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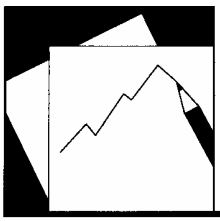

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Excess Liquidity and Effectiveness of Monetary Policy: Evidence from Sub-Saharan Africa

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

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Abstract

This paper examines the pattern of excess liquidity in sub-Saharan Africa and its consequences for the effectiveness of monetary policy. The paper argues that understanding the consequences of excess liquidity requires quantifying the extent to which commercial bank holdings of excess liquidity exceed levels required for precautionary purposes. It proposes a methodology for measuring this quantity and uses it to estimate a nonlinear structural VAR model for the CEMAC region, Nigeria and Uganda. The study suggests that excess liquidity weakens the monetary policy transmission mechanism and thus the ability of monetary authorities to influence demand conditions in the economy.

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I. INTRODUCTION

Over the last decade, African economies have made significant progress in improving their frameworks 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 a year on average, between 1997 and 2004 as a result of large capital inflows, particularly owing 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 particular, the assets of many commercial banks in the region include nonremunerated liquid assets at levels that significantly exceed statutory requirements. There is a fear that if there is a sudden improvement in demand conditions, banks will expand lending with possible adverse consequences for inflation.[2]

Going 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 bank liquidity, it becomes difficult to regulate the money supply using the required reserve ratio and the money multiplier, so that the use of monetary policy for stabilization purposes is undermined. In other words, one would expect excess bank liquidity to weaken the monetary policy transmission mechanism.

Despite the concerns expressed about the impact of excess bank 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 bank liquidity is excessive. The aim of this paper is to carry out such an analysis for the Central African Economic and Monetary Community (CEMAC), Nigeria, and Uganda. The approach we adopt can be divided into two stages. First, the paper estimates a model of excess bank liquidity which enables us to differentiate between excess bank liquidity held for precautionary purposes and reserve holdings in excess of that level. Second, 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

[2] These fears are not limited to Africa. The recent buildup 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).

mechanism switches between different regimes, depending on the amount of excess bank liquidity in the economy.

The remainder of this paper is organized as follows: Section II discusses some stylized facts about excess bank liquidity in the region where excess bank liquidity, or excess reserves, is defined as the holdings of liquid assets above the statutory level (statutory excess reserves). Section III, argues 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 for the effectiveness of monetary and fiscal policy and for efforts to improve the efficiency of the financial sector. Extending the model by Agénor, Aizenman, and Hoffmaister this paper proposes a framework for how such a decomposition of excess liquidity can be achieved. Section IV briefly outlines the econometric methodology and presents the estimates of the monetary policy transmission mechanism for the three case studies. Section V summarizes the study's main findings and discusses policy implications.

II. Some Stylized Facts on Reserve Requirements and Excess Liquidity in African Countries

With a few notable exceptions, time-series data on reserve requirement ratios in SSA countries are not readily available.[3] One of the main contributions of this project has been the creation of a database of reserve requirements covering all 44 SSA countries that fall within the responsibility of the African Department of the International Monetary Fund (IMF), using data provided by the authorities and IMF staff. For the majority of countries, data are available on a quarterly basis from 1990: Q1 to 2004: Q4 and include 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.[4] The data on required reserve ratios are used to calculate statutory excess reserves using data on commercial bank reserves and deposits from the IMF's International Financial Statistics (IFS) database.

Figure 1 shows the effective reserve ratio for all countries in the sample at the end of 2004, 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.[5] In the majority of

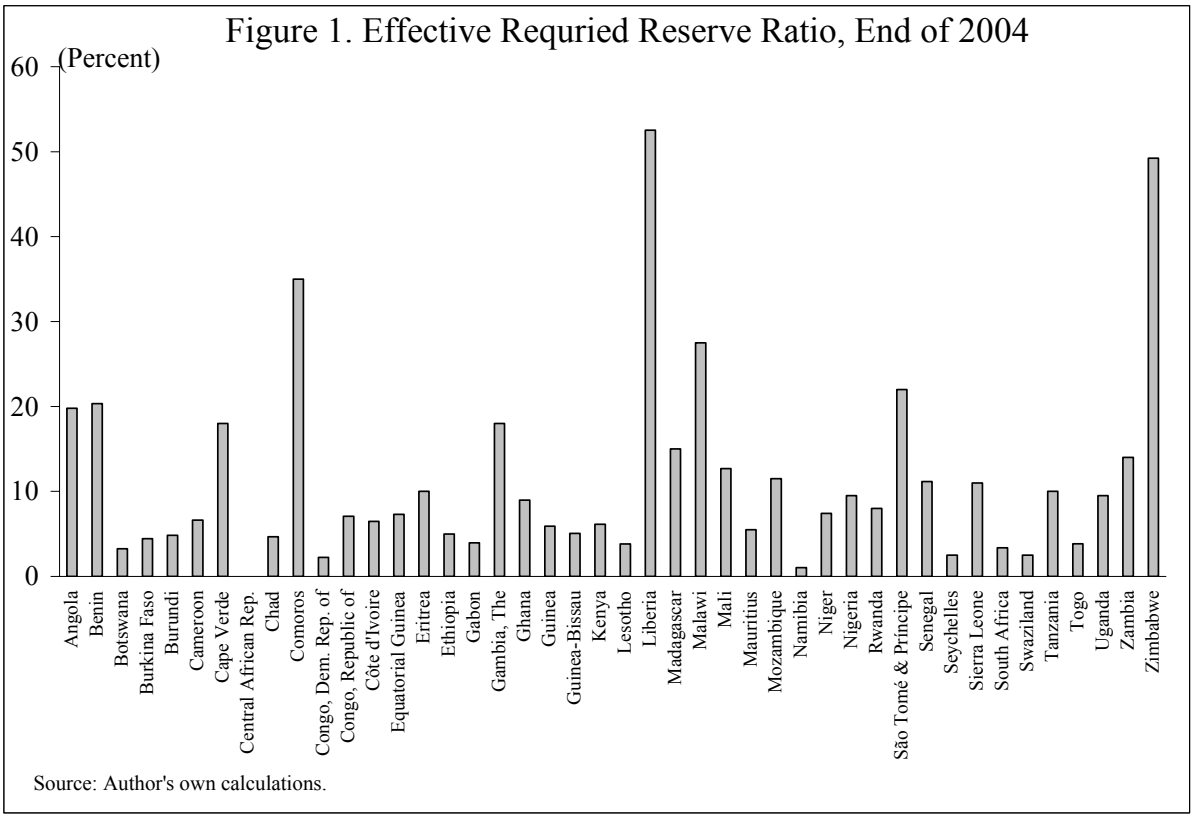
[3] The Central Bank of West African States (BCEAO) and the Bank of Central African States (BEAC) publish current and historical data on reserve requirements.

[4] For the last available observation. For some countries, these data are taken from Kovanen (2002).

[5] 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.

countries, the reserve ratio is currently just below 10 percent with a median of 7 percent although the variation is high, from a low of 0 percent in the Central African Republic to around 50 percent in Liberia and Zimbabwe. The average across all countries in the sample is 11.3 percent with a coefficient of variation of 1. 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.[6]

Figure 1. Effective Requried Reserve Ratio, End of 2004



Source: Author's own calculations.

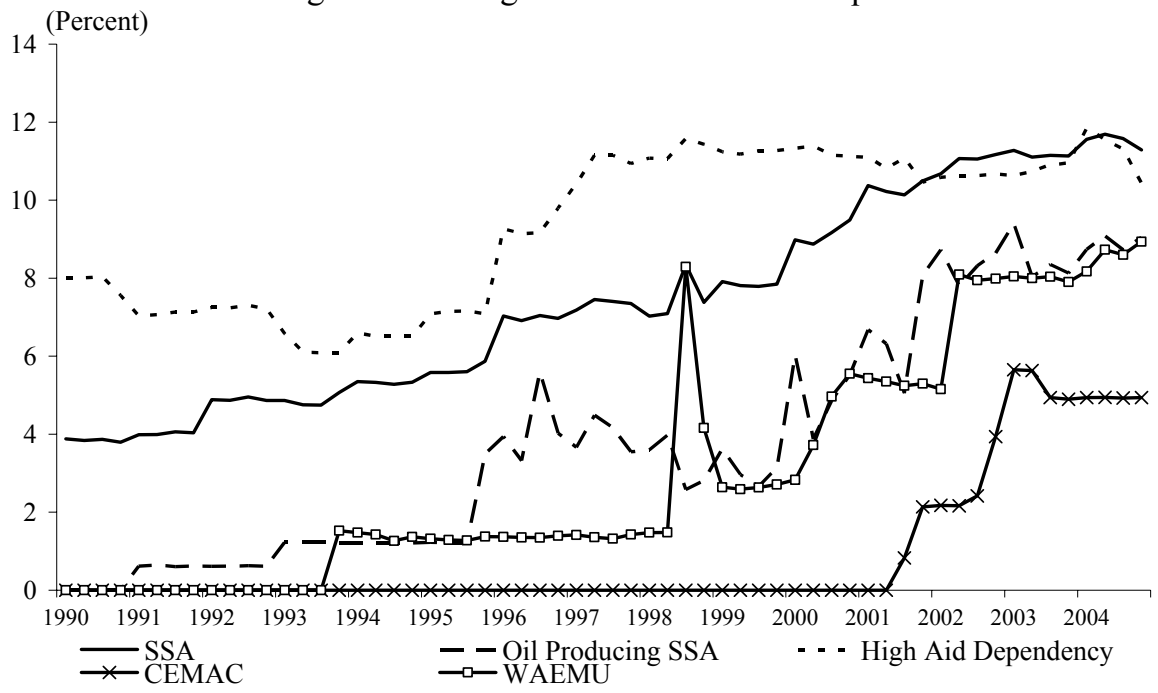
Figure 2 suggests that, on average, reserve requirements have been increasing over time in SSA countries.[7] This is true for oil producing and non-oil producing countries, as well as

[6] 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.

