

## Chapter 4

# Involuntary Excess Liquidity and the Effectiveness of Monetary Policy: Evidence from Sub-Saharan Africa

### 4.1 Introduction

Over the last decade, African economies have made significant progress in improving the framework for the conduct of monetary policy. These improvements have yielded tangible benefits in terms of historically low rates of inflation in the region. In Sub-Saharan Africa (SSA) average inflation declined to 9.1 percent in 2004 from an average of 14.6 percent between 1997 and 2001. At the same time, the amount of liquidity has been growing rapidly. Throughout the region, the stock of broad money (M2) rose by 21.3 percent on average between 1997 and 2004 as a result of large capital inflows, particularly due to increases in aid inflows and revenues from the export of oil. Because of the recent improvement in the economic outlook in many countries in the region, there is now increasing concern that the growth of liquidity poses significant inflationary risks. In partic-

ular, the assets of many commercial banks in the region include non-remunerated liquid assets at levels that significantly exceed statutory requirements. If there is a sudden improvement in demand conditions, there is a fear that banks will expand lending with possible adverse consequences for inflation.<sup>1</sup>

Beyond acknowledging the threat of increasing inflation, several authors have observed that this abundance of liquidity is likely to have adverse consequences for the ability of monetary policy to influence demand conditions, and thus to stabilize the economy. Agénor, Aizenman, and Hoffmaister (2004), for example, note that if banks already hold liquidity in excess of requirements, attempts by the monetary authorities to increase liquidity to try and stimulate aggregate demand will prove largely ineffective. Similarly, (Nissanke and Aryeetey 1998) argue that in the presence of excess liquidity, it becomes difficult to regulate the money supply using the required reserve ratio and the money multiplier, hence undermining the use of monetary policy for stabilization purposes. In other words, one would expect excess liquidity to weaken the monetary policy transmission mechanism.

Despite the concerns expressed about the impact of excess liquidity on the effectiveness of monetary policy, there has been no attempt to formally test the hypothesis that the monetary policy transmission mechanism is weakened when liquidity is excessive. The aim of this paper is evaluate whether the transmission of shocks to reserve money, which in our study is taken as the instrument

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<sup>1</sup>These fears are not limited to Africa. The recent build-up of excess liquidity in the euro area has led to fears that “should excess liquidity persist, it could lead to inflationary pressures over the medium term.” (Trichet, 2004).

of monetary policy, to CPI and output is weakened when liquidity is in excess of that demanded commercial banks in Kenya, Nigeria and Uganda. The approach we adopt can be divided into two stages. Firstly, we estimate a model of excess liquidity which enables us to differentiate between excess liquidity held for precautionary purposes and reserve holdings in excess of that level. Secondly, we estimate regime-switching models of the transmission mechanism for each case study. In particular, we estimate a threshold vector autoregressive (TVAR) model that formalizes the idea that the monetary policy transmission mechanism switches between different regimes depending on the amount of excess liquidity in the economy. This approach is preferred to carrying out a panel data study on a wider sample of countries in the region because, although the technology exists for estimating threshold panel data models (see *inter alia* Hansen (2000)) and dynamic panel data models, dynamic threshold panel data models have not yet been developed. Using a TVAR methodology enables us to take seriously the dynamic aspects of the monetary policy transmission.

The remainder of this paper is organized as follows: In section 2 we discuss some stylized facts about excess liquidity in the region in general and the three case-study countries in particular. In Section 3, we argue that for analytical purposes it is necessary to decompose excess liquidity further. In particular, Agénor, Aizenman, and Hoffmaister (2004) argue that whether excess reserves are caused by a decline in the supply of loanable funds, that is a credit crunch, or a reduction in the demand for credit, has important implications in terms of the

threat of increased inflation and for the effectiveness of monetary policy. Section 3 proceeds with a discussion of the transmission mechanism of monetary policy with particular emphasis on the role of excess liquidity. Having argued that it is important to differentiate between the different forms of excess liquidity, this chapter proposes a framework for how such a decomposition can be achieved. Section 4 briefly outlines the econometric methodology and presents the estimates of the monetary policy transmission mechanism for the three case studies. A final section summarizes our main findings and discusses policy implications.

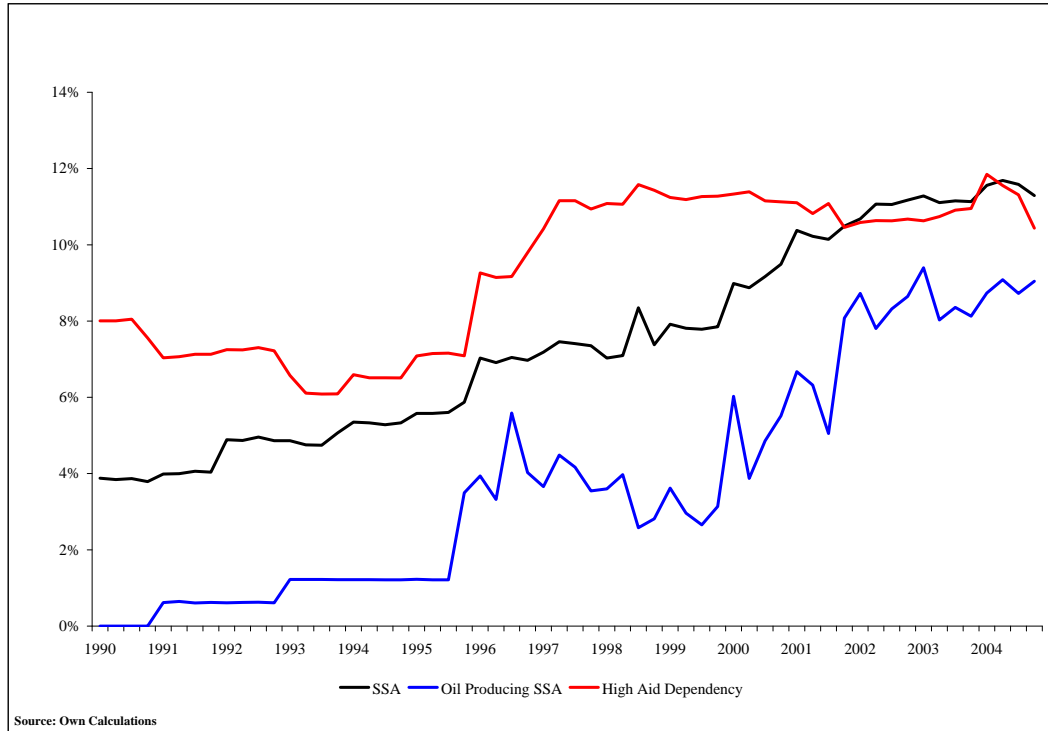
## **4.2 Some Stylized Facts on Reserve Requirements and Excess Liquidity in African Countries**

The analysis in this chapter is based on database of reserve requirements covering 44 SSA countries. For the majority of countries, data is available on a quarterly basis from 1990Q1 to 2004Q4 and includes a detailed description of the base on which required reserves are calculated and any changes in the legislation that have taken place during the sample period. Information about whether reserves are remunerated or not is also included.<sup>2</sup> The data on required reserve ratios is used to calculate statutory excess reserves using data on commercial

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<sup>2</sup>For some countries, this data is taken from Kovanen (2002). With the exception of a few countries in SSA, required reserves in the form of deposits with the central bank are not remunerated. In some countries, such as Angola and Ghana, commercial banks can satisfy a portion of their reserve requirement by holding treasury bills or central bank securities. In Malawi, commercial banks are allowed to deposit part of their required reserves in discount houses. However, even in these countries remuneration rates are much lower than market rates. See appendix 2 for details.

Figure 4.1: Average Effective Reserve Requirement



bank reserves and deposits from the IFS database.

Figure 1 shows the effective required reserve ratio for different groups of countries over the sample period where the effective reserve ratio is calculated as the ratio of statutorily required reserves to the sum of demand and time, savings and foreign currency deposits.<sup>3</sup> The data suggests that, on average, the reserve requirement has been increasing over time in SSA countries.<sup>4</sup> This is true for oil producing and non-oil producing countries, as well as countries that are highly

<sup>3</sup>See appendix 3 for details on the required reserve ratio and excess reserves in each country in the sample at the end of 2004.

<sup>4</sup>Note that due to a lack of data, the sample of countries is decreasing the further back in time one goes. This may cause a sample selection bias. However, examination of data for the subset of countries for which we have a complete time-series indicates that this is insufficient to explain the overall trends that emerge from figure 2.

dependent on aid.<sup>5</sup> The increase in reserve requirements over the sample period has been particularly pronounced in the group of oil producing countries. The group of countries that is classified as highly dependent on aid raised reserve ratios rapidly in the mid-nineties and has maintained a high reserve requirement ratio since.<sup>6</sup>

The secular increase in the average reserve requirement in the region is in contrast with the tendency to reduce reserve requirements in most OECD countries such as the United States.<sup>7</sup> This reflects a number of developments. Firstly, the increased focus on stabilizing inflation, coupled with a lack of open market and open market type monetary policy instruments, has forced central banks to rely on increases in the rule-based instruments, such as the reserve requirement, to combat inflation. This is particularly true given the move away from other rule based instruments such as interest rate controls. Secondly, the increasing concern with maintaining the stability of financial system is likely to have caused increases in the required reserve ratio for prudential reasons. Thirdly, it reflects the development of a modern fractional reserve banking system in SSA countries and liberalization of financial markets during the 1990s. Finally, there is little doubt that the increasing capital inflows from aid and oil revenue, coupled

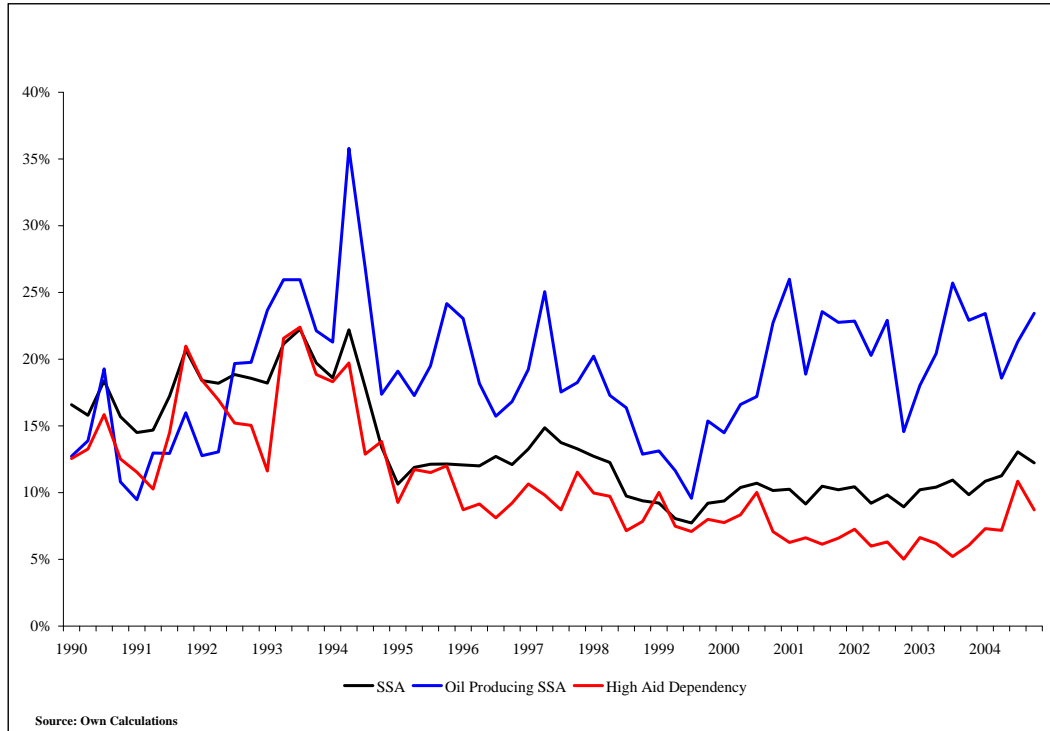
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<sup>5</sup>Countries are classified into groups based on their end of sample characteristics. This implies that a country classified as oil producing may not have been producing oil over the whole sample period. See appendix 1 for the classification of countries.

<sup>6</sup>The sharp increase in reserve requirements in oil-producing countries and high aid countries in 1995 reflects lack of data for Angola and Cape Verde prior to this date.

<sup>7</sup>Reserve requirements in the US have been gradually decreased since 1975 when reserve requirement ratios varied between 16.5 and 3 percent depending on the size and maturity structure of deposits to their current level between 10 and 0 percent.

Figure 4.2: Ratio of Excess Reserves to Total Deposits



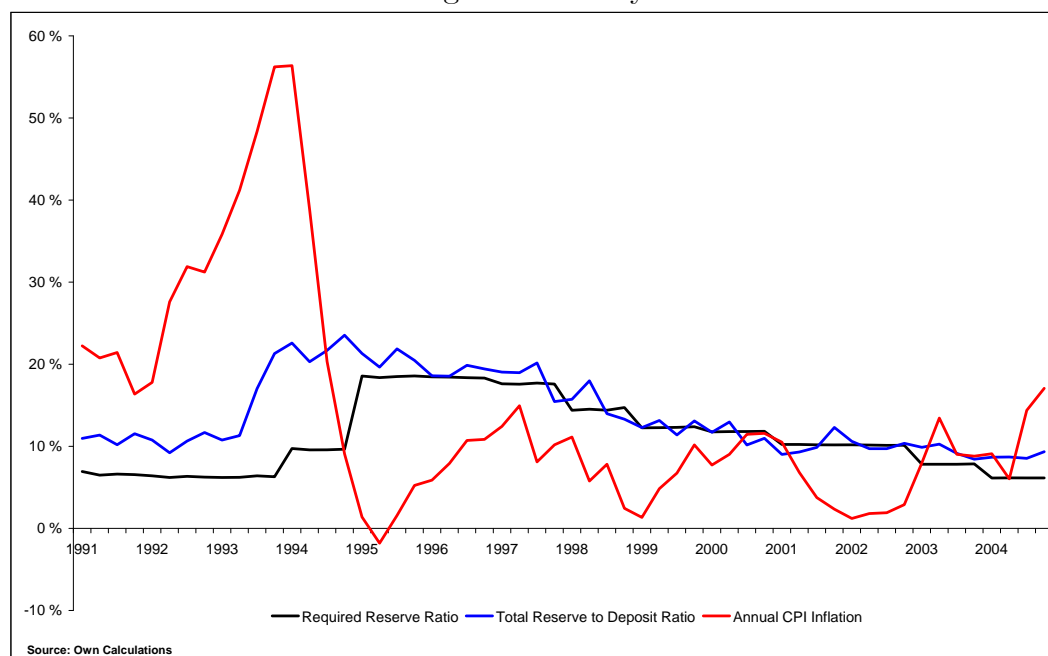
with government absorption constraints, has forced central banks to increase reserve requirements in order to try and prevent the build-up of inflationary pressure.<sup>8</sup>

During the period of our sample average reserve requirements in the CFA countries have tended to be below the average in the rest of the region. Moreover, reserve requirements in these countries were introduced at a later stage than reserve requirements in the majority of other countries in SSA.<sup>9</sup> Part of the

<sup>8</sup>A final possibility for why effective reserve requirements may seem to be rising is a shift towards deposits that carry a higher reserve requirement. Examination of the data suggests, however, that since 1995 the composition of deposits has remained fairly constant whilst reserve requirements on both demand and time and savings deposits have been rising, on average.

<sup>9</sup>Reserve Requirements in the CEMAC region were introduced in September 2001, several years later than in the WAEMU region where they were introduced in October 1993.

Figure 4.3: Kenya



explanation for this trend is probably the low rates of inflation in CFA countries relative to the regional average which has reduced the pressure on the authorities to constrain the growth of monetary aggregates by increasing reserve requirements.<sup>10</sup>

Using the data on reserve requirement ratios, we calculate excess reserves as commercial banks' holdings of cash and deposits at the central bank in excess of statutory requirements.<sup>11</sup> Figure 2 shows the evolution of statutory

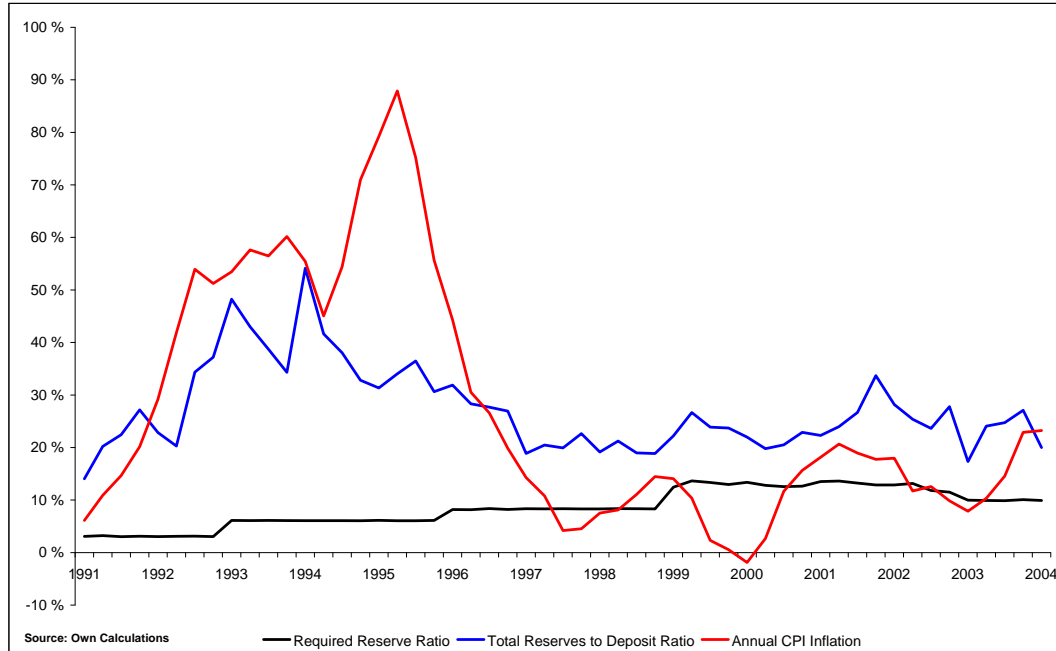
<sup>10</sup>Between 1990 and 2004, annual CPI inflation in the CFA countries averaged less than 5 percent relative to nearly 25 percent in the SSA region as a whole.

