Why do banks demand excess liquidity? The case of Guyana

Tarron Khemraj
Assistant Professor of Economics
New College of Florida – The Honours College
of the Florida State University
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Abstract

This paper posits two alternative hypotheses to explain why commercial banks demand non-remunerative excess liquidity. The first hypothesis holds that commercial banks require a minimum interest rate in the loan market and the market for the domestic short-term government security. The minimum rates are mark-up interest rates owing to oligopoly power in the loan market and oligopsony power in the government security market. The second hypothesis is the existence of a foreign currency constraint, which explains why banks seemingly refuse to invest all excess liquidity in safe accounts abroad. The stylized facts, econometric and calibration exercises are all consistent with the hypotheses.

Key words: oligopoly banking, excess liquidity, monetary policy, Guyana.

JEL Classifications: E50, E52, O16, O10

1. INTRODUCTION

This paper examines why commercial banks demand excess liquidity in a small open economy, Guyana, which has undergone significant financial reforms after 1988. The framework, however, is general enough to be applicable to other small open developing economies. Excess liquidity is defined as total non-remunerative commercial bank reserves minus required non-remunerative reserves.

The required reserve ratio is set by the central bank. The paper proposes two alternative explanations to those that currently exist in the literature.

The literature on the demand for excess bank liquidity in developing countries is very sparse. The few papers that have examined the excess liquidity phenomenon in developing countries have relied on the classic reserve management model – that was applied mainly to the United States – as presented by Baltensperger (1980; 1973), Frost (1971), and Morrison (1966). More recently Agenor, Aizenman, and Hoffmaister (2004) expand 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) extends the empirical model of Agenor, Aizenman, and Hoffmaister (2004) to include a vector of variables that account for "involuntary" excess reserves in the Central African Economic and Monetary Community (CEMAC), Nigeria and Uganda[1]. In another paper, Fielding and Shorthand (2005) estimate an autoregressive distributed lag (ARDL) model of excess liquidity for Egypt. They argue that political violence is the key determinant of excess liquidity in that country. Caprio and

[1] 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.

Honohan (1993) – whose thesis went beyond the reserve management model – proffer the money overhand hypothesis, which holds that excess liquidity results from rationing in the commodity markets. Since agents expect the rationing to be removed sometime in the future, they accumulate money balances today rather than diminish labor supply. The authors emphasize, however, that the money overhand hypothesis is more applicable to former planned economies.

This paper hypothesizes that commercial banks in Guyana require a minimum rate of interest before they make loans to private businesses and purchase the domestic government security. Hence, the paper posits the *minimum rate hypothesis*, which is a minimum mark-up rate of interest. A calibration exercise lends support to this new proposition. The paper will argue and demonstrate that the mark-up interest rate is due to the oligopoly power banks possess in the loan market and the oligoposony power they possess in the market for the short-term government security. In order to present its case, the paper utilizes (and extends) the industrial organization banking model of Klein (1971) and Freixas and Rochet (1999).

However, given the fact that the formal exchange control regime has been dismantled, why would profit-maximizing private banks seemingly refuse to invest all non-remunerative excess reserves in a counterpart bank in New York or London and earn the money market rate or London Interbank Offered Rate (LIBOR)[2]? The paper explains this puzzle by postulating the existence of an unofficial *foreign currency constraint* in the domestic interbank foreign exchange market. The paper will demonstrate that the level of excess reserves is highly correlated with the surplus or deficit of the US dollars traded in the domestic foreign currency market.

An important piece of background information is the fact that the Guyanese financial system, like many other developing countries (see Gelbard and Leite, 1999), has undergone significant reforms since 1988. For instance, loan and deposit rates are no longer controlled, but are determined freely by the banks. Similarly, credit is no longer rationed by government nor is it directed to priority sectors. All banks were privatized and foreign banks are allowed to invest in the local economy. The exchange control regime was jettisoned and the exchange rate regime shifted from a fixed to a flexible regime[3].

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[2] One aspect of the literature uses the transaction costs argument to explain the home bias that exists in international portfolio choice. This theory is not directly related to the banking firm and in most cases it is applied to equity portfolios. Using a mean-variance framework, Lewis (1999) demonstrates that an investor can achieve higher returns and lower risk by holding an internationally diversified equity portfolio rather than a portfolio comprising 100 percent US stocks. Yet the investor chooses a portfolio in which domestic equities predominate. Lewis explains this tendency by introducing transaction costs to the mean-variance portfolio model. However, it is unlikely that there will be substantial transaction costs involved when purchasing US Treasury bills or investing in deposits in a foreign counterpart bank.

[3] 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 authorized 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 foreign currency reserves. On several occasions the central bank sells from its reserves. However, most times it must buy United States dollars and other currencies from the local market since the domestic currency is not convertible in the main

Inflation has been curtailed and averages in single digit after the reforms[4]. Monetary policy uses indirect instruments (via the financial programming framework[5]) such as open market operations. The indirect or market-based monetary policy operates on the reserve position of the banking system since excess reserves is assumed to engender changes in bank credit and bank investments in foreign assets. The adoption of indirect monetary policy in developing and emerging economies is very widespread and is not limited to Guyana (see Buzeneca and Maino, 2007).

The paper takes the following format. Section 2 presents the stylized facts that underscore the tendency for banks to desire minimum rates (or form mark-up rates). The oligopoly banking model is presented in section 3. Section 4 uses the banking model to explain to want extent market-based monetary policy is likely to be effective. Section 5 confirms the validity of the minimum rate hypothesis by performing a calibration exercise. Section 6 introduces the foreign currency constraint and tests for its validity via an econometric exercise. Section 7 concludes and also outlines several key policy implications.

2. THE STYLIZED FACTS

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international financial centres.

[4] Historically, however, Guyana has not been a high inflation country. The main episode of inflation occurred from 1988 to 2001 during the rapid devaluation of the Guyana dollar.

[5] See Tarp (1993) for a detailed discussion of financial programming.

Figure 1 shows that the banking sector started to accumulate non-remunerative excess liquidity in the post-reform period that commenced in 1988. It should be noted, however, this is not an isolated phenomenon. Saxegaard (2006), for instance, details the extent of excess bank liquidity in Sub-Saharan Africa. Figures 2 and 3, respectively, plot the level of non-remunerative excess liquidity against the 3-month Guyanese Treasury bill rate and loan rate. The purpose is to extract the liquidity preference curves. The curves are fitted using locally weighted polynomial regressions (LOESS) of degree one. They are local regressions because only a subset of observations within a neighbourhood of the point to fit the curve is used. The regression is weighted so that observations further from the given data point are given less weight. Cleveland (1979) introduced the technique and it was and further developed by Cleveland and Devlin (1988). The subset of data used in each weighted least squares fit is comprised of αN, where α = the smoothing parameter and N = number of data points. A higher parameter, α, gives a smoother fit, but the fitted curve is less “local”. Throughout the exercise a smoothing parameter of 0.3 is used.