[7] 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.

countries that are highly dependent on aid.[8] The increase in reserve requirements over the sample period has been particularly pronounced in the group of oil producing countries, mainly due to the introduction of a reserve requirement in the CEMAC region in 2001 which has been rapidly increased. The group of countries that are classified as highly dependent on aid raised reserve ratios rapidly in the mid-nineties and has maintained a high reserve requirement ratio since.

Figure 2. Average Effective Reserve Requirement



Source: Author's own calculations.
Note: WAEMU denotes the West African Economic and Monetary Union.

The secular increase in the average reserve requirement in the region is in contrast with the tendency to reduce reserve requirements in most member countries of the Organization for Economic Cooperation and Development (OECD), such as the United States.[9] 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

[8] 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 I for the classification of countries.

[9] 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.

instruments such as interest rate controls. Second, the increasing concern with maintaining the stability of financial system is likely to have caused increases in the required reserve ratio for prudential reasons.[10] Thirdly, it reflects the development of a modern fractional reserve banking system in SSA countries and liberalization of financial markets during the 1990s.[11] Finally, there is little doubt that the increasing capital inflows from aid and oil revenue, coupled with government absorption constraints, has forced central banks to increase reserve requirements in order to try and prevent the build-up of inflationary pressure.[12]

During the period of our sample average reserve requirements in the CEMAC and West African Economic and Monetary Union (WAEMU) regions have tended to be below the average in the rest of the region.[13] Moreover, reserve requirements in these two monetary unions were introduced at a later stage than reserve requirements in the majority of other countries in SSA. Part of the explanation for this trend is probably the low rates of inflation in the CEMAC and WAEMU regions relative to the regional average, which have reduced the pressure on the authorities to constrain the growth of monetary aggregates by increasing reserve requirements.[14]

With the exception of a few countries in SSA, required reserves in the form of deposits with the central bank are not remunerated.[15] 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. As a result, the deposit of required reserves with the central bank imposes a significant burden on the balance sheet of commercial banks, particularly in countries where reserve requirements are high. Moreover, as figure 2 shows, the rise in reserve requirement ratios implies that the burden on banks has been steadily increasing with potential adverse effects on the viability of banks. Finally, as IMF (1996, 2005a) notes, the high spread between market interest rates and required reserve remuneration rates creates the potential for market distortions and inefficient allocation of resources. In particular, the

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[10] To the extent that required reserves can be held on an average basis, they serve as a prudential tool to safeguard liquidity. Reserve requirement systems, including in SSA, have increasingly moved to allowing averaging.

[11] I am grateful to Arto Kovanen for this last point.

[12] Chris Geiregat noted that 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 while reserve requirements on both demand and time and savings deposits have been rising, on average.

[13] The exception occurred towards the end of 1998 when reserve requirements in five WAEMU countries were briefly raised from 1.5 percent to 9 percent before being reduced to 3 percent later that year or early in 1999.

[14] Between 1990 and 2004, annual CPI inflation in the WAEMU and CEMAC regions averaged less than 5 percent relative to nearly 25 percent in the SSA region as a whole.

[15] In countries where reserves are remunerated the rates of remuneration are typically very low. See appendix 2.

implicit tax on commercial banks and consumers creates an incentive for borrowers and depositors to bypass the depository system and for banks to develop new products instead of reservable liabilities.[16]

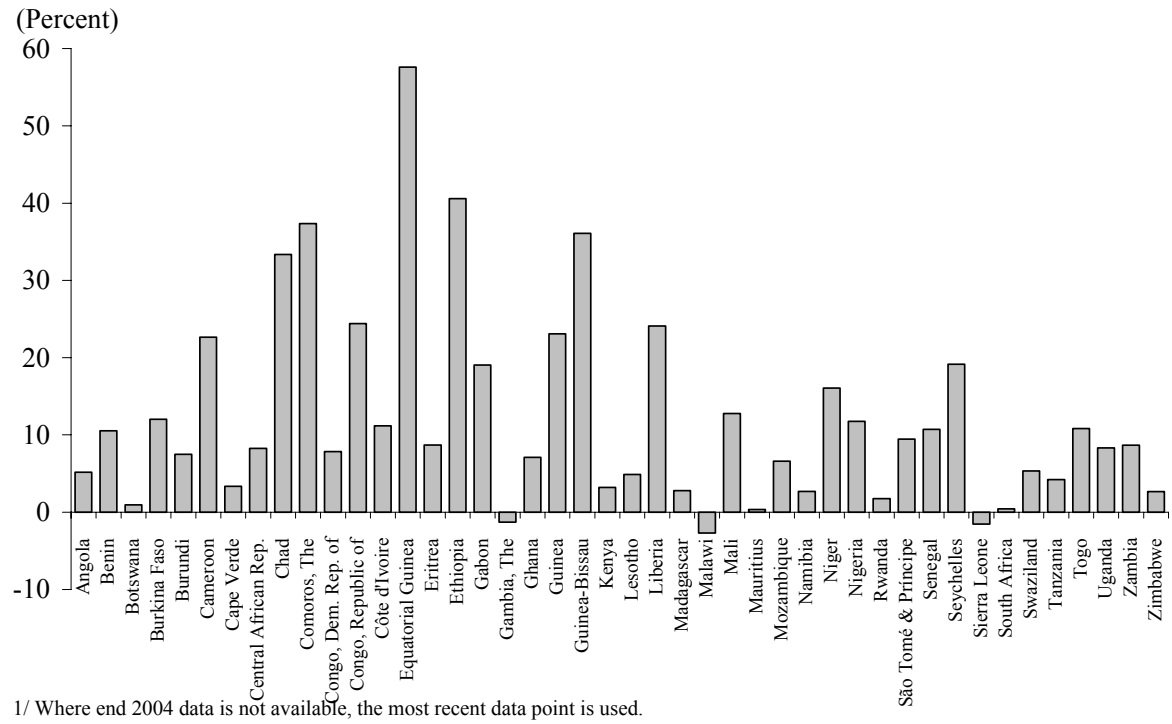
Using the data on reserve requirement ratios, we calculate excess reserves as commercial banks' holdings of cash and deposits at the central bank in excess of statutory requirements.[17] Figure 3 shows the level of excess reserves as a percentage of total deposits (demand deposits and time, savings and foreign currency deposits) for each country in our sample at the end of 2004. 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.[18]

[16] IMF (2005) also points out, however, that remuneration rates on reserves deposited with the central bank should be lower than the cost of borrowing from the central bank at the discount window in order to encourage banks to trade with each other in the interbank market.

[17] We do not consider the impact of liquid asset requirements in this paper.

[18] 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.

Figure 3. Ratio of Excess Reserves to Total Deposits, End of 2004[1]



1/ Where end 2004 data is not available, the most recent data point is used.
Source: Author's own calculations.

