR system. Variable x_{jt} is said to be exogenous if shocks to all variables can explain none of its variations in all forecasting horizons. It is also known to be perfectly endogenous if forecasting error variance is entirely explained in term of shocks to all other variables but itself. Tables A4, A5 and A6 present variance decomposition results for Tanzania, Kenya, and Uganda, respectively.

Generally, the *Tanzania's* variance decomposition results show that the exchange rate and Treasury bill rate shocks do substantially account for variations of the other variables. Within the same horizon and in the first six models, proportions of the variations in the exchange rate are attributed by interbank, followed by lending rate (see Table A4).

These results are consistent with the granger causality/block exogeneity tests and impulse response; confirming the existence of the exchange rate channel of monetary policy transmission in Tanzania. It is important to note that there exists a weak interest rate transmission channel of monetary policy that is confirmed for Tanzania. Innovations to policy rates are not significant in explaining the lending rate in some models.

In the case of *Kenya,* variance decomposition results show that exchange rate innovations are generally not instrumental in explaining variation in other variables. The remarkable result which is consistent with Granger causality and impulse response is the significance of policy rates in explaining the movement in the market rate. Also, movement in the lending interest rate is attributed to innovations in CPI. Reserve money innovations contribute to variations in the lending rate but less has occurred to account for movement in the reserve money because of shocks to lending rates (see Table A5).

These results reconfirm the evidence of the existence of lending rate channel of monetary policy transmission in Kenya.

Variance decomposition results for *Uganda* indicate that exchange rate is virtually a key variable in explaining variation in almost all other variables. The fact that exchange rate explains money supply, and money supply influences price regardless of how it is measured, is a good evidence of the existence of exchange rate channel of monetary policy transmission in Uganda. This is also consistent with Granger causality and impulse response function results (see Table A6).

Although reserve money has caused some influence in the lending rate in Uganda, the significant proportion of variability in lending rate is a result of its own shocks. This indicates a weak interest channel of monetary policy transmission in Uganda when M0 is a policy instrument.

6. Conclusion

The main objective of this study was to investigate the channels of transmission and effectiveness of monetary policy in Tanzania, Kenya, and Uganda. The study is based on time series data that are analysed using a VAR estimation technique. The results in the case of Tanzania indicate that exchange rate is the most dominant monetary policy transmission channel; and though it works, the interest channel is a weak transmission mechanism. Similarly, exchange rate channel is a strong transmission mechanism of monetary policy in Uganda, especially when policy rates are the target instruments. However, exchange rate channel is not effective for Kenya. The credit transmission channel is found to be the dominant channel of monetary policy transmission in Kenya. The difference in the findings on the transmission channels of monetary policy in the three EAC countries can be attributed to the level of financial sector development, which is relatively more developed in Kenya than in Tanzania and Uganda, in that order. The results of this study are consistent with most previous studies done in developing countries, and sub-Saharan Africa in particular.

The interbank and Treasury bill rates in the three EAC countries explain movement in CPI more than reserve money (M0) does. This finding suggests the need for these countries to shift from monetary aggregates targeting to inflation (or at minimum interest rate) targeting. The BoU has already shifted to inflation targeting. Tanzania and Kenya continue to do monetary aggregate targeting, however, with some inflation targeting frameworks for only operational comparisons. Full-fledged movement to inflation targeting in Kenya and Tanzania will produce better monetary policy transmission results than the current monetary targeting frameworks.

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Appendices

Table 1: Granger Causality/Block Exogeneity Test – Tanzania
(** and * denote significant at 1% and 5%, respectively)

Model 1

	INTR	LEDR	LOG(EXCR)	LOG(M2)	LOG(CPIF)	ALL
INTR		0.8822	0.0325*	0.4428	0.6826	0.1178
LEDR	0.7575		0.4517	0.1205	0.6347	0.1879
LOG(EXCR)	0.3272	0.0229*		0.2311	0.0028*	0.0087*
LOG(M2)	0.4598	0.4024	0.4628		0.0724	0.1267
LOG(CPIF)	0.4358	0.2008	0.9590	0.0031*		0.0711

Model 2

	INTR	LEDR	LOG(EXCR)	LOG(M2)	LOG(CPIN)	ALL
INTR		0.6017	0.0176*	0.0798	0.8497	0.0468*
LEDR	0.9350		0.2034	0.0433*	0.2212	0.0395*
LOG(EXCR)	0.7509	0.2982		0.8356	0.8223	0.4388
LOG(M2)	0.3943	0.5976	0.2038		0.4627	0.3466
LOG(CPIN)	0.2927	0.4882	0.0560	0.2080		0.1653

