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Khemraj, Tarron and Pasha, Sukrishnalall

New College of Florida, University of Guyana

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Tarron Khemraj
New College of Florida

Sukrishnalall Pasha
University of Guyana

Abstract

Starting in 2004 the Guyanese foreign exchange rate has been remarkably stable relative to earlier periods. This paper explores the reasons for the stability of the rate. First, the degree of concentration in the foreign exchange market has increased, thus making the task of moral suasion relatively straightforward once this policy tool comes to bear on the dominant trader (s). Second, long-term or non-volatile capital inflows make the exchange rate less susceptible to sudden reversal. Third, commercial banks, the dominant foreign exchange traders, have large outlays of assets in domestic currency, thus their desire for exchange rate stability. The econometric exercise is consistent with the notion that trader market power has contributed to lower volatility in the G$/US exchange rate. The paper also presents a model that analyzes monetary policy effects in the presence of a mark-up or threshold interest rate.

Key Words: exchange rate, foreign exchange market, market power

JEL Codes: F31, F40, F41

1. Introduction

As part of a broad macroeconomic reform agenda implemented in 1988, Guyana adopted a floating exchange rate in 1990 (Egoume-Bossogo et al, 2003; Thomas and Rampersaud, 1991). The parallel or street rate was merged with the official rate as one aspect of comprehensive macroeconomic and financial sector reforms. A notable spread, prior to 1990, existed between the official and parallel rates; however, as the reforms intensified the spread declined and the rates converged (Fardmanesh and Douglas, 2008). The agenda of foreign exchange market reform was not limited to Guyana. Instead, it was a widespread reform movement in other parts of the world such as the Caribbean and

African economies (Fardmanesh and Douglas, 2008; Galbis, 1993). The banking and financial sector reforms pursued in Guyana included: promoting financial market development, decontrolling interest rate, implementing market-based monetary policy through a Treasury bill auctioning framework, privatizing state-owned banks, and dismantling direct credit schemes (Das and Ganga, 1997; Egoume-Bossogo et al, 2003).

Starting from around 2004, despite the extensive nature of the financial reforms, the exchange rate moved from a relatively flexible to a virtually fixed rate[1]. This regime shift went unnoticed to most except the IMF which started to classify Guyana as having a de facto pegged exchange rate regime (IMF, 2006). Heretofore, the academic literature has not analyzed this silent transition; thus this paper intends to make a contribution in that regard. However, using a probit model, Hagen and Zhou (2005) examine the factors allowing for a divergence between de facto and official exchange rate regimes in twenty-five Transition economies. They argue that it is less costly to adjust the de facto exchange rate because less commitment is required.

Upon examination of the institutional features of the foreign exchange market, the paper argues that this market is highly concentrated where a few commercial banks dominate the trading of foreign currencies. Therefore, we postulate that trader market power and high concentration (in the foreign exchange market) helps in the stabilization of the rate. In addition, given that commercial banks, in the aggregate, possess a large portfolio of assets in domestic currency (loans, treasury bills and excess reserves), it is not in their interest to see the nominal exchange rate depreciate rapidly because of the potential inflation pass-through. Therefore, to the extent that moral suasion is used as a

[1] The issue of exchange rate stability is important because volatility tend to be inversely related to economic growth (Schnabl, 2008).

monetary management tool, it is more likely to succeed given the institutional features of the Guyanese foreign exchange market[2].

Moreover, the paper also hypothesizes that the nature of capital inflows facilitates and buttresses the market power role of the commercial banks in stabilizing the rate[3]. Portfolio or hot money inflows are very small relative to stable long-term capital inflows. The latter include foreign direct investments, remittances, aid funds, and multinational loans. Remittances form an important source of foreign exchange inflows; therefore, to the extent the altruistic motive to remit is dominant, this form of foreign exchange inflow eases the exchange rate volatility and reinforces the strategic exchange rate formation role of the large commercial bank traders[4].

The paper adopts a three-tier methodology to present its case. Firstly, we present a narrative approach outlining stylized facts and features of the Guyana foreign exchange market. Secondly, we present a simple model that illustrates how a threshold domestic interest rate influences the central bank's management of commercial bank reserves (as is done under the financial programming model). The threshold is identified by an aggregate commercial bank liquidity preference curve that becomes flat at the interest threshold, which is assumed to be a mark-up over the foreign interest rate. Thirdly, we

[2] It should be noted that the central bank has never announced that moral suasion is part of its monetary policy toolkit. Instead, the central bank indicates that it follows an indirect monetary policy tool that manages commercial bank excess reserves. However, Egoume-Bossogo et al (2003) suggest that moral suasion was exercised during 1996-97 when there was major political unrest.

[3] Sudden swings in capital inflows – especially short-term inflows – can be devastating and result in bankruptcies, destruction of the credit channel, and impose an adverse effect on human capital (Calvo, 1998).

[4] Agarwal and Horowitz (2002) found the altruistic motive to be the important factor in determining the inflow of remittances into Guyana.

provide some econometric evidence which models exchange rate volatility and concentration as measured by the Herfindahl-Hirschman index.

The paper is structured as follows. Section 2 presents background information that outlines the de facto pegged rate and other key macroeconomic variables. Section 3 examines the composition of capital inflows. Section 4 explores the structure and features of the foreign exchange market. Section 5 presents several arguments why the rate stabilized. Section 6 presents a theoretical model which shows that a binding threshold mark-up interest rate could generate a stable exchange rate in the presence of monetary expansion. Section 7 provides econometric evidence that shows that exchange rate volatility is negatively related to concentration (the market power thesis). Section 8 concludes. This study focuses on Guyana because the unannounced exchange rate regime change presents an opportunity for this type of analysis. Furthermore, we were only able to obtain micro level data on foreign exchange traders for Guyana in order to calculate the Herfindahl-Hirschman index (HHI) for the said economy. However, the banks' liquidity preference curves – central to the analysis of this paper – can be found for other economies in addition to Guyana (see Khemraj, 2006).