<sup>11</sup>The sum of demand and time, savings and foreign currency deposits is calculated as the sum of line 24 and 25 in the IFS database. Note that for countries where data is not readily available, foreign currency deposits are not included. In Liberia, for example, the effective reserve ratio overstates the actual reserve ratio because IFS does not include data of foreign currency reserves even though these are subject to a reserve requirement. Finally, whether foreign currency deposits should be included in the calculations depends on the extent to which they are intermediated in the domestic economy. This consideration is beyond the scope of this paper. Finally, we do not consider the impact of liquid asset requirements in this paper.

excess reserves in SSA over time. The data suggests that excess reserves in the region have been fairly stable since 1995, with a sharp drop in excess reserves coinciding with the devaluation of the CFA franc in 1994. The data also suggests that excess reserves in oil-producing countries in SSA have been higher than in the remaining countries since the middle of the 1990s. Moreover, excess reserves in these countries has tended to be more volatile than in the rest of the region as one would expect given the volatility of the oil price and the potential role of oil revenues in the build-up of excess liquidity. Given the tendency for oil-producing countries to have higher levels of excess reserves than the region as a whole, it is not surprising that excess reserves in the CFA countries, which includes the oil-exporting countries in the CEMAC region, have also tended to be relatively high.

There is no *prima facie* evidence that countries that are highly dependent on aid have higher ratios of excess reserves to deposits than other countries in the region. This may reflect a number of issues. One possible explanation for this is that several of the countries that receive a lot of foreign aid, such as Uganda and Mozambique, have successfully implemented structural reform programs that have contributed to the development of the financial sector. It is also possible that countries that are highly dependent on aid inflows have adopted a relatively flexible exchange rate regime which allows the exchange rate to adjust rather than domestic liquidity. High levels of aid inflows may also help ease supply constraints thus contributing to reduce excess liquidity.

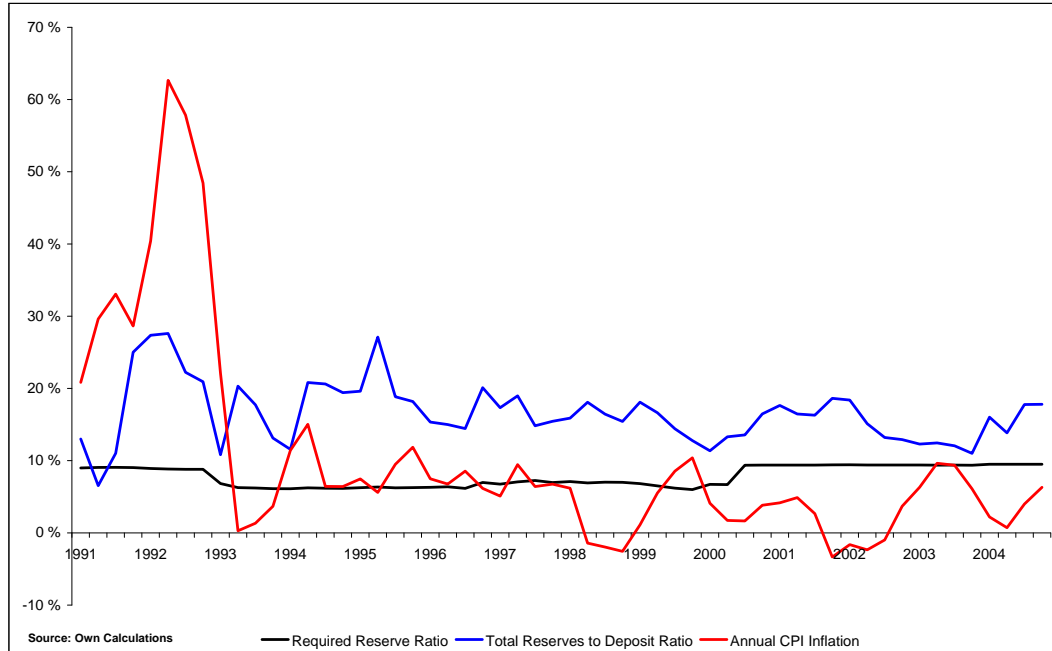
Figure 4.4: Nigeria



Figures 3-5 provide more detailed information regarding the evolution of the reserve to deposit ratio, the required reserve ratio and inflation in Kenya, Nigeria and Uganda, respectively.<sup>12</sup> The difference between the reserve to deposit ratio and the required reserve ratio corresponds to excess liquidity. Figure 3 shows that in Kenya the required reserve ratio was raised from 10 percent to nearly 20 percent at the end of 1994. This coincided with a dramatic fall in excess liquidity from 15 percent of total deposits to less than 5 percent of deposits suggesting that the required reserve ratio may be an important determinant of excess liquidity in Kenya. The decrease in excess liquidity occurred as Kenya was undergoing financial sector liberalization including a switch to market determined interest

<sup>12</sup>See appendix 4 for a description of the monetary policy regime in these countries.

Figure 4.5: Uganda



rates in 1991 and elimination of virtually all foreign exchange restrictions by 1995. Because of increased spending in the run-up to the 1992 election and money-financing of the fiscal deficit due to the aid embargo at the time the financial liberalization was not accompanied by the necessary fiscal adjustments. As a result Kenya in the early 1990s suffered from high and volatile inflation which only started to be brought under control following a tightening of monetary and fiscal policy, including rising reserve requirements, as part of a resumption of aid.

It is interesting to note that inflation was brought under control before the excess liquidity in the system was drained from the system. In part this reflected exchange rate appreciation in the wake of private capital inflows as well as an improvement in the credibility of the governments policies following a

following the agreement with the IMF and the World Bank in 1993. The renewed commitment to a stable macroeconomic environment in turn prompted the central bank to take actions to drain the existing excess liquidity from the system to safeguard price stability. Finally, it is worth noting that both excess liquidity and CPI inflation appear to exhibit some seasonality. This is not surprising given the importance of the agricultural sector whose earnings and demand for credit follow a well defined seasonal pattern.

Figure 4 shows that Nigeria experienced a period of very high excess liquidity in the early 1990s reaching close to 50 percent in 1994. To a large extent this reflected the lack of a framework for dealing with highly volatile revenues from oil exports and fiscal dominance. Sterilization of excess liquidity was also complicated by the capping of interest rates in open market operations which, in the high inflation environment, ensured negative real interest rates on Treasury bills. Finally, the room for maneuver for the central bank was curtailed by exchange rate inflexibility until 1999. Figure 4 also suggests that high excess liquidity has been associated with high and volatile inflation in Nigeria. In particular, following a gradual tightening of both fiscal and monetary policy, inflation was brought under control in the second half of the 1990s. This coincided with a gradual fall of excess liquidity to levels around 10 percent of total deposits. Although there has been gradual increase in reserve requirement ratios in Nigeria which is likely to have contributed to the fall in excess liquidity, the Central bank of Nigeria (CBN) relies mainly on open market operations and the discount

window for liquidity management. Finally, there is some evidence of seasonality in both excess liquidity and inflation although less than was the case in Kenya which is not surprising given the importance of the oil industry in Nigeria which does not have a clear seasonal pattern.

Finally figure 5 shows that in Uganda the first part of the 1990s was characterized by extremely high volatility in excess liquidity. Part of the reason for this is undoubtedly the fact that reserve averaging was not allowed. More recently, however, banks have been allowed to fulfill up to fifty percent of their reserve requirement on the basis of average reserve holdings during a two week maintenance period. Levels of excess liquidity have remained reasonably high throughout the sample period as the central bank has sought to neutralize the effect of government injected liquidity as donor funds are released into the system. Liquidity management is largely carried out using a combination of Treasury bill auctions, repos and foreign exchange rate interventions. The reserve requirement on the other hand has remained remarkably stable during the sample period suggesting that it is solely used for prudential purposes. After an initial period of significant volatility at the beginning of the sample period inflation has remained fairly low and stable since the mid 1990s. This is an indication of the success of the Central Bank's strategy of containing inflationary pressure arising from capital inflows. The experience in the first few years of the sample do, however, suggest that at high levels of excess liquidity there may be a link between excess liquidity and inflation. Once again, there is clear evidence of seasonality in both

excess liquidity and inflation.

### 4.3 Measurement of Excess Liquidity

Excess liquidity is typically equated to the quantity of reserves deposited with the central bank by deposit money banks plus cash in vaults in excess of the required or statutory level. However, excess liquidity thus measured may simply reflect the holding of liquidity for precautionary purposes. In other words, the accumulation of non-remunerated reserves may be a result of commercial banks' optimizing behavior. Agénor, Aizenman, and Hoffmaister (2004), for example, argue that the accumulation of reserves in excess of requirements in Thailand during the Asian crisis was a result of a contraction in the supply of credit by banks, and not due to a reduction in the demand for credit. Hence, their results suggest that the build-up of reserves in Thailand during the Asian crisis was not excessive in the sense that it exceeded commercial banks' desired level of reserve holdings.

Agénor, Aizenman, and Hoffmaister (2004) highlight, in particular, the role of increased uncertainty or risk of default as a rationale for commercial banks' voluntary build-up of holdings of non-remunerated liquid assets during the East-Asian crisis. Institutional factors may also encourage commercial banks to hold precautionary reserves. Poorly developed interbank markets, for example, make it difficult for banks to borrow in order to cover contingencies. It has also been suggested that difficulties encountered by banks in tracking their position at the central bank may require them to hold reserves above the statutory limits. In

addition, banks may want to hold precautionary excess reserves due to problems with the payments system. In SSA, for example, remote branches may need to hold excess reserves due to transportation problems. Finally, the importance of agricultural finance for commercial banks in most SSA countries is likely to make both the demand for credit and supply of deposits highly seasonal. The resulting seasonal volatility of deposits and credit demand is likely to increase demand for excess liquidity during certain seasons to cover contingencies.

However, not all excess liquidity may be voluntary. Some authors, for example Dollard and Hallward-Driemeier (1999) argue that, contrary to Agénor, Aizenman, and Hoffmaister (2004) findings, the build-up of excess liquidity in East-Asian countries during the crisis was a result of the reduction in the demand for credit, which itself was a result of the contraction in aggregate demand that accompanied the crisis. Similarly, Wyplosz (2005) argues that the current build-up of excess liquidity in the euro zone is due to deficient borrowing due to weak growth prospects, despite low interest rates. Hence, these studies suggest that in certain situations, commercial banks may hold *involuntary* excess liquidity. The term *involuntary* is used in this context to describe non-remunerated reserves that do not provide a convenience return which offsets the opportunity cost of holding them.<sup>13</sup>

Is it possible for involuntary excess liquidity to prevail in equilibrium rather than just being a temporary deviation away from the optimal structure

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<sup>13</sup>Another way to think about these two concepts of excess liquidity is that holdings of precautionary excess liquidity requires commercial banks to be risk-averse, whereas the holdings of involuntary excess liquidity is possible even if banks are risk-neutral.

of commercial banks' balance sheets? If commercial banks hold more liquidity than they require, why do they not expand lending, buy government securities or reduce deposits? One possible explanation may be that these economies are in a liquidity trap.<sup>14</sup> In a standard liquidity trap where the rate of return on lending is too low to cover intermediation costs (and where bonds and reserves are perfect substitutes), banks have a higher yield on reserves than they do on loans. Hence, a monetary expansion by the central bank just leads to an increase in excess reserves, even beyond banks' prudential requirements.

However, in most SSA economies nominal interest rates are quite high which is inconsistent with the presence of a liquidity trap. However, there may be impediments to the efficient functioning of financial markets that lead commercial banks to hold reserves in excess of that required for statutory and prudential purposes. In terms of the loan market, commercial banks may be (a) unable or (b) unwilling to expand lending to reduce involuntary reserves even if interest rates are positive.

Obviously, commercial banks may be unable to lend if, for example, interest rates are regulated, which creates an artificial floor for interest rates and limits commercial banks' ability to expand lending or reduce deposits.<sup>15</sup> However, even if banks are unable to lend one would still expect them to reduce the size of their deposit base if there is a build-up of involuntary excess reserves. In

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<sup>14</sup>This section relies heavily on O'Connell (2005)

<sup>15</sup>This is the case, for example, in the CEMAC region where the central bank sets a floor for lending rates and a ceiling for deposit rates above and below which interest rates are negotiated freely.

some cases, however, this may be difficult. Firstly, if the depositor is the government then it may be difficult for commercial banks to refuse accepting these deposits. Secondly, governments in SSA are often concerned about promoting financial deepening in the economy and may therefore use moral suasion to make commercial banks accept deposits even where these lead to excess liquidity.

Even if banks are able to expand lending, however, asymmetric information and lack of competition suggest that may not be willing to do so. In SSA, the financial sector is often dominated by a few commercial banks that essentially act as monopsony purchasers of private sector loans and government securities. Thus, the benefit of expanding lending at the margin, which is the same of the opportunity cost of involuntary excess reserves, may be much lower than the interest rate and sufficiently low for commercial banks to be willing to accumulate involuntary reserves even when the interest rate is positive. A related issue in this context are countries such as Ethiopia and Guinea-Bissau where the banking sector is dominated by state-owned banks that may not be profit-maximizers and thus may not have an incentive to reduce their holdings of non-remunerated assets.

In addition, the loan rate may be sticky because of imperfect information about potential new borrowers for reasons similar to those analyzed by Stiglitz and Weiss (1981). In particular, asymmetric information may make banks reluctant to reduce their lending rate to attract new borrowers because of adverse selection and the resulting increase in the riskiness of the bank's loan portfolio.

If these adverse selection effects are important enough, the loan market may not clear and banks will prefer to hold non-remunerated reserves.

Even if commercial banks are unable or unwilling to expand lending, one would still expect banks to reduce involuntary excess reserves by buying government bonds as these carry a higher yield than reserves. As commercial banks buy bonds, the spread between the return on bonds and reserves should fall until commercial banks are at a point of indifference where the prudential return on reserves equals the return on bonds. In this setting, involuntary excess reserves should only arise if bond yields went to zero so that the economy was in a liquidity trap.

This should be the case even if the non-bank public does not hold bonds. If banks are the only holders of bonds, then the central bank can effectively control the amount of bonds held by the banking sector. However, in this case, competition for bonds among banks should ensure that bond rates eventually fall as bonds are rolled over until a point of indifference between reserves and bonds. Hence, the existence of involuntary excess liquidity in equilibrium is inconsistent with the existence of a liquid and competitive bond market.

In SSA, however, bond markets tend to be characterized by lack of competition between banks and a lack of a secondary market.<sup>16</sup> Hence, there is no guarantee that the bond market will be able to perform the equilibrating role referred to above and thus enable commercial banks to run down involuntary

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<sup>16</sup>In the CEMAC region, Equatorial Guinea and Chad, the lack of a market for government or central bank securities curtails the ability of banks to reduce holdings of excess liquidity by buying bonds. See Christensen (2004) for a review of domestic debt markets in SSA.

excess reserves. Therefore as O'Connell (2005) observes:

“...involuntary excess liquidity in African banking systems...is being retained on the margin only because the opportunity cost of holding it is at a lower bound of zero (there are no remunerative alternatives). Since there are costs of intermediation and banks may have market power, this lower bound can take place, in the case of involuntary bank liquidity, when interest rates or bond yields are strictly positive.” (O'Connell (2005), p. 4)

To conclude, there are compelling reasons to suggest that banks in SSA may hold non-remunerated excess reserves that do not provide a convenience return. These relate in particular to asymmetric information and lack of competition in the financial sector as well as to the underdeveloped nature of bond markets in the region.

#### **4.4 The Implications of Precautionary and Involuntary Excess Liquidity**

The distinction between precautionary and involuntary excess liquidity is not innocuous for the purpose of our analysis. In terms of the potential inflationary effects, involuntary excess liquidity is likely to be rapidly lent out if demand conditions in the economy improve. Hence, the amount of lending in the economy may rapidly increase without a loosening of monetary policy at a time when liquidity conditions should be tightened. This in turn carries with it

the risk of increased inflation. Precautionary excess liquidity, on the other hand, is likely to be less footloose and thus pose less of a risk in terms of inflation. Furthermore, as mentioned previously, several authors have suggested that this abundance of liquidity may undermine the ability of the monetary policy authorities to stabilize the economy. In order to understand the implications of excess liquidity on the effectiveness of monetary policy this section first briefly reviews the main channels through which monetary policy decisions are transmitted to aggregate demand and the supply side of a small open developing economy before analyzing the implications of excess liquidity on the monetary policy transmission mechanism.

#### 4.4.1 The Transmission of Monetary Policy

The channels through which monetary policy is thought to affect the economy can be usefully classified into the interest rate channel, the exchange rate channel and the balance sheet or asset price channel.<sup>17</sup> These channels operate essentially through interest rates which the monetary policy authority seek to influence by varying the demand and supply of liquidity through the use of indirect instruments such as open-market operations, repurchase agreements, the use of discount facilities and reserve requirements.