Model 3

	INTR	LEDR	LOG(EXCR)	LOG(M2)	LOG(CPIO)	ALL
INTR		0.0390*	0.0298*	0.3061	0.4094	0.0098*
LEDR	0.4329		0.5465	0.0076*	0.2064	0.0208*
LOG(EXCR)	0.0727	0.0249		0.3188	0.0237*	0.0350*
LOG(M2)	0.3722	0.5040	0.3386		0.1216	0.2369
LOG(CPIO)	0.2710	0.2724	0.7489	0.0083*		0.0222*

Model 4

	TBR	LEDR	LOG(EXCR)	LOG(M2)	LOG(CPIF)	ALL
TBR		0.3641	0.0536*	0.9235	0.7317	0.0143*
LEDR	0.1228		0.1912	0.0001*	0.0207*	0.0003*
LOG(EXCR)	0.3087	0.1465		0.4774	0.2822	0.1552
LOG(M2)	0.1600	0.2678	0.2490		0.0621	0.1450
LOG(CPIF)	0.1133	0.02552*	0.6185	0.0008*		0.0062*

Model 5

	TBR	LEDR	LOG(EXCR)	LOG(M2)	LOG(CPIN)	ALL
TBR		0.0400*	0.0061*	0.2501	0.0519	0.0001
LEDR	0.9682		0.3339	0.2030	0.6672	0.0974
LOG(EXCR)	0.6732	0.3797		0.7435	0.8079	0.5107
LOG(M2)	0.1870	0.6519	0.2046		0.3879	0.2779
LOG(CPIN)	0.0589	0.0206*	0.0231*	0.7114		0.0024*

Model 6

	TBR	LEDR	LOG(EXCR)	LOG(M2)	LOG(CPIO)	ALL
TBR		0.0069*	0.0336*	0.6690	0.5587	0.0037*
LEDR	0.3732		0.3889	0.1051	0.4237	0.0579
LOG(EXCR)	0.3571	0.0587		0.2921	0.0014*	0.0045*
LOG(M2)	0.1349	0.4829	0.2169		0.0363*	0.0509*
LOG(CPIO)	0.0540*	0.5458	0.5380	0.0363*		0.0609*

Model 7

	LOG(M0)	LEDR	LOG(EXCR)	LOG(M2)	LOG(CPIF)	ALL
LOG(M0)		0.5858	0.8371	0.0334*	0.0006*	0.0202*
LEDR	0.6045		0.0272*	0.6970	0.9771	0.3100
LOG(EXCR)	0.3933	0.0134*		0.1483	0.1066	0.0165*
LOG(M2)	0.0097*	0.6279	0.0277*		0.0702	0.0051*
LOG(CPIF)	0.8577	0.1863	0.6773	0.0443*		0.0190*

Model 8

	LOG(M0)	LEDR	LOG(EXCR)	LOG(M2)	LOG(CPIN)	ALL
LOG(M0)		0.7615	0.6466	0.5288	0.6207	0.9014
LEDR	0.9858		0.2230	0.3762	0.4154	0.0466*
LOG(EXCR)	0.4534	0.4477		0.5315	0.8480	0.3098
LOG(M2)	0.0032*	0.5080	0.1223		0.0710	0.0126*
LOG(CPIN)	0.2817	0.9602	0.0211*	0.1607		0.1607

Model 9

	LOG(M0)	LEDR	LOG(EXCR)	LOG(M2)	LOG(CPI0)	ALL
LOG(M0)		0.6606	0.8110	0.0478*	0.0006*	0.0198*
LEDR	0.7084		0.0460*	0.6726	0.7328	0.2359
LOG(EXCR)	0.4306	0.0166*		0.1917	0.0792	0.0128*
LOG(M2)	0.0052*	0.6978	0.0253*		0.1093	0.0077*
LOG(CPI0)	0.5563	0.3503	0.5039	0.2035		0.1337

Table A2: Granger Causality/Block Exogeneity Test – Kenya
(** and * denote significant at 1% and 5%, respectively)

Model 1

	INTR	LEDR	LOG(EXCR)	LOG(M2)	LOG(CPIF)	ALL
INTR		0.0000*	0.0102*	0.8272	0.6573	0.0000*
LEDR	0.0000*		0.0087*	0.2825	0.2825	0.0000*
LOG(EXCR)	0.0143*	0.1020		0.6352	0.7866	0.0311*
LOG(M2)	0.9905	0.7916	0.1858		0.9228	0.6887
LOG(CPIF)	0.7974	0.4609	0.0799	0.0118*		0.1937

