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Excess Liquidity and the Foreign Currency Constraint: The Case of Monetary Management in Guyana*

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ABSTRACT

This paper examines why commercial banks in Guyana demand non-remunerated excess reserves, a phenomenon that became even more widespread after financial liberalisation. Despite the removal of capital controls, banks do not invest all excess reserves in a safe foreign asset because the central bank maintains an unofficial foreign currency constraint by accumulating international reserves. The findings suggest that commercial banks do not demand excess reserves for precautionary purpose – which is the conclusion of several other studies – but rather because of the maintained constraint. The estimated sterilisation coefficient is consistent with the hypothesis of an enforced constraint. The results, moreover, suggest an alternative way of looking at the monetary transmission mechanism in developing countries. The central bank maintains price and exchange rate stability through the accumulation of foreign reserves.

Key Words: Excess bank liquidity, monetary transmission mechanism, ARDL model, Guyana

JEL Classifications: O11, E58, N16

I. INTRODUCTION

This paper posits the notion that banks in Guyana, operating within a supposed liberalised environment, are unable to invest all non-remunerated excess reserves in a safe interest-earning foreign asset because the central bank maintains an unannounced foreign currency constraint¹. The framework, however, is general enough to be

¹ The issue of global excess liquidity has occupied several researchers in recent times. See for instance D'Arista (2006 and 2005). Also, in a fairly recent issue of *The Economist* (August 13, 2005), the magazine sought to explain the decline in long-term bond yields, in the presence of a series of successive short-term

applicable to other small open developing countries that have liberalised their financial system, interest rate determination, and capital flows. Excess reserves, which are unremunerated, are defined as total commercial bank reserves minus required reserves. The required reserve ratio is set by the Bank of Guyana, Guyana's central bank. Hence, there are obvious empirical and theoretical puzzles as to why profit-maximising private commercial banks demand this asset when they can make loans, invest in government securities, or purchase foreign assets. The paper does not seek to explain why banks have refused to make private loans or buy domestic government securities. That is another matter which is explained theoretically and empirically in Khemraj (2006). Instead, this is an empirical paper which furnishes an answer to the question of why the Guyanese commercial banks seemingly refuse to invest all excess reserves in a safe interest-earning foreign asset, even though inflation, coupled with exchange rate depreciation, is likely to make Guyanese banks susceptible to loss.

The existing literature on the demand for excess bank reserves in developing countries is very sparse. The few papers that have examined the issue in developing countries have relied on the classic reserve management model as outlined by Baltensperger (1980; 1973), Frost (1971), and Morrison (1966). As outlined in those papers, the model is more applicable to the advanced economies, or more specifically to the United States². More recently Agenor, Aizenman, and Hoffmaister (2004) extended

rate increases by the Federal Reserve, by proffering two hypotheses – a global savings glut and a situation of global excess liquidity. The latter was seen as being more consistent with the existing situation of low long-term bond yields and high output growth rates. However, this paper seeks to address the issue within a developing country context and in so doing adds to a scarce literature on the phenomenon in the developing world.

² A key prediction of the model is the notion that banks demand excess reserves for precautionary purposes. The paper finds no evidence that this is the case.

this model in order to derive a testable empirical demand function for excess liquidity in Thailand. Their primary objective was to decipher whether the curtailment of bank credit in Thailand after the Asian financial crisis was consistent with a credit crunch. Saxegaard (2006) extended the empirical model of Agenor, Aizenman, and Hoffmaister (2004) to include a vector of variables that accounts for “involuntary” excess reserves in the Central African Economic and Monetary Community (CEMAC), Nigeria and Uganda³. In another paper, Fielding and Shorthand (2005) estimated an autoregressive distributed lag (ARDL) model of excess liquidity for Egypt. Political violence was found to be an important determinant of excess liquidity in Egypt. Caprio and Honohan (1993) proposed two reasons why banks might demand excess liquidity. Their explanation, however, went beyond the classic reserve management model. They proposed the credit rationing hypothesis and money overhang hypothesis⁴.

None of the papers, however, has addressed the question as to why commercial banks seemingly refuse to invest excess reserves into a safe interest-earning foreign asset, especially since exchange control facilities have been dismantled (and flexible exchange rates adopted) in several of those countries. In the case of Guyana a flexible exchange rate was adopted in 1991, while exchange control has been jettisoned since 1995⁵.

³ According to Saxegaard (2006) several variables that account for involuntary reserve accumulation include inflows of foreign aid, newfound oil revenue, weak demand for bank loans (resulting from high loan rates), and government deposits in commercial banks.

⁴Caprio and Honohan (1993) noted that the money overhang hypothesis is more applicable to former planned economies in which there was a period of goods rationing in the commodity market. Credit rationing, on the other hand, is likely to occur in both advanced and developing countries.

⁵ In 1991 the Guyanese authorities merged the parallel foreign currency market with the official market. Since then there has been no misalignment between the official rate and the “street” rate. The exchange rate is determined freely by market traders in foreign currencies – mainly commercial banks and other authorised non-bank traders who must obtain a license from the central bank. The Guyanese central bank (the Bank of Guyana) defends the rate by accumulating international reserves. On several occasions the central bank sells from its reserves. However, most times it must buy United States dollars and other

This paper proposes the hypothesis of a *foreign currency constraint* that is maintained by the central bank. The constraint results from the fact that the central bank is operating within the ambits of an indirect monetary policy⁶ regime, which was adopted after 1988 within the context of radical financial and economic reforms such as bank privatisations, interest rate and credit deregulation, market-based monetary policy, and the adoption of a flexible exchange rate regime. The main finding of this paper is that the foreign currency constraint provides the best explanatory variable for excess bank liquidity. The research finds no evidence that Guyanese banks demand excess reserves for precautionary purposes. Moreover, the factors such as foreign aid, remittances, and other capital inflows that Saxegaard (2006) tested for in the Sub-Saharan African context are irrelevant in the Guyanese situation since rational profit-maximizing private banks, operating in an environment of capital account liberalisation, would seek to free themselves of the non-remunerative asset by accumulating interest-earning foreign assets.

