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EXCESS RESERVES IN UGANDA'S BANKING SYSTEM AND THE EFFECTIVENESS OF MONETARY POLICY

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Abstract

By applying a threshold vector auto regression model, it was found that monetary policy effectiveness in Uganda was weakened when banks accumulated excess reserves. The study showed that excess reserves levels were above the identified threshold of excess reserves of 2.1 percent as a share of deposits during the period 2009 to 2010. The implication of the findings is that monetary policy formulation needs to be continuously cognizant of both the level relative to the threshold and persistence of excess reserves. The findings support further financial markets reforms to expand available investment options and structural policies address existing constraints to credit extension in the banking sector.

1. INTRODUCTION

The global financial crisis and subsequent recession pressures on the global economy put monetary policy at the fore front of mitigating the economic slowdown[1]. However, it cannot be argued that the role of monetary policy in riding out the woes of the economic slowdown was unequivocally successful for all countries. Policy makers in different countries faced numerous challenges that were largely unique to the structures of the respective economies. In the case of Uganda, the challenge faced by monetary policy was how to invigorate aggregate demand using the banking system amid a large build-up of excess reserves. The implication of the difficulties faced by monetary policy in Uganda during the economic slow-down point to potential difficulties that will be faced in regard to controlling inflation when oil revenues start flowing as excess reserves accumulation in the banking system is likely.

The holding or accumulation of excess reserves by banks should in itself not be a problem. However, the level of accumulation and timing can be of concern. For instance, commercial banks between 2008 and 2010 accumulated excess reserves even when conditions in the financial markets did not warrant such behaviour. Money market conditions discouraged investment in domestic securities when real returns become negative starting in 2008 through 2010. However, the credit expansion that should have substituted for domestic securities remained mostly moderate. Moreover, lending rates remained static despite the decline in the bank refinance rate. For instance, private sector credit growth in 2009 averaged 27.1 percent compared to 44.5 percent the year before despite an average real lending rate of 8.2 percent compared to the real return on the 91-day Treasury bills of -5.7 percent. Efforts of Bank of Uganda (BOU) to encourage bank lending through reduced issuance of securities were met with much reluctance on the part of banks as indicated by the increase in the share of excess reserves to base money from an average of 1.3 percent in 2008 to 2.9 percent in 2009.

This excess reserves accumulation by commercial banks indicates that commercial bank actions conflicted with the expected credit expansion objective of monetary policy. It would seem that the accumulation of excess reserves was associated with an undesired response to the monetary policy stance. Nonetheless, it

[1] IMF Global Finanical Stability Report of April 2009.

should be noted that the excess reserves accumulation was not entirely detrimental to the economy. It has been argued that in the case of depositors, excess reserves ensure that banks are able to meet depositors demand for withdrawals (Agenor et al 2004). From the regulatory perspective, capital requirements are more than met when banks accumulate excess reserves which translate into improved observance of prudential requirements. Subsequently, at the business level it may be desirable for banks to hold excess reserves. Nonetheless, despite the benefits at the business level, there are complications that can be faced in the implementation of monetary policy with real costs to the economy as a whole. Divergence between actual and expected outcomes of monetary policy is likely especially if the conduct of monetary policy does not explicitly entail some adjustments to take care of the levels of excess reserves. The holding of large levels of excess reserves in banks also implies that banks are positioned favourably should market conditions change to increase credit thereby increasing inflationary risks (Saxegaard 2006).

There are direct solutions for suppressing excess reserve accumulation that include raising statutory reserves of banks, reducing interest rates on savings, or directing credit to certain sectors. However, some of these potential solutions have lost viability owing to difficulties in determining the persistence or transitory nature of the reserves and constraints due to lack of controls on credit. In addition, if the purpose of monetary policy is to expand credit, then adjusting statutory reserves may not necessarily favour credit increase if banks are risk averse. Overall, Central bank prediction of credit growth loses accuracy when banks accumulate excess reserves which generally weaken monetary policy. Developments in the banking sector in Uganda indicate that in 2009 and 2010, credit expansion may have been incompatible with the monetary policy stance. The coinciding increase in the spreads between Treasury bill rates and lending rates over the same period is another indication of asymmetrical response of lending rates to the monetary policy stance. This study provided evidence on the effect of excess reserves accumulation on the central bank's policies aimed at its inflation and growth objectives.

The main research question of the study was therefore to establish whether excess reserves held by banks affected the implementation of monetary policy. In attempting to answer this key question, two

complimentary questions emerged as follows: What is the effect of excess reserve accumulation on monetary policy implementation? What level of excess reserves should monetary policy makers in Uganda be concerned about?

The main objective of the study was therefore to establish the effect of excess reserves on monetary policy implementation. The specific objectives included:

i. Determining the threshold of excess reserves above which monetary policy implementation was affected.
ii. Establishing the effect of a high excess reserve regime on monetary policy implementation.
iii. Establishing whether excess reserve accumulation was transitory or permanent.

The reminder of the study is organized as follows: Section 2 describes monetary policy implementation in Uganda and provides some stylized facts about the banking system. Section 3 reviews studies that have focussed on the effect of excess reserves on monetary policy implementation and section 4 presents the methodology, data used and the findings. Section 5 concludes with a summary of the findings and policy implications.

2. EXCESS RESERVES AND MONETARY POLICY

2.1. Monetary policy implementation

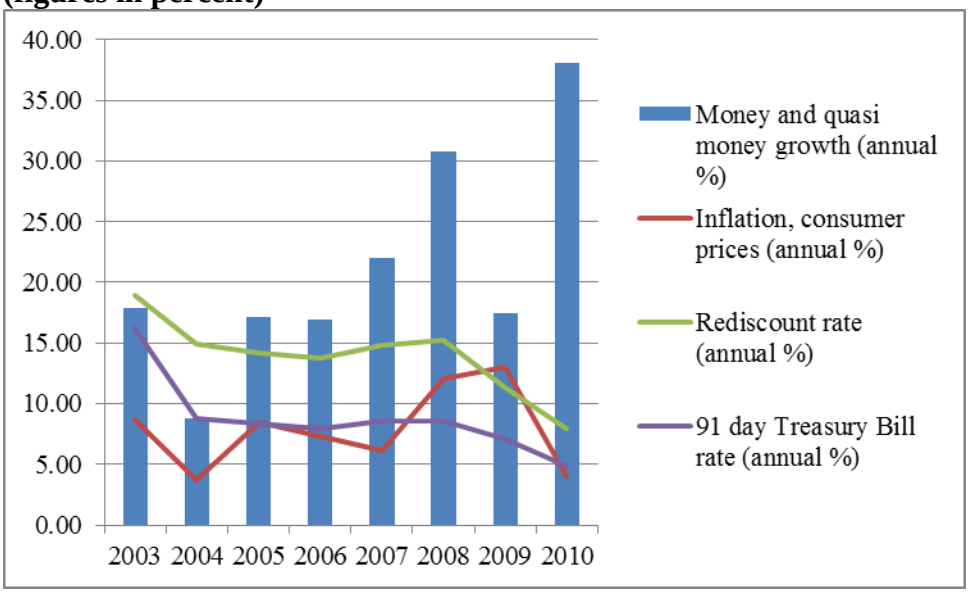
A description of the monetary policy implementation process is presented in this section to provide a sense of the interaction between excess reserves and monetary policy. The monetary policy framework in Uganda over the period of analysis was based on the Reserve Money Program (RMP). The RMP framework was used to derive growth in the broad monetary aggregates that are consistent with real GDP growth, private sector credit growth, and change in net credit to government, inflation, international reserve levels in months of imports of goods and services, velocity and the money multiplier.