2. Background Information

In November 1989 several bank and non-bank traders (or cambios) were licensed to buy and sell foreign currencies at freely determined rates. By March 1990 the cambio market system – in which bank and non-bank traders freely buy and sell foreign currencies – was implemented. Figure 1 shows the G$/US$ exchange rate from first quarter 1991 to last quarter 2009. This is the effective rate as over 90 percent of foreign currencies traded are the United States dollar. On the left- axis is the G$/US$ rate. It is

obvious the rate depreciated substantially in the early period of the formation of the cambio market system; as at end 2009, the exchange rate stood at G$204 for US$1. However, by fourth quarter of 2004 the rate stabilized remarkably relative to previous periods.

It is easier to spot the relative stability by looking at the bars (right-axis), which shows the change in the exchange rate from one period to the next. Thus a large spike shows a large and volatile change in the exchange rate from period to period. On the other hand, stability is indicated by a less volatile oscillation of the bar spikes. Moreover, when the spike is above zero it signals depreciation, while a spike below zero reflects an appreciation of the Guyana dollar vis-à-vis the US dollar. Also reported is the GARCH (1, 1) measure of volatility which shows remarkable tranquillity after 2004[5].

Table 1 presents selected macroeconomic indicators. The data suggest that the external debt ratio continued to decline in the post-2004 period; a noticeable accumulation of foreign reserves in 2008 and 2009; and a surplus in the current account balance in 2008 and 2009. The unprecedented accumulation of foreign exchange reserves and the surplus occurred long after the exchange rate stabilized. Otherwise, there is no other conspicuous change in the data that provides a clue as to what accounted for the stability of the rate in the post-2004 era. There was also no noticeable shift in the monetary aggregates that could account for the regime change.

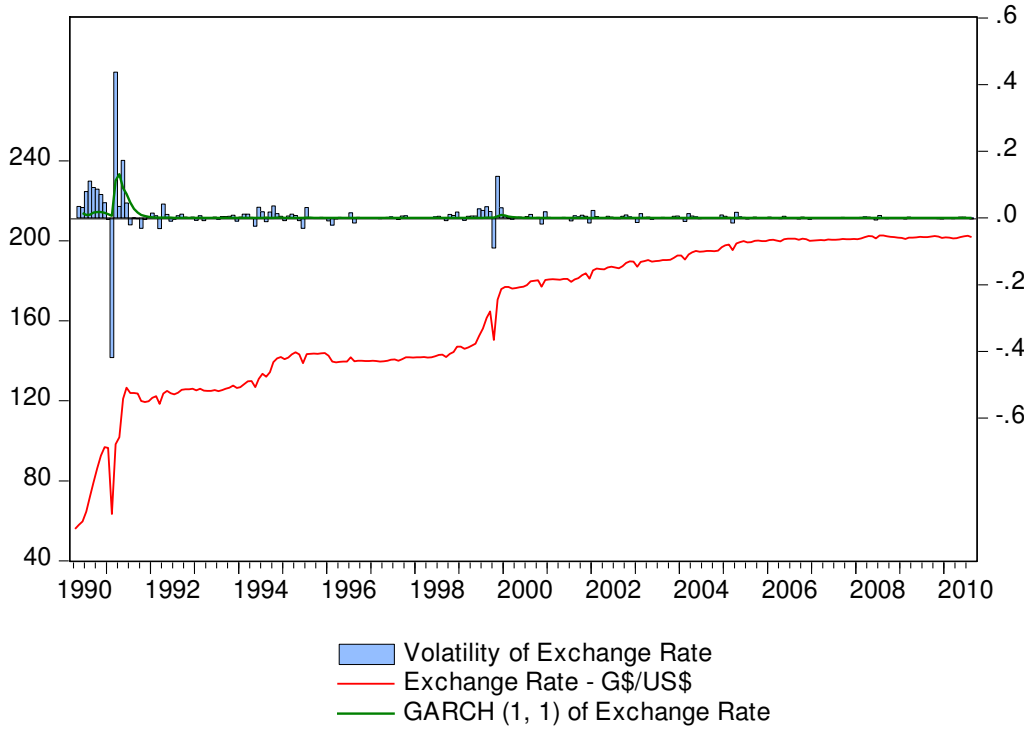
3. The Nature of Capital Inflows

Given that the exchange rate can be affected by capital inflows, this section outlines the type of capital inflows into the Guyana economy. We are particularly

[5] We follow the suggestions and procedures outlined by Enders (2010) and Brooks (2008) when determining the fit for the GARCH (1, 1) model. According to Brooks (2008) the GARCH (1, 1) model is typically sufficient for modeling the conditional volatility.

interested in whether the type of capital inflows can suddenly reverse direction and exit. The data on key components are presented in Table 2. The main items are long-term foreign direct investments and remittances. A study in the Guyanese context found that remittance inflows are motivated by senders' altruism (Agarwal and Horowitz, 2002). Long-term loans and grants to the government also form a main inflow that is not susceptible to sudden reversal. Short-term capital inflows, which are made up mainly of foreign bank deposits held in Guyana, are relatively small compared with the other categories. A precipitous decline in these potentially volatile deposits in 2008 did not appear to influence the exchange rate in a substantial manner.