With respect to Treasury bill rate (depicted by figure 2) the curve flattens at approximately five percent, while in the loan market (given by figure 3) the fitted liquidity preference curve becomes flat at just over sixteen percent. The flat curve vis-à-vis the loan market implies that non-remunerative excess liquidity is a perfect substitute for private loans at the very high rate of approximately 16 percent. The flatness of the curve in the Treasury bill market, on the other hand, suggests excess reserves and the government security become perfect substitutes at around 5 percent Treasury bill rate. While at first glance the latter might be reminiscent of a liquidity trap –in which the bond rate falls to zero and as a result money and government bonds become perfect substitutes – it does not seem to be the case because of the high interest rate at which excess reserves and the government security become perfect substitutes. A similar plot of excess reserves against the short-term interest rate (the 90-day bankers' acceptance rate) for the US during the 1930s shows a flat liquidity preference curve at a zero bond rate (Morrison, 1966, p. 44). Eggertsson and Ostry (2005, p. 8) made a similar observation for Japan using data over the period 1980 to 2004 to plot the monetary base against the Japanese short-term interest rate. In the Japanese case the curve also becomes flat at zero. These two cases are often declared by several authors to be the classic liquidity trap scenario.

Figure 1, Actual reserves (RA), required reserves (RR), and excess reserves (ER): 1987 – 2006 (G$ million)

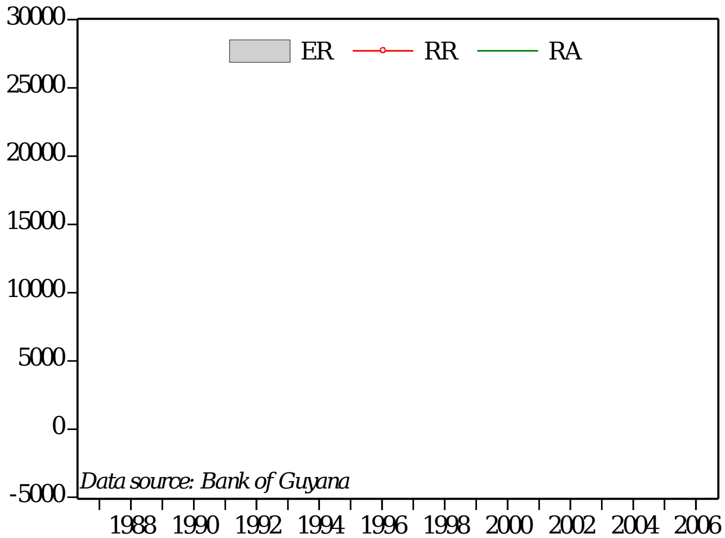


Figure 2, Excess reserves and 91-day Treasury bill rate (Quarterly data: 1988Q1 – 2005:Q4)

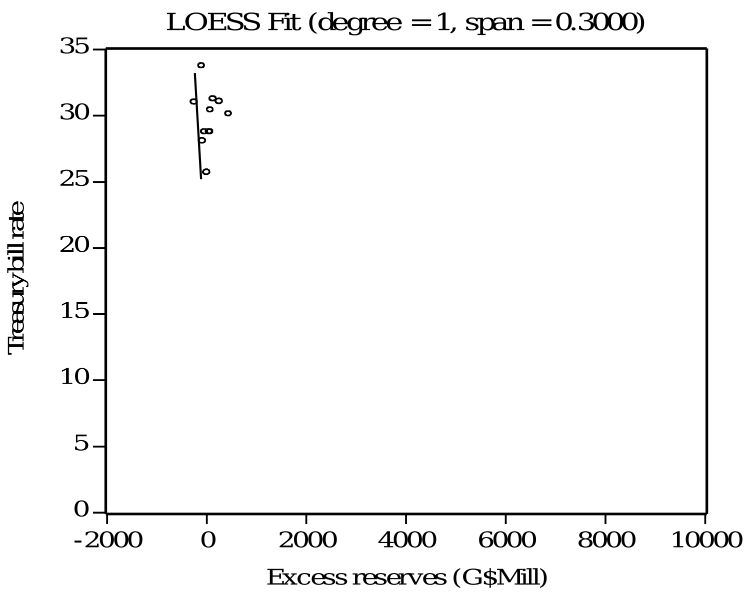
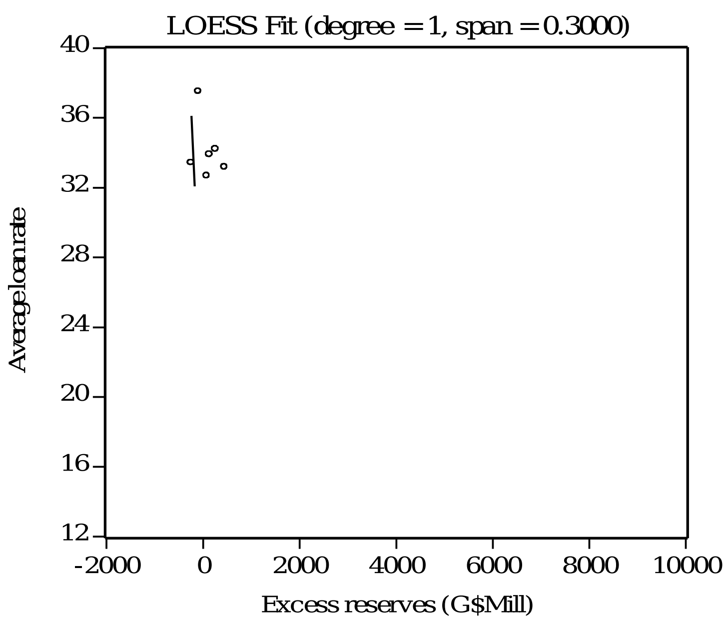


Figure 3, Excess reserves and the average loan rate (Quarterly data: 1988Q1 – 2005:Q4)



The flat curves at very high interest rates are more consistent with mark-up interest rates (or desired minimum rates) in both the loan and Treasury bill markets. In the loan market, for instance, if the marginal borrower cannot pay a rate of interest which the bank desires as minimum, the bank does not lend and instead hold excess liquidity or buy foreign assets if it can find the foreign currency in the local market (that is the foreign currency constraint is non-binding). In the case of the Treasury bill market the implication is also profound, highlighting three key issues: (i) banks do not take the Treasury bill rate as given as in the United States and other advanced economies (in other words, they require a minimum rate before they bid for the government asset); (ii) This behavior demonstrates market power that is consistent with a banking sector that is oligopolistic; (iii) indirect monetary policy that depends on liquidity shocks will not lead to interest rate changes when the curves are flat; and (iv) indirect monetary policy can only be effective when interest rates are very high (that is, over the downward sloping portion of the liquidity preference curves).