To determine whether the constraint is indeed maintained by the central bank, the paper also estimates the sterilisation coefficient. A sterilisation coefficient that is closer to -1 is indicative of a maintained constraint, while a coefficient closer to zero implies the central bank is more interested in maintaining slack liquidity conditions. Given these findings, the paper proposes another way of looking at the monetary transmission mechanism in Guyana with potential applications in similar small open economies.

currencies from the local market since the domestic currency cannot be traded in the main global international financial centres.

⁶ Alexander et al (1995, p. 2) define direct versus indirect monetary policy instruments. Direct instruments set or limit prices (interest rates) or quantity (credit). The quantity-based direct instruments often place restrictions on commercial banks' balance sheet. Indirect instruments, in contrast, operate through the market by influencing the demand and supply conditions of commercial bank reserves. Embedded within the IMF's financial programming framework is the view that the reserve position of the banking system determines bank credit and broad money supply.

The paper is structured as follows. Section II examines important background information relating to excess liquidity and the foreign currency constraint. Section III tests for the foreign currency constraint and estimates the sterilisation coefficient. Section IV explains the implications of the empirical findings for the monetary transmission mechanism. Section V concludes.

II. BACKGROUND INFORMATION

Figure 1 presents the extent of non-remunerative excess bank reserves over a period long enough to compare pre- and post-financial liberalisation. The diagram shows the ratio of actual reserves (AR) to required reserves (RR) over the period 1980 to 2006. A ratio of one signals zero excess reserves, less than one signals a deficit, while a ratio greater than one indicates excess reserves. Although the general economic reforms commenced in late 1988, the main financial reforms started in 1991. Figure 1 indicates that the banking system became a lot more liquid after the reforms which include bank privatisation, interest rate and credit liberalisation, and the entry of foreign banks⁷. Although not the focus of this paper, it should be noted that over the same period the private commercial banks have diminished loans to the private sector. They have, however, in addition to demanding more excess liquidity, increased their purchase of foreign financial assets, which comprise of mainly deposits in foreign counterpart banks.

(FIG. 1 HERE)

The foreign exchange market in Guyana is made up of bank and non-bank traders who buy and sell mainly US dollars. The stock of US dollars traded at any time comes mainly from export proceeds, foreign aid, remittances, and foreign loans. The US dollar

⁷ Non-remunerative excess bank reserves have also been on the rise in Barbados, Jamaica, Trinidad and Tobago, Belize, The Bahamas, and the Eastern Caribbean Currency Union (see Khemraj, 2006).

is used for importing, servicing the external debt, accumulating international reserves (by the central bank), and investing in foreign assets (by commercial banks)⁸. At any given point in time the foreign currency constraint (FCC) is measured by the amount of US dollars that is purchased minus the amount that is sold. A surplus would mean the amount purchased by banks is greater than the amount sold. Hence, it is possible to study the extent to which a surplus or deficit of US dollars (the FCC) in the domestic foreign exchange market can influence the level of non-remunerative excess bank reserves, the change in foreign assets, and the flow of loans to the private sector.

When faced with a foreign currency constraint, commercial banks are unable to purchase all desired amounts of foreign assets. In other words, if the foreign exchange market is in a deficit, the change in foreign assets will decline, while at the same time the level of excess bank reserves will increase. It is therefore expected that the change in foreign assets will be positively related to a surplus in the foreign exchange market, while excess reserves will be negatively correlated with such a surplus. It is also interesting to see the extent to which the FCC can influence the flow of bank loans to the private sector. However, if there is no such relationship it implies banks prefer to acquire excess reserves rather than make loans to the private sector when the foreign exchange market is in a deficit.

The scatter plots (Figures 2, 3 and 4) are based on monthly data from Jan 1996 to Dec 2006. Figure 2 shows a positive correlation between the change in the level of commercial bank foreign assets and the surplus or deficit of US dollars in the foreign

⁸Mainly the US currency is traded in the Guyanese foreign currency market. As at the end of 2005 US\$674 million was purchased, while £23.8 million was bought by traders. At the same time US\$651.9 million was sold compared with £21.7 million. Small amounts of the Canadian dollar and the Euro were bought and sold during that period.

exchange market (the FCC). The information contained in Figure 2 is largely consistent with the existence of a foreign currency constraint. Figure 3 shows the correlation, which is negative, between the FCC and the ratio of total bank reserves divided by required bank reserves. The ratio of total reserves to required reserves will be one if the level of excess reserves is zero. The fitted line in Figure 3 shows that the ratio approaches one as the quantity of US dollars in circulation rises. On the other hand, banks are willing to amass excess reserves when there is a shortage of US dollars.

(FIG. 2 HERE)

(FIG. 3 HERE)

Figure 3 illustrates the extent to which the FCC influences the loan market. If a deficit in the foreign exchange market induces the banks to make loans it implies bank portfolios are responsive to liquidity shocks. If liquidity shocks do not elicit much of a change in the loan market, then bank portfolios are static. This implies bank lending is a function of another mechanism and not the liquidity position of the system. Figure 4 illustrates an almost flat fitted line that intersects the vertical axis just above zero. The implication being a surplus or deficit of US dollars in the foreign exchange market is not likely to elicit a substantial change in the supply of bank loans to private agents. This outcome is consistent with the hypothesis of Khemraj (2006, 2007) that LDC banks demand a minimum mark-up loan rate (owing to oligopoly power) in the loan market. Therefore, liquidity shocks along the minimum rate do not elicit a response in bank lending.

(FIG. 4 HERE)

III. EMPIRICAL ANALYSIS

This section tests formally for the determinants of excess reserves by estimating an autoregressive distributed lag model (ARDL). In addition to testing for the validity of the foreign currency constraint, the paper also seeks to establish whether commercial banks demand non-remunerative excess reserves for precautionary purposes. Several other authors – for instance: Agenor, Aizenman, and Hoffmaister (2004), Saxegaard (2006), and Fielding and Shorthand (2005) – have also tested for precautionary excess reserves. Typically several measures of volatility are utilized to proxy uncertainty and therefore precautionary demand.