Figure 1. The G$/US$ exchange rate (left-axis) and volatility (right-axis) – 1990: April to 2010: Aug



Data source: *International Financial Statistics*

Table 1. Selected macroeconomic indicators

Real GDP Growth (%)	-1.4	2.3	1.1	-0.7	1.6	-1.9	5.1	5.4	3.1	2.3
Annual Inflation (%)	6.1	2.6	5.3	6.0	4.7	6.9	6.6	12.3	8.1	2.9
Current Account/GDP (%)	-15	-18	-15	-11	-9	-19	-28	-18	14	9
Capital Account/GDP (%)	19	16	12	8	5	22	30	16	13	18
External Debt/GDP (%)	170	170	187	162	152	148	115	67	73	74
Reserve Money Growth (%)	14	11	10	10	8	11	5	8	7	24
M1 Growth (%)	15	0	6	17	12	9	27	13	13	9
M2 Growth (%)	11	9	5	8	8	8	16	14	13	10
International Reserves (US$-Mill)	305	287	284	276	232	252	280	313	356	631

Source: Caribbean Centre for Money and Finance; International Financial Statistics

Table 2. Capital inflows (US$ millions)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Short-term inflows	19	16	22	21	34	49	50	52	40	50
Foreign direct investments	67	56	44	26	30	77	102	110	184	208
Workers' remittances	47	44	40	47	74	167	216	287	329	300
Long-term loans and grants	66	66	45	68	61	102	107	105	187	135

Source: Bank of Guyana *Annual Report* (various years)

4. Features of the FX Market

The number of bank and non-bank foreign exchange (hereafter FX) traders is presented in Table 3, which also provides a summary of the volume of purchases by the two categories of traders. We did not report the percentages from the sales quantities as they did not change the results in any significant way. It is clear that the volume of foreign currencies purchased by the traders has expanded continually since 2000. There was a noticeable increase of US$71 million in total purchases in 2004. The total volume of US dollar purchased in 2009 grew by US$77 million, accounted for mainly by a steep increase of purchases by non-bank traders. Table 3 shows that commercial banks are the largest traders accounting for approximately 90 percent of FX purchases.

Table 3. Total foreign exchange purchased by traders (US$ million)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Commercial banks	359	378	420	479	534	604	671	860	1052	1065
Non-banks	45	47	51	53	69	70	64	83	72	137
Total purchases	403	425	471	532	603	674	735	943	1125	1202
					Percentages					
Commercial banks	89	89	89	90	89	90	91	91	94	89
Non-banks	11	11	11	10	11	10	9	9	6	11
					Number of Traders					
Commercial banks	7	7	7	6	6	6	6	6	6	6
Non-banks	24	24	23	21	21	21	21	21	21	21
Total FX traders	31	31	30	27	27	27	27	27	27	27

Source: Bank of Guyana *Annual Report* (various years)

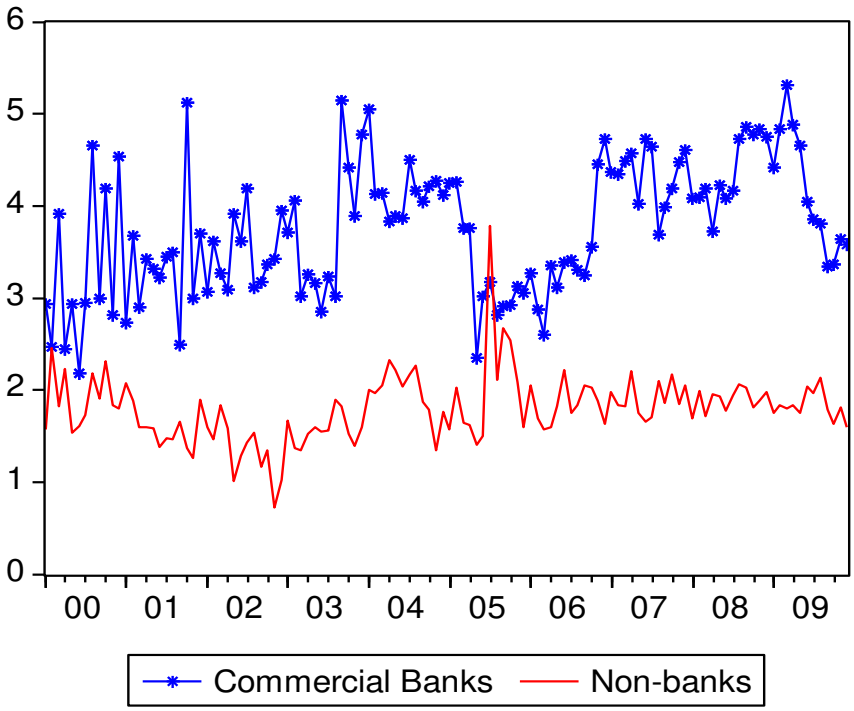
The main currencies traded in the market are the US dollar, Canadian dollar and the Euro. The US dollar accounts for the largest percentage of all FX trades, persistently accounting for approximately 90 percent of all currency trades. The Canadian dollar or Euro often switches places for the second spot. There is no central market for foreign currency trading; thus trades occur primarily over-the-counter; and there is no trading of forward exchange rate contracts in Guyana – thus the exchange rate is a spot rate.

Figure 2 is consistent with the notion of the existence of market power in the FX market. The spread for commercial banks is higher for most of the sample period for which data are available. Notwithstanding the fact that the bid-ask spread can be determined by other factors[6], it is important to note that the commercial banks possess the higher spread. As indicated by the data given in table 3, the commercial banks are the larger traders, despite their smaller numbers. The bank concentration would have been enhanced in 2003 given the merger of the state-owned commercial bank (Guyana

[6] For an examination of different determinants of FX market bid-ask spread see Melvin and Tan (1996) and Sager and Taylor (2006).

National Cooperative Bank) with the private bank (National Bank of Industry and Commerce).