These results have important implications for Guyana and underdeveloped economies in general that have tried to liberalize interest rates by implementing a bidding system for the government paper. The deposit and discount rates are usually pinned to the 91-day Treasury bill rate. Fry (1997, Chapter 6) note that the development of a voluntary Treasury bill market in developing countries can have several advantages such as: (i) enabling a shift from direct to indirect monetary policy techniques (hence improving efficiency and effectiveness of monetary policy); and (ii) provide a reference rate in the form of market determined yields on Treasury bills. However, if the government security rate is not competitive, then by extension, the other rates will also be determined by oligopolistic forces.

3. THE OLIGOPOLY BANKING MODEL

Banks are assumed to possess market power in the loan, deposit and government security markets. The monopoly banking model was first introduced by Klein (1971) and later applied to a liquidity management model under uncertainty by Prisman, Slovin and Sushka (1986). However, an important difference between the model in this paper and the earlier approach is the fact that the government security market is not perfectly competitive as was originally postulated by Klein (1971), Slovin and Sushka (1983), and by Prisman, Slovin and Sushka (1986). While the government security market is likely to be highly developed and liquid in the advanced economies – hence the individual bank accepts this rate as given – it is not the case in Guyana where a few institutional investors dominate the purchase of Treasury bills. Therefore, the individual bank faces an upward sloping Treasury bill supply curve, thus making the bank an oligopsonist. If the Treasury bill market is uncompetitive, then the Treasury bill yield cannot be used as the exogenous reference rate which pins down the domestic term structure. The discount rate is another candidate rate that can serve as the exogenous reference rate since it is clearly exogenous and under the control of the central bank. However, given the persistence of excess liquidity, this rate has not been very useful to signal monetary policy stance since banks seldom borrow reserves from the central bank.

In light of the very open nature of the Guyanese economy, and owing to the abandonment of foreign exchange control, bank managers must always be mindful, subject to suitable adjustments for exchange rate risks, of the prevailing rate of interest on foreign assets (which can be represented by the US Treasury bill rate or the LIBOR). Bank managers need to compare the international rate (adjusted for exchange rate movements) with the prevailing domestic Treasury bill rate and the loan rate (also adjusted for domestic risk scenarios and transaction costs).

The non-bank public must also consider the international safe rate and exchange rate movements when making investment decisions particularly in domestic deposit accounts. Banks will lose deposits and market share if the deposit rate becomes too low vis-à-vis the risk adjusted foreign rate. The existence of such an arbitrage mechanism in an unregulated open economy provides for a link between the asset and liability sides (of the bank's balance sheet) in a banking model even though domestic financial markets are subjected to market power. Therefore, the foreign interest rate, which is clearly exogenous to the domestic economy, can be used as the exogenous reference rate in the modelling exercise. Hence, the model is applied in an open economy environment, thereby accounting for another important difference between the approach of this paper and the traditional approach which is always presented in a closed economy setting.

Equation 1 is the representative bank's profit function that is assumed to be concave in loans to the private sector (*L*); domestic government securities (*G*); foreign assets (*F*); and deposits (*D*). The *i* subscript attached to each variable signals the quantity of the respective variable held by the representative bank. Other key variables include r_L = the average loan rate; r_D = average deposit rate; r_F = rate of interest on the international security (the LIBOR for instance); $c_i(L)$ = transaction and monitoring costs associated with making loans to private agents; ρ = the proportion of borrowers (where $0 \quad \rho \quad 1$) who are likely to default on their loans; and ψ = the probability (where $0 \quad \psi \quad 1$) that the government will fail to meet its debt obligations. The latter probability, for instance, is a function of the debt-GDP ratio or some other measure of debt sustainability. The bank's balance sheet identity in which *zD* = required reserves (where *z* = ratio of total excess and required liquidity) is given by the identity equation 2.

$$\Pi_i = (1-\rho) r_L(L) L_i + (1-\psi) r_G(G) G_i + r_F F_i - r_D(D) D_i - c_i(L) \qquad (1)$$

$$zD_i + G_i + F_i + L_i = D_i \qquad (2)$$

After solving the balance sheet constraint for F_i and substituting into equation 2, the profit function (equation 3) is derived.

$$\Pi_i = [(1-\rho) r_L(L) - r_F] L_i + [(1-\psi) r_G(G) - r_F] G_i - [r_D(D) - r_F(1-z)] D_i - c_i(L) \qquad (3)$$

$$L = L_i + \sum_{i \neq j} L_j \,;\; G = G_i + \sum_{i \neq j} G_j \,;\; D = D_i + \sum_{i \neq j} D_j \qquad (3a)$$

Following Freixas and Rochet (1999) the paper assumes a Cournot oligopoly. In the Cournot equilibrium the *i*th bank maximizes profit by taking the volume of loans, Treasury bills, and deposits of other banks as given. In other words, for the *i*th bank, (L_i^*, G_i^*, D_i^*), solves equation 3. Equation (3a) denotes the aggregate quantity of loans, Treasury bills and deposits demanded, respectively, by the entire banking sector.

The loan market

The author is now in a position to derive a pricing equation for the representative bank in the loan market. Equation 4 is the first order condition after maximizing the profit function with respect to L_i. The market demand curve the bank faces is downward sloping giving rise to the elasticity of demand expression in equation (4c) in which ε_L denotes the elasticity of demand. Bank *i* accounts for the fraction s_i^L out of the industry's total quantity of loans (4b). The expression $r_L(L)$ represents the first derivative of the loan rate with respect to *L*. As demonstrated by (4a) it is simply the inverse of $L(r_L)$.

$$\frac{d\Pi_i}{dL_i} = (1-\rho) r_L(L) + (1-\rho) r_L(L) L_i - r_F - c_i(L) = 0 \qquad (4)$$

$$r_L(L) = 1/L\,(r_L) \qquad (4a)$$

$$s_i^L = L_i / L \qquad (4b)$$

$$\varepsilon_L = r_L \;\; L\,(r_L)/L \qquad (4c)$$

Upon substituting 4a, 4b and 4c into the first order condition, equation 5 is obtained. The equation shows that the loan rate is a mark-up over the foreign rate and the marginal cost of transacting, $c_i(L)$. The mark-up is dependent on the market elasticity of demand and the share of the individual bank's demand for loan out of the total for the industry. As $s_i^L \quad 1$ there is the case of a monopoly and the mark-up is highest, while as $s_i^L \quad 0$ one bank has an infinitesimal share of the market; the equilibrium approaches the competitive state in which the mark-up approaches zero. The bank also increases the mark-up rate once the perceived probability of default increases (that is: $\rho \quad 1$).