This paper adopts a similar measure of volatility as Agenor, Aizenman, and Hoffmaister (2004), and Saxegaard (2006). In particular, the paper looks at the volatility of currency withdrawals and bank credit to the private sector. The currency withdrawal variable is approximated by the ratio of demand deposits to total deposits. A rise in volatility of these two variables should induce banks to demand excess reserves. Hence, a positive relationship is expected. Equation 1 identifies the measure of volatility that is adopted in this paper. According to the formula, the volatility is the sample standard deviation of the variable X , where X represents (i) the ratio of demand deposits to total deposits and (ii) the ratio of private sector credit to total deposits. In this case n is the averaging period, which is taken to be three months.

$$volX_t = \left[(1/n) \sum_{i=1}^n (X_{t-i} - \bar{X})^2 \right]^{1/2} \quad (1)$$

According to the classic reserve management model, the penalty for a reserve deficit position can be an important factor forcing banks to hold liquidity for precautionary purposes. The penalty rate is represented by the central bank's discount rate. A high discount rate forces banks to avoid the penalty by holding sufficient excess

reserves. Therefore, a positive relationship between the discount rate and excess reserves is expected. Another key determinant of excess reserves ought to be the required reserve ratio. An increase (decrease) in the ratio ought to decrease (increase) excess reserves. However, including this variable as an independent variable is problematic given that it has only changed three times over the period of analysis. Hence, the total sum of squares of this variable would be very low. It was therefore omitted as an independent variable.

The foreign currency constraint – which is measured as the total purchases of US dollars minus the total sales of US dollars by commercial banks – is postulated to have a negative effect on excess reserves. If there is a surplus of US dollars in the domestic foreign exchange market, banks would decrease excess reserves and purchasing foreign assets. On the other hand, a deficit (or shortage) of US dollars in the domestic foreign exchange market forces banks to accumulate excess reserves. As discussed in previous section, banks do not increase lending to the private sector when faced with a shortage of foreign exchange.

Given the above discussion, the general ARDL model is represented by equation 2. The relevant variables are er_t which denotes the ratio of total reserves to required reserves; fcc which denotes the foreign exchange market surplus or deficit; Δexr which represents the change in the Guyana dollar-US dollar exchange rate⁹ (where $\Delta exr > 0$ signals a depreciation and $\Delta exr < 0$ an appreciation of the Guyana dollar vis-à-vis the US dollar); $disr$ which symbolise the discount rate; and $volX$ which represents the volatility

⁹ An earlier version of this paper included the volatility of the exchange rate. However, it was found to be statistically insignificant.

measure. The term ε_t denotes the serially uncorrelated, homoskedastic, and normally distributed error term.

$$er_t = \alpha_0 + \sum_{i=0}^n \alpha_i fcc_{t-i} + \sum_{j=0}^p \alpha_j \Delta exr_{t-j} + \sum_{k=0}^q \alpha_k volX_{t-k} + \sum_{\kappa=0}^s \alpha_\kappa disr_{t-\kappa} + \sum_{l=1}^m \alpha_l er_{t-l} + \varepsilon_t$$

(2)

Given the explanation above, the coefficient $\sum \alpha_j$ is expected to be negative; indicating a depreciation of the Guyana dollar would encourage commercial banks to diminish non-remunerative excess reserves as there is a flight to foreign assets. It is expected that increased uncertainty with respect to currency withdrawal and private sector credit would encourage banks to hold precautionary balances of excess reserves. Therefore $\sum \alpha_k$ is expected to be negative. Since the penalty rate (which the discount rate proxies) exerts a positive effect on excess reserves, we can expect $\sum \alpha_\kappa$ to be positive.

The estimation is based on a sample of monthly data that ranges from January 1996 to December 2006, a total of 132 observations¹⁰. However, before estimating equation 1, it is important to examine the time series properties of each variable in the equation. Therefore, the Augmented Dickey Fuller (ADF) test is applied to each univariate time series in order to establish the order of integration. In other words, it is important to determine whether the variable is stationary in its level, in first or in second difference. The results of the unit root tests, based on a unit root null hypothesis versus a stationary alternative, are reported in Appendix 1 (Table A). The tests indicate that both

¹⁰ The excess reserves and foreign exchange market purchases and sales data were obtained from the Bank of Guyana *Statistical Bulletin*, while all other series were obtained from the IMF *International Financial Statistics*.

(*er*) and (*fcc*) are stationary in their level. *Exr* is non-stationary in its level, but becomes stationary after differencing once.

According to equation 2, there are five independent variables (that include two volatility variables and one lagged dependent variable). Since monthly data are used, the general regression ought to be estimated with at least twelve lags; however, trying to do so resulted in near perfect multicollinearity. Therefore, in order to come up with the most suitable dynamic structure of the ARDL model, several separate bi-variate regressions with twelve lags of each independent variable (with *er* as the dependent variable) were estimated. In each regression, t-tests and Wald (F-tests) were used to exclude the contemporaneous and lagged variables. After testing down the following regression (equation 3) was suggested by the data.

$$er_t = \beta_0 + \beta_1 er_{t-1} + \beta_2 er_{t-2} + \beta_3 fcc_t + \beta_4 \Delta exr_t + \hat{\varepsilon}_t \quad (3)$$

Interestingly, neither of the volatility variables was found to be a significant determinant of excess reserves¹¹. Similarly, the discount rate was also insignificant in both contemporaneous and lagged effects. These results tend to suggest that Guyanese commercial banks do not demand excess reserves for precautionary purposes.

The estimation results for equation 3 are presented in Table 1. Each coefficient has the expected sign and the *fcc* term is highly significant, thereby implying the foreign currency constraint is binding. Δexr is also very significant at the 1 percent level (as the p-values and/or t-statistics indicate). (*Er*) is also explained by its one period lag er_{t-1} . The equation performs very well on the diagnostic tests. The Lagrange multiplier tests for serial correlation at one and twelve lags of the residual term do not reveal this

¹¹ Experimentation with GARCH (1, 1) models as a measure of volatility of the different series could not change this conclusion.

problem. In light of the Jarque-Bera test, the null hypothesis of normality cannot be rejected. White's test could not reject the null hypothesis of homoskedasticity, thus indicating that the residuals of the model have a constant variance. The model was also tested for coefficient and variance stability using the CUSUM and CUSUMSQ that were applied by Bahmani-Oskooee and Rehman (2005). The tests which were applied to the residuals of the model were favourable (see Appendix 1; Figures A and B).