To achieve the desired targets, Bank of Uganda used three main tools of monetary policy implementation: Discount rate (DR), Required Reserves Ratio (RRR) and Open Market Operations (OMO). The DR is the rate

at which banks borrow from the Bank when they require funds and can be uised to iinfluence funds available to banks. However, the DR is not regularly used as a tool of monetary policy because banks are usually highly liquid. The RRR refers to the amount of funds banks are required to hold with the central bank as reserves against their deposits and its increase or decrease can influence the amount of funds banks have for credit extension. As in the case of the DR, the RRR has not been used frequently by the BOU mainly because any changes to it have significant effects on lending and money supply. OMO refer to regular purchases or sales of government securities (Repurchase Agreements, Treasury bills and Treasury bonds) to either reduce or increase money supply respectively. OMO have by far been the most popular tool for monetary policy implementation and thus explain the importance of Treasury bills and bonds.

In addition to OMO, BOU also sold small but regular foreign exchange sales under sterilization to extract structural liquidity. Sterilisation of foreign exchange inflows was used as a tool for extracting liquidity related to government spending of foreign inflows of overseas development assistance. Short term liquidity was managed using repurchase agreements (REPO's) and reverse REPO's. Liquidity was generally regularly monitored on the basis of commercial bank's accumulation of excess reserves defined as the sum of reserves deposited with the Central bank by commercial banks and cash held in vaults in excess of the required or statutory level. As shown in Figure 1, the link between the monetary target and the rediscount rate and 364-Day Treasury bill rate was strong. Money growth was at its highest when the Treasury bill and rediscount rates were at their lowest level during 2010. Similarly, Treasury bill rates fell when inflation was low and rose when inflation was high. The mechanism through which Treasury bill rates were influenced to align them with the inflation objective was through the amounts of security issuances.

Figure 1: Inflation, Rediscount rate, 364-Day Treasury bill rate and Broad Money growth (figures in percent)



Source: BOU

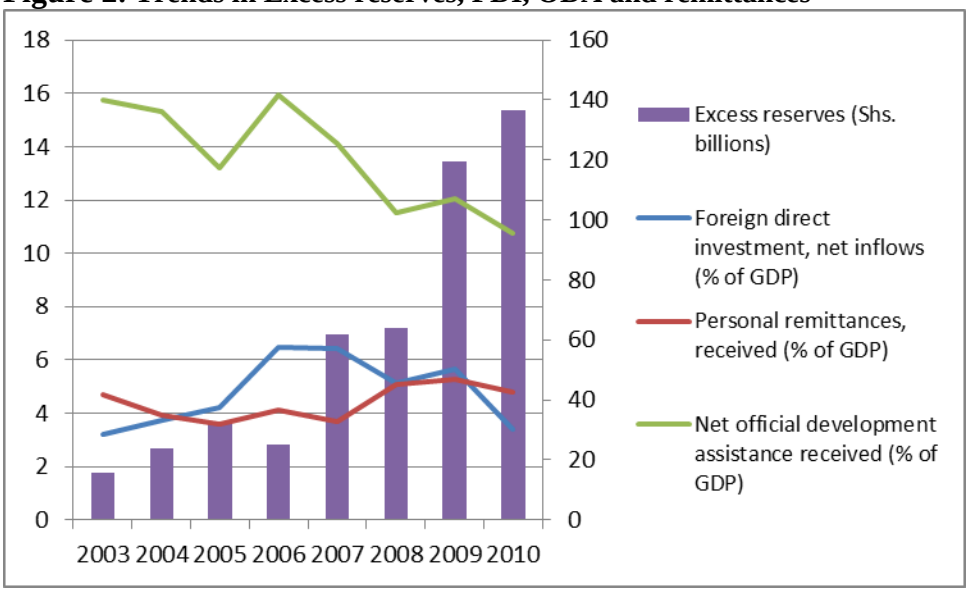
2.2. Total excess reserves in the banking system

In nominal terms, excess reserves averaged Uganda shillings 24 billion between 2003 and 2006. In 2007 and 2008 they more than doubled to an average of Uganda shillings 62 billion and then more than doubled to an average of Uganda shillings 128 billion between 2009 and 2010. This is also the period during which M3 had the highest growth and the rediscount and 364-Day Treasury bill rate were at their lowest as shown in Figure 2. In the period between 2004 and 2006, the build-up in excess reserves (difference between reserves held by banks and statutory reserves) of banks was mainly driven by a surge in donor inflows for project support, foreign direct investment and short-term capital inflows attracted into the domestic securities markets. During the period of the global financial crisis, excess reserves increased slightly.

However, after 2008 there was a surge in the accumulation of excess reserves. The surge could not be attributed to the traditional sources among sub-Saharan African countries comprised of overseas development assistance (ODA), foreign direct investment FDI) and worker's remittances (Saxegaard 2006 and Gilmour 2005). Both FDI and ODA fell from the 2006 levels of around 6.5 percent and 16.0 percent of GDP to the

2010 levels of 3.4 percent and 10.8 percent of GDP respectively. Although worker's remittances increased, the increase was not sufficient to offset the decline in FDI and ODA.