$$r_L\left(1 + \frac{s_i^L}{\varepsilon_L}\right) = [r_F + c_i(L)]/(1-\rho) \qquad (5)$$

This equation helps to explain the existence of a minimum loan rate, at which point excess liquidity and private loans become perfect substitutes; hence, it explains the flattening of the empirical liquidity preference curve that was presented earlier. Since the bank possesses the ability to choose a minimum rate, it will simply accumulate excess liquidity when the marginal borrower cannot pay the desired minimum loan rate. In other words, the bank accumulates excess liquidity because the marginal benefit from the additional unit of loan is less than the marginal cost of that same unit of loan. The minimum rate also implies that the removal of financial repression[6] will result in very high loan rates as banks behave more like theoretical oligopolies. High loan rates, especially after the liberalization of financial systems, have been observed in many developing countries (see Chirwa and Mlachila, 2004).

The Treasury bill market

As noted earlier the commercial banks do not take the domestic Treasury bill rate as given. With only a few large institutional purchasers of government securities, it is assumed that buyers do exert influence over the Treasury bill rate when they place bids for the security. In other words, banks face an upward sloping supply curve rather than a flat curve that is more applicable to advanced economies. Therefore, the Treasury bill rate can also be derived as a mark-up over the international rate, especially since banks will compare the two interest rates in any highly open economy with free capital movements.

[6] Fry (1982) explains the main forms of financial repression as nominal interest rate ceilings for deposit and loan rates, directed credit to particular industries, and the expropriation by government of seigniorage by the use of high cash and liquid asset requirements and obligatory holding of government securities.

$$\frac{d\Pi_i}{dG_i} = (1-\psi) r_G(G) + (1-\psi) r_G'(G) G_i - r_F = 0 \qquad (6)$$

Maximizing the profit function with respect to G_i gives the first order condition in equation 6. Substitute 6a, 6b and 6c into equation 6 to obtain the new pricing equation 7. The equation postulates that the minimum Treasury bill rate at which a bank will bid for the security is denoted by a mark-up over the exogenous foreign rate and market-specific risk. The minimum mark-up rate increases as s_i^G 1 (where s_i^G is the share of total outstanding bills bought by bank *i*). The minimum rate also increases as ψ 1, hence the bank will bid at a higher rate once the likelihood of a government default increases. This result is also consistent with the notion that a market Treasury bill rate that is below the minimum stipulated by the mark-up rule will result in the bank accumulating excess reserves passively. Should the central bank choose a bid rate that is below the minimum desired rate, bank *i* will demand excess reserves (or foreign assets is the foreign currency can be found) since the marginal cost of making the investment in Treasury bills is greater than its perceived marginal benefit. The equation, therefore, is consistent with the observed tendency for the liquidity preference curve to flatten at a high Treasury bill rate. As noted earlier, such a behaviour is inconsistent with the classic liquidity trap in which the bond rate falls to zero and the liquidity preference curve flattens at zero bond rate.

$$r_G(G) = 1/G\,(r_G) \qquad (6a)$$

$$s_i^G = G_i\,/G \qquad (6b)$$

$$\varepsilon_G = r_G \;\; G\,(r_G)\,/G \qquad (6c)$$

$$r_G(1+\frac{s_i^G}{\varepsilon_G}) = r_F\,/(1-\psi) \qquad (7)$$

The deposit market

It is now possible, using a similar procedure, to derive a pricing equation for the deposit rate. The first order condition is given by equation 8. Following a similar procedure as before, the deposit rate is a mark-up over the foreign interest rate (equation 9). This is not hard to envisage since an unfavourable rate of return on Guyanese deposit accounts will encourage capital flight and a loss of reserves by commercial banks. The larger banks, measured by when s_i^D 1, are in a position to offer a higher mark-up over the international rate and therefore attract more deposits and market share. Equation 9 also suggests that the higher the ratio of liquidity (z) the lower the deposit rate. An important policy for increasing the deposit rate, and curtailing capital flight, would be to lower z. This is very difficult, however, in a situation of persistent excess liquidity.

$$\frac{d\Pi_i}{dD_i} = r_D(D) + r_D(D)D_i - r_F(1-z) = 0 \qquad (8)$$

$$r_D(D) = 1/D\,(r_D) \quad (8a)$$

$$s_i^D = D_i / D \quad (8b)$$

$$\varepsilon_D = r_D \;\; D\,(r_D)/D \quad (8c)$$

$$r_D(1+\frac{s_i^D}{\varepsilon_D}) = r_F(1-z) \quad (9)$$

4. ANALYZING MONETARY POLICY

It is interesting to see the extent to which indirect monetary policy can influence the loan and deposit rates. If monetary policy can influence these two key rates, then it can alter both consumption and investment decisions. Guyana's monetary authority, the Bank of Guyana, has consistently focused on mopping up excess reserves by selling domestic Treasury bills from its asset portfolio. This belief emerges from the idea that excess liquidity is a manifestation of excess money supply over the desired quantity of money demand. Therefore, the excess reserves must me neutralized so as to forestall adverse exchange rate and price outcomes.

Therefore, the objective is to analyze the effect on r_D and r_L when the central bank manages bank liquidity by varying the quantity of *G* (where *G* is an exogenous variable and r_D and r_L are endogenous variables). To derive the effect on the deposit rate, equations 7 and 9 are combined since they both include the common term r_F. The combined equation is given by equation 10. An increase in the sale of Treasury bills is indicative of a monetary tightening and a concomitant increase in r_G (that is: $r_G(G) > 0$); the opposite occurs when the sale of G declines. Equation 10 can now be used to find the derivative dr_D / dG (equation 11), which suggests that tightening domestic monetary policy increases r_D, while an expansion will have the opposite effect. Equation 11 implies that the effect of indirect monetary policy on the deposit rate depends on the parameters z, ψ, s_i^D, s_i^G and $r_G(G)$. The impact of the liquidity management policy on the deposit rate is weakened as s_i^D 1 and the higher the required reserve ratio (z). The effect also weakens as ψ 1. The pass-through from instrument (G) to the deposit rate is stronger the more responsive is the Treasury bill rate to the open market policy (that is: $r_G(G)$ is high). Conversely, a weak $r_G(G)$ diminishes the pass-through. Interestingly, the policy becomes more effective as s_i^G 1; this result indicates that when banks are willing to bid up the rate on domestic Treasury bills they will have to be willing to increase the deposit rate also since they risk losing deposits and market share as the non-bank investors move deposit funds into government securities.