(TABLE 1 HERE)

The sterilisation coefficient

The sterilisation coefficient can provide important insights into the monetary policy stance of the Bank of Guyana. The coefficient takes values from 0 to -1. A coefficient value closer to -1 signals the extent to which the central bank compensates the commercial banks for the foreign currency constraint it imposes on them when it buys the hard currency from the domestic market. It should be noted that the Guyana dollar is not tradable in the international foreign exchange markets; hence, the central bank can only pay for foreign exchange by using the domestic currency at home in the local foreign exchange market. Commercial banks could use the foreign currency to purchase foreign assets and earn a rate of return instead of holding non-remunerative excess reserves. Instead, the banks are compensated with domestic government Treasury bills. Therefore, the size of the coefficient gives information on the central bank's monetary policy objective. A coefficient closer to -1 would signal a strong desire for stabilisation of the exchange rate and prices. It should also be noted that a coefficient closer to -1 signals

that the central bank has been successful in neutralizing the impact of foreign exchange market interventions on the money supply (or bank liquidity¹²).

On the other hand, a coefficient that approaches 0 will indicate a desire for monetary expansion – and by extension economic expansion – since liquidity is injected into the system. If the coefficient equals 0, then a change in the international reserve position of the central bank is completely reflected in the monetary base. One can conclude that the stimulation of bank lending and economic growth is the paramount objective.

(FIG. 5 HERE)

Figure 5 plots the change in net foreign assets (*NFA*) and the change in net domestic assets (*NDA*) of the Bank of Guyana. The figure underscores a tendency for one to offset the other – a behaviour that is typical of Guyana’s monetary policy in which the central bank varies its net domestic assets (the main component being Guyana government Treasury bills) in order to offset variations in net foreign assets. The latter is comprised of foreign currency reserves that the monetary authority must purchase from the domestic foreign exchange market by paying with the national medium of exchange. To prevent the unwanted build-up of the monetary base and excess bank reserves, the central bank sterilises the prior liquidity injections by selling Treasury bills from its asset portfolio.

In order to estimate the sterilisation coefficient, the central bank reaction function given by equation 4 is estimated. The sterilisation coefficient is denoted by γ_1 . The central bank is also likely to vary its instrument (*NDA*) in anticipation of changes in

¹² An earlier version of this paper tested for whether a change in international reserves of the central bank influences the level of excess reserves. It was found to be statistically insignificant. The high sterilisation coefficient in this section would tend to corroborate this finding.

inflation and the exchange rate¹³. These variables are captured in the vector Π . We would expect a depreciation of the exchange rate to be followed by a tightening of monetary policy. In other words, the central bank is likely to decrease *NDA* when the exchange rate depreciates ($\Delta exr > 0$) and increase *NDA* when the opposite occurs with the exchange rate. The expected result is therefore a negative response coefficient with respect to the exchange rate. A negative response coefficient vis-à-vis the inflation rate (or the rate of growth of the CPI) can also be expected.

$$\Delta NDA_t = \gamma_0 + \sum_{i=0}^n \gamma_i \Delta NFA_{t-i} + \sum_{j=0}^m \gamma_p \Pi_{t-j} + \sum_{k=1}^p \gamma_k \Delta NDA_{t-k} + e_t \quad (4)$$

There is, however, an important methodological issue – which was raised by Magee (1976) – that emerges when one tries to estimate equation 4. It is the problem of simultaneity that results from the likelihood that ΔNFA is an endogenous variable and is therefore correlated with the equation error term e_t . In such a situation the use OLS estimator is not recommended since it is biased and inconsistent. Therefore, most researchers have instead utilised two-stage least squares (TSLS). Others who have used TSLS to estimate the sterilisation coefficient include Cumby and Obstfeld (1983), Brissimis, Gibson and Tsakalotos (2002), and Seo (2005).

This paper, however, does not take it for granted that ΔNFA is endogenous. A test for endogeneity, as suggested by Wooldridge (2006, p. 532), is performed. A reduced form regression is estimated by OLS. The independent variables in the reduced

¹³ The Bank of Guyana notes that the NDA is its instrument which it manipulates to achieve the objectives of stable prices and exchange rate stability. To enable the day to day management of excess reserves the central bank utilises a reserve money programme, which is itself rooted in the financial programming framework. See Tarp (1993) for detailed discussion of the financial programming framework.

form equation are: (i) ΔNFA_{t-1} , (ii) ΔNDA and ΔNDA^{14}_{t-1} , (iii) ΔExr , (iv) ΔCPI and (v) the opportunity cost of holding foreign assets (estimated in its first difference). It would have been useful to include a scalar variable such as import in the reduced form regression (Huang, 1995). However, a long enough monthly import series is unavailable. The opportunity cost for holding foreign assets is the loss of developmental funds to the domestic economy (Huang, 1995). Hence, this variable is measured as the difference between the domestic lending rate and the US three month Treasury bill rate. The t-statistic could not reject the null hypothesis of non-endogeneity of ΔNFA . Therefore, given that the TSLS estimator would be less efficient relative to OLS when ΔNFA is exogenous, the paper proceeds with the OLS estimates. It should be noted, however, that the TSLS coefficient estimates are identical to the OLS. However, the TSLS standard errors are higher. One would expect such an outcome since it was found that ΔNFA is exogenous.

The time series properties of the variables in equation 4 are reported in Appendix 1 (Table A). There it can be seen that both NDA and NFA are I (1) series. Hence, the chance of spurious regression problems is diminished when the equation is estimated in first differences. Table 2 reports the parsimonious estimation results for equation 4. The estimate for the sterilisation coefficient overshoots the expected upper bound of -1. As was done earlier, the final lag structure was arrived at by using the Wald test and individual t-tests to eliminate the higher order lags.

The estimated value of -1.06 is statistically significant as the p-value indicates. The result nevertheless implies that the central bank has a strong preference for monetary

¹⁴ Lags beyond the first period lag were insignificant. Hence, only contemporaneous and one period lag for the respective independent variable was included in the reduced form equation.

contraction over monetary expansion (for the review period). The monetary policy stance, therefore, focuses extensively on mopping up excess reserves through the sales of Treasury bills to commercial banks. The policy is inherently deflationary (as banks are compensated with Treasury bills – hence there is reduced incentive for banks to augment credit to businesses), which possibly helps to explain why the Guyanese economy continues to stagnate in light of significant financial liberalisation and pro-market reforms over the period of analysis.