Model 2

	INTR	LEDR	LOG(EXCR)	LOG(M2)	LOG(CPIN)	ALL
INTR		0.0602	0.0878	0.3427	0.0000*	0.0000*
LEDR	0.0001*		0.1458	0.2217	0.0139*	0.0000*
LOG(EXCR)	0.1066	0.3350		0.8476	0.1998	0.0560*
LOG(M2)	0.8891	0.4697	0.0036*		0.2509	0.1347
LOG(CPIN)	0.0053*	0.0464*	0.1253	0.5474		0.0000*

Model 3

	INTR	LEDR	LOG(EXCR)	LOG(M2)	LOG(CPIO)	ALL
INTR		0.0000*	0.0078*	0.8869	0.4516	0.0000*
LEDR	0.0000*		0.0083*	0.2943	0.0817	0.0000*
LOG(EXCR)	0.0115*	0.1076		0.7044	0.5618	0.0196
LOG(M2)	0.9903	0.7874	0.1154		0.4094	0.4338
LOG(CPIO)	0.6890	0.5819	0.3189	0.0176*		0.4668

Model 4

	TBR	LEDR	LOG(EXCR)	LOG(M2)	LOG(CPIF)	ALL
TBR		0.0041*	0.7666	0.8762	0.1804	0.0002*
LEDR	0.0000*		0.0127*	0.6857	0.3644	0.0000*
LOG(EXCR)	0.6381	0.8804		0.8041	0.7872	0.6920
LOG(M2)	0.5644	0.1897	0.0035*		0.4574	0.1914
LOG(CPIF)	0.8960	0.9245	0.4305	0.6186		0.8390

Model 5

	TBR	LEDR	LOG(EXCR)	LOG(M2)	LOG(CPIN)	ALL
TBR		0.1903	0.5311	0.5961	0.0003*	0.0000*
LEDR	0.0000*		0.0027*	0.4230	0.0073*	0.0000*
LOG(EXCR)	0.2921	0.8549		0.7087	0.0750	0.1438
LOG(M2)	0.8247	0.3068	0.0013*		0.2647	0.1103
LOG(CPIN)	0.2479	0.0241*	0.4118	0.3962		0.0001*

Model 6

	TBR	LEDR	LOG(EXCR)	LOG(M2)	LOG(CPIO)	ALL
TBR		0.0012*	0.3973	0.2557	0.5969	0.0005*
LEDR	0.0000*		0.0139*	0.5999	0.3068	0.0000*
LOG(EXCR)	0.1858	0.2481		0.4179	0.8062	0.1434
LOG(M2)	0.6605	0.4108	0.0437*		0.2196	0.0917
LOG(CPIO)	0.2674	0.4720	0.3126	0.0249*		0.3148

Model 7

	LOG(M0)	LEDR	LOG(EXCR)	LOG(M2)	LOG(CPIF)	ALL
LOG(M0)		0.3371	0.5079	0.5818	0.6560	0.3975
LEDR	0.0519*		0.0033*	0.1362	0.2971	0.0288*
LOG(EXCR)	0.0011*	0.5461		0.0511*	0.6327	0.0046*
LOG(M2)	0.2726	0.5952	0.0297*		0.5345	0.2840
LOG(CPIF)	0.3193	0.6455	0.4653	0.9452		0.3767

Model 8

	LOG(M0)	LEDR	LOG(EXCR)	LOG(M2)	LOG(CPIN)	ALL
LOG(M0)		0.1032	0.4424	0.7394	0.8913	0.2213
LEDR	0.3285		0.3429	0.0755	0.1591	0.0042*
LOG(EXCR)	0.0028*	0.2108		0.2050	0.1237	0.0015*
LOG(M2)	0.3003	0.4118	0.0171*		0.2877	0.0832
LOG(CPIN)	0.0659	0.0027*	0.0030*	0.9750		0.0000*

Model 9

	LOG(M0)	LEDR	LOG(EXCR)	LOG(M2)	LOG(CPI0)	ALL
LOG(M0)		0.4616	0.4073	0.5498	0.2776	0.2044
LEDR	0.0733		0.0032*	0.1737	0.2722	0.0261*
LOG(EXCR)	0.0007*	0.4471		0.0311*	0.3518	0.0016*
LOG(M2)	0.2901	0.4349	0.0044*		0.0636	0.0511*
LOG(CPIO)	0.6061	0.7566	0.7668	0.9681		0.7226