$$r_D \frac{1+\frac{s_i^D}{\varepsilon_D}}{(1-z)(1-\psi)(1+\frac{s_i^G}{\varepsilon_G})} - r_G(G) = 0$$

(10)

$$\frac{dr_D}{dG} = \frac{r_G(G)(1-z)(1-\psi)(1+\frac{s_i^G}{\varepsilon_G})}{1+\frac{s_i^D}{\varepsilon_D}} > 0 \qquad (11)$$

Similarly, to analyze the effect of *G* on the loan rate, equations 5 and 7 are combined to form equation 12, which can then be used to find the derivative: dr_L / dG. Again it can be seen that the loan rate, like the deposit rate, is affected positively by a monetary contraction (increased sales of *G*) and negatively by a monetary expansion (decrease sales of *G*). However, the pass-through effect is weakened given the oligopolistic nature of the loan market. As s_i^L 1 the effect gets smaller; while it gets stronger as s_i^G 0, which in turn implies that as banks bid up the government security rate the loan rate will also rise to maintain the positive correlation between the two asset returns. Equation 12 further implies that efforts to persistently mop up excess reserves are likely to lead to higher loan rates and the possible crowding out of private sector investments; which is indeed the case in Guyana. Moreover, at the point where the liquidity preference curve is flat (that is $dr_L/dG = 0$) indirect monetary policy will have no impact on interest rate, which lead to no alteration of consumption or investment decisions.

$$r_L \frac{(1+\frac{s_i^L}{\varepsilon_L})(1-\rho)}{(1+\frac{s_i^G}{\varepsilon_G})(1-\psi)} - \frac{c(L)}{(1+\frac{s_i^G}{\varepsilon_G})(1-\psi)} - r_G(G) = 0 \qquad (12)$$

$$\frac{dr_L}{dG} = \frac{r_G(G)(1+\frac{s_i^G}{\varepsilon_G})(1-\psi)}{(1+\frac{s_i^L}{\varepsilon_L})(1-\rho)} \quad 0 \qquad (13)$$

5. A QUASI-CALIBRATION EXERCISE

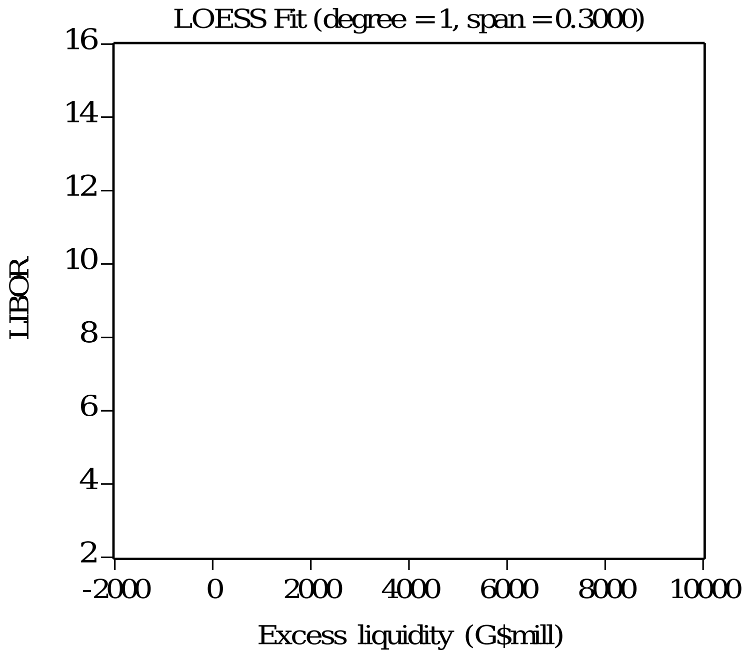
A calibration exercise – in the context of this paper – would normally involve choosing values for the parameters found in equations 5 and 7, together with a suitable proxy for the foreign interest rate, in order to replicate a flat liquidity preference curve given by the stylized information. This interpretation of calibration is in keeping with the outline given by Cooley (1996).

However, for the purpose of this paper arbitrary values will not be chosen for the parameters in equations 5 and 7. Instead, Guyana's excess liquidity is plotted against the exogenous foreign interest rate. If there is flattening of the liquidity preference curve – when non-remunerative excess liquidity is graphed against the foreign rate –

then there is evidence to suggest that equations 5 and 7 are valid representations of the behaviour of the loan and Treasury bill markets, respectively. Since values are not chosen for the model parameters, the term quasi-calibration is used instead of the conventional interpretation given by Cooley (1996). The LOESS method is again utilized to fit the quasi-calibrated liquidity preference curve from the non-linear scatter plot.

The other methodological issue concerns the relevant interest rate that must be used in the analysis. The 3-month London Interbank Offered Rate (LIBOR) is chosen as the representative base rate. This makes sense since each bank in Guyana has a counterpart bank in an advance economy. The deposits are likely to be made in money market accounts that are typically sensitive to the LIBOR. Indeed, the 3-month LIBOR generates the remarkably similar result of a perfectly elastic bank liquidity preference curve at just above four percent (see Figure 4). This result is taken as evidence consistent with the minimum rate hypothesis in both the Treasury bill and loan markets.

Figure 4, Excess liquidity and the LIBOR (Quarterly data: 1988Q1 – 2005Q4)



6. THE FOREIGN CURRENCY CONSTRAINT

There is still the outstanding puzzle as to why banks will choose to hold zero-interest excess reserves rather than invest in a safe foreign asset, whose rate might be low but still compensates for the inevitable exchange rate risk associated with holding cash in terms of Guyanese currency. It is an intriguing behaviour especially in light of the fact that restrictions on the outflow and inflow of foreign currencies have been dismantled since the early 1990s. One theoretical explanation that comes to mind is the encumbrance of transaction costs when investing in foreign assets. Transaction costs are known to enforce an inherent home bias in asset portfolios (Lewis, 1999). However, Guyanese banks are not likely to face these costs when depositing foreign currencies in a counterpart bank abroad since these are not inherently costly operations.

The second key hypothesis is the foreign currency constraint (FCC). The proposed hypothesis holds that banks' investment behaviour is a function of the quantity of foreign currency that is traded at any moment in the domestic foreign exchange market. More specifically for our concern is the proposition that banks are forced to hold the non-remunerative asset because the minimum rate is binding in the loan and Treasury bill markets and at the same time local banks cannot obtain the US dollars to place abroad with foreign counterpart banks.