(TABLE 2 HERE)

Figure 6 presents the recursive least squares estimate of the sterilisation coefficient. The recursive coefficient is computed using ever larger subsets of the sample data until all the sample data points are utilised. The recursive estimate depicts the extent to which the coefficient changes over time. Over the period of analysis, the coefficient tends to persistently overshoot the upper limit expected value of -1. It however tends to stabilise after 2004 around the static estimate of -1.06. The recursive estimates, therefore, also corroborate the finding that the central bank has a strong desire for monetary contraction, which is done by compensating the commercial banks for the induced foreign currency constraint. The very high sterilisation coefficient, moreover, indicates that foreign exchange market interventions of the central bank are not reflected in the monetary base and therefore do not influence the persistent excess reserves in the banking system. This policy, however, is not without its costs. Calvo (1991), for instance, cautioned against the policy of persistent monetary sterilisation since it results in the accumulation of domestic debt.

(FIG. 6 HERE)

The diagnostic tests reported in Table 2 are favourable, except there was a problem of heteroskedasticity in the residual of the estimated model. Therefore, in order to correct the standard errors to obtain unbiased estimates, the White heteroskedasticity-consistent standard errors were computed and are therefore reported. Furthermore, the coefficient that captures the response of *NDA* to a change in the CPI was highly insignificant and it did not possess the expected sign. The response coefficient to the change in the exchange rate is reported since it possesses the correct sign despite only being statistically significant at the 10 percent level. As a stability check, CUSUM and CUSUMSQ plots are reported in Appendix 1 (Figures C and D). These suggest no inherent instability in the estimated reaction function.

IV. ALTERNATIVE MONETARY TRANSMISSION MECHANISM

In light of the findings in the preceding sections, the following view of the monetary transmission mechanism (as outlined in Figure 7) is proposed. This view is very different from that of the current literature. Mishkin (1995) summarises the main channels through which monetary policy can affect prices and output. Numerous empirical analyses have tried to validate which channel is most suited to a particular country. For example, Iturriaga (2000) examines the transmission mechanism for twelve OECD countries. Several studies have also tried to replicate the established mechanisms found in the advanced economies to periphery or underdeveloped economies. It is not so clear, however, why these mechanisms are also applicable to underdeveloped economies. The reason being that the financial structure of these economies is dominated by commercial banks, many (or most) of which have been privatised (after the wave of financial liberalisation). The commercial banking sector, moreover, is highly

concentrated and therefore the few dominant banks, which are the price setters, possess market power in both the loan market and the newly established markets for the government securities (such as Treasury bills). In such a situation, therefore, the banks are not likely to set the loan rate and even the bid rate on Treasury bills (at primary auctions) endogenously of central bank monetary policy (or liquidity) shocks. Rather, banks are more likely to set these rates exogenously by marking up the rates (see Khemraj, 2007).

(FIG. 7 HERE)

Given the empirical results, it seems as though the ultimate objective of the Guyanese central bank is price stability. Growth and employment creation, on the other hand, do not seem to be high priority objectives. Therefore, prices are stabilised by accumulating international reserves (which form the bulk of NFA of the central bank). The increase in NFA means a build-up of excess reserves that can stimulate bank loans and domestic demand (consumption + business investments) once borrowers are willing to pay the rate of interest stipulated by the desired minimum mark-up loan rate, which is derived in Khemraj (2006; 2007). Also an exogenous increase of bank loans diminishes excess reserves as illustrated by the double-pointed arrow linking the loan market with excess reserves (or the interbank market). However, when banks choose to accumulate excess reserves the loan market exert limited influence on domestic demand.

However, the central bank has a more potent weapon against inflation when it accumulates NFA. By buying foreign currency from the local market it enforces a foreign currency constraint in that market. It prevents banks from investing all excess reserves in a safe foreign asset and it curtails the import of foreign goods and services.

As was argued earlier, commercial banks are forced to hold excess reserves when the constraint is binding. The exchange rate, which passes through to inflation, is likely to be stabilised.

As a result of the imposed foreign currency constraint, the central bank compensates the commercial banks by selling them the domestic government Treasury bills, which also serves as a tool to mop up excess reserves. The easy availability of Treasury bills cause banks to hold large levels of excess liquid assets (mainly domestic government Treasury bills in excess of the liquid asset ratio). In so doing, the banks are in no hurry to compete against each other for private business loans by bidding down the loan rate. The private oligopoly banks, therefore, are in an even better position to enforce the minimum mark-up loan rate. Hence, many private businesses are crowded out by the perennially high loan rates. The central bank also maintains exchange rate and price stability by enforcing confidence (optimistic expectations) when it builds up foreign reserves.

V. CONCLUSION

The paper argued that commercial banks demand excess reserves because they cannot invest the entire holdings of non-remunerative assets in a safe foreign asset, in spite of the fact that there is no official legal barrier prohibiting such outflows. The condition of a constraint is enforced by the central bank when it accumulates foreign exchange reserves. The estimated sterilisation coefficient supports this premise. The banks are in turn compensated by the central bank which sells them government securities. Contrary to the findings of recent authors, the empirical results indicate that commercial banks do not demand excess reserves for precautionary purposes.

The build-up of excess reserves – caused by the enforced foreign currency constraint – does not lead to increased lending to the private sector. Although not the focus of this paper, Khemraj (2006) has argued that commercial banks demand a minimum mark-up rate of interest in the loan market and even the government Treasury bill market. For instance, when a borrower wishes to pay an interest rate below the desired minimum rate, the bank will accumulate excess reserves passively if the foreign currency constraint is simultaneously binding. Such behaviour is also consistent with profit-maximisation.

The findings of this paper provide an alternative viewpoint of the monetary transmission mechanism for Guyana, and possibly similar developing countries. The central bank seems to focus extensively on price stability in a highly open developing economy. The central bank can achieve its objective of price stability (through exchange rate stability) by amassing international reserves. Furthermore, in such a situation the central bank loses control of the monetary base unless it can fully sterilise the effects of foreign exchange market interventions.