Table A3: Granger Causality/Block Exogeneity Test – Uganda
(** and * denote significant at 1% and 5%, respectively)

Model 1

	INTR	LEDR	LOG(EXCR)	LOG(M2)	LOG(CPIF)	ALL
INTR		0.0213*	0.0017*	0.5016	0.9022	0.0008*
LEDR	0.0001*		0.5306	0.2633	0.1972	0.0011*
LOG(EXCR)	0.0352*	0.2165		0.5991	0.7357	0.0027*
LOG(M2)	0.0612	0.1110	0.1650		0.1515	0.0001*
LOG(CPIF)	0.3121	0.1008	0.1165	0.0101*		0.0013*

Model 2

	INTR	LEDR	LOG(EXCR)	LOG(M2)	LOG(CPIN)	ALL
INTR		0.0043*	0.0142*	0.4616	0.0001*	0.0000*
LEDR	0.0095*		0.8915	0.5237	0.1284	0.0005*
LOG(EXCR)	0.0340*	0.0698		0.0186*	0.0170*	0.0000*
LOG(M2)	0.1040	0.0355*	0.0554*		0.1773	0.0001*
LOG(CPIN)	0.4472	0.6747	0.0104*	0.0684		0.0025*

Model 3

	INTR	LEDR	LOG(EXCR)	LOG(M2)	LOG(CPIF)	ALL
INTR		0.0012*	0.0050*	0.2876	0.0043*	0.0000*
LEDR	0.0053*		0.8276	0.5795	0.0636	0.0002*
LOG(EXCR)	0.0209*	0.2096		0.0463*	0.0253*	0.0000*
LOG(M2)	0.0640	0.0661	0.1023		0.1780	0.0002*
LOG(CPIF)	0.5110	0.6121	0.5205	0.2446		0.1162

Model 4

	TBR	LEDR	LOG(EXCR)	LOG(M2)	LOG(CPIF)	ALL
TBR		0.1474	0.0191*	0.2099	0.0301*	0.0276*
LEDR	0.0118*		0.9223	0.3414	0.2958	0.0768
LOG(EXCR)	0.0014*	0.0971		0.1431	0.8661	0.0006*
LOG(M2)	0.0601	0.1382	0.0704		0.2578	0.0004*
LOG(CPIF)	0.0447*	0.2550	0.0035*	0.0001*		0.0000*

Model 5

	TBR	LEDR	LOG(EXCR)	LOG(M2)	LOG(CPIN)	ALL
TBR		0.5437	0.3844	0.4736	0.0037*	0.0114*
LEDR	0.0149*		0.2412	0.1282	0.0813	0.0059*
LOG(EXCR)	0.0102*	0.0055*		0.0640	0.0422*	0.0000*
LOG(M2)	0.1973	0.2156	0.0382*		0.1229	0.0013*
LOG(CPIN)	0.0261*	0.5198	0.0023*	0.0090*		0.0002*

Model 6

	TBR	LEDR	LOG(EXCR)	LOG(M2)	LOG(CPIO)	ALL
TBR		0.4697	0.1565	0.4129	0.0023*	0.0074*
LEDR	0.0730		0.6814	0.2550	0.1846	0.0166*
LOG(EXCR)	0.0068*	0.0280*		0.2032	0.1158	0.0000*
LOG(M2)	0.1791	0.1727	0.0676		0.1092	0.0011*
LOG(CPIO)	0.4059	0.8961	0.1833	0.3789		0.0935

Model 7

	LOG(M0)	LEDR	LOG(EXCR)	LOG(M2)	LOG(CPIF)	ALL
LOG(M0)		0.8715	0.4677	0.0116*	0.0619	0.0080*
LEDR	0.4211		0.8981	0.2262	0.1355	0.3411
LOG(EXCR)	0.5864	0.2607		0.3860	0.3106	0.1242
LOG(M2)	0.9140	0.0188*	0.0015*		0.2085	0.0097*
LOG(CPIF)	0.2855	0.4469	0.3494	0.3333		0.0186*