It is possible to measure the FCC by subtracting the banks' total sales of US dollars from the total purchases of the same currency. A positive number indicates there is a surplus of US dollars, a negative value a deficit, and zero indicates no surplus or deficit (analogous to an equilibrium). The Guyanese foreign exchange market is made up of bank and non-bank traders who buy and sell mainly the US dollar. The stock of US dollars traded at any time comes mainly from export proceeds, foreign aid, remittances, and foreign loans. The stock is used for imports, servicing the external debt, accumulation by the central bank of international reserves, and investments in foreign assets by commercial banks[7].

[7]Mainly 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.

When the FCC is binding 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 (assuming the minimum rate hypothesis is also binding). 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 a surplus or deficit in this market can influence the flow of bank loans to the private sector. However, if there is no such relationship it implies that banks prefer to acquire excess reserves rather than make loans to the private sector when the market is in a deficit. Such an outcome can be interpreted as being consistent with the minimum rate hypothesis that was proposed earlier.

The scatter plots (Figures 5, 6 and 7) are based on monthly data from Jan 1999 to Jun 2006. Figure 5 shows a positive correlation between the change in the level of commercial bank foreign assets and the surplus or deficit in the foreign exchange market (the FCC). The information contained in Figure 5 is largely consistent with the existence of a foreign currency constraint. Figure 6 shows the correlation, which is negative, between the FCC and the ratio of total

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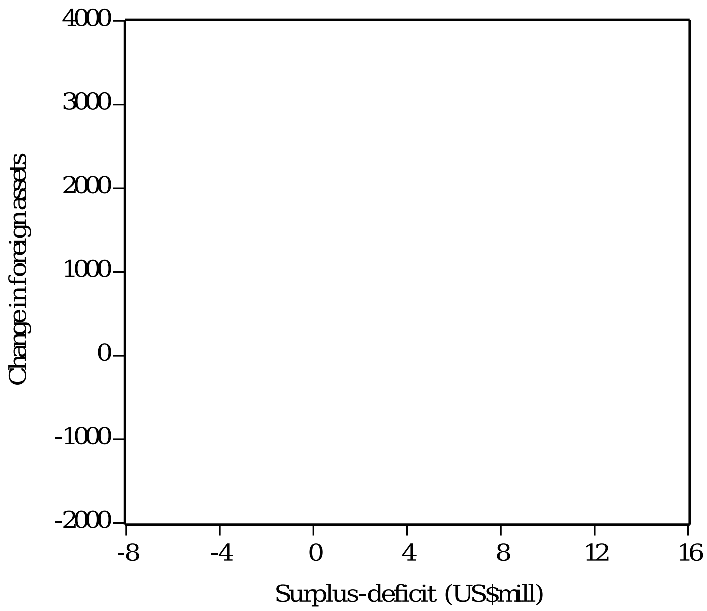
Small amounts of the Canadian dollar and the Euro were bought and sold during that period.

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 6 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 liquidity when there is a shortage of US dollars.

Figure 5, Foreign currency market (surplus-deficit US$) and change in commercial banks foreign assets



It is now interesting to see the extent to which the surplus or deficit in the foreign exchange market can influence 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 changes. If liquidity changes do not elicit much of a change in the loan market, then bank portfolios are static, a position that is consistent with the hypothesis of the minimum mark-up interest rate. Figure 7 – which is based on monthly data from Jan 1999 to Jun 2006 – illustrates an almost flat fitted line that intersects the vertical axis just below zero. Hence, a binding FCC is not likely to elicit a substantial change in the supply of bank loans to private agents. The reason being the quantity of loans is determined by different dynamics – principally in our context, the minimum rate determined by the banks which customers are required to pay.

Figure 6, Foreign currency market (surplus-deficit of US$) and commercial banks excess reserves

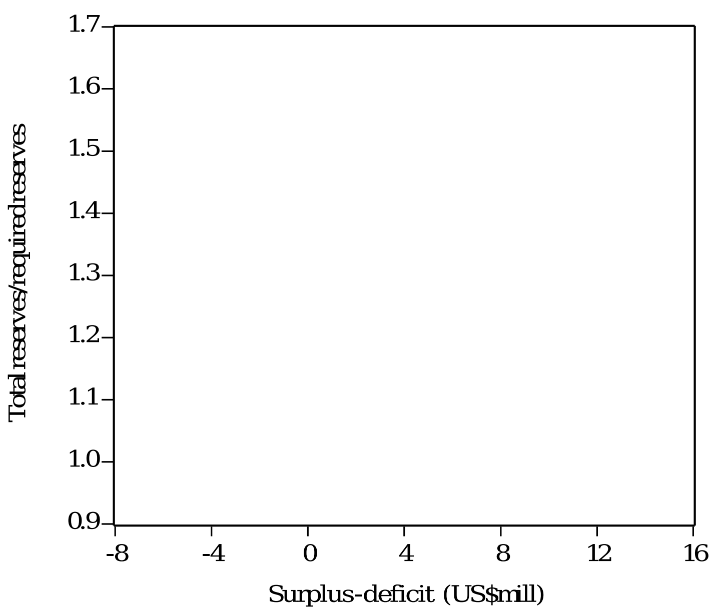
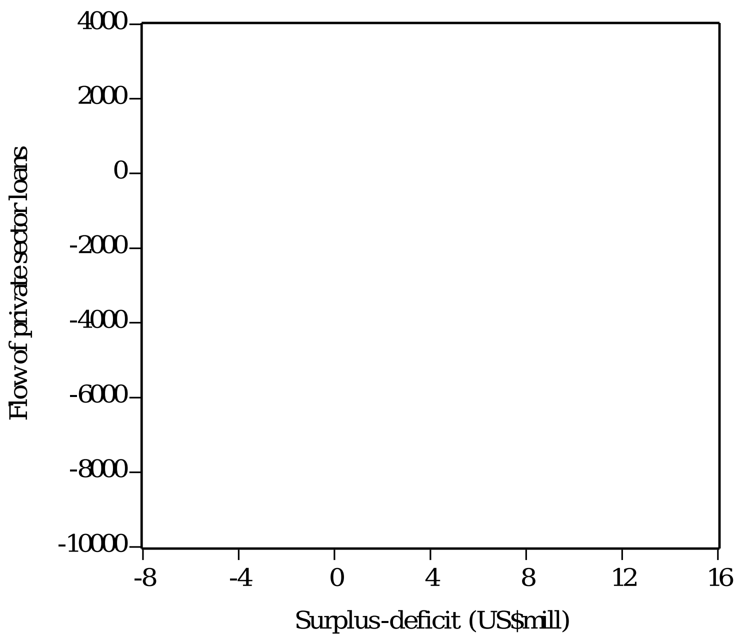


Figure 7, Foreign currency market (surplus-deficit of US$) and change in commercial banks credit to private sector



Econometric analysis of excess reserves

This section examines the determinants of excess reserves by estimating an autoregressive distributed lag model (ARDL). In keeping with the empirical models of Agenor, Aizenman, and Hoffmaister (2004), Saxegaard (2006), and Fielding and Shorthand (2005), a very general model was first estimated.