Until the late 1980s countries in SSA frequently resorted to the use of direct instruments or financial repression to regulate the price and quantity of liquidity in the economy. Recognition of the severe inefficiencies that such

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<sup>17</sup>This section draws heavily on Agénor (2004) and Adam and O'Connell (2006).

an approach entails, however, led to a transition towards increasing reliance on indirect policy instruments during the 1990s. This is the assumption we assume in this section although it is important to note that due to the underdeveloped nature of financial markets in SSA the link between indirect policy instruments and market interest rates is not as reliable as it is in industrialized countries.

### **The Interest Rate Channel**

Changes in interest rates affect both aggregate demand and supply through a variety of channels. The first of these is the cost of capital channel whereby an increase in short-term market interest rates raises the cost of capital. If firms must borrow to fund capital formation then a rise in a rise in the cost of capital will tend to lower investment and aggregate demand. The importance of this channel in SSA is likely be negligible, however, given that the ratios of private credit to GDP tend to be relatively low. In Tanzania, Uganda and Zambia, for example, the ratio of private credit to GDP is below 10 percent.

In addition, interest rates may affect aggregate demand through its effect on household wealth and income. With respect to the former, an increase in interest rates will tend to raise the attractiveness of domestic financial assets such as bank deposits or Treasury bills which in turn reduces the demand for other assets such as real estate and equity. This will tend to reduce the price and the value of these assets in households' balance sheets. The overall effect on wealth and expenditure will depend on the share of interest bearing and non-interest bearing assets in a household's portfolio.

With respect to the latter, rising interest rates will raise household income if households are net creditors towards the banking system. This is likely to be the case in SSA where, as Adam and O'Connell (2006) point out, the primary business of commercial banks is to convert highly liquid deposits from households and firms into short to medium term loans to the public sector and a few large private clients.<sup>18</sup> An increase in household income in turn is likely to translate into higher spending.

Adam and O'Connell (2006) also argue that in developing countries with typically significant deposit dollarization, changes in interest rates and inflation will have important implications for money demand due to availability of a ready substitute for domestic money. Other things equal this will serve to increase the sensitivity of inflation and capital flows to changes in monetary policy.

Finally, Agénor (2004) argues that a rise in interest rates may affect the supply side of the economy via a production cost effect, in particular in developing countries. An example is the case where the firm has to borrow money to pay workers prior to the sale of the output. In this case a rise in interest rates will increase firms' production costs.

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<sup>18</sup>The role of commercial bank lending in financing public expenditure in Tanzania is discussed in Collier and Gunning (1991). They argue that in such situations conventional measures of the budget deficit are inappropriate and need to be consolidated with those of the banking system. Moreover in such a setting, raising interest rates to reduce inflation may be counterproductive as it raises the interest rate on deposits and thus raises the government's domestic debt service payments. This in turn is likely to lead to an increase in the use of the inflation tax.

### The Exchange Rate Channel

In emerging-market economies exchange rates are typically thought to play a more central role in the transmission of monetary policy than in industrialized countries. In an economy with flexible exchange rates the effect of an increase in interest rates is an inflow of capital and an appreciation of the exchange rate. This has a number of important effects on the economy:

Firstly, there is a direct effect on the cost of imported goods which is likely to be particularly important in developing countries given the openness of these economies. An appreciation will lower the domestic currency price of imports and exert a downward pressure on import competing goods. The impact of this channel will be affected by the pass-through of import prices which is typically thought to be higher in developing countries than in industrialized countries.

In addition there is an indirect intratemporal substitution effect resulting from movements in the relative price of tradable and nontradable goods. In particular, an appreciation of the real exchange rate implies an increase in the relative price of non-tradable goods and hence lowers the demand for these goods putting downward pressure on inflation. Agénor (2004) also argues that in developing countries, where capital imports are important, a real appreciation may stimulate investment by lowering the domestic price of investment goods.

Finally, on the supply side an appreciation of the nominal exchange rate will lower the price of imported inputs in the production process and may

therefore lead to a contraction in domestic output unless perfect substitutes for these inputs are available at home.

### **The Balance Sheet or Asset Price Channel**

As mentioned previously, changes in the value of assets such as land may as a result of changes in monetary policy are an important part of the monetary transmission mechanism. The most important asset prices for developing countries are the price of land and the exchange rate. A depreciation of the exchange rate, for example, will increase reduce the net wealth of a country with a net foreign-currency liability position. The public sector, in particular, is typically a large foreign-currency creditor. As Adam and O'Connell (2006) point out, however, the reliance of SSA economies on foreign currency transfers from official donors as well being dependent on the traded goods sector for tax revenues typically means that an appreciation confers a fiscal loss upon the country. The private sector in SSA, on the other hand, is typically net holders of foreign exchange in the form of domestic currency deposits and will therefore experience an erosion of the value of their assets following an appreciation of the exchange rate.

A sizeable literature furthermore argues that balance sheet effects may be propagated via an external finance premium or the financial accelerator mechanism. The external finance premium is essentially the difference between the cost of external funds, in other words the bank lending rate, and the opportunity cost of internal funds such as the Treasury bill rate or the bank deposit rate for example. Because of information and incentive problems this premium depends

inversely on the value of the borrower's assets that may be used as collateral. Changes in monetary policy that improve a borrower's balance sheet, either directly by changes in the interest rate or indirectly via a change in the exchange rate, will therefore lower the external finance premium and the cost of capital, thereby contributing to stimulate capital formation. Financial accelerator mechanisms of this sort have been shown, by *inter alia* Bernanke and Gertler (1989) and Bernanke, Gertler, and Gilchrist (1999), to magnify the effect of a change in interest rates on aggregate expenditure.

#### **4.4.2 Excess Liquidity and the Monetary Transmission Mechanism**

How do excess reserves affect the transmission of monetary policy as described above? To understand this note first that the impact of monetary policy depends on the pass-through of policy changes initiated by the monetary policy authority such as a raise in the discount rate to short-term market interest rates such as bank lending rates. Lower rates of pass-through to short-term rates will, other things equal, lower the strength of the channels of monetary policy outlined above. Cottarelli and Kourelis (1994) argued that stickiness in bank lending rates depends on factors such as the degree of competition in the banking system and the ownership structure of financial intermediaries. We argue that excess liquidity, and in particular involuntary excess liquidity, provides a related but distinct reason for why there may be limited pass-through to short-term

market interest rates.

To understand this let us first assume that banks hold excess reserves only for precautionary purposes. A loosening of monetary policy, for example by reducing the discount rate, would increase excess liquidity above the level demanded by commercial banks for precautionary purposes. Hence, one would expect banks to expand lending by lowering the cost of borrowing or reducing the rationing of loans. Similarly, one would expect contractionary monetary policy would lead banks to contract lending to maintain their desired level of excess reserves.<sup>19</sup> The change in bank lending rates would in turn affect the domestic economy via the different channels outlined in the previous section.

However, if the holdings of excess liquidity are involuntary in the sense that banks are unable to expand lending, then attempts by banks to boost credit demand by lowering the cost of borrowing will be largely ineffective. An expansionary monetary policy in that case would simply inflate the level of unwanted excess reserves in commercial banks and not lead to an expansion of lending. Similarly, contractionary monetary policy will simply cause banks to reduce their unwanted reserves, and will only affect monetary policy if it reduces reserves to a level below that demanded by banks for precautionary purposes. Quoting O'Connell (2005) once again:

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<sup>19</sup>Of course, banks may only partly expand lending following the loosening of monetary policy if they want to hold a portion of the increase in excess reserves for precautionary purposes. At the limit where all new borrowing is perceived by banks to be too risky, lending will not expand at all.

“When there is involuntary excess liquidity in the economy in equilibrium, the transmission mechanism of monetary policy, which usually runs from a tightening or loosening of liquidity conditions to changes in interest rates or asset demands and then to economic activity, is altered and possibly interrupted completely.” (O’Connell (2005), p. 4)

In other words, there are reasons to suspect that commercial banks hold significant levels of involuntarily excess liquidity, the degree of pass-through from monetary policy to short-term market rates will be much lower than otherwise. Clearly therefore, an analysis of the impact of excess liquidity on the monetary policy transmission mechanism requires an understanding of the extent to which statutory excess reserves are consistent with commercial bank’s demand for excess reserves. Moreover, an understanding of the source of excess liquidity is important in terms of what reforms or policy measures are appropriate.<sup>20</sup>

### 4.4.3 Econometric Specification

In this paper we propose an approach to separating statutory excess reserves into precautionary excess reserves and involuntary excess reserves which builds on the methodology proposed by Agénor, Aizenman, and Hoffmaister (2004). The approach is applied to excess liquidity in Kenya, Nigeria and Uganda.<sup>21</sup>

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<sup>20</sup>The policy implications of precautionary and involuntary excess liquidity will be discussed in more detail in the conclusion to this paper.

<sup>21</sup>The three case studies share the feature that excess liquidity has been relatively high at some point during our sample period. However, they are sufficiently different to enable us to

Agénor et al.'s methodology consists of estimating a model of banks' demand for excess liquidity which includes explicitly the precautionary motive for holding excess reserves. The portion of excess liquidity which is involuntary can then be calculated as the difference between statutory excess liquidity and the level of excess liquidity predicted by the model of banks' demand for excess reserves.

For our purposes, this approach suffers from the weakness that the estimation procedure seeks to minimize that part of statutory excess reserves which cannot be explained by commercial banks' demand for excess liquidity. Hence, it minimizes involuntary excess reserves. To overcome this problem we propose augmenting the model estimated by Agénor, Aizenman, and Hoffmaister (2004) with variables which are thought to be important for explaining the build-up of involuntary reserves. Thus we propose estimating a specification of the form:

$$\alpha_1(L)EL_t = \alpha_2(L)X_t^1 + \alpha_3(L)X_t^2 + v_t \quad (4.1)$$

where  $EL_t$  is the ratio of statutory excess reserves to total deposits and  $X_1$  and  $X_2$  are vectors of variables that explain, respectively, the precautionary motive for holding excess reserves and the involuntary build-up of excess reserves.  $v_t$  is a well-behaved error term and  $\alpha_j(L)$  are vectors of lag polynomials defined as:

$$\begin{aligned} \alpha_1(L) &= 1 - \alpha_{11}L, \\ \alpha_j(L) &= \alpha_{j0} + \alpha_{j1}L, \quad j \geq 2 \end{aligned} \quad (4.2)$$

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form a broader understanding of the causes and consequences of excess liquidity.

where  $L$  is the lag operator. The model is estimated with one lag due to the relatively large set of regressors coupled with a relatively short sample size.

The above methodology has the added benefit of yielding insights on the cause of the build-up of excess liquidity. In particular, we include the following explanatory variables that have been suggested as important causes for excess liquidity:

$$X^1 = \left\{ RR^+, VOL_Y^+, VOL_{CD}^+, VOL_{PS}^+, VOL_{GOV}^+, PORT^+, Y^+, r_D^+ \right\}$$

$$X^2 = \left[ DEP_{PS}^+, DEP_G^+, CRED_{PS}^+, CRED_G^+, BOND^+, AID^+, OIL^+, POIL^+, r_L^+ \right]$$

Where  $RR$  is the ratio of required reserves to total private sector deposits. Hence, it is a measure of the reserve requirement which is comparable across countries.  $VOL_Y$  and  $VOL_{CD}$  are five year moving standard deviation of the output gap and the cash to deposit ratio, respectively.  $VOL_{CD}$  is additionally weighted by the five year moving average of the cash to deposit ratio as in Agénor, Aizenman, and Hoffmaister (2004).  $VOL_{PS}$  and  $VOL_{GOV}$  are five year moving standard deviation of private sector and government deposits divided by the five year moving average of these variables.  $PORT$  is the ratio of demand to savings deposits and  $Y$  is the output gap.<sup>22</sup>  $r_D$  is the central bank discount rate.  $DEP_{PS}$  and  $DEP_G$  are, respectively, private sector and government deposits, expressed as a fraction of GDP.  $CRED_{PS}$  is the ratio of private sector credit

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<sup>22</sup>The output gap is constructed as the percentage deviation of output away from a quadratic trend.

to GDP whereas  $CRED_G$  is the ratio of bank credit to the central government and public enterprises to GDP.  $BOND$  is the ratio of securitized domestic debt to GDP whereas  $AID$  and  $OIL$  are the ratios of aid inflows and oil exports to GDP.  $POIL$  is the quarterly percentage change in the oil-price. Finally,  $r_L$  is the commercial bank lending rate.<sup>23</sup>

Although the list of explanatory variables is not exhaustive due to data limitations, we believe that it captures many of the elements that are thought to be important for the build-up of excess reserves.<sup>24</sup> The set of variables in the vector  $X_1$  captures many of the elements identified by Agénor, Aizenman, and Hoffmaister (2004) as important in their theoretical model of commercial bank's demand for excess reserves. In particular,  $RR$  captures the impact of reserves requirements. An increase in the reserve requirement would, other things being equal, be expected to lower excess liquidity. Note, however, that Agénor et al.'s decision to include the reserve requirement ratio in banks' demand function for excess reserves is not completely obvious. One possible rationale is that because required reserves are typically not remunerated, raising the reserve ratio raises the overall cost of holding reserves and thus may thus induce banks to reduce their desired holdings of excess reserves. In this scenario, increases in the reserve requirement will thus reduce commercial banks' holdings of precautionary excess

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<sup>23</sup>This set of variables needs to be adapted if it is to be used for conducting a similar analysis for other countries.

<sup>24</sup>Notable omissions include proxies for the liquidity of the interbank market, capital account restrictions, information on the efficiency of the banking sector and regulatory constraints, such as difficulties in raising collateral and the legal environment. Information on some of these variables is available, notably from the World Bank, but usually only on a cross-sectional basis or for short periods of time.

reserves. It is clear, however, that policymakers also view increasing the required reserve ratio as a way to drain potentially inflationary excess liquidity from the banking system. In this case, raising the reserve ratio is viewed as a way to reduce involuntary excess liquidity. The reality is likely to be a combination of both, namely that raising reserve ratios reduces both precautionary and involuntary excess reserves by some proportion which may be difficult to predict ex-ante. Hence, although for the time being we retain the assumption that increases in the reserve ratio reduces precautionary excess reserves we will investigate the robustness of our results to this assumption at a later stage.

$VOL_Y$  and  $VOL_{CD}$  account for the precautionary motive for holding excess reserves which was emphasized previously. One would expect an increase in these volatility measures to be positively correlated with the demand for excess liquidity. We also include measures of the volatility of deposits -  $VOL_{PS}$  and  $VOL_{GOV}$  - as banks will tend to hold a higher level of reserves to protect themselves against unexpected withdrawals if the deposit base is relatively volatile. Similarly, the ratio of demand deposits to time and savings deposits -  $PORT$  - is included to capture the effect of a high proportion of short-term deposits on the volatility of commercial banks' liabilities.<sup>25</sup> We also include the output gap  $Y$  to proxy for demand for cash. In particular, in a cyclical downturn one would expect the demand for cash to fall and commercial banks to decrease their holdings of excess reserves. Finally, we include the discount rate  $r_D$  as a proxy for the cost

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<sup>25</sup>The large proportion of demand deposits and the volatility of the deposit base, especially government deposits, was one of the explanations given by BEAC official for the high levels of excess liquidity in commercial banks in the CEMAC region during a recent IMF mission.

of liquidity for banks. This is likely to be more accurate than the money market rate due to the lack of an interbank market in most SSA countries. Other things being equal, one would expect banks to hold a larger amount of excess reserves if the cost of borrowing at the discount window is high.

There is less theoretical guidance concerning the choice of variables in the vector  $X_2$  that explain the involuntary portion of excess liquidity. Time series indicators of the structural problems in the financial markets that we argued were necessary for involuntary reserves to persist in equilibrium are typically not available. Moreover, the choice of these indicators is likely to be particularly dependent on the country being studied. Our set of variables therefore reflects, to a large extent, anecdotal evidence that has been used to explain the build-up of excess reserves in SSA countries and elsewhere. Thus they tend to capture the manifestations of the underlying structural problems rather than the problems themselves and should therefore only be viewed as imperfect proxies. Gilmour (2005), for example, reports that the build-up of excess liquidity in Ethiopia has been associated with an increase in private sector deposits -  $DEP_{PS}$  - at commercial banks. He suggests that this can be partly explained by the need for businesses to maintain large liquid balances for operational as well as investment needs, given the difficulty of obtaining credit. The increase in deposits by individuals, on the other hand, is thought to reflect, firstly, increased remittances from abroad and, secondly, the lack of alternative savings vehicles. Gilmour (2005) also reports that the build-up of excess liquidity has been associated with a rapid in-

crease in government deposits -  $DEP_G$ . In the case of Ethiopia this expansion has coincided with fiscal decentralization which has exacerbated existing absorption constraints and problems in expenditure management.

Several authors have pointed to weak bank lending as one of the main reasons for the build-up of excess liquidity. Wyplosz (2005), for example, identifies weak bank lending due to poor growth prospects as the reason for the increase in excess reserves in the euro area. Similarly, Gilmour (2005) argues that in Ethiopia the emphasis on the restructuring of the financial and banking sectors has forced banks to tighten control over lending activities in order to reduce the incidence of non-performing loans and improve their balance sheets. Hence, one would expect that an increase in the ratio of private sector credit to GDP -  $CRED_{PS}$  - would be associated with a reduction in excess liquidity. A similar argument can be made with respect to credit to the government and public enterprises -  $CRED_G$ . We also include the lending rate -  $r_L$  - as one of our explanatory variables even though in SSA, interest rates are sometimes subject to regulatory control with the implication that they are frequently unable to adjust in the face of disequilibrium in the market for loanable funds.<sup>26</sup> Nevertheless, other things being equal one would expect that an increase in lending rates would reduce lending and contribute towards increasing excess reserves. If banks are unable to lend one would still expect them to use unremunerated reserves to invest in bonds if a bond market exists. In this case one would expect  $BOND$  to be negatively

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<sup>26</sup>This has been the case at times in Kenya and Nigeria.

correlated with excess liquidity.