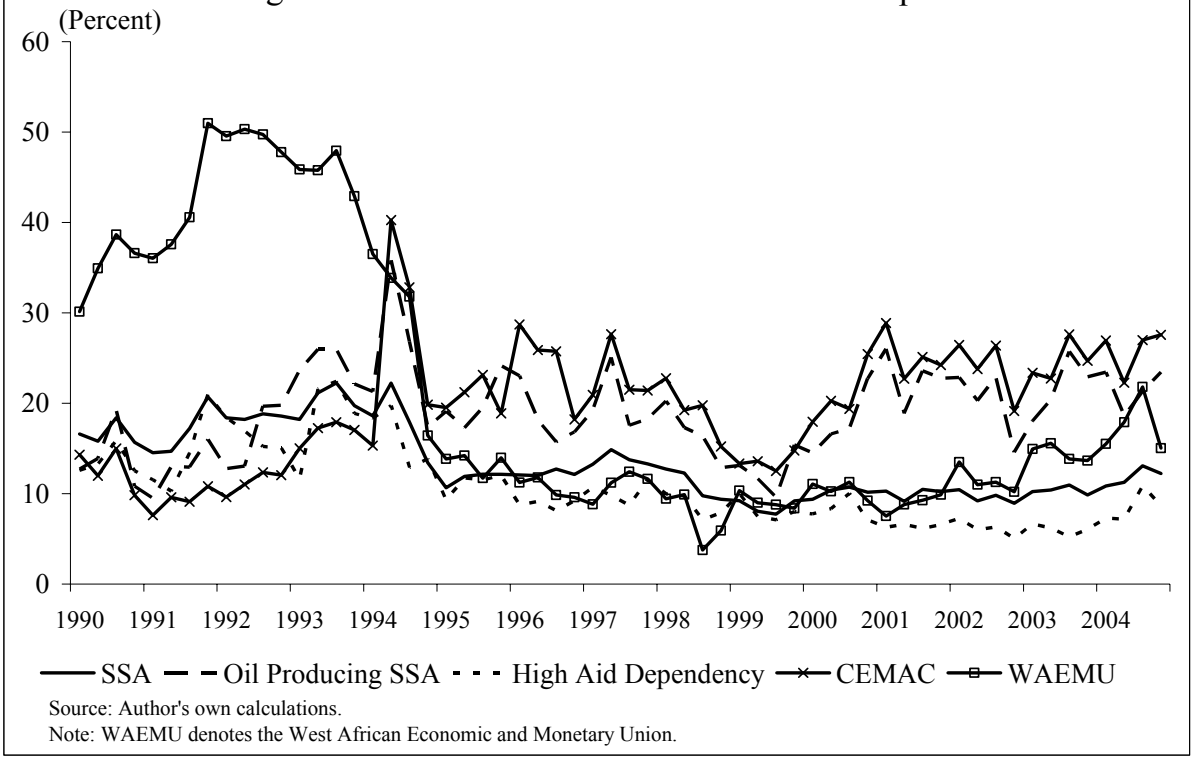
The different characteristics of these countries are an illustration of the fact that it is difficult to identify a single cause behind the build-up of excess liquidity. In Equatorial Guinea and Chad, for example, the oil sector contributed 21.4 and 40.2 percent, respectively, of the overall growth in real GDP in 2004. The associated revenues and transfers from oil companies, accompanied by limited opportunities for lending, have caused excess reserves to balloon. In Ethiopia and Guinea-Bissau, on the other hand, rapidly rising aid inflows has been one of the factors that is likely to have contributed to the rise in excess reserves.

As we will argue later, however, persistent high levels of excess liquidity can only be explained by the existence of underdeveloped financial markets such as lack of competition in the banking sector, asymmetric information, or an underdeveloped interbank market and market for government securities. In Ethiopia, for example, the commercial banking sector is dominated by a single state-owned bank that accounts for 75 percent of total bank assets and 73 percent of all deposits (Gilmour, 2005). Similarly, in Guinea-Bissau, there is only one bank in operation after the closure of two other banks during the recent civil war (IMF, 2004). In the CEMAC region, Equatorial Guinea and Chad, on the other hand, 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.

Figure 4 shows the evolution of statutory 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, especially

in the WAEMU region. 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 CEMAC region have also tended to be relatively high. More surprising, however, is the fact that excess reserves in the WAEMU region were extremely high, relative to the average, before the devaluation of the CFA franc in 1994 and have once again risen above the regional average during the last few years.

Figure 4. Ratio of Excess Reserves to Total Deposits



Source: Author's own calculations.
Note: WAEMU denotes the West African Economic and Monetary Union.

There is no evidence that countries that are highly dependent on aid have higher ratios of excess reserves to deposits than other countries in the region. 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. In addition, the successful completion of numerous donor funded projects in these countries suggests that absorption constraints that are likely to cause a build-up of government deposits and excess reserves following large aid inflows are not as important in these countries.

Figure 4 clearly shows that the depreciation of the CFA franc had an impact on excess liquidity in both the CEMAC and WAEMU regions. In the CEMAC region, the data suggest

that the main effect was nearly a three-fold increase in the local currency value of commercial banks' reserves, suggesting that banks held a significant portion of their reserves in foreign currency.[19] This is corroborated by Clément et al. (1996) who report evidence which suggest that net foreign assets of the banking system improved dramatically, to the extent that CEMAC moved from a net debtor to a net creditor position. After a few months, bank reserves gradually fell as banks diverted their excess reserves to more attractive investments. In the WAEMU region, however, the depreciation of the CFA franc coincided with a dramatic fall in excess reserves. Preliminary evidence suggests that this is not directly linked to the depreciation. Instead, the decline in excess liquidity from values as high as 50 percent of total deposits coincided with the introduction of reserve requirements in the WAEMU region in October of the same year, and a large sterilization operation by the regional central bank in July 1994 aimed at mopping up the excess liquidity in the system.

III. Measurement of Excess Liquidity

A. Sources and Uses of 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 buildup of holdings of nonremunerated 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. Finally, 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.[20]

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[19] The type of assets that are eligible to satisfy reserve requirements differ across countries. For further details, see Kovanen (2002).

[20] I am grateful to Marc Quintyn for this comment.

However, not all excess liquidity may be voluntary. Some authors, for example Dollar and Hallward-Driemeier (2000) 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 buildup 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.[21]

Is it possible for involuntary excess liquidity to prevail in equilibrium rather than just being a temporary deviation away from the optimal structure of commercial banks' balance sheets? If commercial banks hold more liquidity than they require, why do they not expand lending or buy government securities? One possible explanation may be that these economies are in a liquidity trap.[22] 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.[23] 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 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.

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[21] Robert Ritz suggested that 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.

[22] This section relies heavily on O'Connell (2005).

[23] 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.

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 is 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 nonbank 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 underdeveloped.[24] 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 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

[24] In the CEMAC region, Equatorial Guinea and Chad, neither member governments nor the central bank issues marketable bonds. This 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.

> 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.

B. 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 liquidity 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, if banks hold excess reserves only for precautionary purposes, then one would still expect monetary policy to be effective. A loosening of monetary policy, for example by lowering the reserve requirement, 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.[25]

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:

> "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

[25] 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.

> asset demands and then to economic activity, is altered and possibly interrupted completely." (O'Connell, 2005, p. 4)

Clearly, 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.[26]

Box 1. Monetary Policy Implementation in CEMAC Region

In 1989, six Central African countries formed a monetary union, with the Bank of Central African States (BEAC) as the regional central bank. The common currency, the CFA franc, is pegged to the euro. The primary objective of BEAC is to maintain the fixed exchange rate regime. Less than complete capital mobility and high transactions costs nevertheless allow BEAC to target a low and stable inflation rate. The attainment of this objective is complicated by the differences between the economies of the CEMAC region, in particular in relation to their dependence on oil exports. Common monetary policy is further exacerbated by limited labor and capital mobility between countries.

The conduct of monetary policy is principally carried out by varying the amount and rate at which commercial banks are allowed to borrow at the discount window (*la politique de refinancement*). If required, the BEAC withdraws liquidity from the system by using *negative bids* whereby commercial banks are offered a certain interest rate for the placement of their free reserves at the central bank. In addition, the central bank sets a floor for lending rates and a ceiling for deposit rates above and below which interest rates are negotiated freely. Interest rates have recently been lowered in order to reduce the interest differential between the euro zone and the CEMAC region and thus discourage capital inflows.

In September 2001, BEAC decided to impose minimum reserve requirements on commercial banks in the region in order to contain the rise in liquidity in the region. The level of required reserves is calculated based on the level of deposits on the 10^{th}, 20^{th}, and 30^{th} (or 31^{st}) of each month and commercial banks are required to satisfy the requirement on these same dates. Because of the different economic conditions in the CEMAC economies, BEAC decided in July 2004 to introduce differentiated reserve requirements across countries with a higher reserve ratio in Cameroon, the Republic of Congo, and Equatorial Guinea than in Chad, Gabon, and the Central African Republic (CAR). Reserve requirements in the CAR were temporarily suspended in May 2003 in response to the difficult economic situation in the country. Commercial banks receive remuneration on their required reserves at a rate which is currently fixed at 0.4 percent.

[26] The policy implications of precautionary and involuntary excess liquidity will be discussed in more detail in the conclusion to this paper.