Figure 2: Trends in Excess reserves, FDI, ODA and remittances



Source: World Bank, World Development Indicators

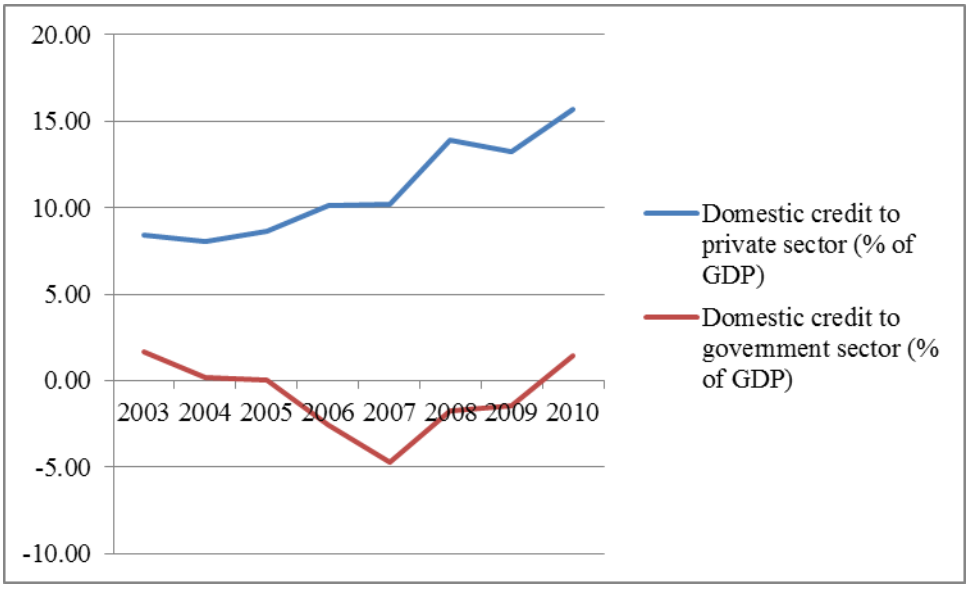
The decline in aggregate external flows indicates domestic sources for the increase in excess reserves observed. Potential domestic factors include monetisation of the fiscal deficit, developments in interest rates (monetary policy), cyclical factors limiting banks willingness to lend or more deep rooted problems in the financial sector that increased the risk of lending. The monetization of the fiscal deficit can however be ruled out given that the inflation developments between 2008 and 2010 were subdued and inflation actually fell as shown in Figure 1. On cyclical factors, it can be argued that the perceived risk of domestic borrowers following the onset of the global financial crisis relative to banks' capacity to manage risk could have had an effect. Thus from a portfolio management perspective, bank behaviour would be to tighten credit policies as a means of reducing credit risk especially for the vulnerable sectors. This can be investigated by looking at the behaviour of banks credit given the interest rate developments.

2.3. Credit and interest rate developments

The responsiveness of banks to monetary policy and its impact on excess reserves in the banking system is depicted by the trends in holdings of government securities and interest rate developments. Banks maintained rising shares of domestic credit to GDP throughout the period. However, the rapid rise in the share of

domestic credit to the private sector appears to have occurred at the expense of credit to government as share of GDP starting in 2005 (see Figure 3). Nonetheless, the post 2007 trend in credit to the private sector shows a decline in credit to the private sector and an unchanged position for government in 2009 suggesting an overall decline in credit before rising in 2010. The post 2008 trend in credit could therefore be associated with the observed increase in excess reserves during 2009. In 2010, the increase in credit to both government and the private sector and the rise in excess reserves suggest that as much as there was a rebound in credit extension during the year, it may have fallen short of bank's supply potential which could be attributed to bank tightening of credit conditions.

Figure 3: Stock of government securities and private sector credit as a share of deposits

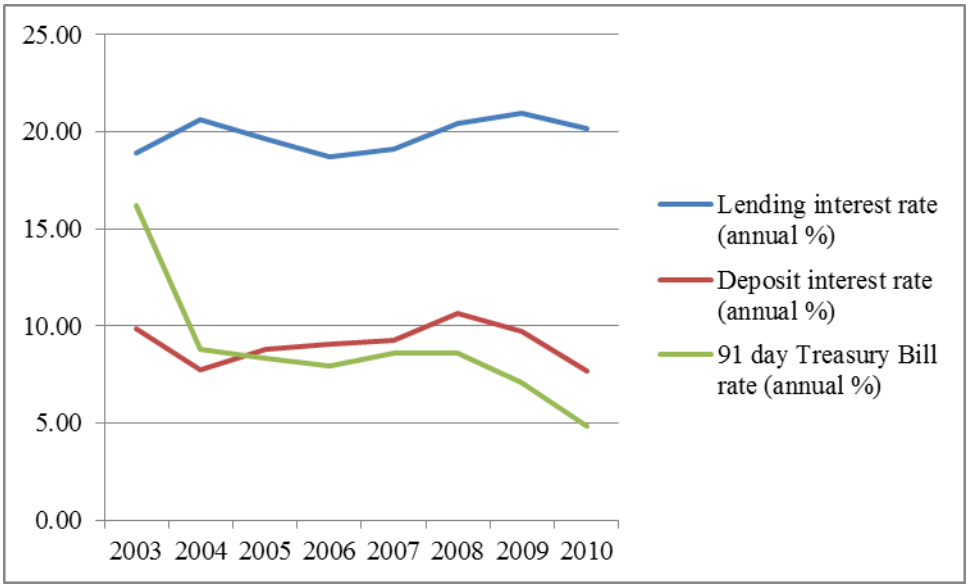


Source: BOU

Indeed a close examination of developments in interest rates shown in Figure 4 shows indicates that the adjustment in lending rates in 2009 and 2010 was much smaller when compared to deposit rates and treasury bill rates resulting in an increase in the margin between lending and deposit rates. This development lends credence to a possible tightening of lending and credit conditions by banks despite the rise in credit during 2010. However, following some tightening banks ended up building excess reserves as alternative attractive options for investment were lacking. Overall, the rigidity exhibited in the lending interest rates suggests that bank's price setting was not fully responsive to monetary policy. The continued accumulation of excess reserves by banks, and stickiness in the lending interest rates at a time of monetary easing highlights weak

response to monetary policy during the period between 2008 and 2010 and the build of excess reserves suggests structural issues in the portfolio markets limiting development of alternative assets for investment by banks.

Figure 4: Treasury bill rates, lending rates and deposit rates



Source: IFS, IMF

2.4. Bank level excess reserves

At the aggregate level, it is not clearly evident that excess reserves accumulation varied across different banks with the 3 large banks (Stanbic bank, Barclays bank and Standard Chartered bank) having negative excess reserves but with higher shares of loans and securities in the period prior to 2008 and the position unwinding after 2008 as their loans and securities shares fell and excess reserves increased. In 2003, the three largest banks had loans expressed as a share of deposits equivalent to 22 percent compared to 18 percent for all other banks. However, by 2010, the loan share of the largest three banks was less than that of all other banks at 31 percent compared to 36 percent for all other banks. Similarly, the share of securities to deposits for the largest three banks when compared to that for the rest of the banks was 23 percent compared to 14 percent for all other banks in 2003 but fell through 2009 to 15 percent before rising in 2010 to 21 percent. On the other hand, the share of securities to deposits for all other banks was smaller than that of the largest banks in 2003 at 14 percent but increased steadily to 23 percent in 2010 surpassing that of the largest three banks.

The evolution of loans and security assets of the banking system depicts a general acceleration of credit supply in the period prior to the financial crisis driven mainly by the largest three banks peaking in 2008. In this period, the largest three banks substituted their holdings of security assets with loan assets and subsequently had negative excess reserves (see Table 1). On the other hand, the remaining banks were only able to expand credit moderately and their security holding remained almost unchanged. Subsequently, they maintained excess reserves. In the post financial crisis period, the trend changed with the largest three banks focusing on loan recovery rather than loan extension and liquidation of security assets which resulted in increases in their holdings of excess reserves. The slack in loan extension by the largest three banks was partially offset by the other banks group which is also depicted by the general reduction in their holdings of excess reserves expressed as a share of deposits. No discernable pattern of excess reserves was noted with regard to ownership of banks decomposed by foreign and local majority ownership.