One of the defining characteristics of many SSA countries is their reliance on aid inflows and revenue receipts from the sale of oil. In the context of SSA it has been argued that often these large capital flows are saved because countries are unable to fully absorb these flows.<sup>27</sup> Gilmour (2005), for example, argues that in Ethiopia a significant part of the increase in aid inflows in the early part of this century were saved and channeled into excess reserves. Similarly, International Monetary Fund (2005a) reports that in the case of Equatorial Guinea large oil inflows have been associated with increases in excess liquidity.

Of course, the effect on capital inflows on liquidity depends on the response of the monetary policy authority to these inflows. If the nominal exchange rate is floating then the amount of liquidity in the economy is unlikely to change. Instead the adjustment will take place in the nominal exchange rate. If, however, the exchange rate is not allowed to float then aid inflows will lead to an increase in liquidity if these flows are used to increase spending on domestic goods and services. Of course, the central bank can intervene to sterilize this increase in liquidity but the resultant increase in interest rates is only likely to lead to further capital inflows.

As noted previously, figure 2 does show that since the middle of the 1990s, oil-producing countries in SSA have had a higher excess liquidity to deposit ratio than the region as a whole suggesting that these capital inflows may not

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<sup>27</sup>For a comprehensive discussion of this issue see International Monetary Fund (2005b).

have been completely sterilized. However, as noted there is no evidence that countries that are highly dependent on aid have higher levels of excess liquidity. With respect to our case studies the data does show that the high levels of excess liquidity in Kenya in 1993-1994 were associated with a surge in the aid to GDP ratio in 1993 although this appears to be largely a valuation effect due to a sharp depreciation of the nominal exchange during the same period. Similarly, there appears at first glance to be an association between an increase in oil exports and the rise in excess liquidity in the early 1990s in Nigeria. Since then, however there is no clear link between either of these variables and excess liquidity. Neither does there appear to be any clear association between aid receipts and excess liquidity in Uganda. Nevertheless, we choose to include *AID*, *OIL* and *POIL* in our estimation in order to investigate the link between aid, oil revenue and excess liquidity more formally.

#### 4.4.4 Results

Table 1 presents the summary of the estimation results for Kenya, Nigeria and Uganda based on quarterly data from the IMF's International Financial Statistics (IFS).<sup>28</sup> To ease interpretation, we only report the sum over the lag polynomial for each variable together with its standard error. Because both *EL* and *RR* are zero

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<sup>28</sup>Quarterly data on GDP, AID and OIL is not available for any of the three case studies. In the case of the data on AID and OIL, we use a simple linear interpolation using annual data from the World Bank's World Development Indicators (WDI) database and the IMF's World Economic Outlook (WEO) database, respectively. With respect to the data on the GDP, we follow Adam (1999) and update the linear interpolation with information from an annual model of GDP, using annual GDP data from the WEO. See appendix 5 for further information on data sources.

or negative in some cases for part of the sample period, we estimate the model using data in levels instead of logarithms. Moreover, because it is common to allow banks to fulfill their reserve requirements based on average reserve balances during a maintenance period, we construct quarterly data on  $EL$  and  $RR$  using averages of the monthly data corresponding to the relevant quarter. Although averages of daily data would have been preferable, this is not typically available. Finally, we exclude the oil-price and the oil to GDP ratio from the model for Kenya and Uganda.

The initial specification of the data generating process is reduced to a more parsimonious representation using a general to specific modeling methodology whereby the initial model is reduced by removing variables that are considered statistically insignificant.<sup>29</sup> Because of the presence of several explanatory variables that are likely to be endogenous, OLS estimation is known to be inconsistent. Hence, we estimate the models using the instrumental variables (IV) estimator. The set of regressors that we consider likely to be endogenous, and hence estimate by IV, include  $\{RR, PORT, r_D, DEP_{PS}, DEP_G, CRED_{PS}, CRED_G, BOND, r_L\}$ . These are the variables that are directly under the control of either the commercial banks or the central bank. Due to lags in the transmission mechanism, we do not consider the macroeconomic variables to be susceptible to contemporaneous feedback. Similarly, we assume that the variables relating to aid inflows and the oil sector are exogenous. The initial set of instruments in-

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<sup>29</sup>See inter alia Hendry (1995) for details.

cludes the second lag of the endogenous regressors as well as the second lag of  $EL$ . If exogenous variables are eliminated because they are statistically insignificant, they are added to the instrument set.

The modeling approach described above is only valid if all the variables are stationary. If they are not, then the marginalization of the model with respect to insignificant variables is likely to be misleading. From an economic point of view, one would not expect any of the variables included in the model to be non-stationary. This is true, in particular, for the variables that have been converted into ratios and the measures of volatility, as well as the lending and discount rates. In addition, we have converted the oil-price into a quarterly inflation rate which one would expect to be stationary. Nevertheless, tests for non-stationary behavior using the Augmented Dickey-Fuller (ADF) tests indicate that several of the variables may still contain a unit root. One explanation for this finding is the fact that within the particular sample period we are analyzing, the variables may display non-stationary behavior, even though the variables are actually stationary. Another possible explanation is the fact that tests for non-stationarity have low power against the alternative of stationarity, with the results that stationarity is often not found. This is evidenced by the fact that testing for the presence of unit roots using the KPSS test, which has a null hypothesis of stationarity, failed to reject stationarity in any of the series included in our model. Hence, we proceed under the assumption that the data is stationary.

For Kenya the results suggest that holdings of precautionary reserves

can be explained by the changes in the required reserve ratio. In particular, an increase in the required reserve ratio lowers commercial banks' excess reserves as we would expect. The importance of the reserve ratio is not surprising given that the data shows a strong correlation between the increase in reserve requirements in 1995 from 10 to 18 percent and the fall in excess reserves during the same period from 15 percent to less than 5 percent. Surprisingly, there is no evidence that any of the volatility measures we include in the estimation are important determinants of excess liquidity. Neither is there any indication that changes in the maturity structure of commercial banks' loan portfolios have any significant effect on excess reserves. This finding was robust to changes in the specification.

Holdings of involuntary reserves in Kenya appear to largely reflect movements in commercial banks' assets and liabilities. In particular, increases in private sector deposits appear to increase excess reserves whereas increases in credit to the private sector lower excess liquidity. Finally, there is also evidence that an increase in the lending rate increases excess liquidity.

In Nigeria commercial banks' demand for excess reserves for precautionary purposes is mainly due to changes in the required reserve ratio, the maturity structure of the deposit base and the volatility of the cash to deposit ratio. In particular, an increase in the required reserve ratio is predicted to reduce excess reserves. This is consistent with the predictions in the theoretical model of banks' demand for excess reserves outlined in Agénor, Aizenman, and Hoffmaister (2004). The importance of the required reserve ratio in Nigeria for the demand

for excess reserves can be explained by the fact that reserve requirements are used as tool for the central bank to mop up excess liquidity (see inter alia Central Bank of Nigeria (2005)). Furthermore, the estimated model predicts that banks will demand more excess liquidity if the ratio of demand deposits to time and saving deposits increases so that the maturity structure of the banks' liabilities is shortened, which is in accordance with our prior beliefs. Finally, the estimated model suggests that in Nigeria increases in liquidity risk, measured by the volatility of the cash to deposit ratio, lead to an increase in demand for excess reserves as banks try to protect themselves from sudden surges in the demand for cash.

As in Kenya, the build-up of involuntary excess reserves seems to mainly reflect changes in the amount of deposits and lending by commercial banks. In Nigeria, however, it is government deposits and lending to the government that is important for explaining involuntary excess liquidity. As expected, a net increase in government deposits has the effect of raising excess liquidity. Lending to the private sector only seems to be important to the extent that it is reflected in changes to the lending rate. In particular, an increase in the lending rate reduces the demand for loans in the private sector and leads to an increase in excess liquidity. Finally, the results for Nigeria suggest that the increases in the ratio of oil exports to GDP are important, independently of government deposits, for the build-up of involuntary excess liquidity.

In Uganda precautionary reserves mainly reflect uncertainty surrounding the size of the deposit base as proxied by the volatility of government deposits.

Table 1: Determination of Statutory Excess Liquidity

Sample Period	Kenya	Nigeria	Uganda
	1991Q1-2003Q4	1992Q1-2003Q4	1993Q1-2003Q4
<i>Constant</i>	0.010 (0.013)	-0.174 (0.071)	0.257 (0.028)
<i>EL</i> $\{-0\}$	0.629 (0.092)	0.644 (0.091)	-
Variables Explaining Precautionary Excess Reserves ( $X^1$ )			
<i>RR</i>	-0.367 (0.090)	-1.750 (0.405)	-
<i>VOL<sub>Y</sub></i>	-	-	-2.190 (0.257)
<i>VOL<sub>CD</sub></i>	-	0.570 (0.229)	-
<i>VOL<sub>PS</sub></i>	-	-	-
<i>VOL<sub>GOV</sub></i>	-	-	0.113 (0.020)
<i>PORT</i>	-	0.228 (0.086)	0.024 (0.013)
<i>Y</i>	-	-	-
<i>r<sub>D</sub></i>	-	-	-
Variables Explaining Involuntary Excess Reserves ( $X^2$ )			
<i>DEP<sub>PS</sub></i>	0.124 (0.061)	-	-
<i>DEP<sub>G</sub></i>	-	1.993 (1.139)	1.747 (0.694)
<i>CRED<sub>PS</sub></i>	-0.279 (0.090)	-	-3.295 (0.425)
<i>CRED<sub>G</sub></i>	-	-2.111 (0.521)	-0.357 (0.118)
<i>BOND</i>	-	-	-
<i>AID</i>	-	-	-
<i>OIL</i>	n.a.	0.2333 (0.078)	n.a.
<i>POIL</i>	n.a.	-	n.a.
<i>r<sub>L</sub></i>	0.003 (0.000)	0.007 (0.002)	-
AR(1-4)	F(1,44) = 0.135 [0.715]	F(1,39) = 0.178 [0.675]	F(1,34) = 0.001 [0.973]
Heteroskedasticity	F(12,32) = 0.979 [0.488]	F(18,21) = 0.898 [0.587]	F(16,18) = 0.697 [0.763]
Normality	$\chi^2(2) = 4.097$ [0.129]	$\chi^2(2) = 0.331$ [0.847]	$\chi^2(2) = 0.549$ [0.760]
Sargan Test	$\chi^2(25) = 26.988$ [0.357]	$\chi^2(28) = 29.505$ [0.337]	$\chi^2(23) = 28.635$ [0.193]
Test for excluding $X^1$	F(2,45) = 37.163 [0.000]	F(3,40) = 6.536 [0.001]	F(5,34) = 16.944 [0.000]
Test for excluding $X^2$	F(3,45) = 12.094 [0.000]	F(5,40) = 6.862 [0.000]	F(3,34) = 28.669 [0.000]

Note: The dependent variable in each regression is the ratio of excess reserves to deposits. The table reports the sum of the coefficients for each statistically significant variable and their standard errors. The table also reports tests for first order serial correlation, the presence of heteroskedastic errors, normality of the distribution of residuals, tests for the validity of excluding variables explaining voluntary and involuntary excess liquidity and the corresponding p-values.

There is also a significant effect from the maturity structure of commercial banks' liabilities as was the case in Nigeria. Our results also suggest that volatility in the output gap is important although this parameter is wrongly signed, relative to our prior beliefs. Finally, there is no indication that changes in the reserve ratio have been an important determinant of excess liquidity in Uganda although this probably reflects a lack of movement in the effective reserve ratio over the course of our sample period. With respect to involuntary excess liquidity our results confirm the finding from the previous two case studies that government deposits and lending to the government are important determinants. As in Kenya we also find a significant effect from lending to the private sector.

To summarize, our analysis of the determinants of excess liquidity suggest that changes in the reserve ratio, some measure of volatility, and the maturity structure of deposits seem to be important for predicting movements in precautionary excess liquidity. There is no evidence, however, that commercial banks take into account the cost of borrowing at the discount window or the demand for cash, as proxied by the output gap, when choosing their desired level of precautionary excess liquidity holdings. However, for the discount rate in particular, this may reflect insufficient volatility to be able to identify any relationship in the data. With respect to involuntary excess liquidity, our results suggest that to the extent they are held by banks they tend to reflect movements in commercial banks' assets and liabilities either to the public or private sector and also the lending rate. The importance of government deposits suggest in particular

that absorption constraints may be an important determining factor as suggested previously. There is no evidence that aid receipts matter for the build-up of involuntary excess liquidity. This is consistent with our earlier finding that aid dependent countries do not appear to have higher levels of excess liquidity than other countries in the region. In the one oil exporting country considered here – Nigeria – there was evidence that an increase in oil exports did contribute to a build-up of involuntary excess liquidity. Finally, there is no indication amount the three countries considered in this paper that the size of the bond market matters for the amount of excess liquidity. As noted previously, this may reflect lack of competition among banks as well as the absence of a secondary market.

#### 4.4.5 Precautionary and Involuntary Excess Reserves

One of the aims of this paper is to propose a methodology that goes somewhat towards enabling the policy maker to distinguish between excess reserves that are held for precautionary purposes, and excess liquidity in excess of that amount. It was argued that being able to differentiate between these two concepts has important implications for economic policy. Hence, this section seeks to construct data on precautionary and involuntary excess liquidity from the models estimated in the previous section. In particular we calculate precautionary and involuntary reserves as:

$$\begin{aligned} EL_t^P &= a\hat{c} + \hat{\alpha}_1^P EL_{t-1}^P + \hat{\alpha}_2(L)X_t^1 \\ EL_t^I &= (1-a)\hat{c} + \hat{\alpha}_1^I EL_{t-1}^I + \hat{\alpha}_3(L)X_t^2 \end{aligned} \tag{4.3}$$

where  $\hat{c}$ ,  $\hat{\alpha}_1$ ,  $\hat{\alpha}_2$ , and  $\hat{\alpha}_3$  are parameter estimates.  $EL^P$  are precautionary reserves as a ratio of total deposits and  $EL^I$  are involuntary reserves.  $a$  is a constant. Thus, if  $\hat{\alpha}_1 \neq 0$ , equation 3.3 is a dynamic forecast of  $EL^P$  and  $EL^I$ . For each period, the sum of  $EL^P$  and  $EL^I$  equals the dynamic forecast of  $EL$ .

A number of observations need to be made about this methodology. Firstly, it is clearly sensitive to the vectors of explanatory variables  $X_1$  and  $X_2$ . Hence, the calculation of precautionary reserves and involuntary reserves is only as good the variables that are being used to explain statutory excess liquidity. As we have already mentioned, data limitations mean that often information on some of the most important factors for explaining excess liquidity is excluded.

Another shortcoming of the methodology is that only the sum of the two constants is identified. To see this note that any given value of the parameter  $a$  is consistent with the requirement that the sum of  $EL^P$  and  $EL^I$  equals total excess liquidity.<sup>30</sup> The implication is that the level of precautionary and involuntary excess liquidity is not identified, only the growth rate. For the purposes of this study this is not a problem because our econometric analysis of the monetary policy transmission only relies on the growth rate of variables. However, for program design there is clearly a need to know not only the year on year change in each component of excess reserves, but also the absolute level.<sup>31</sup>

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<sup>30</sup>To be precise, any value of the parameter  $a$  is consistent with the sum of the constant terms of  $EL^P$  and  $EL^I$  equals the constant term in the estimated specification for  $EL$ .

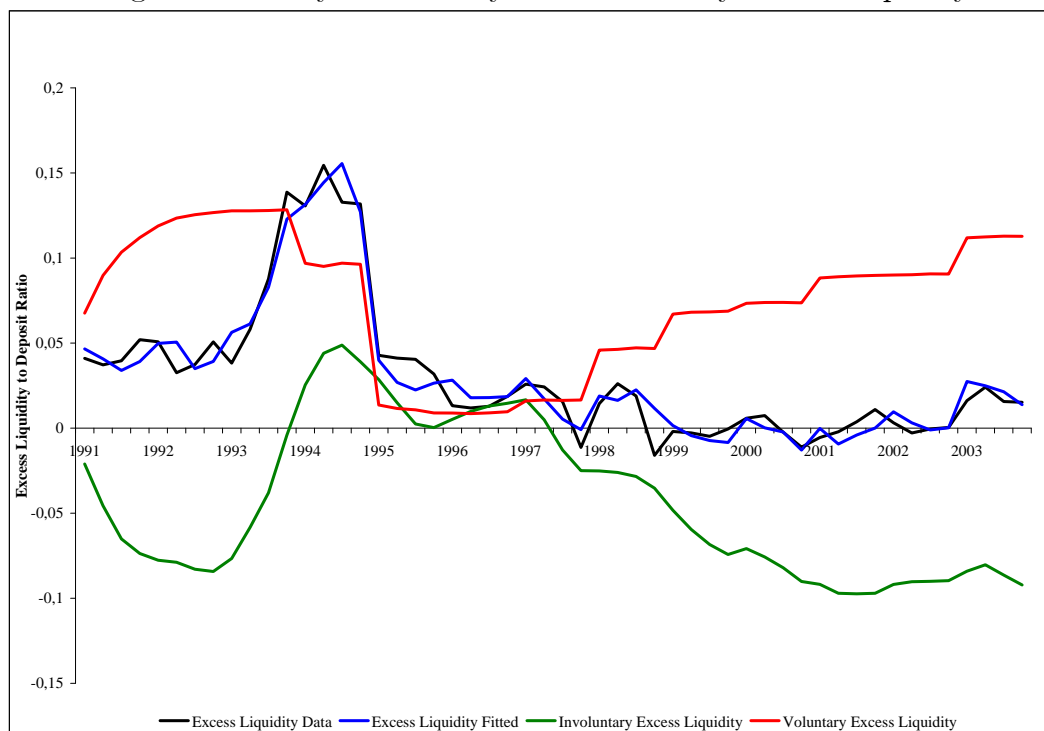
<sup>31</sup>A practical solution to this problem may be to rely on guidance from commercial banks themselves as to what proportion of excess liquidity is precautionary. Using the model in equation 1.3 the time path of the level of the two components of excess liquidity can then be traced out.