High levels of international reserves tame expectations of future exchange rate depreciations and therefore engender expectations of stable prices. Importantly, also, the build-up of international reserves creates a shortage or constraint in the foreign currency market. Commercial banks are unable to invest all excess reserves in a foreign asset and at the same time importers have to curtail or postpone imports. By curtailing the demand for foreign financial securities and foreign goods, the demand for the scarce foreign currency is diminished.

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Figure 1: The ratio of total reserves divided by required reserves (annual data: 1980 – 2006)



Figure 2: Change in commercial banks foreign assets (FA) and the FCC (1996: Jan – 2006: Dec)

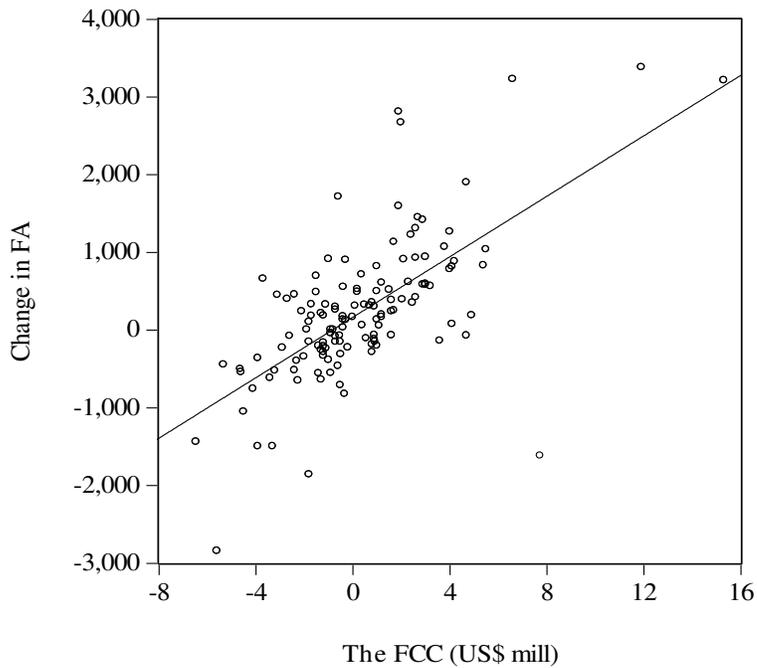


Figure 3: Excess reserves and the FCC (1996: Jan – 2006: Dec)

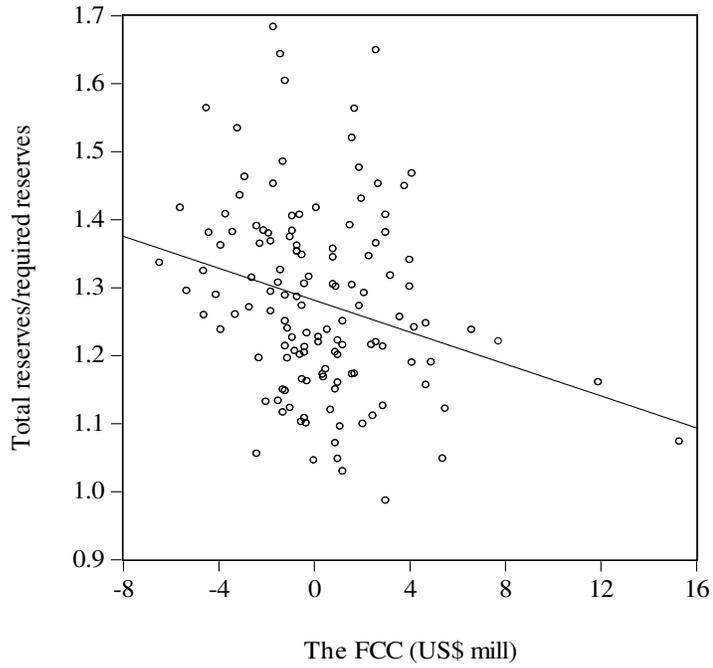


Figure 4: Change of loans to the private sector (LP) and the FCC (1996: Jan – 2006: Dec)

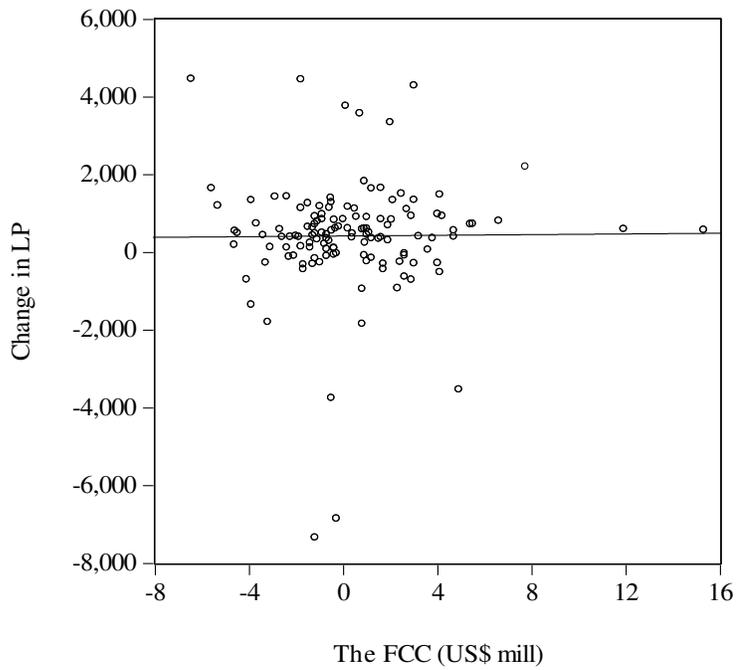


Figure 5: Bank of Guyana-change in net foreign (NFA) and domestic (NDA) assets (1996: Jan – 2006: Dec)