Table 1: Trends in excess reserves/deposits for old banks (percent)

Size	**Ownership**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Large	Foreign	-2.0	-3.9	0.9	-4.4	-9.3	3.4	-4.9	-3.7
Large	Foreign	0.0	-3.2	-3.8	-9.2	-5.7	-0.3	1.6	3.0
Large	Foreign	1.0	0.4	-4.1	1.3	0.5	-2.5	2.3	3.0
Small and medium	Foreign	0.2	-3.1	1.0	-1.5	-0.5	-2.9	1.6	0.7
Small and medium	Foreign	-1.3	-1.8	2.0	-5.3	-1.2	-3.7	0.6	1.6
Small and medium	Foreign	0.8	-3.9	3.9	0.6	18.9	5.6	8.9	29.6
Small and medium	Foreign	-3.0	-3.0	0.2	-0.4	0.9	-5.1	4.1	-0.4
Small and medium	Foreign	6.6	0.6	-2.2	1.2	9.1	-0.6	-2.5	1.2
Small and medium	Foreign	-1.4	4.9	4.0	-0.3	3.4	-4.9	-1.8	12.1
Small and medium	Local	-2.3	1.1	-1.3	-4.6	-3.9	-4.4	-1.3	0.1
Small and medium	Local	-3.1	-1.2	-0.6	-3.4	-0.3	-1.8	2.1	8.4
Small and medium	Local	26.6	7.5	2.1	10.5	-1.1	-1.6	4.4	-4.1
Small and medium	Local	0.9	2.1	1.1	0.7	-0.5	-1.7	1.1	9.3
banks with negative excess reserves		**7**	**7**	**5**	**8**	**8**	**11**	**4**	**3**
banks with positive excess reserves		**6**	**6**	**8**	**5**	**5**	**2**	**9**	**10**

Source: BOU and authors computations

Table 1 also shows that the while all banks had negative and positive excess reserves in different periods, positive excess reserves were generally much larger when compared to negative excess reserves which explains why at an aggregate level the banking system had positive excess reserves. For instance the highest level of positive excess reserves as share of deposits was 29.6 percent in 2010 compared to the highest level of negative excess reserves as share of deposits of 9.3 percent in 2007. Overall the developments indicate that

excess reserves were not uniformly distributed across all banks although they were positive for the entire banking system. Some banks had positive excess reserve while others had negative excess reserves which were to a large extent explained by the credit extension and holdings of securities. Given the variation in excess reserves at bank level, it is plausible that the operations of the interbank market failed to address the imbalance among the banks.

3. A survey of the literature

A literature review was done to establish the theoretical analysis and empirical evidence of excess reserves effects on monetary policy. The theoretical literature focuses on two potential effects of excess reserves on bank behaviour; one where banks behaviour is symmetric and the other where bank behaviour is asymmetric to monetary policy. The distinction between the two is attributed to categorisation of excess reserves by purpose into precautionary excess reserves and involuntary excess reserves (Agenor, Aizenman and Hoffmaister, 2000; Khemraj, 2006; and Agenor and Aynaoui, 2008). In the analysis, the models showed that under conditions where excess reserves have no effect on monetary policy effectiveness (i.e. when excess reserves are not too large to impact on monetary policy effectiveness), an increase in the refinance rate raises the bank's marginal cost of borrowing, which is directly passed on through the lending rate. As a result, a drop in investment and consumption occurs due to the substitution effect induced by a high deposit rate. Given that consumption falls, excess supply prevails and prices necessarily fall following the contractionary monetary policy. When the monetary policy instrument is the reserve requirement rate, an increase induces the bank to reduce the deposit interest rate, which in turn discourages saving and stimulates current consumption. The excess demand for goods leads to an increase in prices (and thus a higher value of collateral), which induces the bank to charge a lower premium. The lower lending rate, in turn, stimulates investment.

On the other hand, when banks have high levels of excess reserves, the analysis showed that banks may respond asymmetrically when making adjustments to the deposit rates. Specifically, they may be less responsive to increases in the refinance rate, or to reductions in the required reserve ratio, because they expect rising deposit rates to attract household deposits resulting in additional increase in excess reserves. Similarly, for lending rates, the analysis showed that if excess reserves were sufficiently high, banks would be inclined to soften collateral requirements or more generally ease credit standards, in order to stimulate the demand for

loans (which generated interest income, in contrast to excess reserves) in response to an increase in the refinance rate. Consequently, the premium (and thus the lending rate) would tend to be lower in the presence of excess reserves and an increase in the refinance rate would now have an ambiguous effect on the lending rate. From the foregoing, a contractionary monetary policy would again be less effective in reducing price pressures under a high degree of excess reserves.

The theoretical models used differed in several ways in terms of the assumptions made on the structure of the economy and depth of the financial sector and by implication causes of excess reserves. For instance Agenor and Aynaoui (2008) developed a model based on a closed economy with an undeveloped capital market while Khemraj (2006) assumed a small open economy. Despite the variation in the assumptions used, they all identified potential asymmetric response to monetary policy shocks that implied more effective monetary policy in an environment of low excess reserves. The excess reserves that were considered problematic for monetary policy effectiveness were regarded as involuntary excess reserves. While the assumption that some level of excess reserves may not impact monetary policy is generally adequate, the view that reserves would be held for precautionary motives may be questionable. The distinction between precautionary and involuntary excess reserves presupposes that precautionary excess reserves are insensitive to interest rate changes compared to involuntary excess reserves. However, it can also be argued that if there were no uncertainties in regard to interest rates then precautionary excess reserves would be held in interest bearing assets as opposed to holding them as non-remunerable assets. In Uganda's case it would seem that excess reserves were mostly precautionary given their poor response to interest rate developments following monetary policy easing post 2008.

The evolution of excess reserves in Uganda during the period is indicative of some non-linearity in the response of banks to monetary policy. Non-linearity in monetary policy transmission has been modelled using a Markov Switching VAR for Armenia by Bordon & Weber (2010). Threshold VAR's have also been used effectively to demonstrate nonlinearity such as regime switching, asymmetry and multiple equilibriums of credit and macroeconomic activity (McCallum 1991, Balke, 2000 and Atanasova, 2003). In particular, Saxegaard (2006) used a Threshold VAR for selected sub-Saharan countries and found evidence of weak

transmission of monetary shocks to inflation in the case of Nigeria and Uganda that was partly explained by the incidence of involuntary excessive reserves in banking system. The study of Saxegaard (2006) is of particular interest as it covered Uganda and also accounted for non-linearities. Specifically, the study used the contemporaneous value of involuntary excess reserves to identify the threshold for dividing the Ugandan sample into periods of low and high involuntary excess reserves before identifying the respective regime effects on monetary policy transmission.