Strictly speaking, the persistence parameter of precautionary and involuntary reserves is not identified. In particular, any combination of  $\hat{\alpha}_1^P$  and  $\hat{\alpha}_1^I$  that satisfy the condition  $\hat{\alpha}_1^P EL_t^P + \hat{\alpha}_1^I EL_t^I = \hat{\alpha}_1 (EL_t^P + EL_t^I)$  is feasible. However, only when  $\hat{\alpha}_1^P = \hat{\alpha}_1^I = \hat{\alpha}_1$  are the autoregressive parameters  $\hat{\alpha}_1^P$  and  $\hat{\alpha}_1^I$  constant. This is the assumption we maintain in our analysis.

Finally it should be noted that the approach outlined above implies that we are decomposing the fitted values from our estimation, setting the residual term in equation 3.1 to zero. Thus, we are assuming that the residual component cannot be attributed to either precautionary or involuntary excess liquidity. This is the baseline assumption we maintain in this paper. However, it can be argued that because we have stronger prior information about the variables that explain precautionary excess liquidity, the residual in equation 3.1 should be attributed to involuntary excess liquidity. We will examine the robustness of our results to this change in our model later in this paper.

For *illustrative* purposes, figures 6, 7 and 8 plot the level of total (explained) excess liquidity together with voluntary and involuntary excess liquidity in Kenya, Nigeria and Uganda. Note, however, that the problem in identifying the level also implies that, mathematically, there is no guarantee that  $EL^P$  and  $EL^I$  are always positive. Economically, of course, persistent negative excess liquidity to deposit ratios do not make much sense, although at any given time excess liquidity may be negative if averaging of daily balances is allowed. Thus we try to choose the parameter  $a$  in such a way as to ensure positive levels for

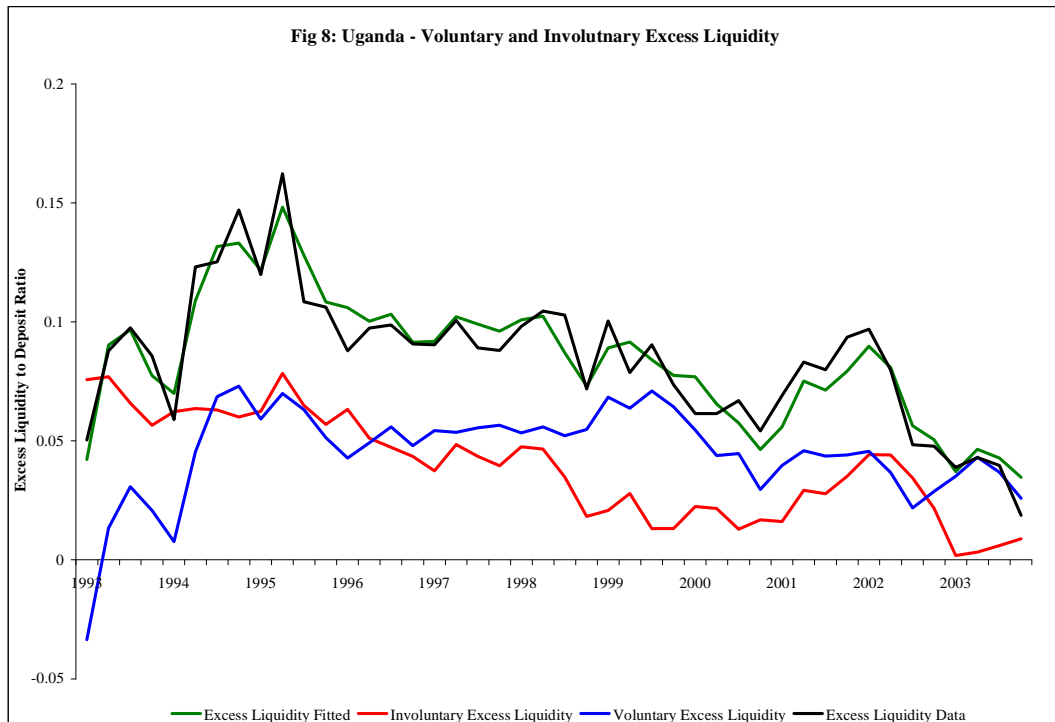
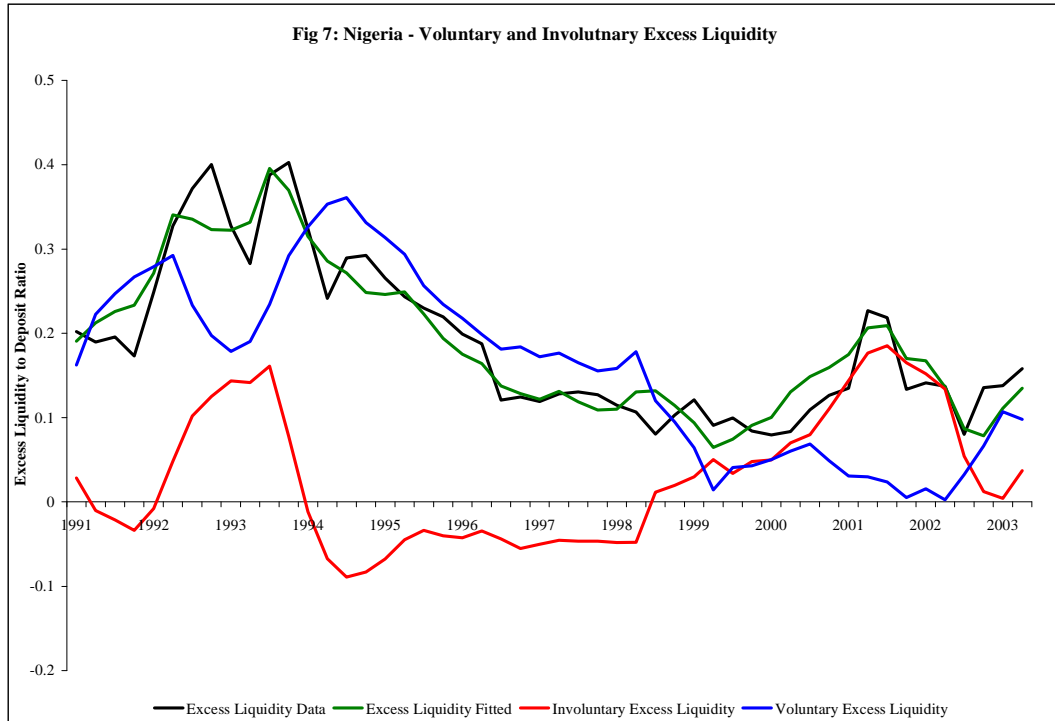
Figure 4.6: Kenya: Voluntary and Involuntary Excess Liquidity



both precautionary and involuntary excess reserves, although this is not always possible.

Referring to figures 6 to 8, our results suggest that in Kenya the fall in excess liquidity in the middle of the 1990s was explained by a fall in precautionary excess reserves. Since then, however, there is evidence that precautionary excess reserves have been steadily increasing in line with the fall in the required reserve ratio. Holdings of involuntary excess liquidity have been declining over the latter part of the sample in line with declining aid inflows as a percentage of GDP.

In Nigeria, on the other hand, voluntary excess liquidity has been gradually falling in line with overall excess liquidity, although it has recently increased



in response to the fall in reserve requirement ratios from 12.5 percent in 2002 to the current level of 9.5 percent. Involuntary excess liquidity in Nigeria was particularly high from 1992 to 1993 as banks sharply increased the cost of lending prior to the imposition of interest rate controls in 1994. Voluntary excess reserves fell during the same period as reserve requirements were raised from 3 to 6 percent in an attempt to reduce inflation. Involuntary excess liquidity also rose sharply between 2001 and 2002 in response to increased lending rates, but declined again as parastatal deposits were transferred from commercial banks to the central bank in 2004.

Finally, in Uganda our results suggest that the observed decline in excess liquidity is largely due to a decline in involuntary excess liquidity following the expansion of credit, especially to the public sector, during the sample period. Holdings of excess liquidity for precautionary purposes, however, have remained fairly stable at around 5 percent of deposits over the sample period.

## **4.5 Excess Liquidity and the Monetary Policy Transmission Mechanism**

The analysis in the previous section suggests that in periods of our sample, commercial banks in Kenya, Nigeria and Uganda have held excess liquidity that is not for precautionary purposes and which therefore is involuntary in the sense that it is surplus to requirements. As we have already argued, there are reasons to suspect that if commercial banks hold significant amounts of involuntary excess reserves, they will be less responsive to changes in monetary policy.

Hence, according to this hypothesis, involuntary excess liquidity will weaken the transmission mechanism of monetary policy. The aim of this section is formally evaluate the effect of involuntary excess liquidity on the monetary transmission mechanism by analyzing the response of the economy to an exogenous monetary policy shock within a structural VAR framework. VARs have been widely used in the analysis of monetary policy issues in both industrial and emerging markets (see *inter alia* Bernanke and Blinder (1992); Sims (1992); Gordon and Leeper (1994); Bernanke and Mihov (1998)).

Analyzing the effect of excess liquidity on the monetary policy transmission mechanism within a VAR framework is not straightforward, however. In particular, Bagliano and Favero (1998) point out that VAR models should only be estimated on a single policy regime in order to ensure that the monetary policy transmission mechanism is stable. However, our hypothesis about the effect of involuntary excess liquidity implies that we expect the monetary policy transmission mechanism to change during the course of our sample. In other words we expect there to be non-linearities in the monetary policy transmission mechanism because of changes in the level of involuntary excess liquidity in the economy.

One possible solution to this problem would simply be to include involuntary excess liquidity as an exogenous regressor in our VAR. This is not entirely satisfactory, however, because we are not claiming that excess liquidity is part of the monetary policy transmission mechanism directly, but rather that it changes the importance of the traditional channels of monetary policy

transmission, most notably the interest rate channel. The approach we follow in this paper therefore explicitly acknowledges the possibility of non-linearities in the transmission mechanism as a result of changes in involuntary excess liquidity by estimating a threshold VAR (TVAR) whereby the economy switches between regimes depending on the size of involuntary excess liquidity relative to some threshold. Threshold autoregressive (TAR) models have been extensively documented by inter alia Tong (1983) and Tong (1990). Potter (1995) uses a univariate TAR model to analyze GNP growth in the United States. Atanasova (2003), Balke (2000) and Calza and Sousa (2005) use a TVAR model to investigate non-linearities in the responses of output and inflation to credit shocks caused by the state of credit conditions in the economy. Finally, Choi (1999) uses a TVAR model to investigate the existence of asymmetries in the monetary policy transmission mechanism across monetary policy stances. Our approach is close in spirit to these studies and aims to investigate whether there are non-linearities in the monetary policy transmission mechanism related to holdings of involuntary excess liquidity in Kenya, Nigeria and Uganda.

It might be tempting at this juncture to suggest that we also estimate a TVAR using the level of precautionary excess liquidity as threshold variable. Recall that according to our hypothesis, changes in the level of precautionary excess liquidity should not affect the effectiveness of monetary policy. In particular, even at high levels of precautionary excess liquidity changes in monetary policy would be transmitted into the economy as commercial banks tried to maintain their

desired liquidity levels. Thus, one might expect that estimating such a TVAR should show no asymmetries in the transmission mechanism. This is unlikely to be the case, however. Moreover, drawing any conclusion on that basis would be misleading.

To see this let us first assume that asymmetries do exist in the transmission mechanism in monetary policy that is systematically related to the level of involuntary excess liquidity. When we use precautionary excess liquidity as a threshold variable these asymmetries in the data do not disappear. Instead, the estimation procedure tries to find a way of relating them to the level of precautionary excess liquidity. In the case of Kenya, where figure 6 suggests that precautionary excess liquidity was high when involuntary excess liquidity was low and vice versa, it's obvious that if the transmission mechanism is relatively strong when involuntary excess liquidity is high then it will appear to be relatively weak when precautionary excess liquidity is low.

In other cases such as Uganda where the pattern between involuntary and precautionary excess liquidity is not so clear, there may appear to be asymmetries in the transmission mechanism of monetary policy related to precautionary excess liquidity. However it's just as likely that the asymmetry in the transmission mechanism reflects other developments in the economy that affect the strength of the monetary policy transmission mechanism, such as the level of financial deepening, that happens to be related to the level of precautionary excess liquidity. In other words interpreting the underlying causes behind the asymmetry in

a TVAR only makes sense in the presence of strong theoretical reasons for why such asymmetries are likely to exist. Based on our previous discussion we believe that these reasons exist in the case of involuntary but not in the case of precautionary excess liquidity. As a result, in what follows we focus exclusively on the implications of involuntary excess liquidity for the monetary policy transmission mechanism.

### 4.5.1 Econometric Methodology

Consider the following benchmark reduced form two-regime TVAR:

$$\begin{pmatrix} \mathbf{Y}_t \\ \mathbf{M}_t \end{pmatrix} = C_i(L) \begin{pmatrix} \mathbf{Y}_{t-1} \\ \mathbf{M}_{t-1} \end{pmatrix} + \begin{pmatrix} \mathbf{v}_{it}^Y \\ \mathbf{v}_{it}^M \end{pmatrix} \text{ for } i=1,2$$

$$i=1 \text{ if } EL_t^I \leq \tau, \quad i=2 \text{ if } EL_t^I > \tau \quad (4.4)$$

where  $\nu_{it}^Y$  and  $\nu_{it}^M$  are, respectively, regime dependent vectors of non-policy and policy shocks with covariance matrix  $\Sigma_i^Y$  and  $\Sigma_i^M$ .  $C_i(L)$  is a regime dependent matrix lag polynomial of autoregressive parameters. Finally,  $EL_t^I$  is the threshold variable whose value relative to a threshold  $\tau$  determines the prevailing regime.

We follow Bernanke and Mihov (1998) and divide the variables into a non-policy block  $\mathbf{Y}_t$  and a policy block  $\mathbf{M}_t$  under the control of the monetary policy authorities. The vector of variables in the non-policy block consists of real GDP and CPI, whereas the nominal exchange rate and M0 are included in the vector of policy variables. For Nigeria, we also include the oil price as

a variable in the non-policy block.<sup>32</sup> Thus the policy block includes variables that may be useful as an indicator of monetary policy, although the identification scheme we adopt implies that the monetary policy authorities do not necessarily have complete control over these variables. We also include exogenous regressors where these are found to improve the fit of the model. In particular, for Kenya we include the first lag of the bond to GDP ratio whereas in Nigeria we include the contemporaneous value of the oil exports to GDP ratio. Finally, in Uganda we include data on the first lag of the aid to GDP ratio. All variables are transformed into natural logarithms and detrended using a linear and a quadratic trend prior to estimation. Where seasonality is evident, this is removed using the X12arima filter.

M0 is used as the instrument of monetary policy instead of the interbank market rate (the federal funds rate in the United States) or a short-term interest which are more commonly used as indicators of monetary policy in VARs estimated on data for industrial countries (see *inter alia* Bernanke and Blinder (1992) and Sims (1992)). This reflects several issues. Firstly, most SSA countries do not have a well developed interbank market and hence there is no interbank interest rate. Secondly, other interest rates, such as the discount rate are rarely used in many SSA countries and thus cannot be viewed as a good indicator of monetary policy. Instead, many SSA countries choose to target a domestic monetary aggregate, typically M0. In industrial countries, the use of M0 as an indicator

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<sup>32</sup>In 2004, Nigeria was the eleventh largest oil producer in the world and the largest in Africa.

of the stance of monetary policy has become less popular in recent years due to a weakening in the link between reserve money and inflation due to financial liberalization and changes in money demand.

In our analysis we restrict ourselves to a one lag TVAR for a number of reasons. In the case of Kenya and Uganda, both the Akaike (AIC) and Hannan-Quinn (HQ) information criteria suggested a lag-length of three whereas the Schwartz (SIC) information criterion suggests a lag-length of one. In Nigeria, both the HQ and the SIC information criteria suggested a lag-length of one period whereas the AIC criterion suggests a lag-length of three. Our results, however, indicated that with a three-lag TVAR it was difficult to avoid complex roots. This probably reflects the fact that in our relatively short sample, the cycles in the data are not that many and fairly similar, meaning that a complex process will fit the data reasonably well. Finally, it should be noted that a first-order non-linear VAR will capture the persistence in macroeconomic data better than a linear first-order VAR as part of the persistence will be absorbed by the non-linearity.

As a result, we proceed by analyzing the results from a TVAR with one lag only. In all cases, we use the contemporaneous value of involuntary excess liquidity as the threshold variable given that it seems reasonable to assume that commercial banks are able to observe their level of liquidity in excess of statutory requirements with little or no delay.<sup>33</sup> Table 2 presents the values of

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<sup>33</sup>In Kenya, using the first lag of excess liquidity as the transition variable resulted in a significant deterioration of fit, whereas in Nigeria and Uganda the results were close to those with the contemporaneous value.

Table 2: Information Criteria for Threshold Vector Autoregressions

Kenya			
Sample	1991:1-2003:4		
Lag	AIC	HQ	SC
1	-17.3099	-16.3111	-14.6962
2	-18.5059	-17.0351	-14.6436
3	-19.0183	-17.0701	-13.8833
Nigeria			
Sample	1991:2-2003:4		
Lag	AIC	HQ	SC
1	-14.0258	-12.5551	-10.1635
2	-13.4972	-11.4439	-8.1053
3	-14.8730	-12.0916	-7.5691
Uganda			
Sample	1993:1-2003:4		
Lag	AIC	HQ	SC
1	-14.2250	-13.1874	-11.4271
2	-15.1391	-13.6203	-11.0436
3	-16.4185	-14.4184	-11.0253

Notes: The table reports the sample period and values for the AIC, HQ and SC information criteria for Kenya, Nigeria and Uganda. The preferred lag-length is highlighted in bold for each criterion.

the information criteria for Kenya, Nigeria and Uganda.