Model 8

	LOG(M0)	LEDR	LOG(EXCR)	LOG(M2)	LOG(CPIN)	ALL
LOG(M0)		0.7631	0.3519	0.0010*	0.7353	0.0208*
LEDR	0.3505		0.5795	0.5896	0.0460*	0.0307*
LOG(EXCR)	0.8053	0.6458		0.1135	0.0710	0.0185*
LOG(M2)	0.8064	0.0427*	0.0033*		0.0014*	0.0000*
LOG(CPIN)	0.2600	0.8862	0.0050*	0.8202		0.0113*

Model 9

	LOG(M0)	LEDR	LOG(EXCR)	LOG(M2)	LOG(CPIO)	ALL
LOG(M0)		0.9944	0.1808	0.0009*	0.0145*	0.0016*
LEDR	0.6631		0.5183	0.3142	0.0110*	0.0717
LOG(EXCR)	0.4767	0.0543*		0.1501	0.0019*	0.0009*
LOG(M2)	0.9765	0.1940	0.0455*		0.4767	0.0308*
LOG(CPIO)	0.2832	0.8842	0.0146*	0.2468		0.0587

Table A4: Variance Decomposition - Tanzania

Model 1

Endogenous Variables	Forecasting Error Variance: Distributions Across Shocks				
	INTR	***LEDR***	***LOG(EXCR)***	***LOG(M2)***	***LOG(CPIF)***
INTR	60.68853	7.360485	22.70452	2.804313	6.442150
LEDR	4.057289	65.66881	16.36171	2.532618	11.37957
LOG(EXCR)	32.67863	16.25981	37.50270	1.508166	12.05070
LOG(M2)	4.024514	5.789491	16.13593	57.14830	16.90176
LOG(CPIF)	8.462540	4.342018	2.282033	11.66086	73.25255

Model 2

Endogenous Variables	Forecasting Error Variance: Distributions Across Shocks				
	INTR	***LEDR***	***LOG(EXCR)***	***LOG(M2)***	***LOG(CPIN)***
INTR	61.56994	6.790648	27.43828	1.832528	2.368599
LEDR	7.293822	55.93060	20.98382	8.012586	7.779169
LOG(EXCR)	34.89902	7.241917	52.17027	4.619832	1.068961
LOG(M2)	3.177061	1.469818	22.77855	71.54283	1.031740
LOG(CPIN)	19.39850	16.22836	6.517682	6.731173	51.12429

Model 3

Endogenous Variables	Forecasting Error Variance: Distributions Across Shocks				
	INTR	***LEDR***	***LOG(EXCR)***	***LOG(M2)***	***LOG(CPIO)***
INTR	46.47833	11.89549	18.21506	9.132080	14.27904
LEDR	2.432183	50.74545	17.97549	15.93822	12.90865
LOG(EXCR)	12.82866	41.05147	28.24964	7.585459	10.28477
LOG(M2)	6.487777	20.66761	24.96311	33.54947	14.33204
LOG(CPIO)	13.66686	5.017032	5.421039	31.81486	44.08021

Model 4

Endogenous Variables	Forecasting Error Variance: Distributions Across Shocks				
	TBR	***LEDR***	***LOG(EXCR)***	***LOG(M2)***	***LOG(CPIF)***
TBR	43.73613	15.38572	24.80896	5.628247	10.44094
LEDR	9.796266	36.42889	33.17237	11.59960	9.002875
LOG(EXCR)	8.477926	24.66543	50.00738	9.160399	7.688865
LOG(M2)	7.685383	12.55298	34.52967	38.05225	7.179721
LOG(CPIF)	38.06485	4.916909	7.779658	21.71942	27.51916

Model 5

Endogenous Variables	Forecasting Error Variance: Distributions Across Shocks				
	TBR	***LEDR***	***LOG(EXCR)***	***LOG(M2)***	***LOG(CPIN)***
TBR	29.47223	5.892840	33.24768	16.60034	14.78691
LEDR	5.324269	55.62757	24.39905	9.184824	5.464293
LOG(EXCR)	22.48296	15.25794	55.77901	4.764701	1.715382
LOG(M2)	2.533673	2.108416	27.36831	67.59941	0.390185
LOG(CPIN)	17.07046	21.89670	15.63392	3.206789	42.19212

Model 6

Endogenous	Forecasting Error Variance: Distributions Across Shocks				
Variables	*TBR*	*LEDR*	*LOG(EXCR)*	*LOG(M2)*	*LOG(CPIO)*
TBR	35.66315	13.07919	25.50250	3.751283	22.00387
LEDR	4.987405	51.26056	25.72913	2.931169	15.09174
LOG(EXCR)	14.34836	19.78293	48.53544	1.332327	16.00095
LOG(M2)	8.434111	3.386462	26.20030	53.71925	8.259879
LOG(CPIO)	23.43386	3.048669	1.248409	8.589696	63.67937

