DYNAMIC INTERACTION OF BANK ASSETS IN TWO FOREIGN CURRENCY CONSTRAINED ECONOMIES.

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by

TARRON KHEMRAJ
AND
R. BRIAN LANGRIN

ABSTRACT

This study explores how shocks in the foreign exchange market influence the allocation of commercial bank assets. A consistent pattern of asset allocation was discovered for Guyanese and Jamaican commercial banks. A positive one standard deviation shock (a surplus) in the foreign exchange market results in significantly greater investments in foreign assets relative to loans to the domestic private sector. The one standard deviation shock also results in a decrease in non-remunerated excess reserves, thus signalling that the excess cash is more likely to be invested into foreign assets rather than domestic currency loans when there is a surplus of foreign currencies. The same unit shock results in a foreign exchange rate depreciation in the contemporaneous time period. That the respective currencies depreciate when there is a surplus could indicate traders hoard the surplus initially for profit taking.

Key words: foreign exchange market, commercial bank assets, foreign currency constraint
JEL codes: O16, F31, G21

1. Introduction

Commercial banks play a pivotal role in financial intermediation and the monetary transmission mechanism in Caribbean economies (Ramlogan 2004). Providing a more global perspective, Stiglitz (1989) argued that the financial system in developing economies is likely to be dominated indefinitely by commercial banks. He was quite sceptical as to whether capital markets could displace banks as the primary source of external financing in developing economies. More recently the Stiglitz prognosis was confirmed by de la Torre et al. (2007). These authors noted that equity markets in the developing world are being adversely affected by delisting, which results in fewer stocks dominating market capitalization and trading. Thus, equity markets are not yet set to seriously challenge the banking sector as a source of external financing in developing economies.

Given the important place of commercial banks in the financial system, this article examines how foreign exchange shortages – which we call the foreign currency constraint – affect commercial banks' dynamic asset allocations. Policies intended to promote financial sector reform have made commercial banks the largest traders of foreign exchange. Therefore, the paper sets out to study how shocks to the foreign currency constraint (in the foreign exchange market) elicit contemporaneous and dynamic responses in domestic currency loans to the private sector, foreign assets and excess reserves. The article also analyzes how the nominal exchange rate responds to shocks in the foreign currency constraint (hereafter FC). The analysis is done for two Caribbean economies – Guyana and Jamaica. These two economies have opened their capital accounts and they have both pursued policies consistent with the agenda of financial liberalization. They both have a similar monetary policy framework along

the lines of reserve money management (Das and Ganga 1997; Ould El Hadj 1997). These similarities provide a justification for studying the two economies together. Data are also readily available to calculate FC for the said economies.

There is an established literature that connects foreign exchange constraints with economic growth, investment and savings (Taylor 1994). This literature often comes under the theme of three-gap models, which have been applied to various developing economies to gauge the foreign exchange requirements to supplement domestic savings and investment. Sepehri et al. (2000) applied the three-gap model to the analysis of macroeconomic adjustment in Iran[1]; while Thanoon and Baharumshah (2003) applied the same three-gap framework to Malaysia. In a related strand of the literature, Moran (1989) examined import capacity in developing economies when faced with a foreign exchange constraint. From a Caribbean perspective, Ramsaran (1989) analyzed the role of foreign capital – within the context of a two-gap model framework – in Caribbean economic development. Two-gap and three-gap models tend to focus on long-term economic issues such as economic growth.

This paper, however, looks at a financial measure of the FC and its implication for commercial bank asset allocations and the short-term issue of exchange rate stability. There are more financial sector rather than real sector issues covered in the two and three-gap literature. We were able to use *ex post* foreign exchange trading data to calculate a unique measure of FC. If the constraint (akin to a shortage of foreign

[1] The reference list of this article provides a detailed overview of the literature dealing with the origins of two and then three-gap models.

exchange) is persistent we would expect the exchange rate to depreciate and therefore possibly increase prices through the pass-through mechanism. Furthermore, it is likely that the relationships among the constraint, exchange rate, and bank assets are dynamic and endogenous. Therefore, the paper uses the vector autoregression (VAR) technique so as to account for the inherent endogenous relationship among the variables[2]. Using *ex post* foreign exchange trading data, the paper calculates FC as the total quantity of foreign currencies purchased in time period *t* minus the total sales of foreign currencies in the same time period[3].