C. Econometric Specification

This paper proposes 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 the CEMAC region, Nigeria, and Uganda.[27] Agénor, Aizenman, and Hoffmaister'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:

$$\boldsymbol{\alpha}_1(L)EL_t = \boldsymbol{\alpha}_2(L)\boldsymbol{X}_t^1 + \boldsymbol{\alpha}_3(L)\boldsymbol{X}_t^2 + \nu_t \qquad (1)$$

where EL_t is the ratio of statutory excess reserves to total deposits and $\boldsymbol{X^1}$ and $\boldsymbol{X^2}$ are vectors of variables that explain, respectively, the precautionary motive for holding excess reserves and the involuntary build-up of excess reserves. ν_t is a well-behaved error term and $\boldsymbol{\alpha_j(L)}$ are vectors of lag polynomials defined as:

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$$\begin{aligned} &\boldsymbol{\alpha}_1(L) = 1 - \boldsymbol{\alpha}_{11}L, \\ &\boldsymbol{\alpha}_j(L) = \boldsymbol{\alpha}_{j0} + \boldsymbol{\alpha}_{j1}L,\ j \geq 2 \end{aligned} \qquad (2)$$

[27] 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 form a broader understanding of the causes and consequences of excess liquidity. The characteristics of the monetary policy regime in these three countries are outlined briefly in http://www-int.imf.org/depts/afr/polres/pwupdates.htm Boxes 1 – 3.

Box 2. Monetary Policy Implementation in 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 commercial banks are only required to report their asset positions to the central bank twice a month. 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 considerations. 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.

Box 3. Monetary Policy Implementation in Uganda[1]

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. Allum (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.

[1]This section relies on IMF (2005a, 2005b, and 2001) and Allum (2005).

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:

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

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

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 averages of the 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 averages of the 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.[28] 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 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.[29]

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.[30] The set of variables in the vector $\boldsymbol{X^1}$ 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.[31] VOL_Y and VOL_{CD} account for the

[28] The output gap is constructed as the percentage deviation of output away from a quadratic trend.

[29] This set of variables needs to be adapted if it is to be used for conducting a similar analysis for other countries.

[30] 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.

[31] 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

(continued…)

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.[32] 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 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 $\boldsymbol{X}^2$ 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.[33] 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 increase 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

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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.

[32] 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.

[33] I am grateful to Marc Quintyn for this point.

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.[34] 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 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.[35] 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, IMF (2005f) reports that in the case of Equatorial Guinea large oil inflows have been associated with increases in excess liquidity. Hence, one would expect that countries where aid inflows are important will tend to have higher excess liquidity. Cursory evidence for the latter is provided in figure 4 where it was shown 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. Thus we would expect *AID, OIL* and *POIL* to be positively correlated with excess liquidity.

D. Results

Table 1 presents the summary of the estimation results for the CEMAC region, Nigeria and Uganda based on quarterly data from the IMF's International Financial Statistics (IFS).[36] 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 or negative in some cases for part of

[34]This is the case for example in the CEMAC region and has been the case at times in Nigeria.

[35] For a comprehensive discussion of this issue see IMF (2005e).

[36] 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 3 for further information on data sources.

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, the *BOND* variable is not included in the estimation for the CEMAC region due to the lack of bond markets in this group of countries. Similarly, we exclude the oil-price and the oil to GDP ratio from the model for 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.[37] 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 includes 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.

[37] See inter alia Hendry (1995) for details.

For the CEMAC region the results suggest that holdings of precautionary reserves can be explained by the volatility of private sector and government deposits. An increase in the volatility of private sector deposits increases commercial banks' holdings of excess liquidity as banks act to insure themselves against shortfalls in liquidity. Surprisingly, however, increasing volatility of government deposits appears to lower excess liquidity. This result proved to be remarkably robust across different specifications and to changes in the sample period. Not only is this counterintuitive, but also contrary to statements made by officials at the regional central bank regarding the cause for the increase in excess reserves in the CEMAC region. Neither is there any indication that changes in the maturity structure of commercial banks' loan portfolios have any significant effect on excess reserves despite statements to this effect by BEAC officials. This finding was robust to changes in the specification. There is no significant effect from changes in the reserve requirement. This is not surprising given that reserve requirements were only introduced in the CEMAC region in 2001.

Table 1. Determination of Statutory Excess Liquidity

	CEMAC	Nigeria	Uganda
Sample Period	1992Q3–2003Q4	1992Q1–2003Q4	1993Q–12003Q4
Variables Explaining Precautionary Excess Reserves (X^1)			
Constant	-0.062 (0.072)	-0.174 (0.071)	0.257 (0.028)
EL {-0}	0.575 (0.099)	0.644 (0.091)	-
RR	-	-1.750 (0.405)	-
VOL_Y	-	-	-2.190 (0.257)
VOL_{CD}	-	0.570 (0.229)	-
VOL_{PS}	0.373 (0.105)	-	-
VOL_{GOV}	-0.103 (0.043)	-	0.113 (0.020)
PORT	-	0.228 (0.086)	0.024 (0.013)
Y	-	-	-
r_D	-	-	-
Variables Explaining Involuntary Excess Reserves (X^2)			
DEP_{PS}	0.860 (0.507)	-	-
DEP_G	2.145 (0.868)	1.993 (1.139)	1.747 (0.694)
$CRED_{PS}$	-0.584 (0.255)	-	-3.295 (0.425)
$CRED_G$	-2.160 (0.693)	-2.111 (0.521)	-0.357 (0.118)
BOND	n.a.	-	-
AID	0.732 (0.300)	-	-
OIL	-		n.a.
POIL	-	-	n.a.
r_L	0.005 (0.002)	0.007 (0.002)	-
AR(1-4)	F(1,34) = 0.372 [0.546]	F(1,39) = 0.178 [0.675]	F(1,34) = 0.001 [0.973]
Heteroskedasticity	F(20,14) = 0.146 [0.999]	F(18,21) = 0.898 [0.587]	F(16,18) = 0.697 [0.763]
Normality	$\chi^2(2)$ = 0.723 [0.697]	$\chi^2(2)$ = 0.331 [0.847]	$\chi^2(2)$ = 0.549 [0.760]
Sargan Test	$\chi^2(2)$ = 26.168 [0.345]	$\chi^2(2)$ = 29.505 [0.337]	

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 and the corresponding *p*-values.

Holdings of involuntary reserves in the CEMAC region appear to largely reflect movements in commercial banks' assets and liabilities. In particular, increases in private sector and government deposits both appear to increase excess reserves whereas increases in credit to the private sector and the public sector lower excess liquidity. There is a significant positive effect on excess liquidity from increases in the aid to GDP ratio, suggesting that there may have been problems in absorption capacity. Surprisingly, however, there is no direct effect from changes in the oil price despite the importance of oil revenues in these countries. The reason for this appears to be the inclusion of government deposits. Once government deposits are excluded from the model, the oil price becomes significant with the expected sign on the coefficient and only a slight deterioration in the performance of the model. This suggests that oil revenues only lead to a build-up of excess reserves to the extent that the economy is unable to absorb these revenues and they are deposited in the banking system.

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 et al. (2004). The importance of the required reserve ratio in Nigeria for the demand for excess reserves, relative to our results for the CEMAC region, can be explained by the fact that Nigeria has had a reserve ratio over the course of the whole sample. Moreover, 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 the CEMAC region, 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. 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. 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 the CEMAC region we also find a significant effect from lending to the private sector.

E. Precautionary and Involuntary Excess Reserves

One of the aims of this paper is to propose a methodology that goes someway 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:

$$\begin{aligned} EL_t^P &= a\hat{c} + \hat{\alpha}_1^p EL_{t-1}^P + \hat{\boldsymbol{\alpha}}_2(L)\boldsymbol{X}_t^1 \\ EL_t^I &= (1-a)\hat{c} + \hat{\alpha}_1^I EL_{t-1}^I + \hat{\boldsymbol{\alpha}}_3(L)\boldsymbol{X}_t^2 \end{aligned} \tag{3}$$

where $\hat{c}$, $\hat{\alpha}_1$, $\hat{\boldsymbol{\alpha}}_2$, and $\hat{\boldsymbol{\alpha}}_3$ 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 is a dynamic forecast of EL^p and EL^I and for each period, the sum of EL^p and EL^I equals the dynamic forecast of *EL*.[38]

A number of observations need to be made about this methodology. Firstly, it is clearly sensitive to the vectors of explanatory variables $\boldsymbol{X^1}$ and $\boldsymbol{X^2}$. 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.[39] 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.

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[38] Thus we are decomposing the fitted values from our estimation, setting the residual term in equation 3.1 to zero.

[39] 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*.