Figure 2: Average bid-ask spreads of bank and non-bank cambios (G$), 2000: Jan – 2009: Dec

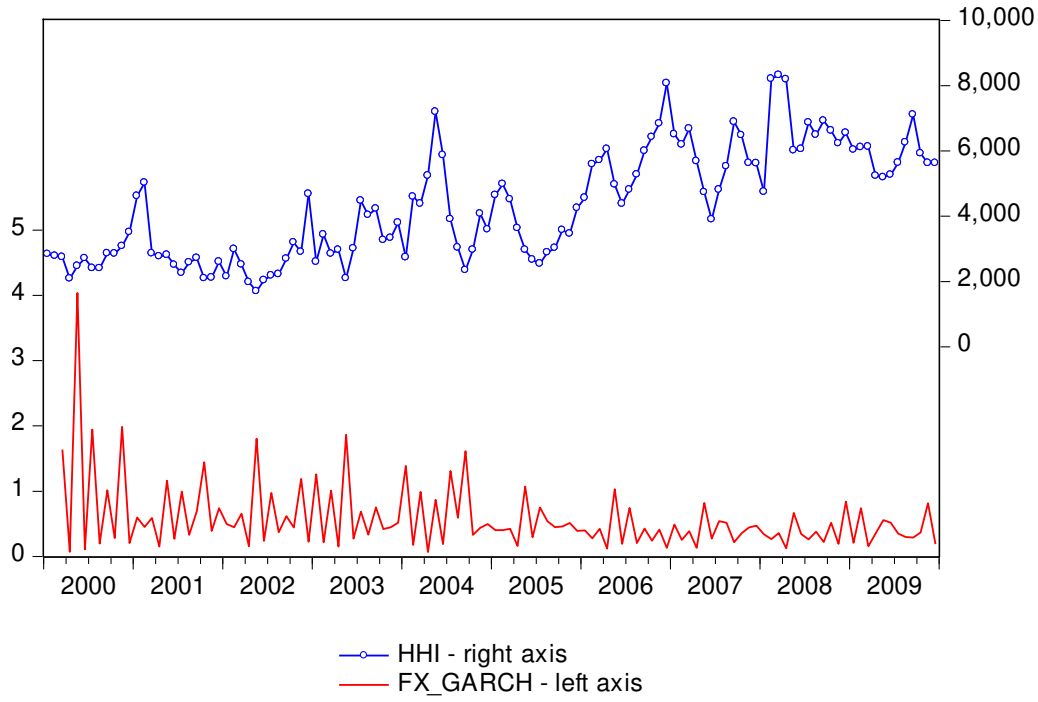


Data Source: Bank of Guyana

Since 2004 the level of concentration in the market has increased (see figure 3). The high concentration in the market is clearly visible from the computation of the Herfindahl-Hirschman index. When this index is graphed with the volatility of the G$/US$ exchange rate there appears to be a clear inverse relationship between the two variables suggesting the higher concentration is associated with lower volatility. The average HHI from 2000 to 2003 was 2897, while for the period 2004 to 2009 it increased to 6200. Clearly the degree of concentration increased substantially after 2004, a period which coincides with the largest bank merger. An HHI of 10,000 is often associated with

a monopoly. Therefore, our calculated HHI appears to be more consistent with an oligopolistic FX market. The volatility of the FX rate also tended to decline by over 50 percent after 2004.

Figure 3: Market concentration (HHI) and GARCH volatility – 2000: Jan to 2009: Dec



Source: Authors' calculations

5. Why the Stabilization of the Exchange Rate?

There has been no announcement of a formal exchange rate regime shift. However, the high concentration of FX trading volumes would make it easy for the large commercial banks to set the rate and the others will have to follow. In other words, there could be a case of price leadership in the determination of the rate, whereby the large volume traders set the rate and the small volume traders follow. The large commercial banks possess a nationwide branch network which allows them to mobilize FX with ease relative to the non-bank cambios. Moreover, the wide branch network allows for a greater

lock-in effect for the public to do over-the-counter trades. Further the larger banks provide greater physical security when the public is exchanging funds. The small traders are often single entities in the main cities and therefore do not benefit from branch networks.

The degree of market concentration enhances the ability of the central bank to use moral suasion, assuming it is used at all[7]. In this case, it is better to influence the dominant volume traders or price leaders as they trade most of the foreign currencies. Even if the smaller traders would like to set different rates they do not mobilize the volumes to do trades that shift the market fundamentally. In addition, should the central bank rely on moral suasion, its task is made easier given the nature of capital inflows that are not susceptible to sudden swings.

One might ask what incentive the price leaders would have to desire a stable rate or cooperate with the policy makers in the event if moral suasion is used as a policy tool. If banks could hoard foreign exchange and the rate depreciates, then they would realize a profit in terms of local currency. However, commercial banks, which also trade foreign currencies, are more importantly lenders with large loan portfolios in Guyana dollars. They also possess an asset portfolio that is liquid in the domestic government securities and excess reserves. Therefore, it is not in their interest to have the Guyana dollar depreciate rapidly given that importers will pass on the higher import prices to consumers. Thus with rising inflation resulting from the depreciation, the banks would

[7] For an empirical analysis of the relationship between bank competition and financial stability see Berger et at (2008). Vives (2001) presents a helpful review of different aspect of the literature relating to bank competition, stability, regulation and competition policy. These authors look at the issue from the point of view of the loan market. In contrast, this paper proposes the hypothesis that banks which are the dominant foreign exchange traders, and have large asset outlays in domestic currency, could result in the stabilization of the exchange rate.

actually realize a loss in loan value and those who borrowed will gain. Also, a rapid depreciation could lead to a flight of foreign currency deposits (this is given in table 2 as short-term inflows). Table 4 reports the asset composition (in percentages) of commercial banks. The table shows that the major asset components are in domestic currency.