This study however deviated from this approach by establishing the threshold level directly from the total excess reserves without distinguishing between precautionary and involuntary reserves for several important reasons. Firstly, the categorisation of precautionary and involuntary reserves presupposes involuntary excess reserves are sensitive to interest rate changes. In the case of Uganda, the post 2008 period showed significant rigidity in bank lending rates despite the reduction in Treasury bill rates and a subsequent build-up in excess reserves. This would imply that excess reserves were mainly precautionary and as such trying to separate them into involuntary and precautionary would not be meaningful. Even then, trying to empirically distinguish between precautionary and involuntary reserves is not always possible because it is difficult to exhaustively identify the respective determinants. In addition, it is difficult to deal with the problem of attribution where a particular determinant of excess reserves affects both types of excess reserves. Related to this, is the difficulty of appropriately controlling for important specific determinants that are of a transitory nature in the modelling. In addition, an analysis of excess reserves to establish whether they were permanent or transitory was conducted. The analysis was motivated by the dichotomy in the policy options available for dealing with persistent as opposed to intermittent excess reserve accumulation.

4. Methodology, data used and findings

4.1. Testing monetary policy transmission exclusive of excess reserve effects

A structural VAR was estimated to provide an initial evaluation of monetary policy transmission. The specification of the VAR used took the form:

$$Y_t = AY_t + B(L)Y_{t-1} + \varepsilon_t \qquad (1)$$

where Y_t is the vector of endogenous variables consisting of output measured by real GDP (y_t), the consumer price index (p_t), the interest rate (s_t), and the monetary aggregate (m_t).

The bank re-finance rate is in the case of Uganda the bank rate. However, the bank rate is implicitly an outcome of the Treasury bill rate as it is derived by adding a margin to the re-discount rate which in turn is derived from the 91-day Treasury bill. For this reason, the Treasury bill rate was used for estimation purposes. The monetary aggregate used was broad money (M2) defined as currency in circulation, plus private sector demand, savings and time deposits held at commercial banks. ε_t is the vector of serially uncorrelated disturbances that have a zero mean and a time invariant covariance matrix. *A* reflects the structural contemporaneous relationship and is assumed to have a recursive structure with ordering of output, consumer price index, Treasury bill rate, and broad money. The ordering was informed by other studies that have used VARs. *B(L)* is a lag polynomial matrix. The VAR in (1) was augmented with exogenous variables comprised of an index of world oil prices (o_t) and the U.S. Federal Funds Rate (f_t) to control for fluctuations in energy prices and overall global economic conditions respectively.

The variables used were seasonally adjusted and expressed in natural logarithms with the exception of the Treasury bill rate and the U.S. Federal Funds rate which were used in levels and were not seasonally adjusted. Unit root tests indicated that the series selected for the VAR were I(1). The data used covered the period 2003Q1 to 2010Q4 and June 2003 to December. The period of analysis was selected on the basis of data availability, particularly the short series on reliable quarterly GDP estimates and excess reserves. Standard information criteria were used to select the lag lengths of the VAR, which turned out to be 2 for quarterly data and 8 for monthly data.

Before estimating the VAR, tests for Bivariate Granger causality were conducted to examine some of the preliminary evidence of the causal links between the real economic activity and inflation with money supply and interest rates (see Table 2).

Table 2: Bivariate Granger causality tests

	F-Statistic	Prob.
Effect on output		
Treasury bill interest rate	0.1044	0.901
M2	1.0223	0.374
Effect on consumer prices		

Treasury bill interest rate	3.5113	0.045**
M2	9.6692	0.001**
Effect on Treasury bill rate		
M2	1.4428	0.255

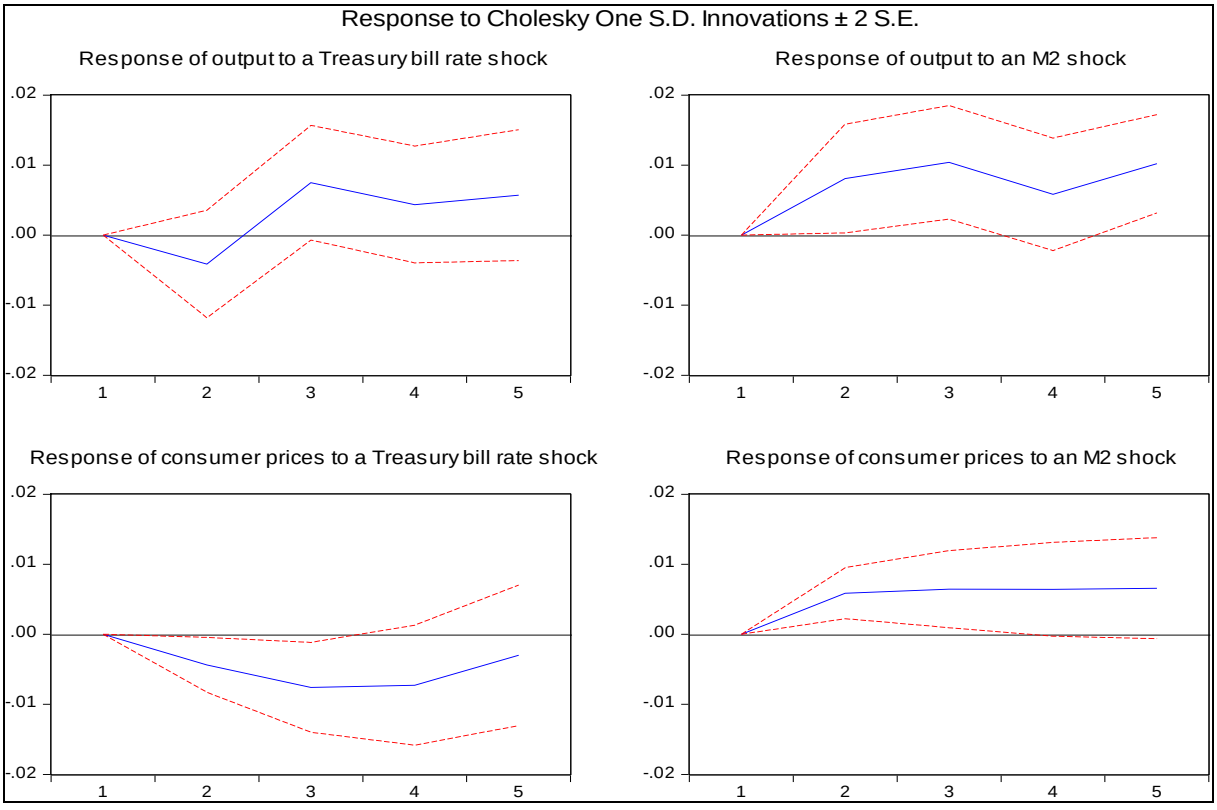
Notes: ** indicates significance at a 5 percent level.

Source: Author's computations

The causality tests for the quarterly data indicated no effect of M2 and the Treasury bill rate on output. However, both M2 and the Treasury bill rate had significant effects on consumer prices. The results also indicated no significant effect of M2 on the Treasury bill rate. The significant effects of M2 and the Treasury bill rate on consumer prices were consistent with expectations. However, the lack of a significant effect of the same variables on output was a noteworthy divergence from the theoretical expectations.