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.[40]

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 $\hat{\alpha}_1^P EL_t^P + \hat{\alpha}_1^I EL_t^I = \hat{\alpha}_1 \left(EL_t^P + EL_t^I \right)$ is feasible. However, only when $\hat{\alpha}_1^P = \hat{\alpha}_1^I = \hat{\alpha}_1$ are the autoregressive parameters α_1^P and α_1^I constant. This is the assumption we maintain in our analysis.

For *illustrative* purposes, Figures 5, 6 and 7 plot the level of total (explained) excess liquidity together with voluntary and involuntary excess liquidity in the CEMAC region, Nigeria, and Uganda. Note, however, that the problem in identifying the level also implies that 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 both precautionary and involuntary excess reserves, although this is not always possible.

Referring to Figures 5–7, our results suggest that in the CEMAC region, the rise in excess liquidity during the course of our sample is explained by an increase in involuntary excess liquidity. Holdings of excess liquidity for precautionary purposes – voluntary excess liquidity – has remained relatively constant over the sample, with the exception of a rise in the demand for excess liquidity in the period surrounding the devaluation of the CFA franc.

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 where 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.

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[40] 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.

IV. Excess Bank Liquidity and Monetary Policy Transmission Mechanism

The analysis in the previous section suggests that in periods of our sample, commercial banks in the CEMAC region, 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 to 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).

Figure 5. CEMAC: Voluntary and Involuntary Excess Liquidity

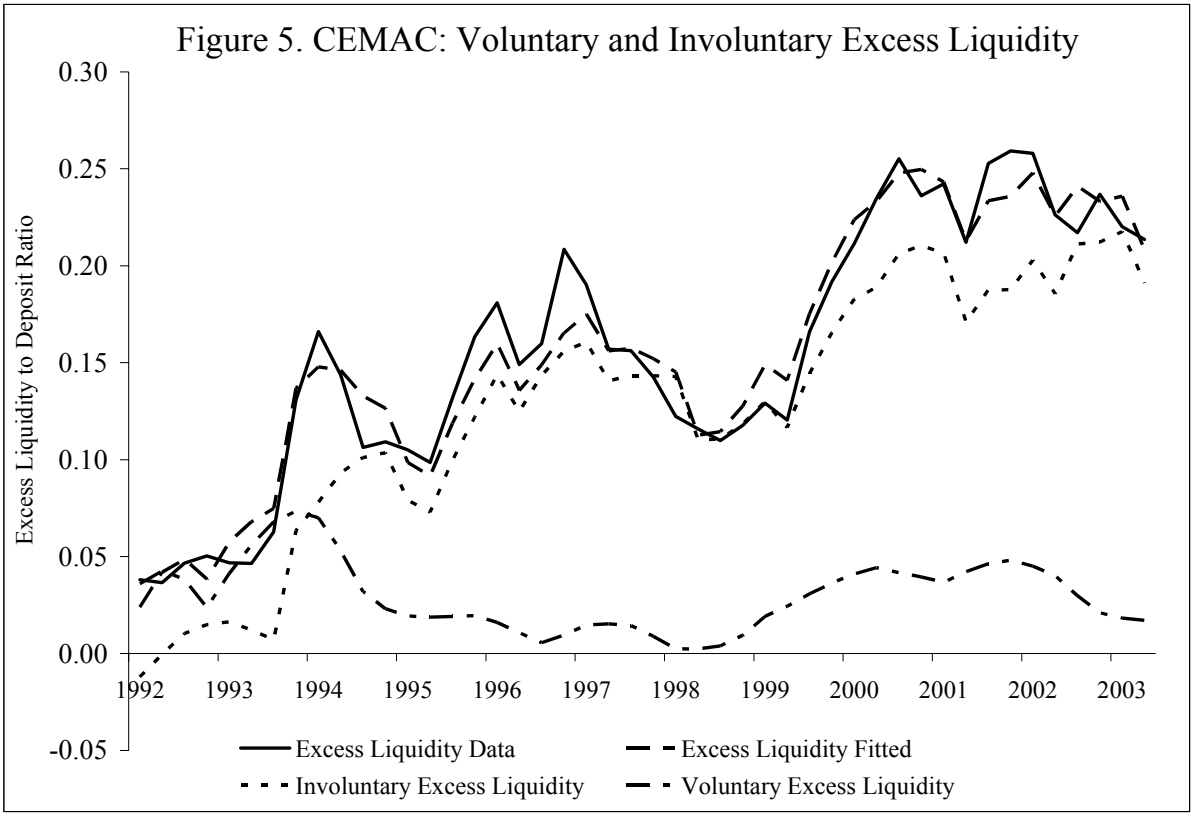


Figure 6. Nigeria: Voluntary and Involutnary Excess Liquidity

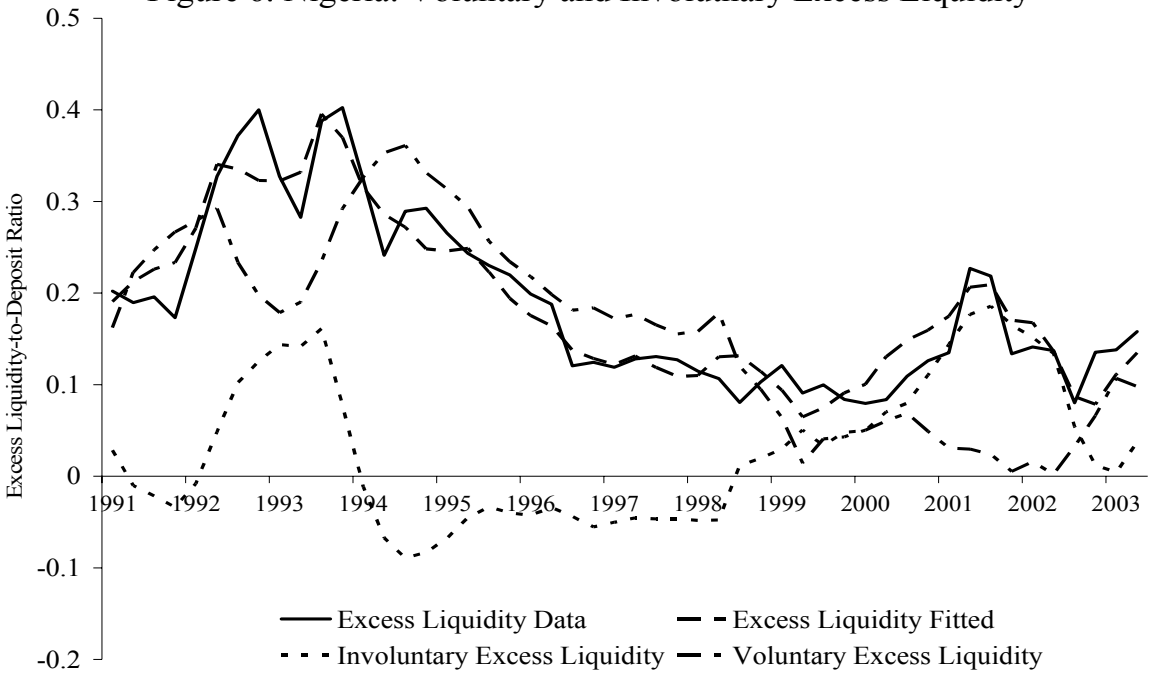
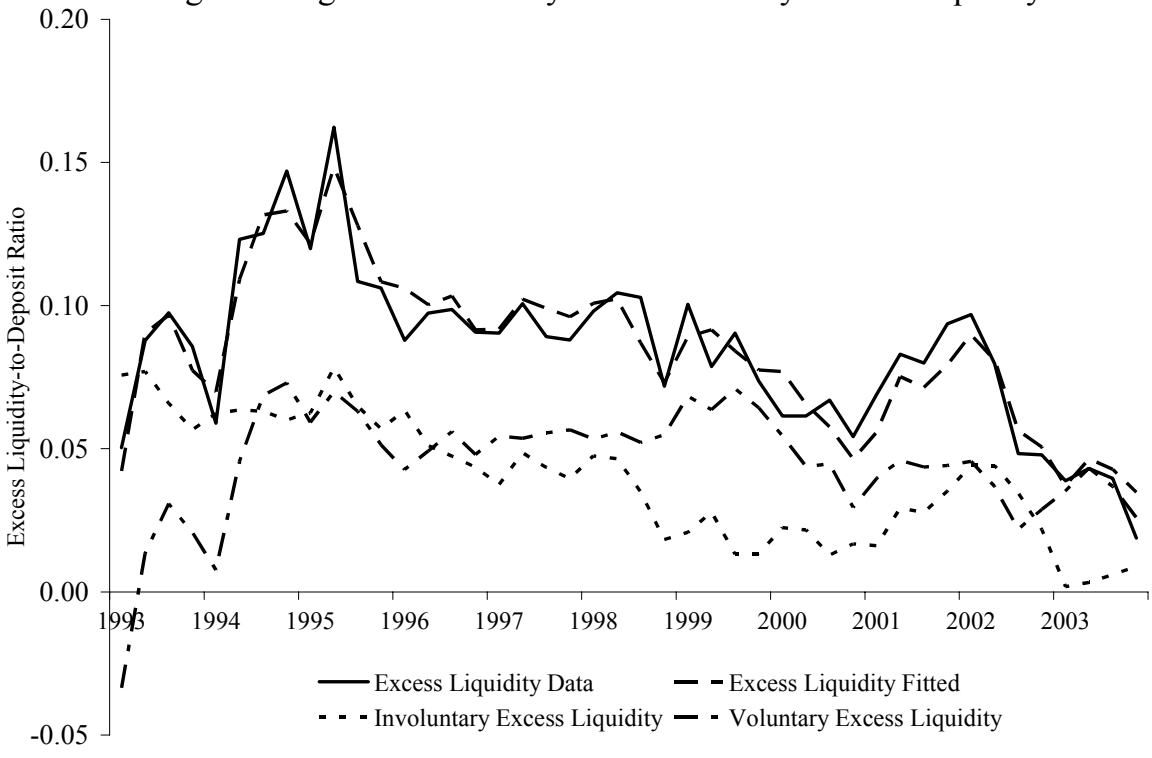