Table 4. Asset composition of commercial banks (percentages)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Foreign assets	7	9	10	14	15	18	17	24	22	17
Credit to government	18	17	18	24	26	25	26	21	22	25
Credit to private sector	46	44	41	34	28	27	27	28	29	26
Reserves and deposits at central bank	14	15	16	16	16	17	16	12	11	14
Other assets	15	16	15	12	14	14	14	14	16	17
Total percentages	100	100	100	100	100	100	100	100	100	100

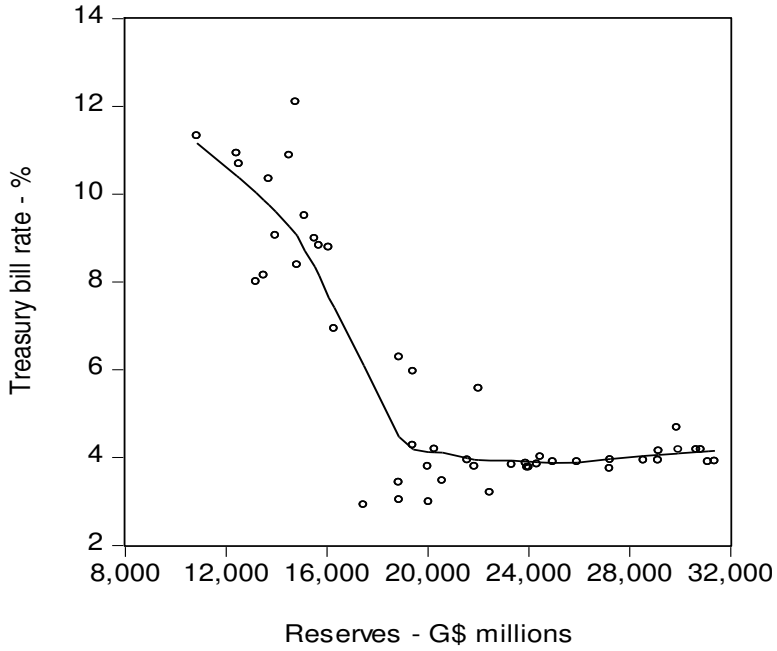
Data source: Bank of Guyana *Annual Reports* (various years)

6. Bank Liquidity Preference and the Exchange Rate

According to the Bank of Guyana (BOG), the main focus of its monetary policy is the effective management of reserves in the banking system. The latter is accomplished by a financial programming tool that facilitates open market operations consistent with forecasts for inflation and international reserves (BOG, 2009; Ganga, 2000). Effective management of the exchange rate is seen as essential for maintaining exchange rate and price stability. In other words, commercial banks possess a demand for reserves – defined as actual reserves plus required reserves – which the central bank must supply based on forecasts for inflation and international reserves. In addition, the central bank varies its tools of monetary policy consistent with the reserves forecasts of the financial programming model (Ganga, 2000). This is the essence of market-based or indirect

monetary policy[8]. Moreover, that monetary policy operates on the reserves of banks is implicitly recognizing the ability of banks in determining economic outcomes in an economy with a bank-dominated financial structure.

Figure 4. Liquidity preference for commercial banks (1998: Q1 to 2009: Q4)



Data source: *International Financial Statistics*

The empirical demand curve for reserves is presented by figure 4[9]. The curve is fitted using quarterly data taken from the *International Financial Statistics*. The reserves level was calculated by subtracting currency in circulation from reserve money. The interest rate is the 3-month Treasury bill rate, which was also sourced from the *International Financial Statistics*. Analytically, the curve is the aggregate banking sector demand curve for reserves, which the central bank manages using open market

[8] See Balino et al (2005) for outline of the nature of indirect monetary policy.

[9] The curve was fitted using the method of locally weighted regressions with a smoothing factor of 0.4. For a detailed explanation of this technique see Cleveland (1979).

operations. The empirical curve is downward sloping and it becomes horizontal at a Treasury bill rate of approximately 4%. This can be termed a threshold or minimum interest rate at which point the banks accumulate reserves passively. Open market operations, which shift a vertical reserve supply curve along the liquidity preference curve, will have no effect on the rate of interest over the flat segment of the curve.

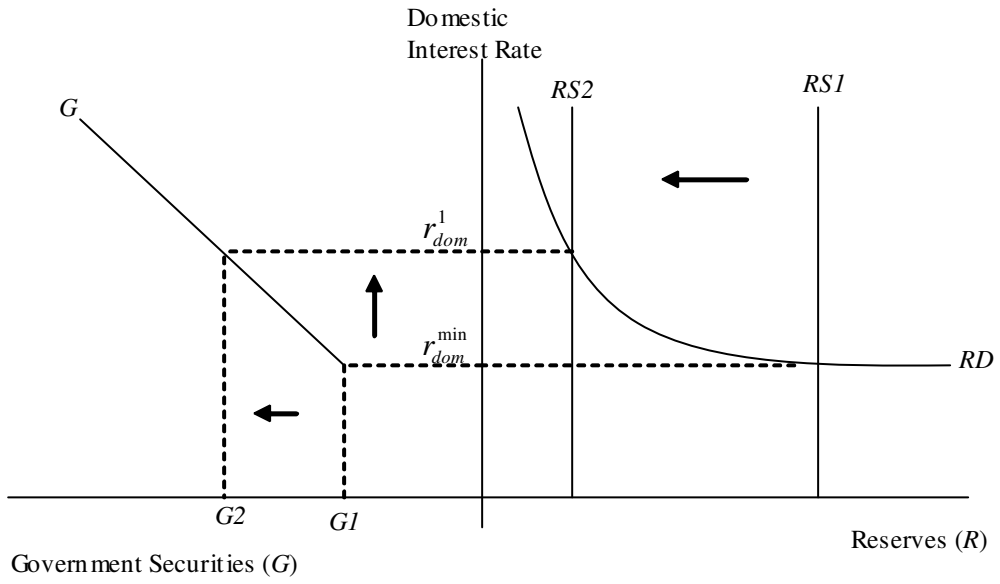
An explanation of what is determining the flat segment of the curve is beyond the scope of this paper. Suffice to say, while it is akin to the textbook explanation of the Keynesian liquidity trap, in the case of Guyana the horizontal segment does not occur at a 0% interest rate; rather it occurs at around 4%, which implies that banks view non-remunerated reserves and Treasury bills as perfect substitutes at above zero interest rate. One potential explanation given for this occurrence would be Frost (1971) who explained that a kinked demand for excess bank reserves in the United States is due to various transaction costs. At the point where the market interest rate falls towards the marginal transaction cost, the curve is kinked.