Owing to space limitation the results for the general estimation is not presented. That is because the central bank discount rate, the required reserve ratio, currency volatility, deposit volatility, and the ratio of demand deposits to total deposits were all found to be insignificant and they possessed the wrong coefficient sign. In particular, the required reserve ratio changed only three times during the period of analysis and that might explain why it was found to be insignificant. Interestingly, the insignificance of the currency volatility measure, deposit volatility[8], the ratio of demand deposits to total deposits, and the discount rate underscore the fact the that liquidity risks are not very important in an environment of persistent excess reserves.

Given these findings, the ARDL model presented in equation 14 uses variables that can better explain the Guyanese situation. The relevant variables are er_t which denotes the ratio of total reserves to required reserves; fx which denotes the foreign exchange market surplus or deficit (the FCC); Δir which represents the change in the level of the central bank's international reserves; and $volfer$ that represents the volatility of the Guyana dollar-US dollar nominal exchange rate. The term ε_t denotes the serially uncorrelated, homoskedastic, and normally distributed error term.

[8] In each case volatility was measured using a method similar to equation 15. Experimentation with a GARCH (1, 1) model as a measure of volatility of the different series could not change the result.

$$er_t = \alpha_0 + \sum_{i=0}^{n} \alpha_i fx_{t-i} + \sum_{j=0}^{p} \alpha_j \Delta ir_{t-j} + \sum_{k=0}^{q} \alpha_k volfer_{t-k} + \sum_{l=1}^{m} \alpha_l er_{t-l} + \varepsilon_t \qquad (14)$$

As noted earlier, a surplus in the foreign exchange market diminishes excess reserves while a deficit exerts the opposite effect. Therefore, the coefficient α_i is expected to be negative. On the other hand, if the central bank engages in asymmetric foreign exchange market interventions – meaning most of the time the central bank buys the international reserve currency rather than sells – the result will be the build-up of excess reserves if there is insufficient sterilization (that is the sterilization coefficient[9] is between 0 and -1). Hence, the coefficient α_j is expected to be positive. That is because the main focus of Guyanese monetary policy is on preserving the stability of the currency vis-à-vis the US dollar. The central bank obtains the hard currency through purchases (and paying with Guyanese currency) from the domestic foreign exchange market. The process therefore injects liquidity into the system – hence the positive coefficient.

It is expected that a volatile exchange rate will induce banks to reduce excess reserves and purchase a safe foreign asset since the depreciation increases the expected return in terms of Guyana dollars. Guyanese banks are likely to associate higher volatility with

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[9] See Seo (2005) for further description of issues pertaining to the sterilization coefficient and foreign exchange market intervention.

depreciations since past evidence suggests the rate can only depreciate further against the main international reserve currency – the US dollar. Therefore, the coefficient α_k is expected to be negative. An important issue now emerges: how to measure volatility? Equation 15 identifies the measure that is adopted in this paper. According to the formula the volatility is the sample standard deviation of the change in the nominal monthly Guyana-dollar/US-dollar exchange rate (*E*). In this case *n* is the averaging period, which is taken to be three months.

$$volfer_t = \left[(1/n)\sum_{i=1}^{n}(E_{t-i} - \bar{E})^2\right]^{1/2}$$

(15)

The estimation is based on a sample of monthly data that ranges from January 1999 to June 2006, a total of ninety observations[10]. However, before estimating equation 14, it is important to examine the time series properties of each variable in the equation. To do so, 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 exchange rate

[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*.

volatility variable (*voler*) and the foreign exchange market surplus/deficit (*fx* – that is the FCC term) are stationary in their levels. The ratio of total reserves to required reserves (*er*) is stationary at the one percent level when the equation includes only the intercept term. However, when both intercept and trend are included, the null of non-stationarity cannot be rejected. However, when the sample size is expanded from January 1991 to June 2006, the ADF test rejects the null at the 1 percent level when an intercept alone is used, and when both intercept and trend are included in the equation. The test statistics turn out to be -4.36 and -7.13, respectively, for the intercept alone and the intercept and trend alternative. Furthermore, visual examination of the autocorrelation and partial autocorrelation functions does not detect long memory in the level of the ratio (*er*). It is therefore concluded that *er* is stationary in its level. Finally, the unit root test for *ir* suggests it is non-stationary in its level but becomes stationary after differencing once (Δir).

Hence, given the way equation 14 is set up each variable is stationary. The inclusion of Δir does not mean the equation is unbalanced since the focus is on how the change in (and not the level of) international reserves impacts on the ratio *er*. Moreover, the possibility that the regression is spurious is greatly diminished when each variable is stationary. The estimation results are presented in Table 1. Each coefficient has the expected sign and the foreign currency constraint term (*fx*) is highly significant. This variable, therefore, constitutes evidence in favour of the existence of a FCC. Δir is significant at the 10 percent level, while *voler* is not significant but it is maintained because it carries the correct sign. *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 first and fourth order serial correlation of the residuals do not reveal this 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 errors of the model have a constant variance. And finally, Ramsey's RESET test for general misspecification could not reject the null hypothesis of correct specification – suggesting that the model is constructed in its correct functional form and not omit relevant variables.

In order to test for coefficient and variance stability the CUSUM and CUSUMSQ tests that were proposed by Brown, Dublin and Evans (1975) are utilized. The tests are applied to the residuals of the estimated model. The CUSUM test is based on the cumulative sum of the recursive residuals based on the first *n* observations. It is then updated recursively and plotted against time. The model coefficients are unstable when the plot of CUSUM strays outside the 5 percent significance lines. The result is presented in Figure 1A (Appendix 1).

It suggests stability at the five percent level of significance. The procedure for the CUSUMSQ is similar: coefficient and variance instability are indicated by a movement of cumulative sum of recursive residuals outside the 5 percent critical lines. Figure 1B (Appendix 1) shows no such tendency, thereby leading to the conclusion that the model is stable.