The economy earns foreign currencies through exports of goods and services, remittances and other capital inflows. The foreign currencies are purchased (or mobilized) by the licensed foreign exchange dealers – the bank and non-bank cambios. The licensed dealers demand foreign exchange for its own sake (in this case they use the funds to invest in foreign assets as commercial banks do) or they sell foreign currencies to customers who need to import goods and services, travel abroad, or remit funds abroad. Therefore, it is of interest to know to what extent a binding or non-binding FC affects financial intermediation and bank liquidity conditions. This is an important question because commercial banks – the main fountain of financial intermediation – are also foreign exchange traders. Moreover, in both economies excess reserves are managed through some form of open

[2] The versatile VAR methodology has been applied to study numerous dynamic relationships among time series. A few examples would include inflation dynamics (Ross 2000), the dynamic relation between savings and investment (Alexiou 2004), the dynamic impact of FDI (Shan 2002), and the monetary transmission mechanism (Morsink and Bayoumi 2001; Watson 2003).

[3] This is similar to the way Khemraj (2009) calculated the constraint.

market operations within a financial programming framework. Therefore, it would be of interest to know whether shocks to the constraint elicit a response in excess bank reserves.

The constraint is non-binding when FC > 0. This is indicative of the fact that banks possess a surplus of foreign currencies – meaning the banks purchased more foreign exchange than they sold in time period *t*. An obvious question of interest would be: how does a non-binding constraint in period *t* lead to the dynamic accumulation of foreign assets in period *t*, *t* + *1*,…, *t* + *n*? In addition, does the non-binding constraint lead to a decline in excess bank reserves[4] and an increase in loans to the private sector in periods *t*, *t* + *1*,…, *t* + *n*? Answering these questions could be helpful information for the central bank, which manages bank reserves using some form of open market operations or reserve requirements. On the other hand, is a binding constraint (that is FC < 0 resulting from the fact that the banks have sold more than they have purchased) accompanied by enhanced or reduced financial intermediation in the form of domestic currency loans to the private sector? Is there a trade-off between banks' domestic investments and foreign assets given a shock to the constraint?

The rest of the paper is structured as follows. Section 2 presents background information that motivates later sections. Section 3 outlines the empirical and estimation issues. Section 4 concludes.

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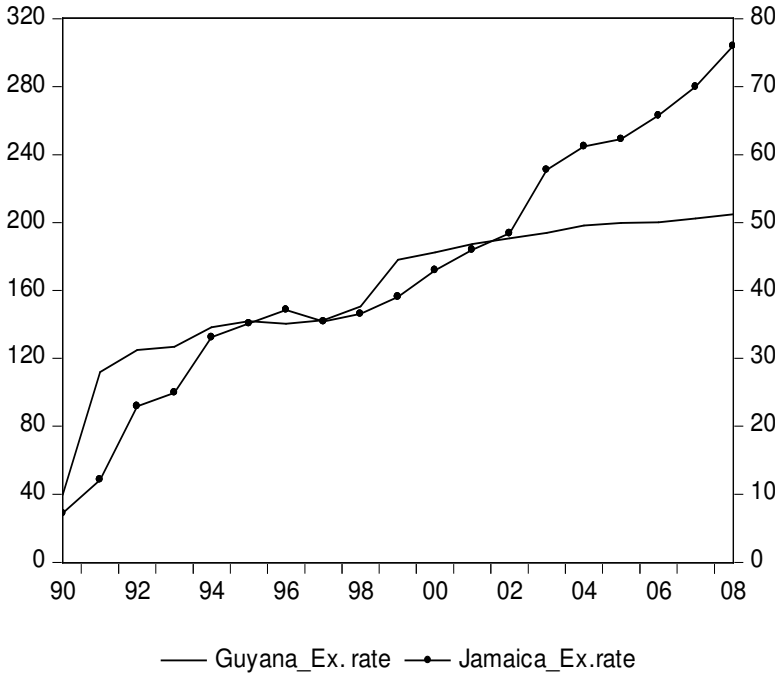
[4] The study of excess bank liquidity, in recent times, has been in focus by several researchers. See for instance Khemraj (2009; 2006) and Saxegaard (2006).

2. Background Information

The Guyana and Jamaica foreign exchange markets reflect remarkably similar histories. The exchange rate regime of both economies was reformed in 1990 when the parallel exchange rate was merged with the official rate. Since 1990 the nominal exchange rate of both economies has depreciated continually (Figure 1). The reform agendas were done within a wider framework of macroeconomic and financial sector liberalizations since the late 1980s. A detailed account of the Guyana foreign exchange market reform, along with the motivations for the reform, was done by Egoume-Bossogo et al. (2003). A similar piece of background information on Jamaica can be found in Bullock et al. (2002).