Model 7

Endogenous	Forecasting Error Variance: Distributions Across Shocks				
Variables	*LOG(M0)*	*LEDR*	*LOG(EXCR)*	*LOG(M2)*	*LOG(CPIF)*
LOG(M0)	58.39533	0.828708	10.01358	3.825427	26.93696
LEDR	2.018438	65.61797	12.53484	4.292921	15.53583
LOG(EXCR)	7.714672	15.89348	62.56591	5.218363	8.607576
LOG(M2)	39.82009	2.043296	18.37796	17.93113	21.82752
LOG(CPIF)	9.014714	1.238298	3.961103	12.62196	73.16393

Model 8

Endogenous	Forecasting Error Variance: Distributions Across Shocks				
Variables	*LOG(M0)*	*LEDR*	*LOG(EXCR)*	*LOG(M2)*	*LOG(CPIN)*
LOG(M0)	78.99673	0.815645	8.319559	11.06745	0.800617
LEDR	12.66971	57.49585	21.94278	3.131555	4.760113
LOG(EXCR)	4.378140	9.767650	76.63525	8.536668	0.682293
LOG(M2)	62.23108	1.486438	12.18597	20.85504	3.241473
LOG(CPIN)	1.541977	16.88305	11.62237	27.00268	42.94992

Model 9

Endogenous	Forecasting Error Variance: Distributions Across Shocks				
Variables	*LOG(M0)*	*LEDR*	*LOG(EXCR)*	*LOG(M2)*	*LOG(CPIO)*
LOG(M0)	60.19427	0.622446	7.791341	6.071859	25.32008
LEDR	2.080822	65.11704	11.09287	2.494556	19.21471
LOG(EXCR)	8.075300	17.25273	59.90863	5.751690	9.011654
LOG(M2)	43.91652	1.757512	15.33116	19.70320	19.29161
LOG(CPIO)	9.274789	2.312801	3.732944	14.22750	70.45196

Table A5: Variance Decomposition - Kenya

Model 1

Endogenous Variables	Forecasting Error Variance: Distributions Across Shocks				
	INTR	*LEDR*	*LOG(EXCR)*	*LOG(M2)*	*LOG(CPIF)*
INTR	31.52915	47.60939	0.787672	2.972457	17.10134
LEDR	18.41156	55.69738	5.156342	4.862986	15.87174
LOG(EXCR)	15.58561	20.89238	57.29221	4.843374	1.386431
LOG(M2)	3.819987	5.983336	2.072502	85.48373	2.640442
LOG(CPIF)	0.375270	4.896154	13.04665	26.94425	54.73768

Model 2

Endogenous Variables	Forecasting Error Variance: Distributions Across Shocks				
	INTR	*LEDR*	*LOG(EXCR)*	*LOG(M2)*	*LOG(CPIN)*
INTR	20.15804	25.06794	6.175444	14.68760	33.91098
LEDR	9.378701	35.44528	7.547990	10.11682	37.51121
LOG(EXCR)	16.78800	6.344557	57.31859	8.330841	11.21800
LOG(M2)	21.15814	7.107372	7.340004	58.92089	5.473590
LOG(CPIN)	6.300638	10.05512	8.271160	42.65728	32.71581

Model 3

Endogenous Variables	Forecasting Error Variance: Distributions Across Shocks				
	INTR	*LEDR*	*LOG(EXCR)*	*LOG(M2)*	*LOG(CPIO)*
INTR	30.51571	46.66563	0.781000	3.216534	18.82113
LEDR	17.03403	54.81157	5.129689	4.940935	18.08377
LOG(EXCR)	15.32536	21.90681	57.08126	4.186850	1.499714
LOG(M2)	3.578918	6.991658	1.916242	85.86376	1.649427
LOG(CPIO)	0.431612	3.908263	13.69525	31.05567	50.90921

Model 4

Endogenous Variables	Forecasting Error Variance: Distributions Across Shocks				
	TBR	*LEDR*	*LOG(EXCR)*	*LOG(M2)*	*LOG(CPIF)*
TBR	66.96883	6.624938	7.715951	4.620605	14.06968
LEDR	53.26272	16.20316	13.72724	3.571088	13.23580
LOG(EXCR)	10.80074	15.35650	60.70939	9.176001	3.957373
LOG(M2)	26.36085	7.305232	13.01506	49.25702	4.061834
LOG(CPIF)	13.65437	2.377803	16.67817	14.23205	53.05761