Table 1, Regression results

Dependent Variable: er
Included observations: 89 after adjustments (Jan1999-Jun2006)

Variable	Coefficient	Std. Error	t-statistic	p-value
Constant	0.5354	0.098	5.49	0.000
fx	-0.0115	0.003	-3.80	0.000
Δir	0.0019	0.001	1.62	0.109
voler	-0.0762	0.058	-1.31	0.192
er (t-1)	0.6106	0.072	8.44	0.000
Adj-R^2	0.52			
Serial corr. LM (1)	$n*R^2$=3.15	p-value=0.075		
Serial corr. LM (4)	$n*R^2$=5.77	p-value=0.217		
Heteroskedasticity (White)	$n*R^2$=4.72	p-value=0.786		
Normality (J-B, χ^2 (2))	0.627	p-value=0.730		
Ramsey RESET (F-stat)	2.15	p-value=0.123		

7. CONCLUSIONS AND POLICY IMPLICATIONS

This paper proposed two alternative hypotheses to explain the persistent excess liquidity phenomenon in Guyana. The evidence presented suggests banks require a minimum rate of interest in the loan market and the market for government Treasury bills. In the case of the loan market, banks accumulate excess liquidity when a marginal borrower is unable to pay the minimum interest rate, which is a mark-up over the foreign interest rate, marginal transaction costs and a risk premium. Banks can mark up the loan rate because they possess oligopoly power in the loan market. In the case of the Treasury bill market, a bank does not bid for the Treasury bill when the government's offered rate is below the desired minimum rate. The mark-up Treasury bill rate suggests banks possess oligoposony power in this market. This behaviour is fundamentally different from previous applications of the oligopoly banking model to problems in the advanced economies. It is also fundamentally important because Guyana-type economies, with oligopoly structures, will never possess a suitable domestic benchmark interest rate that pins down the domestic term structure of interest rates. This is particularly important for future pricing of short-term and long-term domestic financial instruments.

The second hypothesis – the foreign currency constraint – explains why local commercial banks cannot convert all excess reserves into bank deposits in foreign counterpart banks. The FCC works in tandem with the other hypothesis to cause banks to hold the non-remunerative asset for long periods. The evidence suggests that when Guyanese commercial banks refuse to make loans, they will try to invest in foreign assets. When faced with a binding FCC simultaneously, they have to accumulate excess liquidity.

There are three key policy implications that emerge from the findings in this paper. The first concerns with the very high loan rate that will result – as banks behave more like theoretical oligopolies – after the financial system is liberalized. The high interest rate is most likely to be detrimental to the developmental objectives of sustaining growth and stimulating private investments. In essence, we are likely to move from a state of financial repression to oligopoly stagnation, especially since foreign capital has largely ignored Guyana-type economies (see Prasad; Rajan and Subramanian, 2007).

The second policy implication is the ineffectiveness of indirect monetary policy over the flat range of the liquidity preference curve. This is because commercial banks set both the short-term interest rate and the loan rate exogenously of central bank monetary policy (or liquidity) shocks. Liquidity shocks will only alter interest rates, hence consumption and investment decisions, over the downward sloping and vertical section of the curves. As we have already seen the minimum rate occurs at an already high level. Therefore, indirect or market-based monetary policy can only be effective at very high interest rates. Society and the policy makers, and the foreigners who advise the domestic policy makers, will have to decide whether indirect monetary policy is so important that it is worth the cost of persistent strangulation of domestic private investments in productive activities.

The third policy has more to do with the operational aspect of doing monetary policy in Guyana-type economies. This study demonstrated that local banks are keen to send hard currencies abroad when the chance emerges. Therefore, it would be useful information if the central bank in these economies can utilize the richness of the econometric techniques, and other methods, to forecast the foreign currency constraint.

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APPENDIX 1

Table A, Dickey-Fuller (ADF) tests

Variable	lags	Intercept alone	lags	Trend & intercept
er	1	-4.55*	1	-3.14
Δer	1	-13.59*	1	-13.59*
voler	1	-16.07*	1	-16.49*
fx	1	-8.55*	1	-8.82*
ir	1	-2.33	1	-3.02
Δir	2	-9.62*	2	-9.68*

*Significant at the 1 percent level.
The optimum number of lags were chosen by Schwarz Information Criterion.

Figure 1A, Plot of cumulative sum of recursive residuals (CUSUM)

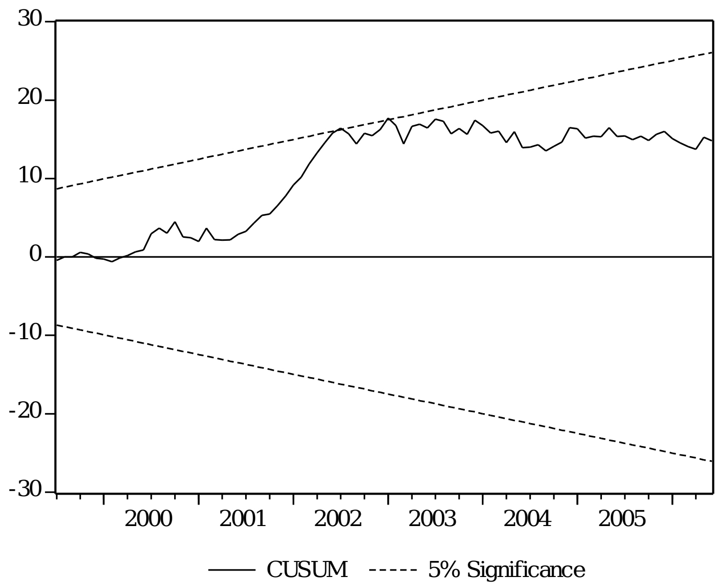
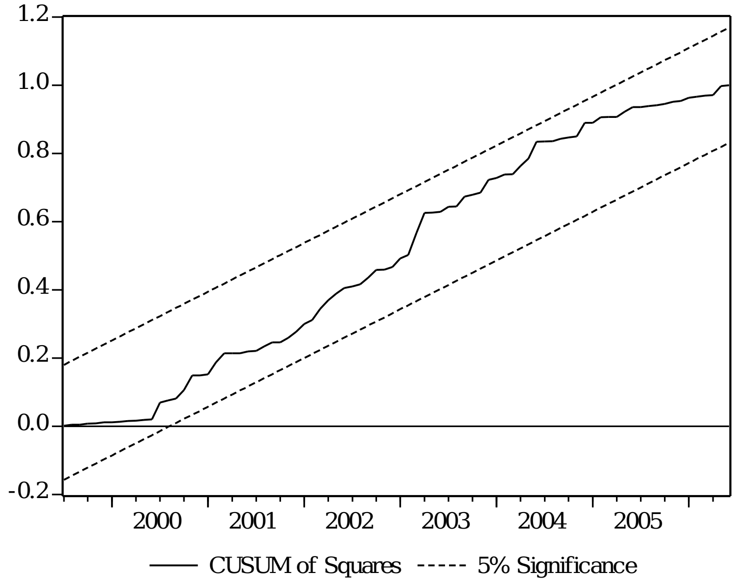


Figure 1B, Plot of cumulative sum of squares of residuals (CUSUMSQ)


1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
2000
2001
2002
2003
2004
2005
CUSUM of Squares
5% Significance