Another explanation comes from Khemraj (2006) who posited the thesis that the flat curve represents a minimum mark-up rate; the thesis holds that the mark-up is done vis-à-vis a foreign benchmark interest rate – namely the US Treasury bill rate[10]. The latter hypothesis is more applicable in an era of financial openness on the capital account. As noted earlier in the paper, Guyana implemented far-reaching reforms in the financial sector. Once the market rate falls to the minimum mark-up rate, banks accumulate reserves at a greater extent than investing in the domestic asset. In other words, the

[10] For this idea to hold there must be a negative relationship between commercial bank reserves and the difference between the Guyana Treasury bill rate and the US Treasury bill rate. This is shown in Appendix 1. The 3-month Treasury bill rate was used for both economies. The relationship shows that as the spread widens reserves decline.

demand for reserves is voluntary at the minimum interest threshold (when the curve is flat); while it is involuntary over the downward sloping range of the curve. Over the involuntary range banks will seek to substitute away from reserves into interest earning assets – therefore the central bank must manage the demand for reserves along this segment of the curve.

Figure 5. Monetary policy and the threshold rate



Therefore, the model which is presented herein to explain the connection between exchange rate dynamics and monetary policy – as conceptualized by the Bank of Guyana – is based on the empirical observation of an aggregate bank liquidity preference curve. Moreover, the model takes into consideration the banking sector's liquidity preference rather than the public's demand for money, which could be unstable owing to the instability of the money multiplier. Therefore, it is important to take into consideration the banks' ability to determine interest rate outcomes asymmetrically. Although it is

beyond the scope of this research, the paper proposes the notion that the threshold rate is determined as a mark-up over the rate of interest on a benchmark asset. At the interest threshold non-remunerated reserves and interest-earning Treasury bills are perfect substitutes.

Assume the domestic minimum threshold rate is given by the simple equation $r_{dom}^{\min}(1+m) = r_F$; whereby $r_{dom}^{\min}$ = the domestic minimum rate that is reached at the flat curve. m = the mark up factor that could be determined by bank preferences, risk, market power and other factors, and r_F is the foreign risk-free rate that serves as the benchmark for Guyanese banks. The basic idea is sketched in figure 5. The latter figure shows that when the threshold rate ($r_{dom}^{\min}$) is binding, an expansion of bank liquidity along the flat liquidity demand curve (*RD*) – to the right of *RS1* – would have no effect in driving down further this rate, which is assumed to be set favorably relative to r_F. Commercial banks would need to mobilize foreign exchange from the domestic market to meet the foreign exchange needs of long established business customers (especially those who have outstanding business loans and exposure to international trade). As postulated earlier, commercial banks also would prefer to maintain a stable exchange rate given their large exposure of assets in domestic currency. On the other hand, should the central bank contract bank reserves by selling them government securities (*G*), then the domestic rate could increase above the threshold to r_{dom}^{1}. In this case there is the concomitant effect of an increase in government securities held by the banks from *G1* to *G2*.

The diagrammatic framework could be looked at more formally. Equation 1 is the augmented uncovered interest parity (UIP), whereby s_t = the rate of change in the spot exchange rate.

$$s_t = \phi s_{t-1} + r_{dom}(1+m) - r_{Ft} \quad (1)$$

Where $\phi < 1$. Given the nature of the liquidity preference curve (figure 4), it is possible to approximate the curve as a reciprocal function in which the threshold rate is the asymptote. R^* represents the equilibrium level of reserves at the point where $RD = RS$. β is the coefficient in the function where $\beta > 0$ and $r_{dom}^{\min} > 0$.

$$r_{dom} = r_{dom}^{\min} + \beta R^{*-1} \quad (2)$$

Substituting equation 2 into 1 gives

$$s_t = \phi s_{t-1} + r_{dom}^{\min}(1+m) + \beta(1+m)R_t^{*-1} - r_{Ft} \quad (3)$$

The term $r_{dom}^{\min}(1+m)$ is assumed to be constant at least in the short-term – hence there is no time index on the expression. Solving equation 3 for its time path using a procedure outlined by Enders (2010) gives equation 4, which allows us to derive the dynamic multipliers (equations 5a to 5d) showing the effectiveness of monetary policy when the threshold interest rate is binding. s_0 = the initial exchange rate utilized in the recursive solution process.

$$s_t = \frac{r_{dom}^{\min}(1+m)}{1-\phi} + \phi^t s_0 + \sum_{i=0}^{t-1} \phi^i \beta(1+m)\frac{1}{R_t^*} + \sum_{i=0}^{t-1} \phi^i r_{Ft-i} \quad (4)$$