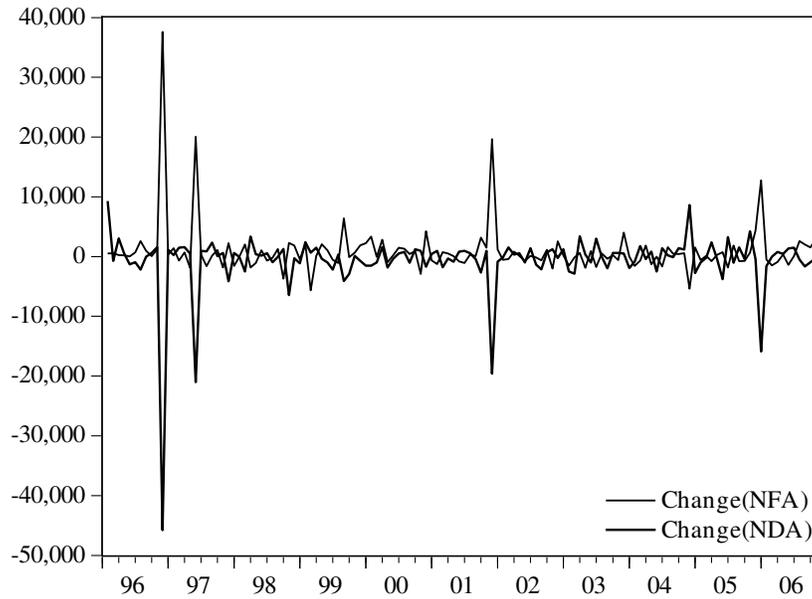


Figure 6: The time-varying recursive sterilisation coefficient

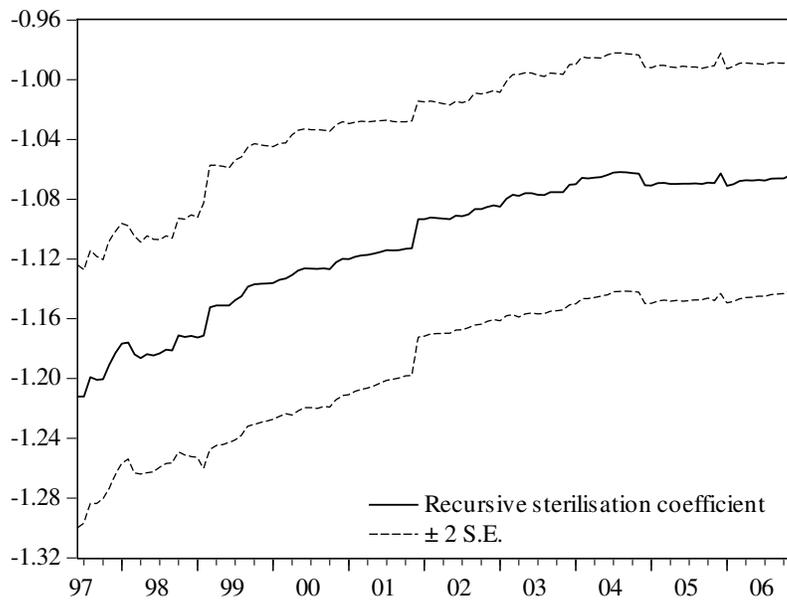


Figure 7: Alternative monetary transmission mechanism

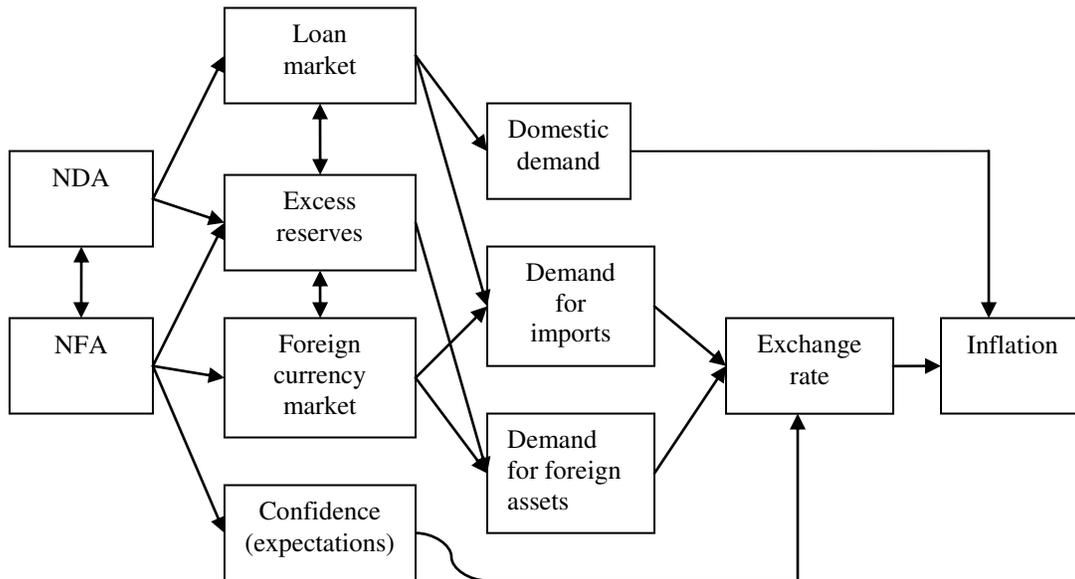


Table 1: Estimation results for equation 3

Dependent Variable: Er

Sample: 1996M01 2006M12 (monthly data)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.373	0.083	4.510	0.000
Er (t-1)	0.516	0.080	6.480	0.000
Er (t-2)	0.202	0.080	2.533	0.013
Fcc	-0.010	0.003	-3.704	0.000
Δ exr	-0.019	0.007	-2.844	0.005
Adj R-square	0.560			
Serial corr. LM(1)	$n \cdot R^2 = 0.003$		P-value = 0.952	
Serial corr. LM(6)	$n \cdot R^2 = 7.8$		P-value = 0.249	
Heteroskedasticity (White)		$n \cdot R^2 = 17.8$	P-value = 0.213	
Normality	Jarque-Bera= 1.82		P-value = 0.402	

Table 2: Estimation results for equation 4

Dependent Variable: $\Delta(\text{NDA})$

Sample: 1996M01 2006M12 (monthly data)