Figure 7. Uganda: Voluntary and Involuntary Excess Liquidity



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 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, 1990). Potter (1995) uses a univariate TAR model to analyze GNP growth in the United States. Atanasova (2003), Balke (2000), and Calza and Soussa (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 the CEMAC region, Nigeria, and Uganda.

A. Econometric Methodology

Consider the following benchmark reduced form two-regime TVAR:

$$\begin{pmatrix} \boldsymbol{Y}_t \\ \boldsymbol{M}_t \end{pmatrix} = \boldsymbol{C}_i(L)\begin{pmatrix} \boldsymbol{Y}_{t-1} \\ \boldsymbol{M}_{t-1} \end{pmatrix} + \begin{pmatrix} \boldsymbol{v}_{it}^{Y} \\ \boldsymbol{v}_{it}^{M} \end{pmatrix} \text{ for } i = 1,2 \qquad (4)$$
$$i = 1 \text{ if } EL_t^I \le \tau,\ i = 2 \text{ if } EL_t^I > \tau$$

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

We follow Bernanke and Mihov (1995) and divide the variables into a non-policy block $\boldsymbol{Y}_t$ and a policy block $\boldsymbol{M}_t$ under the control of the monetary policy authorities.[41] The vector of variables in the non-policy block consists of real GDP and inflation, 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.[42] 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 the CEMAC region we include the first lag of the oil price and the first lag of the aid 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.[43] 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 seasonal dummies.

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; 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 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. Given the underdeveloped nature of financial markets in SSA, this is unlikely to be a significant problem in our analysis.

In our analysis we restrict ourselves to a one lag TVAR for a number of reasons. Firstly, in the CEMAC region, we choose not to model the period prior to the 1994 devaluation which implies that we only have sufficient data for a one lag TVAR. In the case of 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

[41] The fixed exchange rate regime in the CEMAC region prevents the regional central bank from adjusting base money independently. In this case, a shock to base money reflects an unexpected change in monetary conditions in the euro area.

[42] In 2004, Nigeria was the eleventh largest oil producer in the world and the largest in Africa.

[43] We do not include the oil-price as an endogenous variable in the model for CEMAC given that the region is a relatively small oil producer and thus has little effect on the world price of oil.

Table 2. Information Criteria for Threshold Vector Autoregressions

	CEMAC			Nigeria			Uganda		
Sample	1995:1–2003:4			1991:2–2003:4			1993:1–2003:4		
Lag	AIC	HQ	SC	AIC	HQ	SC	AIC	HQ	SC
1	-24.5885	-23.4073	-21.1667	-14.0258	**-12.5551**	**-10.1635**	-14.2250	-13.1874	**-11.4271**
2	n.a.	n.a.	n.a.	-13.4972	-11.4439	-8.1053	-15.1391	-13.6203	-11.0436
3	n.a.	n.a.	n.a.	**-14.8730**	-12.0916	-7.5691	**-16.4185**	**-14.4184**	-11.0253

Notes: The table reports the sample period and values for the Akaike Information Criterion (AIC), Hannan-Quinn Criterion (HQ) and Schwarz Criterion (SC) information criteria for the CEMAC region, Nigeria and Uganda. The preferred lag-length is highlighted in bold for each criterion. n.a. implies that there was insufficient data to estimate the VAR at the relevant lag-length.

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.[44] 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.[45] Table 2 presents the values of the information criteria for the CEMAC region, 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 τ which maximizes the conditional log-likelihood of the model. In particular, for any given τ, 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 τ is consistent.

B. 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 0.17082 in the CEMAC region, 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.

[44] I am grateful to Alejandro Justiniano for pointing this out.

[45] For the CEMAC region, 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 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*, τ is only identified under the alternative hypothesis. This leads to the presence of so-called nuisance parameters 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 (1998) that the distribution of the test can be approximated by a χ^2 distribution with $r+q$ degrees of freedom where q is the number of nuisance parameters.[46]

Table 3. Estimation Results

		CEMAC	Nigeria	Uganda
Estimated Threshold		0.17082	0.04825	0.05658
Regime Classification	Low	1995:2–2000:2	1991:3–1992:3 1994:3–1999:3 2000:1–2000:2 2003:2–2003:4	1996:2–2003:4
	High	2000:3–2003:4	1992:4–1994:2 1999:4–1999:4 2000:3–2003:1	1993:1–1996:1
LR Test		156.0790	159.8653	90.8709
p-values (adjusted χ^2)		[0.0000]	[0.0000]	[0.0000]

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

In the CEMAC region the estimated critical value for the threshold implies that the economy has gradually moved from a state of low involuntary excess liquidity in the late 1990s to high involuntary excess liquidity from 2000 onwards. In Nigeria on the other hand, 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. 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. Figure 8 plots involuntary excess liquidity for the CEMAC region, Nigeria and Uganda with the periods of high and low involuntary excess liquidity highlighted for illustrative purposes.

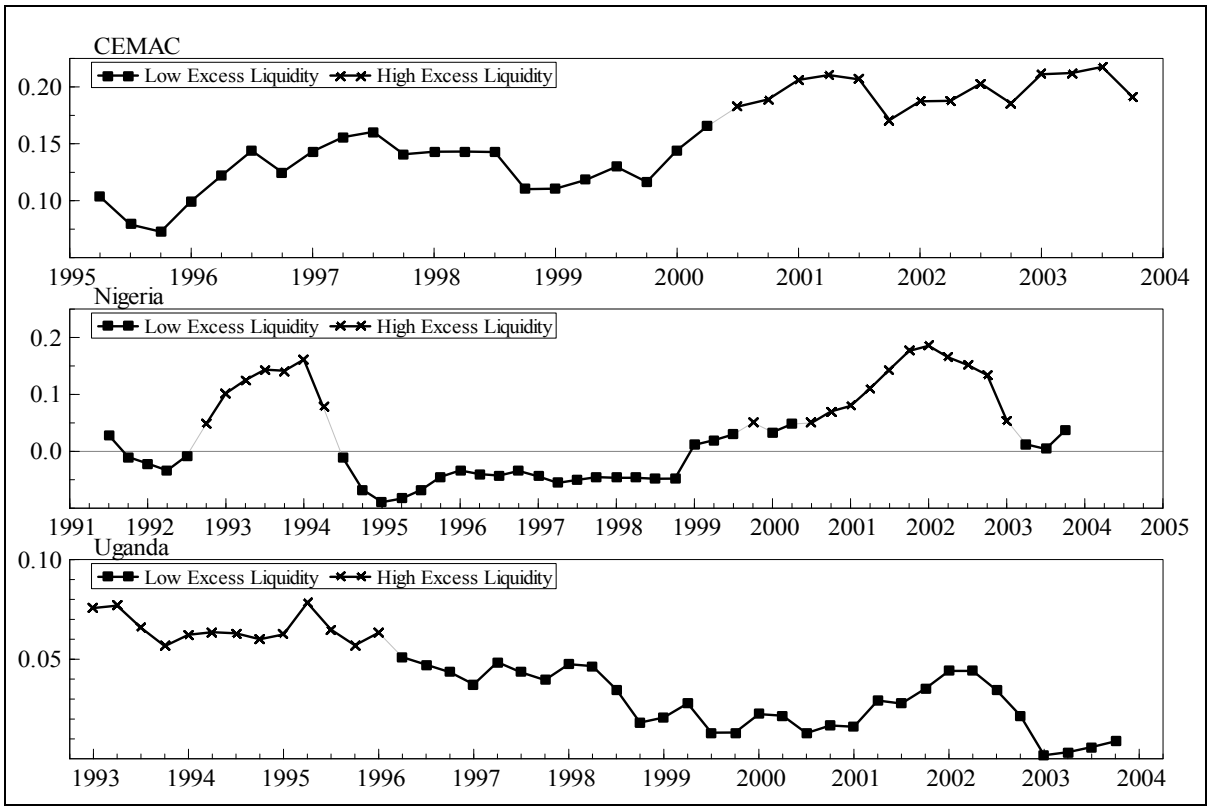
[46] Alejandro Justiniano pointed out that in our study the tests will be biased upwards because we ignore the added uncertainty involved in the procedure used to generate the threshold variable – involuntary excess liquidity.