Model 5

Endogenous Variables	Forecasting Error Variance: Distributions Across Shocks				
	TBR	*LEDR*	*LOG(EXCR)*	*LOG(M2)*	*LOG(CPIN)*
TBR	17.49034	8.924351	5.110927	6.971051	61.50334
LEDR	12.90917	18.03636	10.49735	6.331201	52.22593
LOG(EXCR)	16.80287	15.40076	49.90839	6.458259	11.42973
LOG(M2)	28.17070	1.868993	15.83989	44.57332	9.547093
LOG(CPIN)	5.899254	4.785722	5.738059	28.88806	54.68891

Model 6

Endogenous Variables	Forecasting Error Variance: Distributions Across Shocks				
	TBR	*LEDR*	*LOG(EXCR)*	*LOG(M2)*	*LOG(CPIO)*
TBR	66.75090	24.50053	2.836996	4.102648	1.808923
LEDR	43.10191	41.18914	9.670453	3.069998	2.968500
LOG(EXCR)	17.20763	28.99425	51.88101	1.337938	0.579172
LOG(M2)	3.684020	2.250837	5.658175	87.33534	1.071623
LOG(CPIO)	5.782794	3.343369	18.73192	23.02734	49.11457

Model 7

Endogenous Variables	Forecasting Error Variance: Distributions Across Shocks				
	LOG(M0)	*LEDR*	*LOG(EXCR)*	*LOG(M2)*	*LOG(CPIF)*
LOG(M0)	61.28156	3.091966	4.546941	21.34409	9.735449
LEDR	11.09296	29.80589	35.70346	17.09199	6.305707
LOG(EXCR)	40.95913	11.65872	33.81794	11.21238	2.351826
LOG(M2)	2.514722	2.199973	5.071793	81.14793	9.065582
LOG(CPIF)	11.64566	2.852368	15.37594	20.71510	49.41094

Model 8

Endogenous Variables	Forecasting Error Variance: Distributions Across Shocks				
	LOG(M0)	*LEDR*	*LOG(EXCR)*	*LOG(M2)*	*LOG(CPIN)*
LOG(M0)	67.43144	4.450902	5.123826	20.84186	2.151975
LEDR	8.073439	27.23873	19.36874	18.47893	26.84016
LOG(EXCR)	32.90400	18.21773	35.71027	9.341039	3.826969
LOG(M2)	1.057758	2.889528	9.121161	85.62002	1.311538
LOG(CPIN)	5.992718	11.64563	8.828993	41.24078	32.29188

Model 9

Endogenous Variables	Forecasting Error Variance: Distributions Across Shocks				
	LOG(M0)	*LEDR*	*LOG(EXCR)*	*LOG(M2)*	*LOG(CPIO)*
LOG(M0)	58.25441	2.262516	3.923963	22.81029	12.74883
LEDR	11.21044	31.36031	34.73171	15.66630	7.031241
LOG(EXCR)	40.13230	11.90818	30.63116	12.62945	4.698905
LOG(M2)	3.063445	1.540313	4.955038	82.80134	7.639865
LOG(CPIO)	19.91696	0.676271	12.94834	19.67624	46.78220

Table A6: Variance Decomposition - Uganda

Model 1

Endogenous Variables	**Forecasting Error Variance: Distributions Across Shocks**				
	INTR	***LEDR***	***LOG(EXCR)***	***LOG(M2)***	***LOG(CPIF)***
INTR	46.14571	23.62627	26.91353	1.831448	1.483034
LEDR	37.30125	38.47880	19.31100	2.885974	2.022969
LOG(EXCR)	3.905058	17.72976	68.10715	4.327159	5.930868
LOG(M2)	16.35313	10.81709	46.26429	25.85801	0.707492
LOG(CPIF)	4.416090	17.98330	32.55151	9.185035	35.86407

Model 2

Endogenous Variables	**Forecasting Error Variance: Distributions Across Shocks**				
	INTR	***LEDR***	***LOG(EXCR)***	***LOG(M2)***	***LOG(CPIN)***
INTR	20.38440	20.51287	13.87657	3.455280	41.77087
LEDR	11.90739	40.51093	8.593199	4.963997	34.02449
LOG(EXCR)	1.482762	11.21923	53.18050	14.76685	19.35065
LOG(M2)	7.330450	4.798416	43.56825	32.44290	11.85998
LOG(CPIN)	3.878604	20.17184	8.687554	12.00721	55.25479