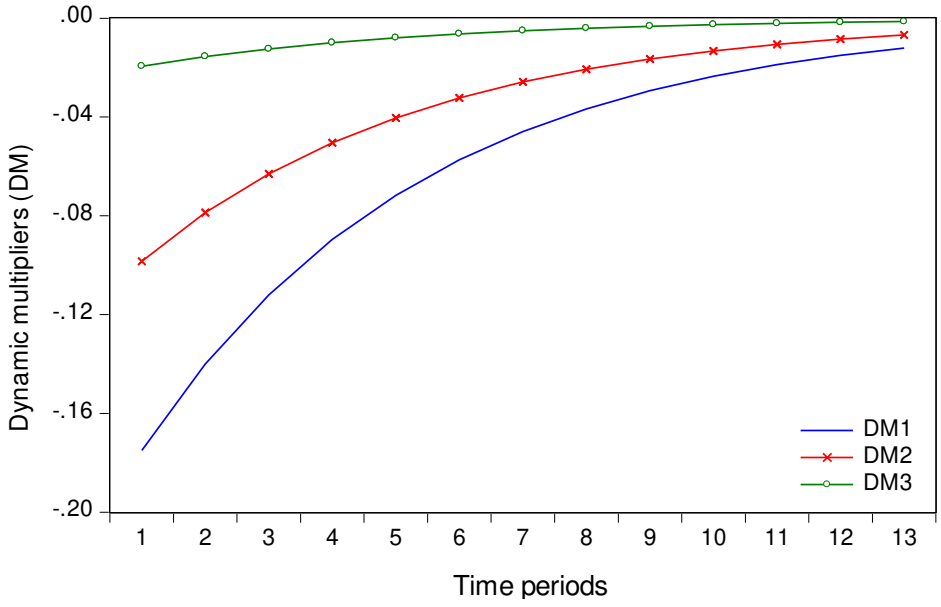
$$\frac{\partial s_0}{\partial R^*} = -\beta(1+m)R^{*-2} \quad (5a)$$

$$\frac{\partial s_1}{\partial R^*} = -\phi\beta(1+m)R^{*-2} \quad (5b)$$

$$\frac{\partial s_2}{\partial R^*} = -\phi^2 \beta(1+m)R^{*-2} \qquad (5c)$$

$$\frac{\partial s_n}{\partial R^*} = -\phi^n \beta(1+m)R^{*-2} \qquad (5d)$$

Figure 6. Dynamic multipliers showing monetary policy effect at the interest threshold



Source: Authors' calculations

Figure 6 graphs the derived multipliers (equations 5a to 5d). This allows us to analyze the effect of monetary policy at the minimum interest rate threshold. The multipliers are given for three levels of bank reserves. We assume $\phi = 0.8$, $\beta = 1.5$ and $m = 0.05$. The simulation exercise is straightforward: we increase reserves to see what happens when the threshold is binding given a change in reserves. The figure shows that as reserves increase at the threshold, the response is negative but gets closer to zero. As noted earlier, the Bank of Guyana manages bank reserves along a system-wide bank demand curve for reserves. The threshold is determined by the mark-up of the

commercial banks. Therefore, monetary policy has less of an exchange rate impact on the exchange rate as the threshold comes into effect.

7. Some Econometric Results

In this study we employ the GARCH framework to determine whether market concentration measured by the HHI impacts the volatility of the G$/US$ exchange rate. The HHI is constructed by taking the sum of squares of the market shares of the average balance held by each cambio. Our model is similar to that of Egoume-Bossogo et al (2003), except that we include a measure of market concentration. Including the HHI in the variance equation allows us to determine how our measure of concentration impacts on the volatility of the G$/US$ exchange rate. Similar to Egoume-Bossogo et al (2003), we adjust the mean and variance equations to incorporate seasonal effects. The exact specifications of the mean and conditional variance equations are as follows:

$$\Delta s_t = \mu_0 + \mu_1 \Delta s_{t-1} + \sum_{\tau=1}^{12} D_\tau + \varepsilon_t$$

$$\sigma_t^2 = \gamma_0 + \gamma_1 \varepsilon_{t-1}^2 + \gamma_2 h_{t-1}^2 + \gamma_3 HHI_t + \sum_{\tau=1}^{12} D_\tau$$

Monthly data from February 2000 to December 2009 and the quasi-maximum likelihood estimator (QMLE) are used to estimate the GARCH model. We report the Bollerslev-Wooldridge robust standard errors as suggested by Brooks (2008). The adequacy of our model is examined with several information criteria and non-linearity test including the Akaike information criteria (AIC) and Ljung-Box Q-statistics. Table 5 presents the econometric results. Only statistically significant variables are reported to reflect our parsimonious model. Consistent with our thesis that the dominant players would take advantage of their market power to minimize the volatility of the exchange

rate, we find a statistically significant negative coefficient for the HHI in the variance equation. Seasonal dummy variables are added to the equations to capture peculiar seasonal effects. It is possible that seasonal variation may be present in our data; early studies have noted this tendency also (Thomas and Rampersaud, 1991; Egoume-Bossogo et al, 2003). There is no a priori sign restriction for these variables. However, a significant positive coefficient for the dummy variable may be interpreted to mean that the average exchange rate is relatively larger during certain periods. The converse interpretation may be attributed to a significant negative coefficient for the dummy variables. Table 5 reports only the statistically significant seasonal dummy variables and the results for the GARCH (1, 1) and the exponential GARCH. Since the threshold term was found to be statistically insignificant, we did not report the threshold GARCH model.

The results indicate that the concentration variable (our proxy for market power) is statistically significant in the variance equation and it has the expected negative sign. This result is consistent with our thesis that higher market concentration contributes to lower volatility in the exchange rate. The small magnitude of the coefficient of HHI reflects the low level of variability (and volatility) in the exchange rate for the post-2004 sample period. Thus, this result should not be interpreted as economically insignificant (note the result is statistically significant). The diagnostic test results are favorable and suggest no serial correlation.