Following the Granger causality tests, the VAR indicated in Equation (1) was estimated using quarterly data and the impulse response functions were generated for the effects of interest rates and money supply shocks to output and consumer prices. Figure 4 presents the impulse response functions of output and consumer prices to the respective shocks.

Figure 5: Impulse response for the standard VAR model



Source: Author's computations

Theoretically, a positive interest rate shock should result in a fall in output and prices while a positive shock to the monetary aggregates should result in an increase in output and prices. The impulse response functions showed a significant increase in output following a positive shock to M2. However, output response to a positive Treasury bill rate shock was not significant at conventional levels. Further, both the Treasury bill rate and M2 had the expected effects on consumer prices and were significant. A positive shock to the Treasury bill rate resulted in a significant fall in consumer prices. On the other hand, a positive shock to M2 resulted in a significant increase in consumer prices. The results of the effects of positive shocks to Treasury bill rates and M2 on consumer prices were consistent with the Granger tests.

Overall, with the exception of the responsiveness of output to a Treasury bill rate shock, the impulse response functions generated were as expected. The absence of a significant effect on output from a Treasury bill rate shock could partly be due to the failure of the usual VAR to incorporate excess reserves effects. However, excess reserves could not be simply included in the VAR as an endogenous or exogenous variable because the interest was to determine how they affect the outcome of monetary policy and not the policy variables. The solution was to use a TVAR in which the excess reserves effects on monetary policy were accounted for through regime effects.

4.2. Evidence from the threshold VAR analysis of quarterly data

The TVAR was used to explicitly account for the effects of excess reserves accumulation by banks on monetary policy effectiveness following the approach of Balke (2000), Saxegaard (2006), and Alfonso et al. (2011). Its use was based on its simplicity in providing a mechanism for integrating excess reserves as a potential non-linear propagator of shocks. In particular, the TVAR provided a mechanism for incorporating non-linearity in the VAR by making it possible to include excess reserves regime switching due to shocks to other variables besides excess reserves. Through this mechanism, it was possible to have the excess reserve regime as an additional endogenous variable in the VAR. The TVAR used took the following structural form:

$$Y_t = A^1 Y_t + B^1(L) Y_{t-1} + (A^2 Y_t + B^2(L) Y_{t-1}) I(ed > \tau) + \varepsilon_t \qquad (2)$$

Where Y_t is a vector containing output, consumer price index, Treasury bill rate, and M2. $B^1(L)$ and $B^2(L)$ are lag polynomial matrices for the different regimes while ε_t are structural disturbances. *ed* is the threshold variable in this case excess reserves/deposits that determines the excess reserve regime (i.e. normal or high

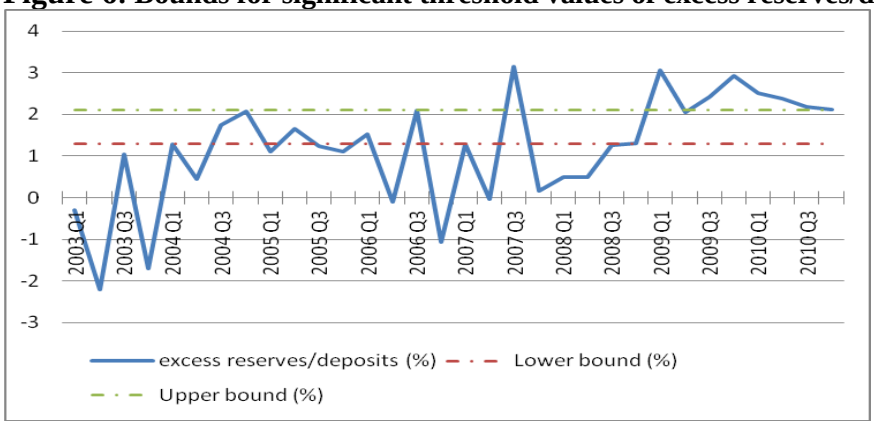
excess reserves relative to a threshold) and $I(ed>\tau)$ is an indicator function that equals 1 when $ed > \tau$ and 0 otherwise. τ is the threshold value of excess reserves/deposits, and A^1 and A^2 reflect the structural contemporaneous relationships in the two regimes respectively. It was assumed as in the baseline VAR that A^1 and A^2 had a recursive structure ordered as output, consumer prices, Treasury bill rate, and M2.

Since the threshold variable (τ) was not known, the first thing that was done was to estimate it before making any attempts to establish its relevance to monetary policy implementation. The approach used to determine the threshold was exploratory. It involved identifying each possible value of the threshold from the data available on the ratio of excess reserves to deposits between 2003Q1 and 2010Q4 as a first step. The possible threshold values were selected from the data between the 15th and 85th percentiles of the observations on the ratio of excess reserves to deposits. The respective percentiles were used to narrow the scope for the search while ensuring the inclusion of a minimum of 15 percent of the total observations below and above each identified threshold value to enable meaningful estimation. The ratio of excess reserves to deposits ranged between -2.20 percent and 3.20 percent and the 15th and 85th percentiles were -0.05 percent and 2.40 percent respectively. Additional rationalisation of the data was achieved by combining computed 2, 3, and 4 quarters moving averages of identified values in the range. The set of potential thresholds identified had 22 values that ranged between 0.3 and 2.4.

In the second step, each of the 22 identified potential threshold values was used for estimating the threshold model in Equation 2 using ordinary least squares estimation. The least squares estimates had the dependent variable as consumer prices as it is the main objective of monetary policy. A Wald test was then used to identify the significant threshold values from the estimated least squares equations. The test was conducted to assess the joint significance of the coefficients for all variables interacted with the indicator function (i.e. $I(ed>\tau)$). Out of the 22 possible threshold values for excess reserves/deposits, 9 were significant with the lowest threshold value equal to 1.3 percent and the highest equal to 2.1 percent. The highest threshold value also had the highest Chi-Square test statistic from the Wald test which indicated it was the most significant. Figure 6 shows the identified minimum and maximum threshold values that were found significant superimposed on the trend in excess reserves/deposits. The Figure shows 2004Q3, 2004Q4, 2005Q2, 2006Q3, 2007Q3 and 2009Q1 to 2010Q4 as quarters during which actual excess reserves/deposits exceeded the lower

bound. It is important to note that the period after 2008Q4 had continuous excess reserves above the upper bound. However, it is important to note that the estimated threshold values are lower than those estimated for Uganda by Saxegaard (2006). Saxegaard (2006) found a higher threshold value of 5.6 percent based on an analysis covering the period between 1993 and 2003. The difference in the thresholds could be partly explained by developments in the financial sector in the period covered by this study compared to that covered by Saxegaard 2006. For instance the banking sector during the period covered by Saxegaard was characterised by the dominance of one state owned bank which was privatised in 2002, a number of poor performing banks which were closed or restructured between 1998 and 2002 and a less developed payments system.