Commercial banks have practical incentives to build foreign currency positions given the depreciating tendency of the Guyana and Jamaica exchange rates, primarily as a result of frequent episodes of foreign currency supply shortfall. In this context, commercial bank foreign assets exceed foreign liabilities considerably for both economies (Figures 2 and 3). On the other hand, there tends to be a greater degree of balancing of domestic assets and liabilities for Jamaica (Figure 4). For Guyana, the tendency for commercial banks to build 'long' foreign currency balance sheet positions is more notable. This is evidenced by the breakdown of the close relationship between domestic currency assets and liabilities for Guyana after mid-2005 as commercial banks 'shorted' their domestic currency positions (Figure 5).

Figure 1, Guyana (left axis – G$/US$) and Jamaica (right axis – J$/US$) nominal exchange rate



In Guyana commercial banks dominate foreign exchange trading, accounting for approximately 90% of all foreign exchange purchases and sales in 2008. This situation has consistently been the case since the foreign exchange reform process of the early 1990s. For Jamaica, commercial bank foreign exchange trading volume was approximately 70% for 2008, also reflecting their relative dominance over the non-bank traders.[5] The main currencies traded in both Guyana and Jamaica foreign exchange markets are the United States dollar, the Euro, the Canadian dollar and British pound. The US dollar has consistently accounted for about 90% of all

[5] The banking sector in both countries comprises of six commercial banks during the period under review.

trades in both countries while the relative trading percentages of the other currencies have changed over time.

Figure 2, Guyana commercial banks' foreign currency assets and liabilities – US$ mill

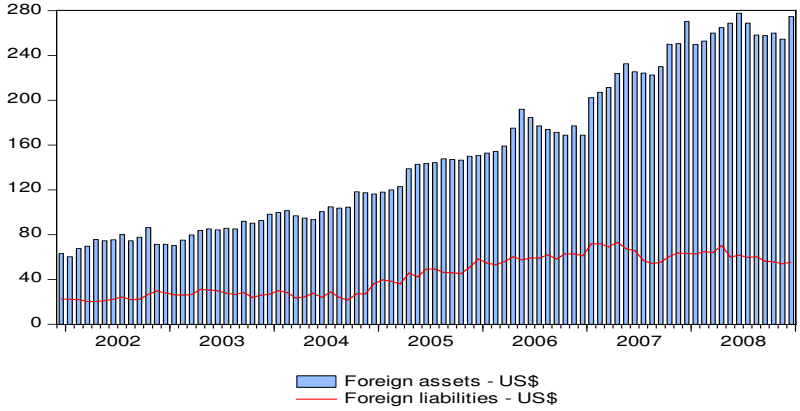


Figure 3, Jamaica commercial banks' foreign currency assets and liabilities – US$

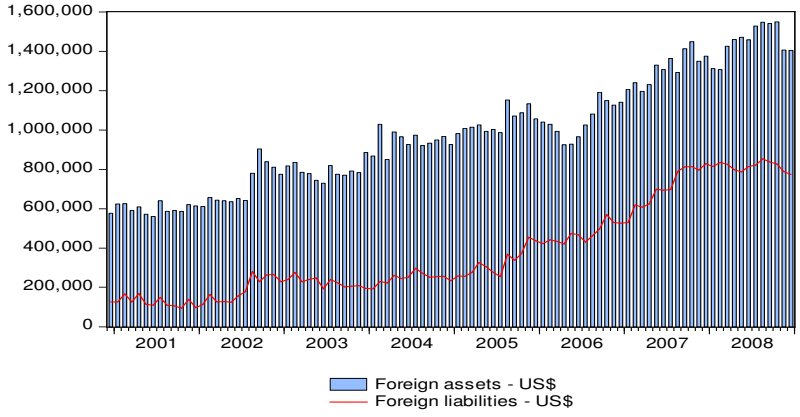


Figure 4, Jamaica commercial banks' domestic currency assets and liabilities – J$ mill