Table 5: Econometric results

GARCH (1, 1)

Mean Equation				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.199	0.050	3.977	0.000
Delta_Exr (-1)	-0.252	0.092	-2.739	0.006
D8	-0.234	0.060	-3.940	0.000
Variance Equation				
C	0.441	0.162	2.726	0.006
ARCH (-1)	0.226	0.089	2.533	0.011
GARCH(-1)	0.530	0.120	4.417	0.000
HHI	-0.008	0.001	-7.970	0.000
D4	-0.492	0.130	-3.784	0.000
D8	-0.522	0.120	-4.338	0.000

EGARCH (1, 1)

Mean Equation				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.298	0.051	5.826	0.000
Delta_Exr (-1)	-0.397	0.063	-6.286	0.000
D8	-0.425	0.142	-2.990	0.003
Variance Equation				
C	-0.566	0.542	-1.045	0.296
Abs(RESID(-1)/ SQRT(GARCH(-1)))	0.460	0.111	4.163	0.000
Log(GARCH(-1))	-0.742	0.069	-10.732	0.000
HHI	-0.003	0.000	-31.949	0.000
D4	-1.162	0.338	-3.432	0.001

8. Conclusion

This paper proposed an explanation for the success of the unannounced foreign exchange regime change. The key argument advanced in this study is as follows: it is easier to implement moral suasion once there is concentration in the foreign exchange market. In this case, the monetary authority needs to control via moral suasion the rate formation of the price leader, which dominates trading activities in the FX market. The large commercial banks, moreover, are likely to cooperate with the monetary authority

given their substantial exposure in domestic currency assets that could decline in the event of a rapid depreciation of the Guyana dollar and the subsequent inflation pass-through. Therefore, in contrast to the existing literature which looks at competition and stability from the point of the loan market (see Vives, 2001; Berger et al, 2008), this paper examines how concentration in the FX market could engender macroeconomic stability through the stabilization of the exchange rate. A second institutional feature that allows for the stability is the nature of capital inflows which are mainly in the form of altruistic remittances, long-term multilateral loans, and foreign direct investments. These inflows are less susceptible to sudden reversal.

Following the observation of a flat aggregate bank liquidity preference curve, the paper proposes the hypothesis that the flat segment of the curve reflects a mark-up threshold interest rate. At the flat segment the market interest rate (marginal revenue) is just equal to the marginal cost of the interest-earning asset – thus it makes sense for the banks to accumulate cash reserves with greater intensity relative to the interest-earning asset. The aggregate bank liquidity preference curve allows for the analysis of monetary policy shocks in the presence of a mark-up threshold interest rate. By doing so, the paper connects the oligopolistic tendency of the money market with that of the foreign exchange market. Monetary policy shocks (movements in the reserve supply curve) are determined by the Bank of Guyana, which notes that its policy stance focuses on managing bank reserves for the purpose of exchange rate and price stability.

Although the Bank of Guyana claims to maintain stability through indirect monetary policy by the management of excess bank reserves, the oligopolistic tendency of the money market will diminish the effectiveness of such a policy. For example, once

the threshold interest rate is binding, open market operations will not engender the kind of interest rate changes in the loan and deposit markets, thus dampening the effect on the exchange rate target. This leaves moral suasion as the more effective tool of monetary policy given the increasing tendency towards concentration in the post liberalization era.

References

Agarwal, R., Horowitz, A., 2002. Are international remittances altruism or insurance? Evidence from Guyana using multiple-migrant households. *World Development* 30, 2033-2044.

Balino, T., Enoch, C., Alexander, W., 1995. The Adoption of Indirect Instruments of Monetary Policy. *IMF Occasional Paper 126*. Washington, DC, International Monetary Fund.

Berger, A., Klapper, L., Turk-Ariss, R., 2008. Bank competition and financial stability. *Policy Research Working Paper 4696*. Washington, DC, World Bank.

BOG. various years. Annual Report. Bank of Guyana. Georgetown, Guyana.

Brooks, C., 2008. *Introductory Econometrics for Finance*, 2nd edition. Cambridge University Press, Cambridge.

Calvo, G., 1998. Capital flows and capital market crises: the simple economics of sudden stops. *Journal of Applied Economics* I, 35-54.

Cleveland, W., 1979. Robust locally weighted regression and smoothing scatterplots. *Journal of the American Statistical Association* 74, 829-836.

Das, U., Ganga, G., 1997. A retrospect and prospect on the reform of the financial sector in Guyana. *Social and Economic Studies* 46, 93-129.

Egoume-Bossogo, P., Faal, E., Nallari, R., Weisman, E., 2003. *Guyana: Experience with Macroeconomic Stabilization, Structural Adjustment, and Poverty Reduction*. International Monetary Fund. Washington, DC.

Enders, W., 2010. *Applied Econometric Time Series*, 3rd edn. Wiley, Hoboken, NJ.

Fardmanesh, M., Douglas, S., 2008. Foreign exchange controls and the parallel market premium. *Review of Development Economics* 12, 72-89.

Frost, P., 1971. Banks demand for excess reserves. *Journal of Political Economy* 79, 805-825.

Galbis, V., 1993. Experience with floating interbank exchange rate systems in five developing countries. *IMF Working Paper 93/36*. International Monetary Fund.

Ganga, G., 2000. Credit, excess liquidity and monetary policy issues in Guyana. *Social and Economic Studies* 49, 199-224.

Hagen, J., Zhou, J., 2005. De facto and official exchange rate regimes in Transition economies. *Economic Systems* 29, 256-275.

IMF, 2006. De facto classification of exchange rate regimes and monetary policy framework. http://www.imf.org/external/np/mfd/er/2006/eng/0706.htm.

Khemraj, T., 2006. *Excess Liquidity, Oligopoly Banking and Monetary Policy in a Small Open Economy*. PhD Dissertation. New School for Social Research, New York.

Melvin, M., Tan, K., 1996. Foreign exchange market bid-ask spreads and the market price of social unrest. *Oxford Economic Papers* 48, 329-341.

Sager, M., Taylor, M., 2006. Under the microscope: the structure of the foreign exchange market. *International Journal of Finance and Economics* 11, 81-95.

Schnabl, G., 2008. Exchange rate volatility and growth in small open economies at the EMU periphery. *Economic Systems* 32, 70-91.

Thomas, C., Rampersaud, R., 1991. The cambio system of an independent exchange rate float: the case of Guyana. *Social and Economic Studies* 40, 115-147.

Vives, X., 2001. Competition in the changing world of banking. *Oxford Review of Economic Policy* 17, 535-547.

Appendix 1

Figure A1: Bank reserves and interest spread – 1998: Q1 to 2009: Q4