To estimate the reduced form system we use the software MSVAR developed by Krolzig (1998). The software employs a grid-search routine to search for the level of the threshold  $\tau$  which maximizes the conditional log-likelihood of the model. In particular, for any given  $\tau$ , the model can be estimated using least squares and the log-likelihood, conditional on the threshold, computed. Pesaran and Potter (1997) and Hansen (1997) prove that the estimate of  $\tau$  is consistent.

#### 4.5.2 Estimation and Test Results

Table 3 reports the estimated threshold critical value and uses this value to divide the sample into periods of low and high involuntary excess liquidity. Maximum-likelihood estimation yields a critical value for the threshold value of -0.08410 in Kenya, 0.04825 in Nigeria and 0.05658 in Uganda. Values of the threshold variable above this level indicate that the economy is in a regime of high involuntary excess liquidity.

Table 3 also reports the results of formally testing the non-linear TVAR against its linear counterpart. In other words, we test the hypothesis that the data is described by a linear VAR against the alternative of a non-linear TVAR. If the threshold had been known this would simply been a conventional likelihood ratio test that the parameters of the model are equal across regimes. However, when we do not know the threshold level *a priori*,  $\tau$  is only identified under the alternative hypothesis. This leads to the presence of so-called nuisance parameters

Table 3: Estimation Results

		Kenya	Nigeria	Uganda
Estimated Threshold		-0.08410	0.04825	0.05658
Regime Classification	Low	1992:4 - 1992:4	1991:3 - 1992:3	1996:2-2003:4
		2000:4 - 2002:4	1994:3 - 1999:3	
		2003:3 - 2003:4	2000:1 - 2000:2	
			2003:2 - 2003:4	
	High	1991:2 - 1992:3	1992:4 - 1994:2	1993:1-1996:1
		1993:1 - 2000:3	1999:4 - 1999:4	
2003:1 - 2003:2		2000:3 - 2003:1		
LR Test	96.3767	159.8653	90.8709	
p-values (adjusted $\chi^2$ )	[0.0000]	[0.0000]	[0.0000]	

Notes: The table reports the estimated threshold value, together with the resulting regime classification for Kenya, Nigeria and Uganda. The table also reports the value of the LR test for linearity with associated p-values.

which imply that the traditional test statistic does not follow the conventional  $\chi^2(r)$  distribution where  $r$  is the number of linearly independent restrictions. The approach followed in this paper uses the built-in testing procedures in MSVAR which exploit the finding by Ang and Bekaert (2002) that the distribution of the test can be approximated by a  $\chi^2$  distribution with  $r+q$  degrees of freedom where  $q$  is the number of nuisance parameters.<sup>34</sup>

In Kenya the estimated critical value for the threshold implies that the economy had two periods of high involuntary excess liquidity in the mid-nineties. In Nigeria, involuntary excess liquidity was particularly high from 1993 to 1994 and from 2001 to 2003. Finally, in Uganda the economy gradually moved from a state of high excess liquidity until 1996 to a state of low excess liquidity thereafter. The reasons for these trends in the data were examined previously.

<sup>34</sup>In our study the tests will be biased upwards because we ignore the added uncertainty involved in the procedure used to generate the threshold variable – involuntary excess liquidity.

In all countries the likelihood ratio test strongly supports the presence of regime shifts. The impulse response functions in the next section will provide further insights into the nature of this non-linearity.

### 4.5.3 Impulse Response Analysis

The evidence of regime-shifts referred to above, does not necessarily imply that there is conclusive evidence of asymmetry across regimes in the monetary policy transmission mechanisms as shifts in parameters may cancel each other out to leave the dynamic response of the system unchanged. As a result this section investigates whether the dynamic response of variables in the system to a monetary policy shock exhibits asymmetry across regimes. As discussed previously, one would expect the transmission mechanism of monetary policy to be weaker in a regime where there is significant involuntary excess liquidity.

As mentioned the analysis monetary policy using VARs explicitly focuses on the response of the economy to a shock to monetary policy. Thus as Bagliano and Favero (1998) point out, "... VAR models of the transmission mechanism are not estimated to yield advice on the best monetary policy; they are rather estimated to provide empirical evidence on the response of macroeconomic variables to monetary policy impulses in order to discriminate between alternative theoretical models of the economy". Of course, monetary policy VARs implicitly involve the estimation of a *monetary policy rule* which links the instrument of monetary policy  $\mathbf{M}_t$  to the macroeconomic variables  $\mathbf{Y}_t$ . However the analysis

of the VAR focuses on unexpected deviations from the rule using impulse response analysis. As Bagliano and Favero (1998) point out it is "...only when central banks deviate from their rules that it becomes possible to collect interesting information on the response of macroeconomic variables to monetary policy impulses...". This information can then be compared to the predictions of alternative models or, as in our case, to the responses derived when the economy is characterized by different levels of involuntary excess liquidity.

The estimation of impulse responses for non-linear models is not as straightforward as in linear VARs, however. In particular, if the system is subject to regime shifts, it may be that the shock itself induces a change in regime. Hence, we differentiate between regime-dependent impulse response functions, which are calculated conditional on the system remaining in the regime prevailing at the time of the shock, and non-linear impulse response functions that do not impose that the system remains in the original regime. The approach which is most useful depends on the ultimate aim of the study. Regime-dependent impulse response functions are useful for exploring the presence of asymmetries in the dynamics of the system between regimes. However, they may be less useful for analyzing the actual impact of a shock on the economy if the probability of changing regimes is non-negligible. In this case it may be more useful to consider non-linear impulse responses (see Koop, Pesaran, and Potter (1996) and Potter (2000)). In this paper, we only consider regime-dependent impulse responses given that the aim of the study is the investigation of asymmetries in the monetary policy transmission

mechanism between regimes rather than a study of the overall effect of a shock to the system.

The reduced TVAR in equation 4.1 does not allow us to identify the impact of a monetary policy shock directly. This is because, as Christiano, Eichenbaum, and Evans (1996) point out, policy actions to some extent depend on the state of the economy. Hence, the response of the economy to a monetary policy intervention reflects the combined effects of the policy action and the variables to which policy is reacting. In terms of equation 4.1 the problem arises because the covariance matrix of the vector of residuals is not diagonal. To resolve this issue requires the imposition of an appropriate set of restrictions which enable us to study the effect of an unexpected shock to that component of monetary policy which is exogenous in the sense that it does not depend upon the other variables in the system.

Solving this identification problem is tantamount to finding a matrix  $\mathbf{A}$  that satisfies:

$$\mathbf{A}_i^{-1} \begin{pmatrix} \mathbf{Y}_t \\ \mathbf{M}_t \end{pmatrix} = \mathbf{A}_i^{-1} \mathbf{C}_i(L) \begin{pmatrix} \mathbf{Y}_{t-1} \\ \mathbf{M}_{t-1} \end{pmatrix} + \begin{pmatrix} \mathbf{u}_{it}^Y \\ \mathbf{u}_{it}^M \end{pmatrix} \text{ for } i=1,2$$

or:

$$\mathbf{A}_i^{-1} \begin{pmatrix} \mathbf{v}_{it}^Y \\ \mathbf{v}_{it}^M \end{pmatrix} = \begin{pmatrix} \mathbf{u}_{it}^Y \\ \mathbf{u}_{it}^M \end{pmatrix} \text{ for } i=1,2$$

where  $\mathbf{u}_{it}^Y$  and  $\mathbf{u}_{it}^M$  are regime dependent vectors of non-policy and policy shocks with diagonal covariance matrices  $\mathbf{A}_i \Sigma_i^Y \mathbf{A}_i$  and  $\mathbf{A}_i \Sigma_i^M \mathbf{A}_i$ .

Our approach to identification centers on the aim of identifying correctly

the effect of an unanticipated shock to monetary policy, which in our model is associated with a shock to growth rate of M0. Bernanke and Blinder (1992) point out that to identify the impact of an exogenous shock to the monetary policy variable without identifying the entire model structure it is sufficient to assume that policy variables react contemporaneously to non-policy variables, whereas the converse is not true. Ignoring the oil price in the TVAR for Nigeria, the system in equation 4.3 can then be written as:

$$\begin{pmatrix} v_t^{GDP} \\ v_t^P \\ v_t^{Ex} \\ v_t^{M0} \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 \\ a_{31} & a_{32} & 1 & a_{34} \\ a_{41} & a_{42} & a_{43} & 1 \end{pmatrix} \begin{pmatrix} u_t^{GDP} \\ u_t^P \\ u_t^{Ex} \\ u_t^{M0} \end{pmatrix} \quad (4.5)$$

where we have used a simple recursive ordering to orthogonalize the reduced form shocks to the two non-policy variables, without attaching any economic interpretation to them.

The system in equation 4.4 includes seven parameters and four variances to be estimated from the four variances and six independent covariances of the reduced form covariance matrix. Hence, it is necessary to impose an additional restriction for the model to be identified. The identification problem then becomes a question of modeling the part of matrix  $A$  which corresponds to the policy variables. In this paper, we impose the condition that  $a_{43}$  is equal to zero which implies that monetary policy does not react contemporaneously to movements in the exchange rate and that the nominal exchange rate reacts contemporaneously

to shocks to monetary policy. Sensitivity analysis suggest that, with the exception of the response of the nominal exchange rate, setting  $a_{43}$  equal to zero and freely estimating  $a_{34}$  does not substantially change the response of the variables to a shock to monetary policy.<sup>35</sup>

Figures 10 to 12 show the regime-dependent impulse response functions for Kenya, Nigeria and Uganda following a one unit contractionary shock to the annual growth rate of M0. The figures also include the asymptotic one standard error bands. This corresponds approximately to a 68 percent confidence interval. This level of confidence is preferred to the conventional confidence intervals in much of the VAR literature (see inter alia Christiano, Eichenbaum, and Evans (1996) and Kim and Roubini (2000)) due to large standard errors caused by the lack of restrictions imposed on the dynamics of the system.<sup>36</sup> Statistically the differences between the estimated impulse response functions across regimes are only significant if the confidence bands are not overlapping.

In all the three case studies, output contracts over some horizon following the monetary contraction although the contraction is not significant in Nigeria and Uganda. In Kenya the contraction occurs immediately, whereas in Nigeria it falls after an initial period in which it increases. In Uganda, the timing of the contraction in output depends on the state of the economy. In all three

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<sup>35</sup>Ideally, one would want an identification scheme that allows both  $a_{34}$  and  $a_{43}$  to be freely estimated. Kim and Roubini (2000) and others argue that this is important to explain the exchange rate puzzle – the finding for the US that the nominal exchange rate appreciates on impact following an expansion in the monetary policy stance. Given that this puzzle is not evident in our results, we do not consider this a significant short-coming.

<sup>36</sup>See Hamilton (1994) for details.

case studies, the price level falls in response to the contraction in reserve money supply as we would expect from economic theory. Similarly, the initial appreciation of the nominal exchange rate observed in all three case studies is consistent with economic theory.

Beyond noting that the impulse responses broadly correspond to our theoretical priors, it is worth highlighting the fact that across both regimes the response of output is broadly consistent across countries. This suggests that the interest elasticity of money demand is broadly similar across countries. This is consistent with evidence presented by Fielding (1994) where the interest elasticity of money demand in Kenya is found to be very similar to that in Nigeria.<sup>37</sup>

It is worth comparing the magnitude of the response of CPI to a contraction in base money in our three case-studies with other studies. Savvides (1998) estimates the response of the differential between domestic and world inflation to domestic money growth for several SSA countries. He finds that in Nigeria, the sum of the coefficients on base money growth equals 0.54. Similarly International Monetary Fund (2005c) reports results which suggest that in Uganda a one percent increase in M2 raises core inflation by 0.2 percent. Notwithstanding the fact that we use a more narrow definition of the money supply and headline CPI, these results are broadly consistent with our findings.

With respect to differences in the monetary policy transmission mechanism across regimes, there is clear evidence that in all three case studies an

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<sup>37</sup>The sensitivity of aggregate demand to interest rate changes may also be different. However, we are not aware of any empirical studies which attempt to measure this for African countries.

Figure 4.7: Kenya - Response to a one-unit negative shock to M0

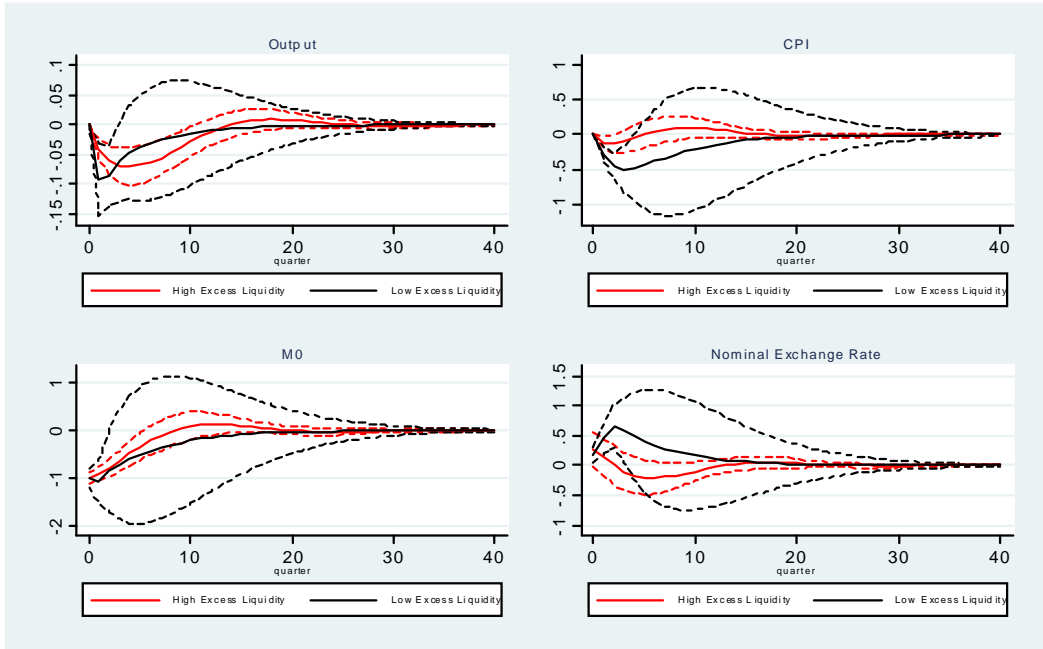


Figure 4.8: Nigeria - Response to a one-unit negative shock to M0

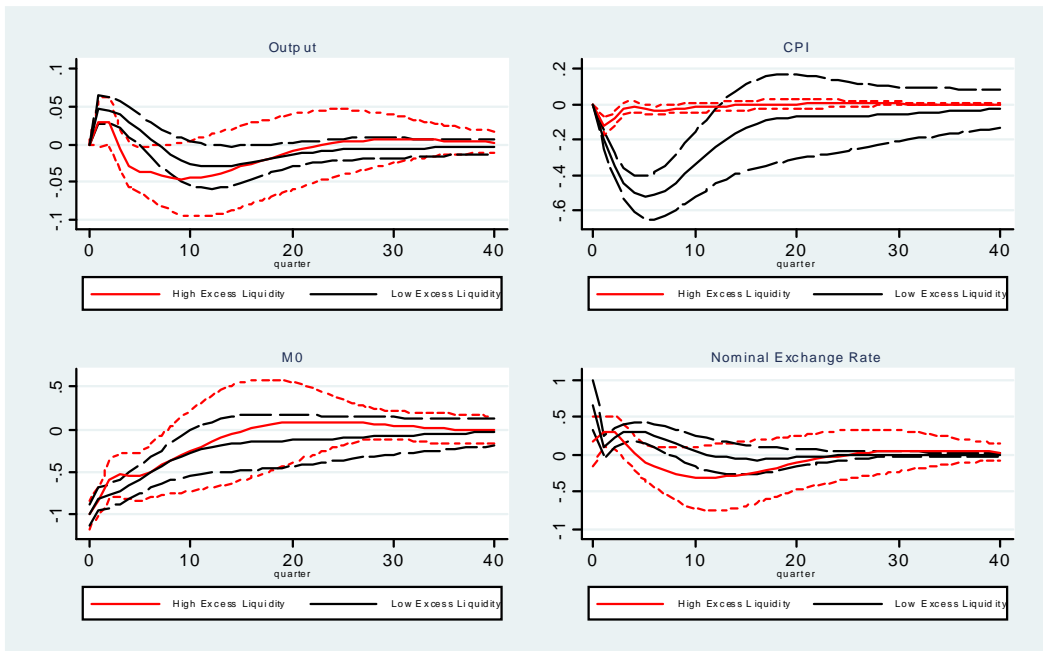
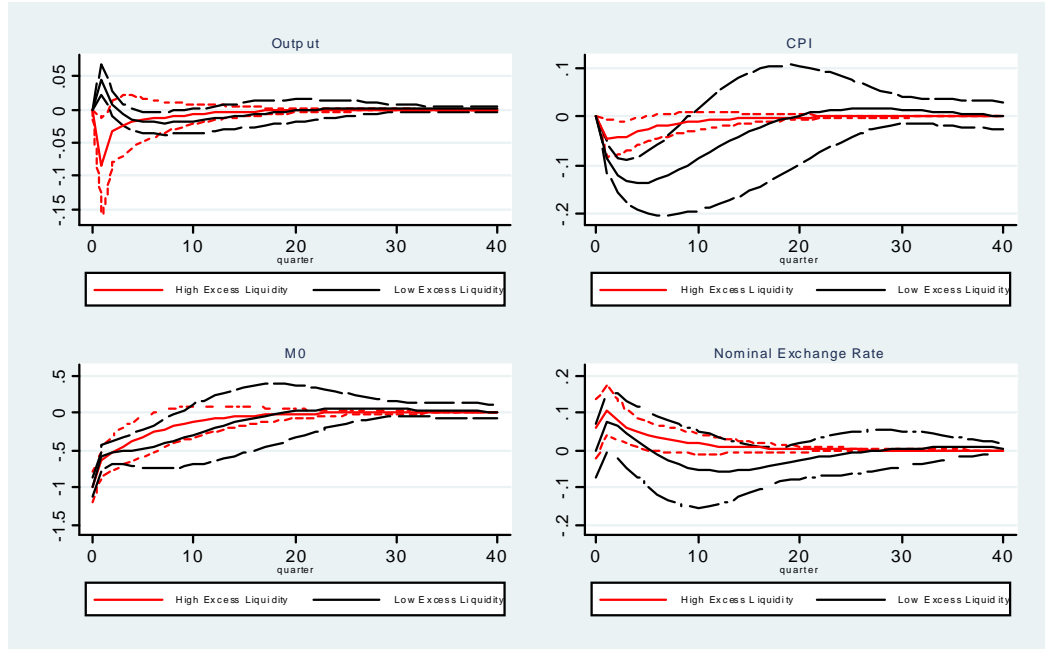


Figure 4.9: Uganda - Response to a one-unit negative shock to M0



unexpected contraction in reserve money lowers CPI more when involuntary excess liquidity is low than when involuntary excess liquidity is high. In Nigeria, the difference is significant for approximately ten quarters after the initial shock to monetary policy. In Uganda, the difference is significant from approximately the third to the seventh quarter after the shock. In Kenya, on the other hand, the difference between the responses does not appear to be significant. This is despite the fact that, economically speaking, the difference in the responses of CPI across the two regimes is larger in Kenya than it is in Uganda. Part of the explanation for why the differences are not significant in Kenya is undoubtedly the high uncertainty surrounding the response of CPI following a monetary policy shock in the low excess liquidity regime caused by a lack of observations in this

regime.