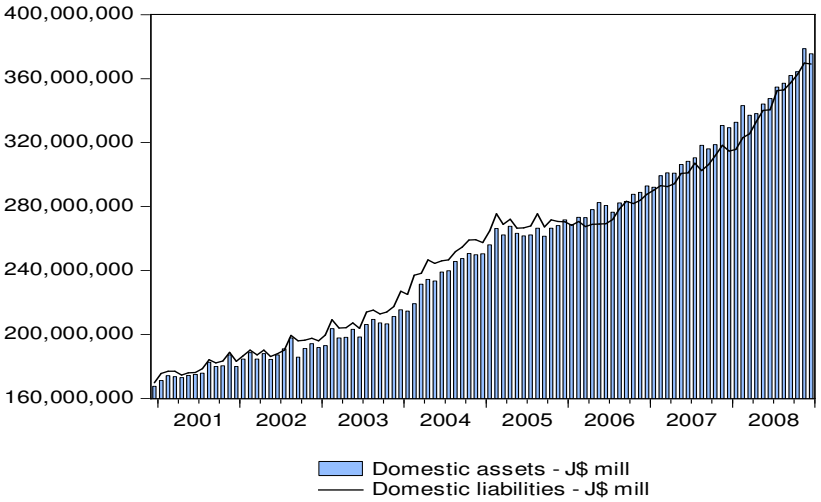


Figure 5, Guyana commercial banks' domestic currency assets and liabilities – G$ mill

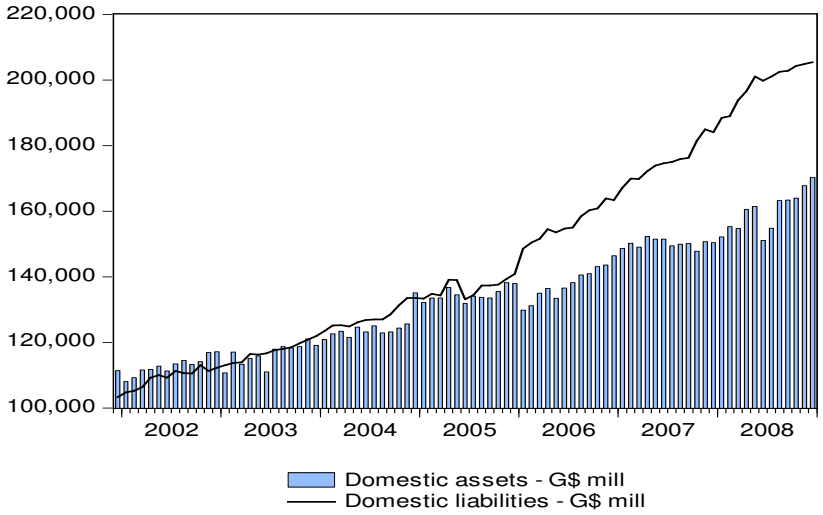


Figure 6, Guyana foreign currency constraint (US$ mill) – Monthly data 1996 to 2008

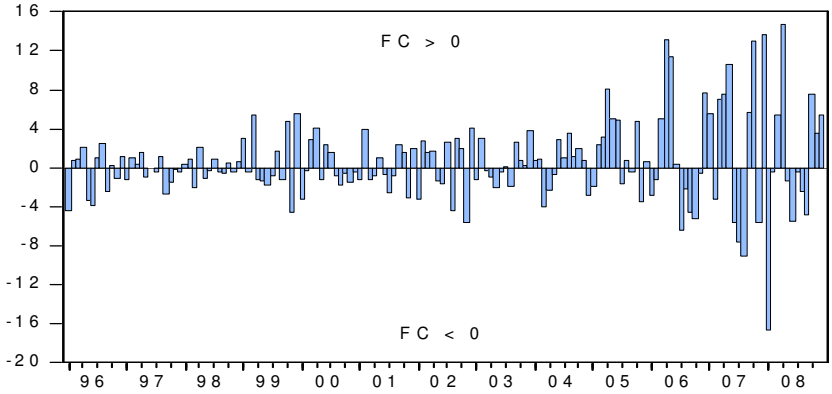
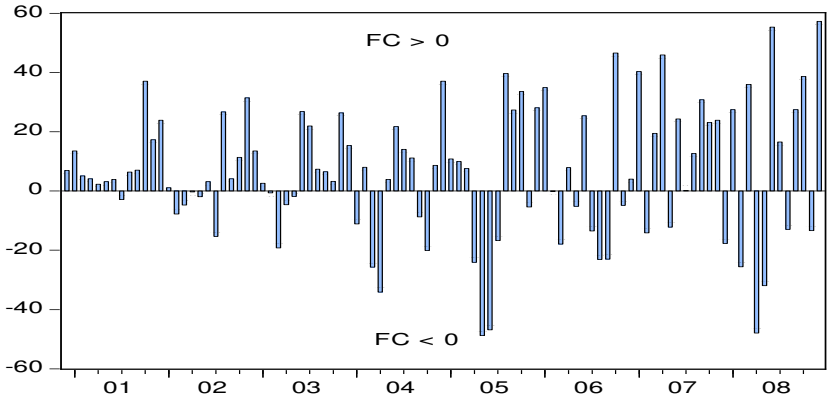