Model 3

Endogenous Variables	**Forecasting Error Variance: Distributions Across Shocks**				
	INTR	***LEDR***	***LOG(EXCR)***	***LOG(M2)***	***LOG(CPIO)***
INTR	22.77207	12.15332	17.74329	5.561295	41.77003
LEDR	15.73626	33.98210	11.64971	5.950182	32.68174
LOG(EXCR)	3.482926	11.74704	55.19801	9.915202	19.65682
LOG(M2)	6.655241	3.200625	53.92192	23.99594	12.22624
LOG(CPIO)	3.762467	2.169787	10.63421	21.34498	62.08856

Model 4

Endogenous Variables	**Forecasting Error Variance: Distributions Across Shocks**				
	TBR	***LEDR***	***LOG(EXCR)***	***LOG(M2)***	***LOG(CPIF)***
TBR	45.46393	1.692113	48.65953	2.278381	1.906048
LEDR	31.14170	24.69047	36.69829	4.783706	2.685831
LOG(EXCR)	6.675119	20.62405	59.10324	9.246294	4.351288
LOG(M2)	7.609141	2.204296	67.18103	22.27322	0.732316
LOG(CPIF)	13.68845	6.733333	46.36284	11.08646	22.12892

Model 5

Endogenous Variables	**Forecasting Error Variance: Distributions Across Shocks**				
	TBR	***LEDR***	***LOG(EXCR)***	***LOG(M2)***	***LOG(CPIN)***
TBR	33.48355	7.906672	15.01461	3.429209	40.16596
LEDR	19.96370	31.16625	12.39276	10.67428	25.80300
LOG(EXCR)	8.743780	15.81683	40.02965	21.59294	13.81681
LOG(M2)	3.843722	2.521190	38.10802	37.87586	17.65121
LOG(CPIN)	8.864060	13.72496	13.13062	12.90373	51.37664

Model 6

Endogenous Variables	Forecasting Error Variance: Distributions Across Shocks				
	TBR	*LEDR*	*LOG(EXCR)*	*LOG(M2)*	*LOG(CPIO)*
TBR	34.29477	4.013632	17.72415	4.766360	39.20109
LEDR	17.92889	33.68315	13.91091	9.646622	24.83044
LOG(EXCR)	7.640104	16.79478	51.05855	14.24257	10.26400
LOG(M2)	2.493790	2.934360	44.13967	34.59688	15.83530
LOG(CPIO)	2.040169	6.557817	7.497523	19.55828	64.34621

Model 7

Endogenous Variables	Forecasting Error Variance: Distributions Across Shocks				
	LOG(M0)	*LEDR*	*LOG(EXCR)*	*LOG(M2)*	*LOG(CPIF)*
LOG(M0)	25.11355	7.778968	48.05167	15.74731	3.308502
LEDR	11.91916	59.11726	13.63170	11.09763	4.234255
LOG(EXCR)	10.89153	3.163733	62.38643	14.58143	8.976865
LOG(M2)	2.472933	12.28522	53.62665	31.07885	0.536348
LOG(CPIF)	4.521287	3.175559	32.70260	11.82099	47.77956

Model 8

Endogenous Variables	Forecasting Error Variance: Distributions Across Shocks				
	LOG(M0)	*LEDR*	*LOG(EXCR)*	*LOG(M2)*	*LOG(CPIN)*
LOG(M0)	28.65822	19.90909	21.82045	23.75898	5.853269
LEDR	10.71494	61.85331	7.773639	1.777520	17.88059
LOG(EXCR)	5.110192	1.206163	73.95998	8.564365	11.15930
LOG(M2)	0.774511	20.29788	26.37753	36.92252	15.62756
LOG(CPIN)	11.18159	11.37276	16.64034	10.67120	50.13412

Model 9

Endogenous Variables	Forecasting Error Variance: Distributions Across Shocks				
	LOG(M0)	*LEDR*	*LOG(EXCR)*	*LOG(M2)*	*LOG(CPIO)*
LOG(M0)	28.48009	8.451900	48.42765	10.46378	4.176583
LEDR	10.97810	48.24734	17.01344	4.640872	19.12025
LOG(EXCR)	7.645195	16.12786	44.32347	22.49928	9.404196
LOG(M2)	1.582666	10.29514	57.65839	24.92396	5.539841
LOG(CPIO)	15.44116	5.359405	23.49813	17.07189	38.62942