It is also worth commenting on the response of output and the nominal exchange rate to the contractionary shock to reserve money. The response of output across the two regimes is not significantly different at any horizon following the shock to monetary policy in Kenya and Nigeria. In Uganda, the response of output in the first few quarters after the shock is asymmetric across regimes. Although this difference is significant statistically it is difficult to attach any economic interpretation to it. With respect to the nominal exchange rate it is clear that the larger fall in CPI when the amount of involuntary excess is low implies that the nominal exchange rate has to appreciate more if the real exchange rate is to remain constant. This appears to be broadly consistent with the results, although the uncertainty surrounding the response of the nominal exchange rate makes it difficult to say whether or not these results are significant.

To conclude, our results suggest firstly that CPI falls relatively less following a contraction in reserve money when involuntary excess liquidity is relatively high. These differences are significant in Nigeria and Uganda but not in Kenya. Secondly, our results suggest that the response of the nominal exchange rate is such that the response of the real exchange rate is symmetric across regimes. This is consistent with our third result that the contraction in output following a contraction in reserve money is not significantly different when involuntary excess liquidity is relatively high. These results are consistent with our hypothesis that commercial banks are unresponsive to signals from the cen-

tral bank when they hold involuntary excess reserves. Hence, the ability of the central bank to control inflationary pressures in the economy is weakened.

#### 4.5.4 Robustness Analysis

As noted previously, there are there are different approaches to constructing a measure of involuntary excess liquidity. In particular, it might be argued that the reserve ratio should be included in the vector of variables  $\mathbf{X}_2$  that explains involuntary excess liquidity. In other words, it can be argued that a change in the reserve requirement induces a change in involuntary, rather than voluntary excess liquidity as argued previously. Similarly, we noted that because of our relatively strong theoretical priors about what causes commercial banks to hold precautionary excess liquidity, the residual term in equation 3.1 should be included in our measure of involuntary excess liquidity rather than being excluded from the decomposition. The aim of this section is to examine whether or findings about the impact of involuntary excess liquidity on the monetary policy transmission mechanism.

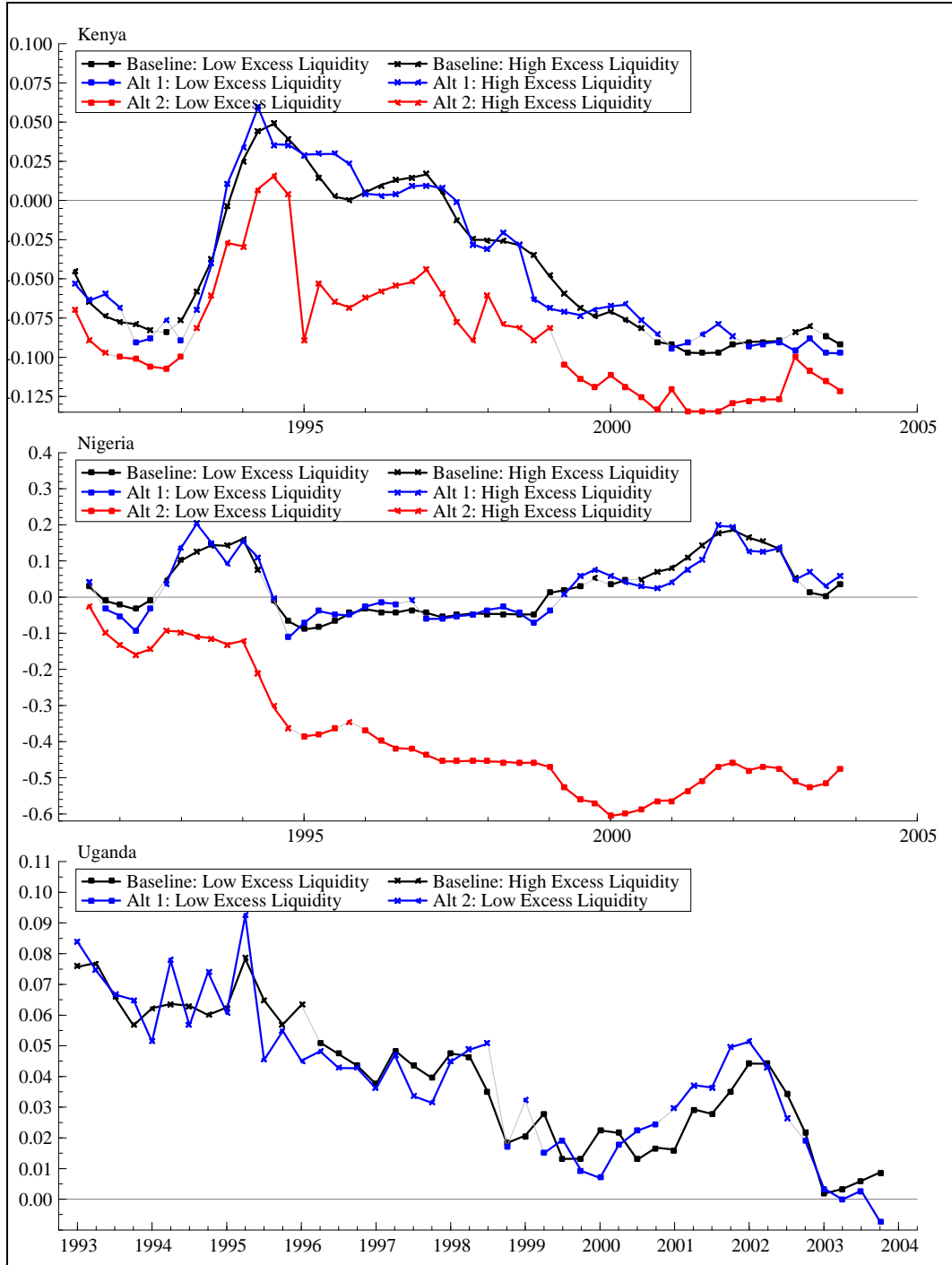
In order to examine the robustness of our results we redo our threshold VAR for each of the three case-studies under the alternative assumptions about how involuntary excess liquidity – the threshold variable – is calculated. Figure 13 illustrates the impact of changing the threshold variable by plotting threshold variable with markers showing periods of high and low excess liquidity. The black line represents the baseline model analyzed previously. The blue line (ALT 1)

represents the model where the residuals from equation 3.1 have been added to the threshold variables. Finally, the red line (ALT 2) represents the model where the reserve ratio is added to the threshold variable. The resulting impulse responses for output and CPI after a one unit negative shock to base money are displayed in figures 14-16. The solid lines represent the response under low involuntary excess liquidity whereas the dotted lines represent high involuntary excess liquidity. For ease of comparison, standard error bands are omitted.

For Kenya, figure 13 suggests that the periods of high and low excess liquidity are relatively robust to the changes in the threshold variables considered here. One particularly noticeable change is the classification of 1999 and 2000 as period of low rather than high excess liquidity when the reserve ratio is added to involuntary excess liquidity. Because of the limited amount of observations in the low excess liquidity regime, however, these few changes have a significant impact on the impulse responses however. In particular, it is clear that the difference between the responses of CPI under high and low involuntary excess liquidity is much smaller under the two alternative assumptions about how to derive involuntary excess liquidity than under the baseline. There is still some evidence that the response of CPI is stronger when excess liquidity is low but this is unlikely to be significant. The response of output does not seem to have altered in any significant way.

For Nigeria our results suggest that the classification of regimes is fairly robust to adding the residuals to involuntary excess liquidity. This is confirmed

Figure 4.10: Robustness Analysis. Periods of High and Low Excess Liquidity

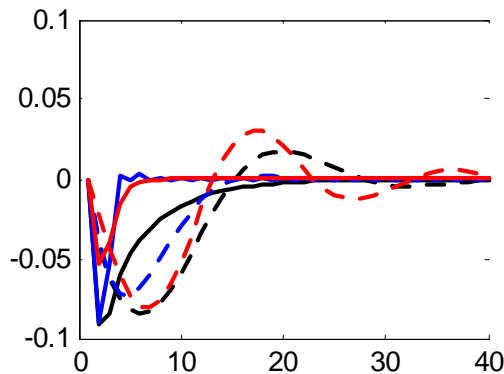


by the impulse responses which still show a marked difference in the response of CPI to a shock to reserve money in the two regimes. Figure 13 shows, however, that the effect of adding the reserve ratio has a dramatic effect on the threshold variable. This is not surprising given the importance of the reserve ratio in our estimated model of excess liquidity for Nigeria. Whereas previously 2001 and 2002 were deemed to be high excess liquidity periods, every quarter from 1996 onwards is classified as low excess liquidity when the reserve ratio is part of the threshold variable. Figure 14 shows that this has the effect of nearly eliminating the difference between the response of CPI across regimes.

Finally, for Uganda the threshold variable becomes significantly more volatile when we add residuals from equation 3.1 due to the volatility of excess liquidity in Uganda that we have commented on previously. This has the effect of significantly altering the classification of regimes with 1996 to 1998 and 2001 now being classified as periods of high excess liquidity. In terms of the regime dependent impulses the change in regime classification introduces an explosive eigenvalue in the system when the economy is the low excess liquidity regime. The reason for this is the concentration of the low excess liquidity regime in periods with rapidly rising prices and reserve money, in particular at the end of the sample, which appear to introduce an explosive root into the system. Our method for detrending the data strengthens this end of sample movement in the data for Uganda. This obviously raises issues about the appropriate way to detrend the data for Uganda. In this study our choice has been guided by the

concern for comparability across countries.

Figure 4.11: Robustness Analysis: Response to a one-unit negative shock to M0 in Kenya



More generally, however, it is clear that the construction of the measure of involuntary excess liquidity matters a great deal to the results. This is particularly true in countries, such as Kenya and Uganda where the excess liquidity to deposit ratio has varied by less than in for example Nigeria. This makes it more difficult for the estimation methodology to identify periods of high and low involuntary excess liquidity in a robust manner.<sup>38</sup>

## 4.6 Summary and Policy Implications

Excess liquidity has become a feature of several economies in SSA. This

<sup>38</sup>One approach to overcome this problem may be to identify periods of time that are characterized by high or low excess liquidity irrespective of how one constructs the threshold variables and then analyze the response to a monetary policy shock. The risk is that this will drastically reduce the size of the sample making it more difficult to make statements about whether or not the differences between regimes are significant.

Figure 4.12: Robustness Analysis: Response to a one-unit negative shock to M0 in Nigeria

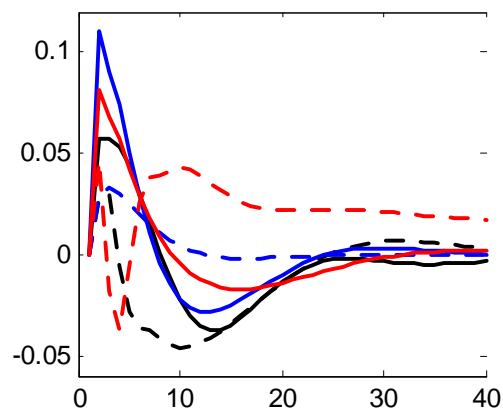
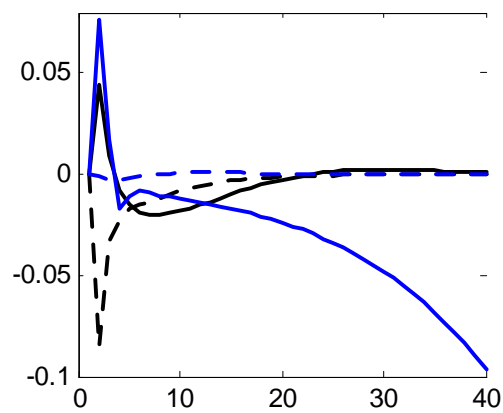


Figure 4.13: Robustness Analysis: Response to a one-unit negative shock to M0 in Uganda



paper has sought to document the phenomenon of excess liquidity and analyze its impact on the transmission mechanism of monetary policy. In doing so we argued that it was important to distinguish between excess liquidity held for precautionary purposes and excess liquidity in excess of that amount, which we chose to refer to as involuntary excess liquidity. We argued that because of the underdeveloped nature of financial markets in SSA, commercial banks may choose to hold such involuntary excess liquidity even if interest rates and bond yields are positive. We proposed a methodology for extracting information on involuntary excess liquidity from data on excess reserves, which we applied to Kenya, Nigeria and Uganda.

Our results suggested that the fall in excess liquidity in Kenya over the course of the sample period was largely due to a fall in precautionary excess liquidity. In Nigeria, our results identified two periods where there had been significant levels of excess liquidity associated with the imposition of interest rate controls in 1994 and an increase in lending to the Government in 2001-2002. Finally, in Uganda our results suggested that involuntary excess liquidity had been gradually falling in line with total excess liquidity as a result of increased lending to private sector. In all three case-studies, our results suggested that involuntary excess liquidity could be largely explained by deficient lending or increases in the amount of deposits, especially government deposits.

The distinction between these different concepts of excess liquidity has important policy implications. If banks hold significant excess liquidity for pre-

cautionary purposes sterilization is unlikely to be an effective way to reduce excess liquidity and is instead likely to induce commercial bank to contract lending in order to preserve their desired level of reserves. In addition, such a strategy is likely to lead to increases in interest rates and the public debt burden. Instead, it is important to recognize that precautionary excess reserves represent a structural problem which, although it does not pose an immediate danger to inflation, entails an inefficient allocation of resources. The shortcomings of the institutional framework governing the access to bank credit in SSA have been extensively documented by Sacerdoti (2005). He highlights, in particular, the need to improve information on borrowers, update accounting and auditing standards and revamp the judicial, legal and regulatory framework governing the enforceability of claims.

If banks hold significant amounts of involuntary excess liquidity, however, there is a real danger that once demand conditions improve, lending will rapidly expand carrying with it the risk of increased inflation. Such an outcome is likely if a) the lending rate increases in the face of increased demand, thus raising the opportunity cost of excess liquidity or b) an improvement in the economic outlook reduces the riskiness of new borrowers. Hence, to the extent that there is involuntary excess liquidity in the system, serious consideration needs to be given to removing that liquidity from the system.<sup>39</sup>

In addition to its importance for the formulation of policy, we argued

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<sup>39</sup>Options for doing so include sterilization operations although these may be unattractive due to the effect on interest rates and on the balance sheet of the central bank. An alternative method would be to increase reserve requirements or to move government deposits from commercial banks to the central bank.

that the distinction between precautionary and involuntary excess liquidity was important for understanding the impact of excess liquidity on the effectiveness of monetary policy. In particular, we argued that it was only if commercial banks held significant involuntary excess liquidity that we expect to see a weakening of the monetary policy transmission mechanism. The effect of involuntary excess liquidity was investigated by estimating a TVAR for Kenya, Nigeria and Uganda with involuntary excess liquidity as the transition variables. Our results suggested that in all three case studies involuntary excess liquidity did weaken the transmission of a shock to monetary policy to CPI.

In proposing a methodology for measuring that component of excess liquidity which is involuntary or surplus to commercial banks' requirements we have been keen to stress that there may be alternative measures that merit consideration. Within our framework we therefore examined the implications 1) of allowing the unexplained residual from our estimation to be part of involuntary excess liquidity and 2) of assuming the a change in the required reserve ratio changes involuntary rather than precautionary excess liquidity. Our results suggested that the choice of how to measure involuntary excess liquidity matters a great deal for our evaluation of the effect of excess liquidity on the monetary policy transmission mechanism.