Figure 7, Jamaica foreign currency constraint (US$ mill) - Monthly data 2001 to 2008



The foreign currency constraint indicates volatile interchange between surplus and deficit for both economies (Figures 6 and 7). As noted earlier, the objective of this paper is to analyze how shocks to this constraint affect bank portfolio allocations and exchange rate. This measurement of the constraint is consistent with Khemraj (2009). It allows us to examine the short-term stabilization implications of the constraint as opposed to the more long-term focus of the two-gap and three-gap literature[6]. The FC is a flow variable while foreign asset and liabilities are stock variables. The constraint could be binding at a time period $t + s$; however, when it is relaxed (there is a transient foreign currency surplus in the domestic foreign exchange market) the banks have an opportunity to accumulate the stock of foreign assets over some period $t + s + j$.

3. Empirical Analysis

The purpose of the empirical analysis is to generate impulse response functions from an estimated VAR model. In particular, we seek to analyze how shocks to FC affect: (i) the change in domestic currency bank credit to the private sector (LP – measured in US$); (ii) the change in commercial banks' foreign assets (FA – measured in US$); (iii) excess reserves (ER); and (iv) the change in nominal exchange rate (EXR). [7] The VAR method allows us to study the dynamic interactions between bank portfolio allocations and the foreign exchange market. It is also a useful method given the underlying endogeneity between the various markets.

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[6] See Taylor (1994) for a theoretical analysis of the interaction of the foreign exchange constraint with investment and savings and the accompanying growth outcomes.

[7] Commercial banks are able to lend in foreign currencies in Jamaica but not Guyana. Hence, foreign currency lending to the private sector is captured in FA but excluded from LP for the Jamaica data.

The paper utilizes the methodology of generalized impulse responses that was proposed by Persaran and Shin (1998). This technique was applied by Wang and Dunne (2003) to study exchange rate dynamics in East Asia. It was also applied by Watson (2003) in the Caribbean when the author examined the monetary transmission mechanism of Trinidad and Tobago. The technique, moreover, allows for the impulse responses to be invariant to the ordering of the variables. Unlike the Choleski decomposition[8], there is no need to place rigid restrictions on the order of the contemporaneous coefficients in the VAR. The algebra of the generalized impulses is well worked out in Persaran and Shin (1998). There is also a good motivation and illustration of the technique in Wang and Dunne (2003). We did not use the co-integrating VAR method for two reasons: (i) the sample size did not span several business cycles that would have allowed us to capture any co-movement in the levels of the variables, and (ii) our crucial variable, FC, was already I(0).

The econometric analysis is done with monthly data over the period 1996-Jan to 2008- Dec for Guyana and 2001-Jan to 2008-Dec for Jamaica. This period of analysis is chosen mainly for the purpose of data availability in the case of Jamaica. While data are available for earlier periods in the case of Guyana, we choose to start six years after the liberalization of the foreign exchange market to allow for structural changes and adjustments in the market after the initial reforms. This relatively short data set, moreover, precluded the use of a co-integrating VAR.

[8] See Enders (2004) for an excellent illustration of the recursive Choleski factorization in a VAR system.

Table 1, Augmented Dickey-Fuller (ADF) tests

Variable	Lags	Intercept alone	Lags
	Trend and intercept		
Guyana			
er	1	-4.03*	1
	-4.01*		
fc	11	-3.26***	11
	-3.23***		
⊿*exr*	2	-4.69*	8
	-3.5*		
⊿*fa*	0	-13.1*	4
	-8.48*		
Jamaica			
er	0	-2.85***	0
	-2.80		
fc	0	-8.81*	0
	-8.81*		
⊿*exr*	1	-2.98**	1
	-3.07**		
⊿*fa*	1	-9.12*	1
	-9.10*		

Notes: The optimum number of lags was chosen by Akaike Information Criterion. *, **, *** indicate significant at the 1%, 5% and 10% levels, respectively.