C. 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.

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.

Figure 8. Estimated High and Low Levels of Involuntary Excess Liquidity



The reduced TVAR in equation (4) does not allow us to identify the impact of a monetary policy shock directly. This is because, as Christiano and Eichenbaum (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) 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 A that satisfies:

$$\boldsymbol{A}_i^{-1}\begin{pmatrix}\boldsymbol{Y}_t\\ \boldsymbol{M}_t\end{pmatrix}=\boldsymbol{A}_i^{-1}\boldsymbol{C}_i\left(L\right)\begin{pmatrix}\boldsymbol{Y}_{t-1}\\ \boldsymbol{M}_{t-1}\end{pmatrix}+\begin{pmatrix}\boldsymbol{u}_{it}^{Y}\\ \boldsymbol{u}_{it}^{M}\end{pmatrix}\text{ for } i=1,2 \tag{5}$$

or

$$\boldsymbol{A}_i^{-1}\begin{pmatrix}\boldsymbol{v}_{it}^{Y}\\ \boldsymbol{v}_{it}^{M}\end{pmatrix}=\begin{pmatrix}\boldsymbol{u}_{it}^{Y}\\ \boldsymbol{u}_{it}^{M}\end{pmatrix}\text{ for } i=1,2 \tag{6}$$

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

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 (6) can then be written as:

$$\begin{pmatrix} v_t^{GDP} \\ v_t^{P} \\ v_t^{Ex} \\ v_t^{M1} \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 \\ a_{31} & a_{32} & 1 & a_{34} \\ a_{41} & a_{42} & a_{43} & 1 \end{pmatrix} \begin{pmatrix} u_t^{GDP} \\ u_t^{P} \\ u_t^{Ex} \\ u_t^{M1} \end{pmatrix} \tag{7}$$

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_{34} equal to zero and freely estimating a_{34} does not substantially change the response of the variables to a shock to monetary policy.[47]

Figures 9–11 show the regime-dependent impulse response functions for the CEMAC region, Nigeria and Uganda following a one unit contractionary shock to the annual growth rate of M0. The figures also include the 95 percent standard error bands. 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 the CEMAC region 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

[47] 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 shortcoming.

three 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 much stronger in the CEMAC region than in Nigeria and Uganda. The relatively strong response of output in the CEMAC region suggests that the interest elasticity of money demand in the CEMAC region is lower than in Nigeria and Uganda. This is consistent with evidence presented by Fielding (1994) where the interest elasticity of money demand in Cameroon, one of the largest countries in the CEMAC region, is found to be significantly lower than in Nigeria, Ivory Coast and Kenya.[48]

It is worth comparing the magnitude of the response of inflation to a contraction in base money in our three case-studies with other studies. Savvides (1999) estimates the response of the differential between domestic and world inflation to domestic money growth for several SSA countries. He finds that among CFA countries, the sum of the coefficients on base money growth equals 0.09, whereas in Nigeria it equals 0.54. This is consistent with our finding that the response of inflation to a contractionary shock to monetary policy is much stronger in Nigeria than in the CEMAC region. Similarly IMF (2005c) reports results which suggest that in Uganda a one percent increase in M2 raises core inflation by 0.2 percent. Not withstanding the fact that we use a more narrow definition of the money supply and headline inflation, 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 Nigeria and Uganda an unexpected contraction in reserve money lowers inflation more when involuntary excess liquidity is low than when involuntary excess liquidity is high. Our results suggest that these differences are significant at the 95 percent level. This suggest that, consistent with our hypothesis, commercial banks are unresponsive to signals from the central bank when they hold involuntary excess reserves. Hence, the monetary policy transmission mechanism, and thus the ability of the central bank to influence demand conditions, is weakened.[49]

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[48] 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.

[49] Of course, the fact that the response of the economy differs across regimes does not necessarily imply that this is *only* because of changes in involuntary excess liquidity. Instead, it is possible, and likely, that the asymmetry in the response partly reflects other developments in the economy that affect the strength of the monetary policy transmission mechanism, such as the level of financial deepening. It would therefore be useful to try and find a method to check the robustness of the results. This is beyond the scope of this paper, however.