Figure 6: Bounds for significant threshold values of excess reserves/deposits



Source: Author's computations

The less stringent regulatory and supervisory environment prior to 2003 was overhauled in 2004 when a new Financial Institutions Act came into force with new regulatory requirements for higher capital. The payments systems were also substantially improved following the introduction of new technology based products and new banks were licensed increasing competition. Subsequently, the reforms which occurred in the sector may have contributed to the general reduction in the need for banks to hold very large excess reserves. Nonetheless, the banking sector still has some residual structural problems that require resolving as shown by the high lending rates and large spread between lending and savings rates in Figure 3 and the expansion of excess reserves during the recent period.

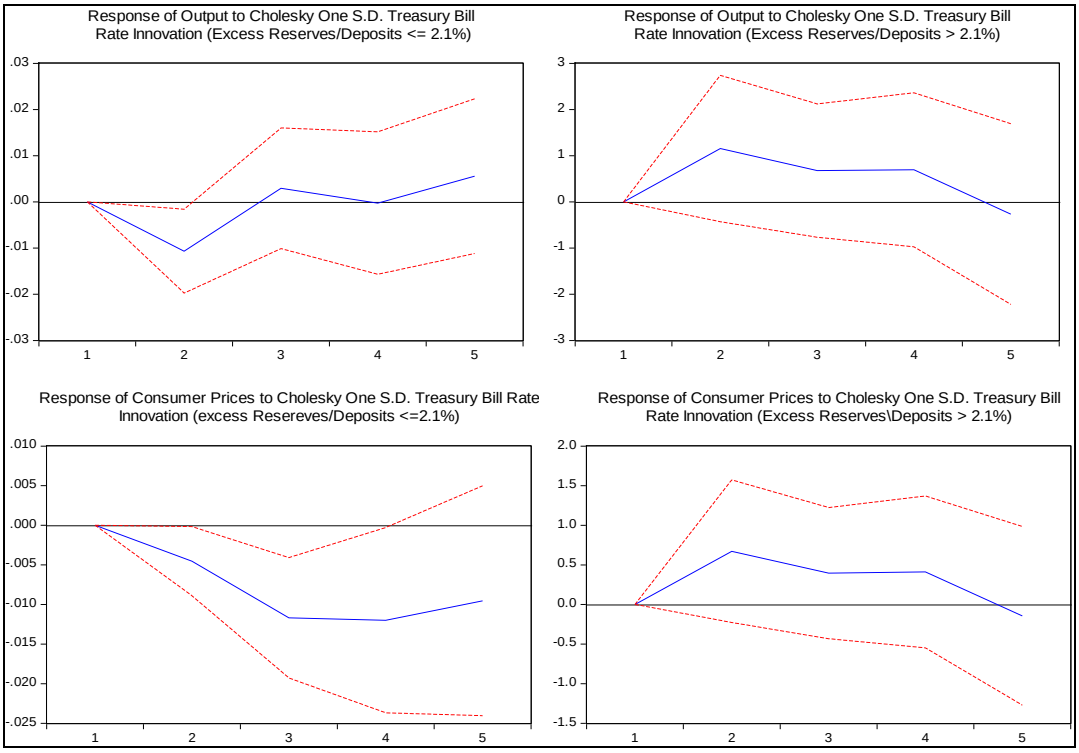
On the basis of the identified thresholds, the TVAR model expressed in Equation (2) was estimated using the established upper bound of the share of excess reserves to deposits of 2.1 as the best threshold value and using the lower bound of 1.3 as the threshold value for comparison purposes. Because the estimates did not change

much we present the analysis on the basis of the 2.1 threshold value as it had the largest log-likelihood estimate for the system as a whole. The TVAR was estimated with a lag of 2 periods as suggested by the lag length criteria. From the estimated TVAR, impulse response functions were generated to examine monetary transmission. Since the objective of using the TVAR analysis was to determine whether asymmetries dependent on the excess reserves regime existed in the system, the impulse response functions generated where calculated conditioned on the system remaining in the regime prevailing at the time of the shock.

4.2.1. Effect of a shock to Treasury bill rates on output and inflation

Impulse response functions showing the effect on output and consumer prices following a positive Treasury bill interest rate shock during the normal excess reserves regime (when excess reserves/deposits are below or equal to 2.1 percent) and during the high excess reserves regime (when excess reserves/deposits exceed 2.1 percent) where generated and are as shown in Figure 6.

Figure 7: Impulse response of output and consumer prices to shocks in Treasury bill rates



Source: Author's computations

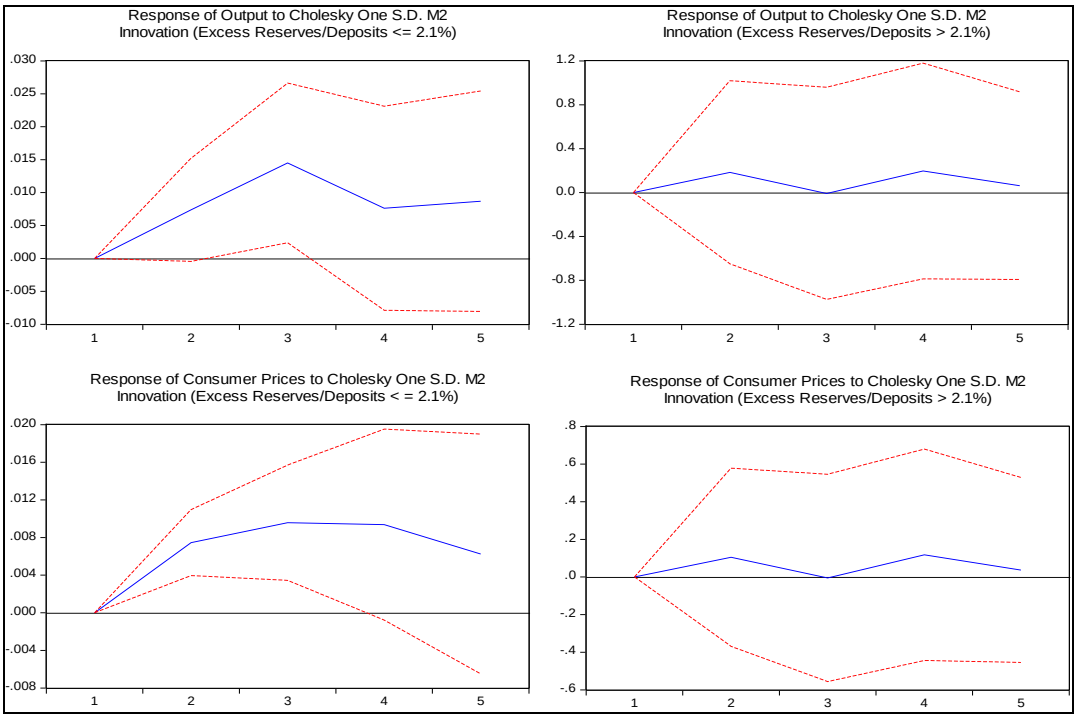
The impulse response functions show that during periods when excess reserves/deposits are less or equal to 2.1 percent, a positive shock to the Treasury bill rate elicits the expected behaviour in output and consumer

prices. On the contrary, a shock to the Treasury bill rate when excess reserves/deposits exceed 2.1 percent results in ambiguous and insignificant changes in output and consumer prices. In addition, controlling for the regime change using the TVAR shows better responsiveness of output to a Treasury bill rate shock compared to the impulse response functions from the basic VAR where output is not affected significantly by a positive Treasury bill rate shock.