White Heteroskedasticity-Consistent Standard Errors & Covariance

	Coefficient	Std. Error	t-Statistic	Prob.
Constant	418.56	184.83	2.26	0.025
$\Delta(\text{NFA})$	-1.06	0.08	-13.10	0.000
$\Delta(\text{NFA}(t-1))$	-0.20	0.10	-2.02	0.045
$\Delta(\text{NDA}(t-1))$	-0.18	0.09	-2.08	0.039
$\Delta(\text{Exr})$	-242.40	140.05	-1.73	0.086
Adj R-square	0.86			
Serial corr. LM(1)	$n \cdot R^2 = 0.93$	P-value = 0.333		
Serial corr. LM(6)	$n \cdot R^2 = 10.9$	P-value = 0.092		
Normality	Jarque-Bera= 0.39	P-value = 0.821		

APPENDIX 1

Table A: Augmented Dickey-Fuller (ADF) tests

Variable	Lags	Intercept alone	Lags	Trend & Intercept
er	1	-3.71 *	1	-4.01 **
fcc	1	-9.16 *	1	-9.11 *
exr	2	-1.57	2	-1.45
Δexr	1	-4.49 *	1	-4.67 *
cpi	1	-0.85	1	-2
Δcpi	1	-11.8 *	1	-11.9 *
NDA	1	-2.24	1	-2.25
ΔNDA	1	-12.2 *	1	-12.4 *
NFA	1	-2.47	1	-2.49
$\Delta(\text{NFA})$	1	-10.6 *	1	-11.1 *

* Significant at 1 percent

** Significant at 5 percent

The optimum number of lags were chosen by Akaike information criterion

Figure A: Plot of cumulative sum of recursive residuals (for equation 3)

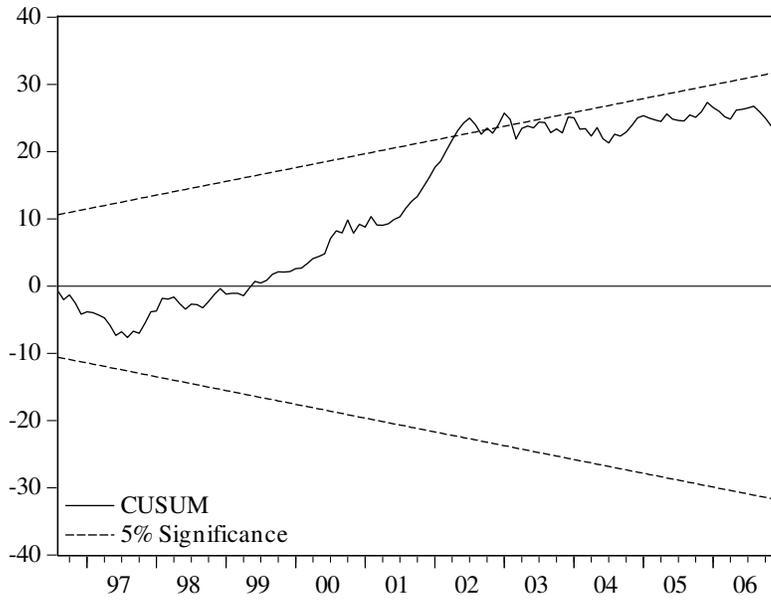


Figure B: Plot of cumulative sum of squares of recursive residuals (for equation 3)

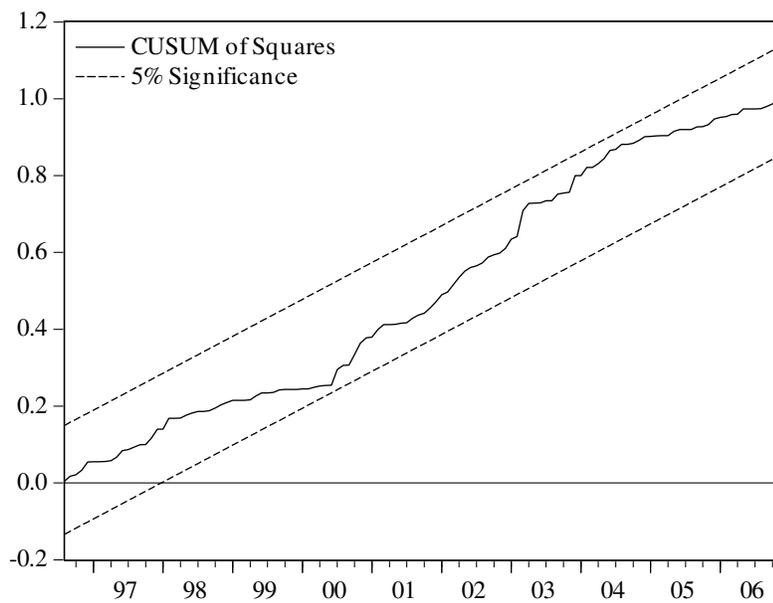


Figure C: Plot of cumulative sum of recursive residuals (for equation 4)

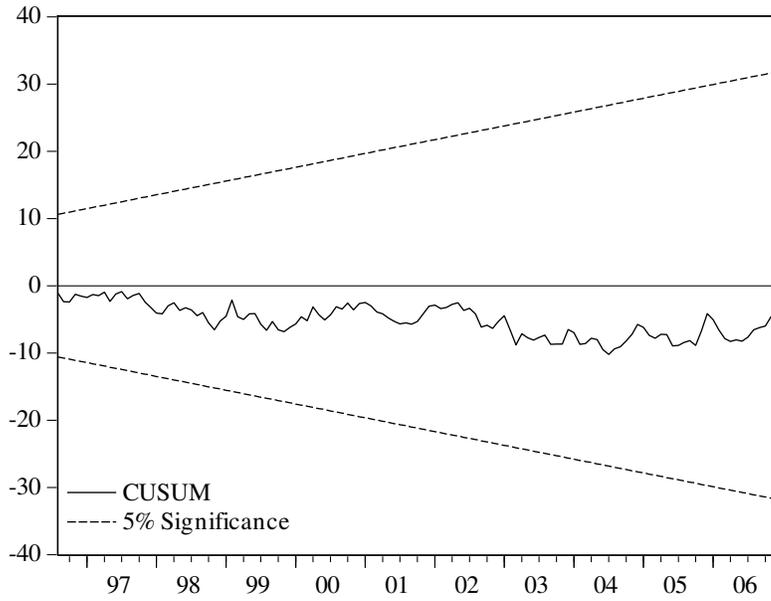


Figure D: Plot of cumulative sum of squares of recursive residuals (for equation 4)