Figure 9. CEMAC. Response to a One-Unit Negative Shock to M0

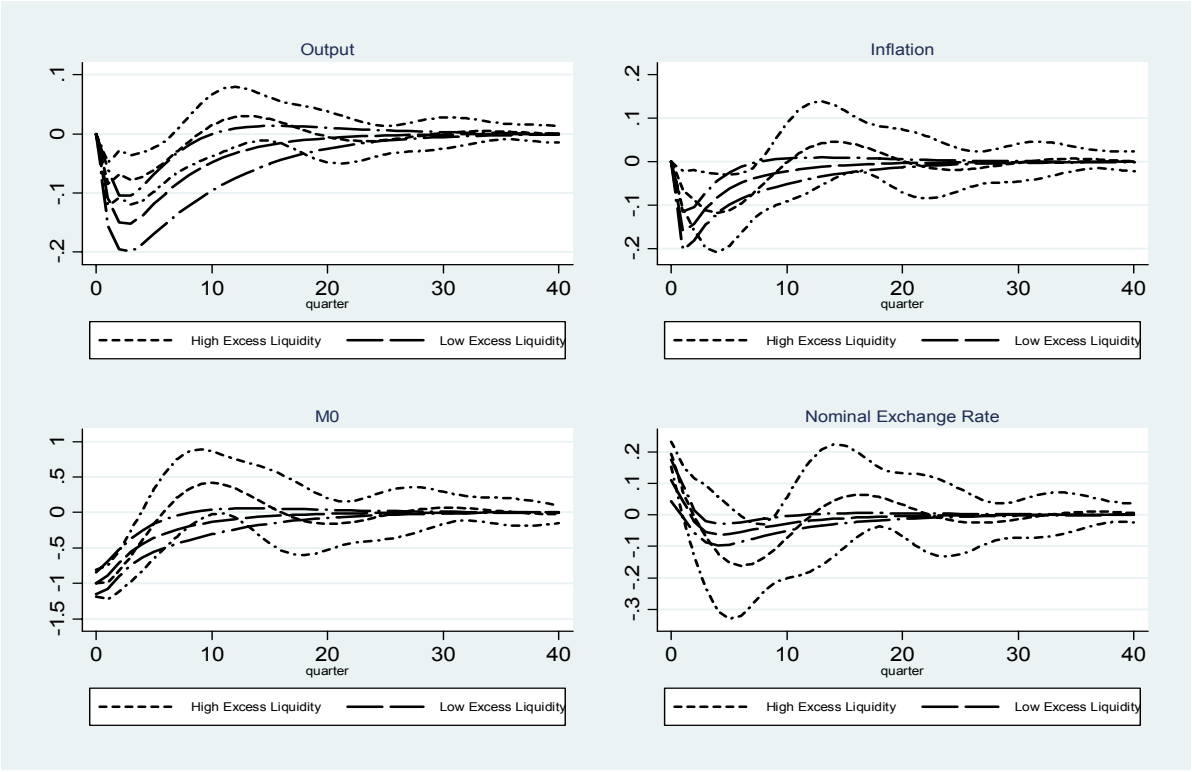


Figure 10. Nigeria. Response to a One-Unit Negative Shock to M0

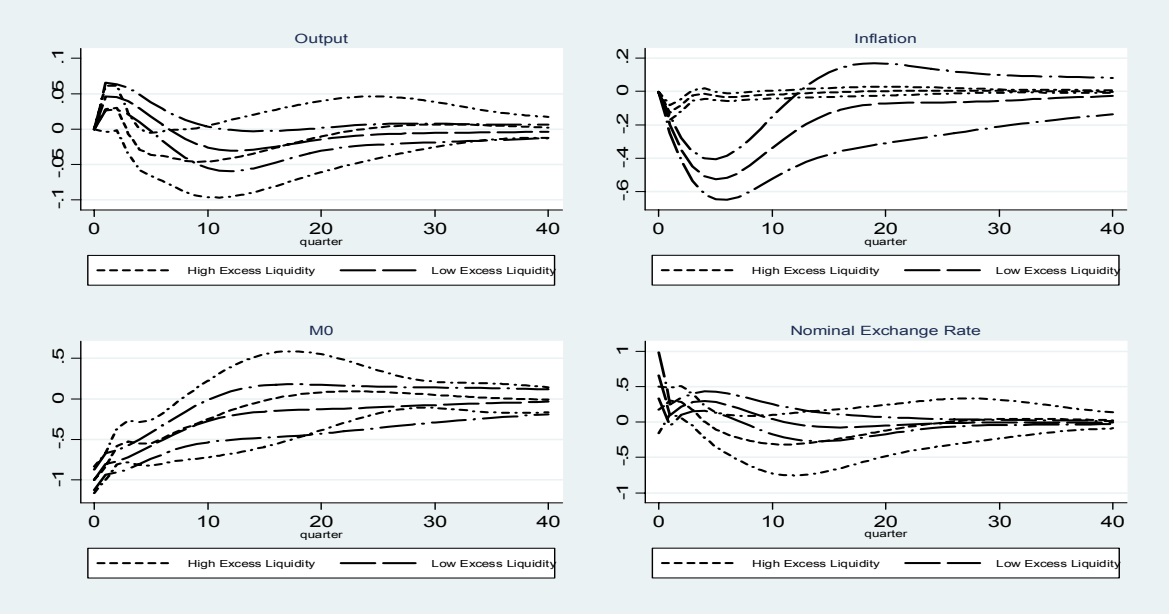
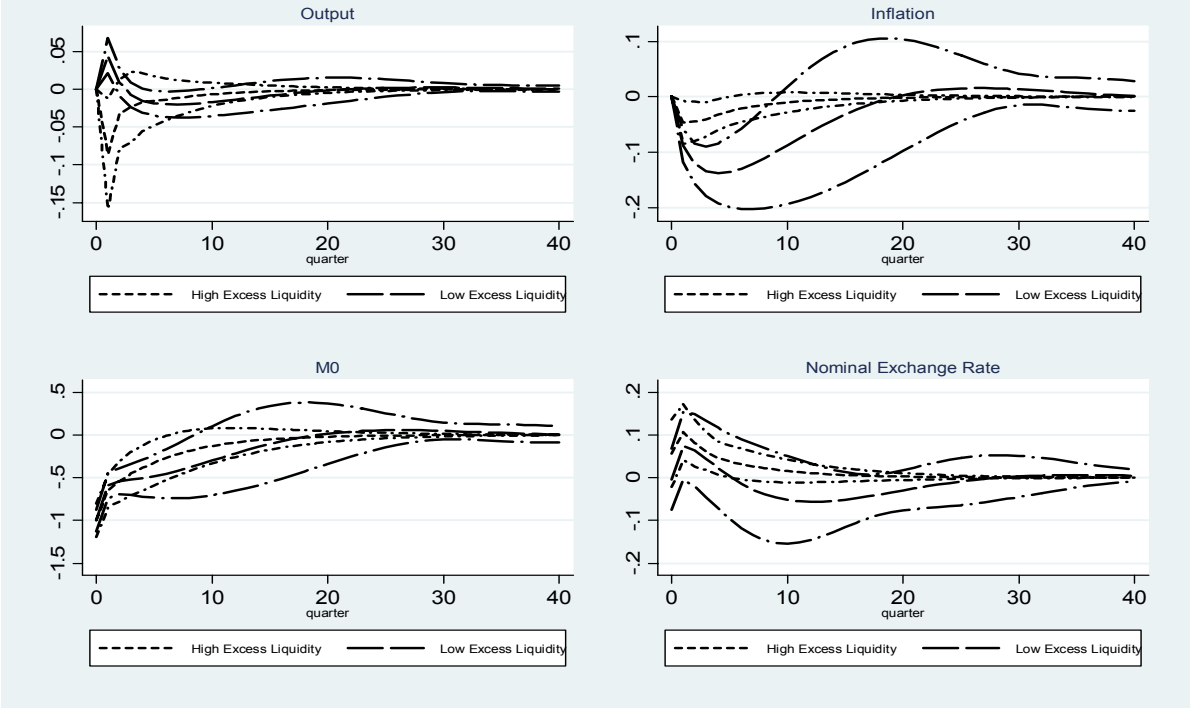


Figure 11. Uganda: Response to a One-Unit Negative Shock to M0



The same does not hold true for the CEMAC region, however. In both regimes, the price level does not respond significantly to unexpected changes in reserve money. A possible explanation for this result is the fact that the post-devaluation sample used to estimate the TVAR for the CEMAC region may be characterized by relatively high involuntary excess liquidity across both regimes. Because of the difficulties in determining the level of involuntary excess liquidity we cannot be certain about this although our decomposition suggests that it is the case. If so then one would not expect to see differences in the monetary policy transmission mechanism across regimes. This is because our hypothesis implies that monetary policy is ineffective as long as banks have involuntary excess liquidity, regardless of how much of it they hold.[50] If they hold *any* amount of involuntary excess liquidity it must be because they are unable to channel those unremunerated assets into more productive investments, such as lending or treasury bills, with the result that the monetary policy transmission is weakened.

It is also worth commenting on the response of the nominal exchange rate to the contractionary shock to reserve money. In the CEMAC region, the nominal exchange rate depreciates although there does not appear to be any significant differences between the two regimes. This is consistent with our finding for inflation, namely that in both regimes the high level of excess reserves implies that market interest rates do not adjust sufficiently to elicit an asymmetric response in the nominal exchange rate. In Nigeria and Uganda, however, the larger fall in inflation 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.

V. Summary and Policy Implications

Excess liquidity is a feature in several economies in SSA. This paper has sought to document the phenomenon of excess liquidity and analyze its impact on the transmission mechanism of monetary policy. In doing so, it has 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 the CEMAC region, Nigeria, and Uganda.

Subject to the limitations of the analysis, our results suggested on the one hand, that the increase in excess liquidity in the CEMAC region over the course of the sample period was largely due to an increase in involuntary excess liquidity. Precautionary excess liquidity, on

[50] Of course, if involuntary excess liquidity is low, then a contractionary monetary policy shock may cause the economy to change regime.

the other hand, remained fairly stable. In Nigeria, our results identified two periods were 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 into line with total excess liquidity as a result of increased lending to the private sector. In all three case studies, this study's 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 precautionary purposes, sterilization is unnecessary, since this liquidity does not have an inflationary potential. It is important, though, 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 need for improvements to 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 the lending rate increases in the face of increased demand, thus raising the opportunity cost of excess liquidity, or 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.[51]

As sterilization does entail costs and drawbacks (IMF, 2005a), the first-best policy response is, as Heenan (2005) points out, to address the underlying causes of involuntary excess liquidity policies. This could entail improving the efficiency and the information structure of the commercial banking system by increasing competition in the financial sector or addressing the lack of well-developed bond market and interbank market. By their very nature however, such reforms have a significant implementation lag. Hence, in the interim, it seems prudent to use one of the methods described above to remove the involuntary portion of excess liquidity from the system, in order to ensure that the risk of increased inflation does not materialize.

[51] In some countries, central banks have at their disposal a stock of government bonds that can be used for sterilization purposes. This is often seen as the "first-best" instrument, because in this case the costs of monetary policy will be borne by the government, leaving the central bank's policy setting unaffected by cost considerations.

This paper argues that, in addition to its importance for the formulation of policy, the distinction between precautionary and involuntary excess liquidity is 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 the CEMAC region, Nigeria and Uganda with involuntary excess liquidity as the transition variables. The study's results suggest that in Nigeria, and Uganda, involuntary excess liquidity did weaken the transmission of a shock to monetary policy to Consumer Price Index (CPI) inflation. In the CEMAC region, the analysis suggested that the transmission mechanism was weak in both regimes, which we explained by noting that involuntary excess liquidity was relatively high across the whole sample period.

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. It is clear that involuntary excess liquidity, coupled with the inflationary risks mentioned previously, poses numerous risks which demand the attention of policymakers.

Table A1. Classification of Countries

Sub-Saharan Africa (SSA)	Oil-Producing SSA	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				

Table A2. Reserve Requirement Framework

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

Table A3. 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 country desks are sometimes used if needed. Data from the IMF's World Economic Outlook (WEO) and the World Bank's World Development Indicators (WDI) databases are available only on an annual basis and are therefore interpolated using the procedure discussed in footnote 25. IFS denotes the IMF's International Financial Statistics database. With the exception of interest rates, exchange rates and the consumer price level, data for the CEMAC region is constructed by simple aggregation. The remaining data is constructed using a weighted average.

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