4.2.1. Effect of a broad money shock on output and consumer prices

Impulse response of output and consumer prices to positive broad money shocks during periods when excess reserves/deposits were less or equal to 2.1 caused the expected changes in output and consumer prices (see Figure 7). Both output and consumer prices increased when broad money was shocked. On the other hand, the response of output and consumer prices to a positive broad money shock when excess reserves are higher than 2.1 percent was not statistically different from zero.

Figure 8: Impulse response of output and consumer prices to shocks in broad money



Source: Author's computations

The impulse response functions showed that both Treasury bill rates and M2 were weak policy instruments when excess reserves exceeded the estimated threshold level. They also showed that M2 had a stronger policy

effect on output compared to the Treasury bill rate. On the other hand, the response of prices to the Treasury bill rate was much stronger relative to its response to M2.

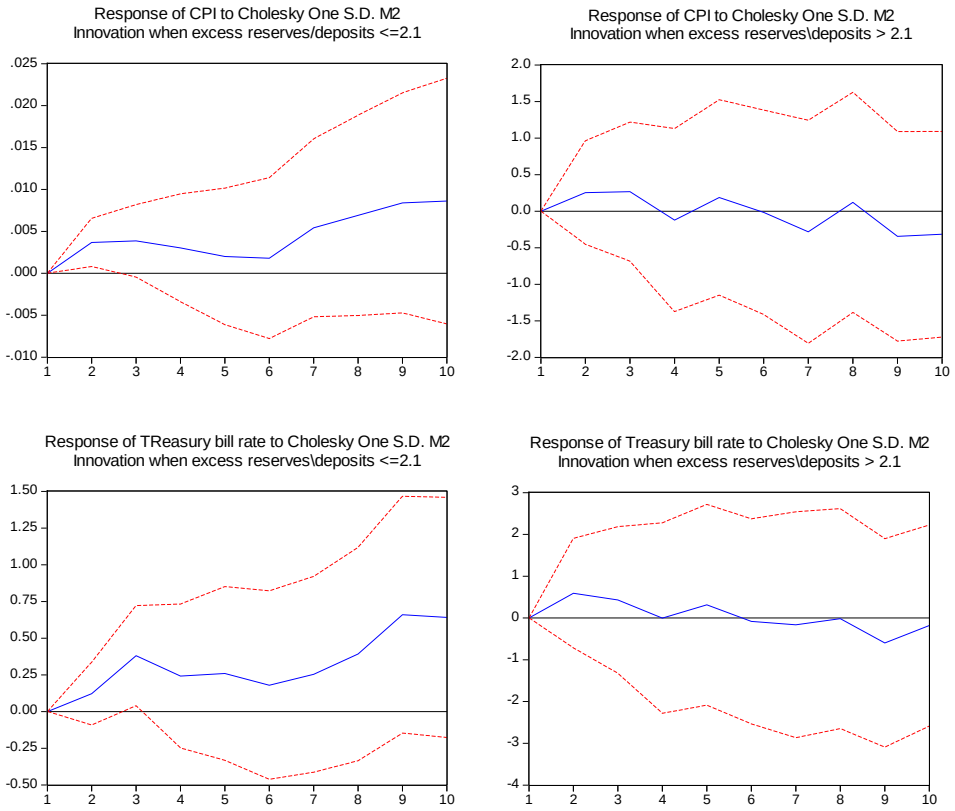
4.3. Evidence from the threshold VAR analysis of monthly data

In the previous section, the analysis of the effectiveness of monetary policy was conducted using quarterly data mainly due to lack of good monthly indicators on output. However, in the case of Uganda, monetary policy formulation during the period was conducted on a monthly basis during the RMP regime and the main target was monthly inflation. Additional analysis was therefore conducted using monthly data as a check for robustness of the findings. A TVAR in which three variables comprised of the composite price index, the 91-day Treasury bill rate and broad money was used for the analysis.

4.3.1. Effect of a broad money shock on the 91-day Treasury bill rate and consumer prices

Impulse response functions showing the effect on consumer prices and Treasury bill rates following a positive broad money shock during the normal excess reserves regime (when excess reserves/deposits are below or equal to 2.1 percent) and during the high excess reserves regime (when excess reserves exceed 2.1 percent) where generated and are as shown in Figure 8.

Figure 9: Impulse response of consumer prices and Treasury bill rates to shocks in broad money



Source: Author's computations

The impulse response functions show that during periods when excess reserves/deposits are less or equal to 2.1 percent, a positive shock to the broad money results in the expected behaviour in the consumer prices and Treasury bill rates.

The effect of a shock to broad money results in a significant increase in consumer prices. On the contrary, a shock to the broad money when excess reserves/deposits exceed the 2.1 percent threshold results in ambiguous and insignificant changes in the consumer prices. In the case of Treasury bill rates, there is initially no significant effect of a shock to broad money in the first two months. However, a significant increase in the Treasury bill rate is noted in the third month following a shock to broad money during the normal excess reserves regime. When compared to the impulse response function for Treasury bill rates following a shock to broad money during the high excess reserve regime, we note ambiguous and insignificant changes in the Treasury bill rate that is similar to that of the CPI.

5. Conclusions and recommendations

The analysis showed that monetary policy effects were vague and/or insignificant as the level of excess reserves in the banking system increased relative to the deposits irrespective of whether low or high frequency data was used. The threshold level identified expressed as a ratio of excess reserves to deposits was 2.1 percent. However, it is also possible that monetary policy effectiveness could be affected even at a level of excess reserves to deposits as low as 1.3 percent as indicated by the lower bound estimate for the threshold level. The findings suggest that the efficacy of the available monetary policy instruments declined during 2009 and 2010 period, the good growth performance and low and stable inflation over the last 20 years notwithstanding.

The obvious implication of the findings is that monetary policy formulation needs to be continuously cognizant of both the level relative to the threshold and persistence of excess reserves. The need for regular decummulation of excess reserves is strongly vouched for by the findings. Deepening the financial sector to provide scope for more portfolio choices for banks including improving the efficiency of interbank market are some policy measures that could be considered. An important consequence of the finding is that addressing excess reserve accumulation may become increasingly vital when Uganda starts receiving large oil revenues from oil production.

These conclusions notwithstanding, it is important to note the following limitations of the study. First it is unclear to what extent the results can be generalized as a stable benchmark used universally irrespective of changing situations as a time invariant benchmark. Related to this shortcoming is the coinciding of the study period with the onset of the global financial crisis whose impact on the results could not be controlled for. These shortcomings provide potential areas of further study.

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