The weakness of the monetary policy transmission mechanism when involuntary excess liquidity is high implies that in a cyclical downturn, efforts by the monetary policy authorities to stimulate aggregate demand will be largely

ineffective. Hence, greater emphasis may have to be placed on countercyclical fiscal policy to stabilize the economy. It is well-known, however, that fiscal policy is not well suited for this purpose because of decision and implementation lags as well as the obvious political constraints. Coupled with the inflationary risks mentioned above, it is clear that involuntary excess liquidity poses numerous risks which demand the attention of policy-makers.

## Appendix 1: Classification of Countries

Sub-Saharan Africa	Oil-Producing	High Aid Dependency	CEMAC	WAEMU
Angola	Angola	Burundi	Cameroon	Benin
Benin	Cameroon	Cape Verde	Central African Rep.	Burkina Faso
Botswana	Congo, Rep. of	Congo, Dem. Rep. of	Chad	Côte d'Ivoire
Burkina Faso	Equatorial Guinea	Ethiopia	Congo, Rep. of	Guinea-Bissau
Burundi	Gabon	Gambia, The	Equatorial Guinea	Mali
Cameroon	Nigeria	Ghana	Gabon	Niger
Cape Verde		Guinea-Bissau		Senegal
Central African Rep.		Lesotho		Togo
Chad		Malawi		
Comoros		Mozambique		
Congo, Dem. Rep. of		Namibia		
Congo, Rep. of		Rwanda		
Côte d'Ivoire		São Tomé & Príncipe		
Equatorial Guinea		Sierra Leone		
Eritrea		Uganda		
Ethiopia				
Gabon				
Gambia, The				
Ghana				
Guinea				
Guinea-Bissau				
Kenya				
Lesotho				
Liberia				
Madagascar				
Malawi				
Mali				
Mauritius				
Mozambique				
Namibia				
Niger				
Nigeria				
Rwanda				
São Tomé & Príncipe				
Senegal				
Seychelles				
Sierra Leone				
South Africa				
Swaziland				
Tanzania				
Togo				
Uganda				
Zambia				
Zimbabwe				

## Appendix 2: Reserve Requirement Framework

Country	Reserve Ratios end 2004 (in Percent)					Remuneration
	Demand Deposits	De-	Time/Savings Deposits	Foreign Deposits	Currency Other	
Angola	15.00		15.00	15.00	100.00 <sup>1</sup>	No
Benin	13.00		0	0	13.00 <sup>2</sup>	No
Botswana	3.25		3.25	0	3.25 <sup>3</sup>	No
Burkina Faso	3.00		0	0	3.00 <sup>2</sup>	No
Burundi <sup>4</sup>	5.00		5.00	0	0	No
Cameroon	7.75		5.75	0	0	Yes (0.55) <sup>12</sup>
Cape Verde	18.00		18.00	18.00	18.00 <sup>5</sup>	No
Central African Rep. <sup>6</sup>	0.00		0.00	0	0	Yes (0.55) <sup>12</sup>
Chad	5.00		3.00	0	0	Yes (0.55) <sup>12</sup>
Comoros	35.00		35.00	0	35.00 <sup>1</sup>	Yes <sup>13</sup>
Congo, Dem. Rep. of	2.00		2.00	2.00	0	No
Congo, Rep. of	7.75		5.75	0	0	Yes (0.55) <sup>12</sup>
Côte d'Ivoire	5.00		0	0	5.00 <sup>2</sup>	No
Equatorial Guinea	7.75		5.75	0	0	Yes (0.55) <sup>12</sup>
Eritrea	10.00		10.00	10.00	10.00	No
Ethiopia	5.00		5.00	5.00	0	No
Gabon	5.00		3.00	0	0	Yes (0.55) <sup>12</sup>
Gambia, The	18.00		18.00	18.00	0	No
Ghana <sup>7</sup>	9.00		9.00	9.00	0	No
Guinea	5.50		5.50	5.50	5.50 <sup>5</sup>	No
Guinea-Bissau	3.00		0	0	3.00 <sup>2</sup>	No
Kenya	6.00		6.00	6.00	6.00	No
Lesotho <sup>9</sup>	3.00		3.00	3.00	3.00 <sup>9</sup>	No
Liberia	36.00		36.00	20.00	0	No
Madagascar	15.00		15.00	15.00	0	No
Malawi <sup>9</sup>	27.5		27.5	0	0	No
Mali	9.00		0	0	9.00 <sup>2</sup>	No
Mauritius	5.50		5.50	5.50	0	No
Mozambique	11.50		11.50	11.50	0	No
Namibia	1.00		1.00	1.00	1.00 <sup>8</sup>	No
Niger	5.00		0	0	5.00 <sup>2</sup>	No
Nigeria	9.50		9.50	9.50	9.50 <sup>5</sup>	Yes (4.00) <sup>14</sup>
Rwanda	8.00		8.00	8.00	0	No
São Tomé & Príncipe	22.00		22.00	22.00	0	No
Senegal	9.00		0	0	9.00 <sup>2</sup>	No
Seychelles	2.50		2.50	2.50	0	No
Sierra Leone	12.50		12.50	0	12.50 <sup>1</sup>	No
South Africa	2.50		2.50	2.50	2.50 <sup>8</sup>	No
Swaziland	2.50		2.50	2.50	2.50 <sup>1</sup>	No
Tanzania	10.00		10.00	10.00	0	No
Togo	3.00		0	0	3.00 <sup>2</sup>	No
Uganda	9.50		9.50	9.50	0	No
Zambia	14.00		14.00	14.00	14.00 <sup>5</sup>	No
Zimbabwe	60.00		30.00/37.50 <sup>10</sup>	0	15.00/30.00 <sup>11</sup>	No

1/ Government deposits

2/ Short-run credit, crop credit and foreign assets.

3/ Call deposits

4/ Cash in vault is not counted as eligible reserves

5/ The uniform reserve requirement applies to total deposits

6/ Due to the difficult economic situation in the Central African Republic, reserve requirements have been temporarily suspended.

7/ Ghana has a secondary reserve requirement which is used to mop up liquidity. Banks satisfy this requirement by holding government or central bank securities

8/ The uniform reserve requirement applies to total liabilities

9/ Banks are only allowed to lend up to 65 percent of their foreign currency liabilities. A portion of banks' reserves can be held with discount houses.

10/ Savings deposits/time deposits.

11/ Reserve requirements on deposits in other financial institutions. Finance houses/building societies and discount houses.

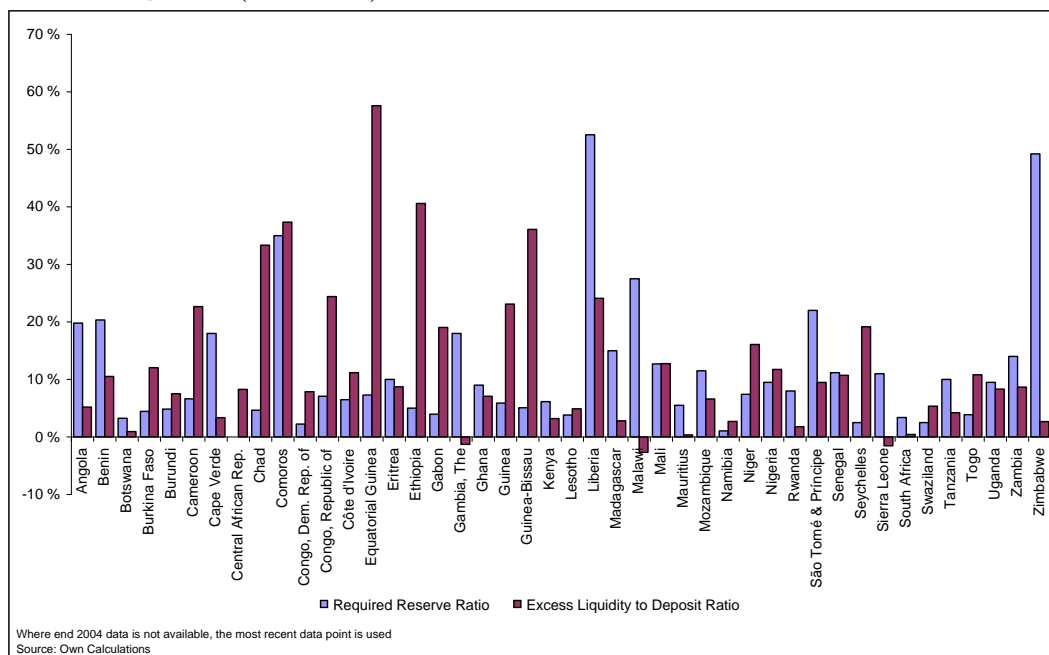
12/ On required reserves only.

13/ Required reserves are remunerated at the EONIA (Euro OverNight Index Average) rate minus 0.125 percent. Excess reserves are remunerated at the EONIA rate.

14/ The first 8 percentage points of the reserve requirement are not remunerated.

## Appendix 3: Effective Reserve Requirement and Excess Reserves

Figure 4.14: Effective Required Reserve Ratio and the Ratio of Excess Reserves to Total Deposits (end 2004)



The above figure shows the effective reserve ratio and the ratio of excess reserves to total deposits for all countries in the sample at the end of 2004. In the majority of countries, the required reserve ratio is currently just below 10 percent with a median of 7 percent although the variation is high, from a low of zero percent in the Central African Republic to around 50 percent in Liberia and Zimbabwe. These figures imply that the reserve requirement in many SSA countries tends to be higher than those in the United States and the euro area.<sup>40</sup> The

<sup>40</sup>The United States has a reserve requirement on short term deposits which varies from 0 to 10 percent depending on the size of the accounts. In the Euro Zone, short term deposits have a 2 percent reserve requirement.

figure also shows that on average countries in SSA had excess reserves amounting to 13.2 percent of total deposits with a median value of 8.3 percent. The relatively high average is largely due to a handful of countries such as Equatorial Guinea, Ethiopia, Guinea-Bissau, the Comoros and Chad, all of whom have excess reserve to deposit ratios in excess of 30 percent.<sup>41</sup>

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<sup>41</sup>The data suggested that a few countries had negative excess reserves. In the case of Malawi, this is because banks are allowed to hold part of their required reserves with discount houses. This is not captured in our data. Zimbabwe had negative excess reserves for a number of years because reserve requirements were not enforced. The explanation for why there are negative excess reserves in The Gambia and Sierra Leone is unclear.

## **Appendix 4: Monetary Policy Implementation in Kenya, Nigeria and Uganda**

### **Kenya**

The pursuit of a tight monetary policy in Kenya during the past decade has contributed to lowering the inflation rate and interest rates. Inflation has declined from 47 percent in 1993 to less than 2 percent in 2002 whereas nominal Treasury bill rates have declined from a high of 70 percent in 1994 to 8.3 percent at the end of 2002. These favorable developments have allowed the nominal and real exchange rates against the US dollar to stabilize which in turn has contributed to a fall in the country risk premium. Recently, however, both overall and core (excluding food and energy) inflation have been increasing on the back of a rebound in private sector credit.

The aim of monetary policy in Kenya, as mandated in the Central Bank Act, is to ensure the stability of the price level whilst providing for a stable environment for financial markets. In the most recent Monetary Policy Statement of the Central Bank of Kenya (CBK) the goal of monetary policy is identified as an inflation rate in the rate of 5 percent by end of June 2006. To achieve this goal the CBK manages the growth of broad money (M3X) by targeting reserve money.

In order to conduct monetary policy the CBK relies mainly on open market operations as well as discount window operations, reserve requirements and foreign exchange interventions. The open market operations are conducted

by CBK trading in the REPO and reverse REPO market for Treasury bills. As lender of last resort, the CBK also provides liquidity to the financial system at its discount window whereby short-term loans are available at a the discount penalty rate which currently stands at 3 percent above the 91 day Treasury bill rate. Historically, reserve requirements have also been used to influence the amount of liquidity in the economy with reserve ratios reaching 18 percent of total liabilities from 1995 to 1996. The required reserve ratio has been stable at 6 percent since July 2003 suggesting that it is no longer being actively used for monetary control. Required reserves are not remunerated. Finally, the CBK occasionally intervenes in the foreign exchange market. In particular, the remarkable stability of exchange rate against the U.S. dollar in 2001 and 2002 prompted the IMF to suggest that Kenya was in practice shadowing the U.S. dollar.

## **Nigeria**

The stated aim of monetary policy in Nigeria is output growth and low inflation. In practice, the achievement of these goals is complicated by the legal, institutional, and political framework in Nigeria: The lack of independence undermines the ability of the central bank of Nigeria (CBN) to conduct monetary operations in an appropriate manner; the government's heavy reliance on central bank credit (the government can borrow up to 12.5 percent of the previous years revenue from the central bank) infringes on the central bank's control over base money; the effective pursuit of multiple and often conflicting goals in addition to the stated

aims of monetary policy, such as interest rate stability, exchange rate stabilization, and strengthening of the banking system, creates confusion among market participants, loss of credibility and increasing risk-premia. As a result, the CBN has been unable to reduce broad money growth, which has averaged more than 20 percent since 2001. As a result the exchange has depreciated, inflation has been rising and international reserves have been falling.

In order to conduct monetary policy operations the CBN relies on a variety of instruments. The CBN imposes both a reserve requirement and a liquidity ratio which currently stand at 9.5 percent and 40 percent, respectively. These are expected to be satisfied on a continuous basis but because commercial banks are only required to report their asset positions to the central bank twice a month, this is unlikely to be true in practice. The first 8 percent of the reserve requirement is not remunerated whereas the remainder is remunerated at a rate which currently stands at 4 percent. The liquidity requirement is satisfied by holdings of cash in vault, deposits at the central bank in excess of requirements, treasury bills and CBN certificates and placements in discount houses and the interbank market.

The CBN also conducts open-market type operations by holding weekly Treasury bill auctions as well as open market operations in the secondary market in the form of repurchase agreements. Money market operations are also conducted through the sale of foreign exchange. In general, however, the CBN's activities in the foreign exchange market are driven by foreign exchange considera-

tions. The CBN also conducts discount and rediscount operations whereby banks and discount houses are able to sell and buy treasury bills or initiate repurchase agreements. Finally, in May 2004 the CBN used transfers of government deposits from commercial banks to the central bank as a means to reducing liquidity.

## Uganda

From its high levels in the 1980s and early 1990s, Uganda has succeeded in stabilizing inflation at single-digit levels due to prudent macroeconomic management. Since 2002, the Bank of Uganda (BoU) has targeted reserve money with the aim to achieve an annual inflation rate below 5 percent. The main challenge facing the BOU is how to absorb the high aid inflows without jeopardizing its price objective and the competitiveness of the economy.

In order to conduct monetary policy the BoU relies on a combination of rule-based instruments and open market and open market type operations. Rule-based instruments include reserve requirements and standing facilities. Reserve requirements were already introduced in 1977 at a rate of 10 percent of total deposits. Currently reserve requirements stand at 9.5 percent for deposits of all maturities and are applied to foreign currency as well as local currency deposits. Commercial banks are required to hold an amount of reserves that on average over a two-week maintenance period exceed the required reserve ratio. The four-week moving average of deposits and vault cash is used to calculate required reserves, which are maintained with a two week lag. Deposits with the central

bank and cash in vaults are eligible to serve as reserve assets. The former are not remunerated.

There are two forms of standing facilities. The first is a rediscount facility whereby banks can transfer an unlimited amount treasury bills with a remaining maturity of 91 days or less to the central bank rate in return for an amount of liquidity discounted by the rediscount rate. The rediscount rate is equal to a moving average yield on 91 day treasury bills plus a policy margin. The maturity of the loan is equal to the remaining maturity of the treasury bills transferred to the central bank. The second facility is a Lombard type facility whereby commercial banks are allowed borrow up to 5 percent of required reserves for a period of up to 5 days at a rate equal to the rediscount rate with a 1 percent margin. Borrowers are required to post treasury bills with a maturity of 91 days or less as collateral.

The BoU uses open market and open market type operations extensively to manage the amount of liquidity in the economy. Altig, Christiano, Eichenbaum, and Lindé (2005) reports that these have reduced average liquidity growth during the last 5 years from more than 100 percent to about 14 percent. Approximately one third of the BOU's money market operations are conducted via the issuance of government securities in the primary market and, more recently, the use of repurchase agreements. As a result, the volume of outstanding government securities in Uganda has risen sharply and currently amounts to approximately 10 percent of GDP with the result that interest payments of government domestic

debt has risen to 1.5 percent of GDP. The remaining two thirds of money market operations is done through sale (or purchase) of foreign currency from the private sector. Over the last five years sales of foreign currency by the BoU have exceeded 3 percent of GDP per year on average.

## Appendix 5: Data Sources

Variable	Database	Code
Reserves (Commercial Banks)	IFS	Line 20
Demand Deposits	IFS	Line 24
Time, Savings and Foreign Currency Deposits	IFS	Line 25
Government Deposits	IFS	Line 26d
Claims on Private Sector	IFS	Line 22d
Claims on Government	IFS	Line 22a
Claims on Non-financial Public Enterprises	IFS	Line 22c
Lending Rate	IFS	Line 60p
Discount Rate	IFS	Line 60
Nominal Effective Exchange Rate	INS	Line ENEER
Consumer Prices	IFS	Line 64
Gross Domestic Product (Current Prices)	WEO	Line NGDP
Gross Domestic Product (Constant Prices)	WEO	Line NGDP_R
Reserve Money (M0)	IFS	Line 14
Currency Outside Banks	IFS	Line 14a
Value of Oil Exports	WEO	Line TXGO
Price Deflator for Oil Exports	WEO	Line TXGO_D
Official Development Assistance and Official Aid	WDI	Line DTODAALLDCD
National Currency per US Dollar Exchange Rate	IFS	Line ae

Note: For the calculations of statutory excess reserves, additional data from the authorities or from the IMF desks is sometimes used if needed. Data from the WEO and WDI are only available on an annual basis and are therefore interpolated using the procedure discussed in footnote 25.

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