The data were pre-tested to make sure each variable is stationary in the VAR (Table 1). There is some debate about whether a VAR should be estimated in levels or in differences (Enders 2004). However, our analysis is institutional and inductive and seeks to uncover whether stylized dynamic relationships exist between the foreign exchange market and bank asset allocation. Therefore, we have decided to enter each variable in its stationary form in the VAR model. The impulse response functions (IRFs) that are presented later also confirm the stationary nature of the time series. This is documented by the fact that the IRFs tend to converge to zero equilibrium after a shock.

Formal unit root tests also reveal the stationary nature of the series. For Guyana and Jamaica, FC is stationary given the ADF unit root test results. A stationary variable, confirmed by the ADF unit root test, was created by dividing total bank reserves by required reserves. Therefore, when the variable ER is greater than one it implies the banking system is inundated with non-remunerated excess reserves; when the ratio is less than one it indicates a shortage of bank reserves. The exchange rate variable is differenced once to give a stationary series. The other variables are entered in first differenced stationary terms. Jamaican data were obtained from the Bank of Jamaica; while Guyana's data came from the IMF's *International Financial Statistics* and the Bank of Guyana *Statistical Bulletin* (excess and required reserves data came from the Bank of Guyana).

Estimation and Analysis

When estimating a VAR the optimal lag length is crucial (Enders 2004). According to the AIC and Schwarz information criterion, the optimal lag length for Guyana and Jamaica should be one. Appendix 1 presents the VAR

estimation results for both countries. Figures 8 to 11 illustrate the Guyana results for the response of each variable given a one standard deviation shock to FC. For instance, the change in foreign assets (where Δ = change) respond positively to the one standard deviation shock to FC. The initial response to the shock is just under US$ 4.5 million. After two months the effect of the initial shock wanes and ΔFA goes back to equilibrium or zero. The change in loans to the private sector ΔLP also responds positively but at a much more moderate level of approximately US$ 0.5 million. However, after one month it drops to zero and negative levels and oscillates with a dampening path to zero.

According to figure 8, a standard deviation shock to FC elicits a negative response in non-remunerative excess reserves. The ratio of total reserves to required reserves (which we denote as ER) initially decreases by approximately three percentage points. By the second month, however, the ratio moves into positive territory and persists for the remaining months. This result is consistent with the findings of Khemraj (2009) who estimated an ARDL model of excess reserves for the Guyana banking system. Khemraj found that an easing of the constraint decreases excess reserves. The figures that follow provide some clues as to how the excess cash is invested given a shock to the foreign exchange market. A positive shock to FC engenders a positive response in ΔFA – an intuitive and expected result (Figure 10). The latter implies that an easing of the foreign currency constraint leads to more investments in foreign positions relative to credit to the private sector (US$ 4.5 mill in ΔFA versus US$ 0.5 mill in ΔLP – see figures 10 and 11).

The initial response of the nominal exchange rate (ΔEXR) is positive, thereby signalling a contemporaneous depreciation that is followed by an appreciation in later periods (Figure 9). This result is somewhat puzzling because a positive shock (a

surplus) should generate an initial appreciation. It could signal short-term profit taking by traders who have a surplus in the initial period. As the rate depreciates traders will realize more G$ profits for hoarding foreign exchange for a short period. The rate appreciates in later periods after profit is realized.

Figure 8, Guyana: percentage response of ER to generalized one standard deviation FC innovation

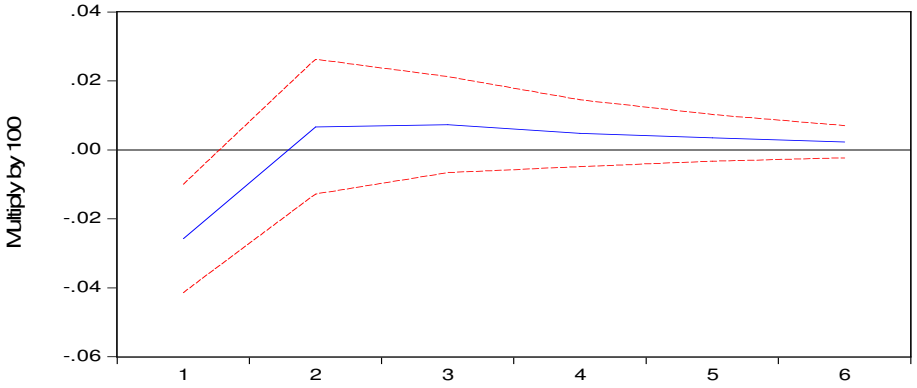


Figure 9, Guyana: G$/US$ response of ΔEXR to generalized one standard deviation FC innovation

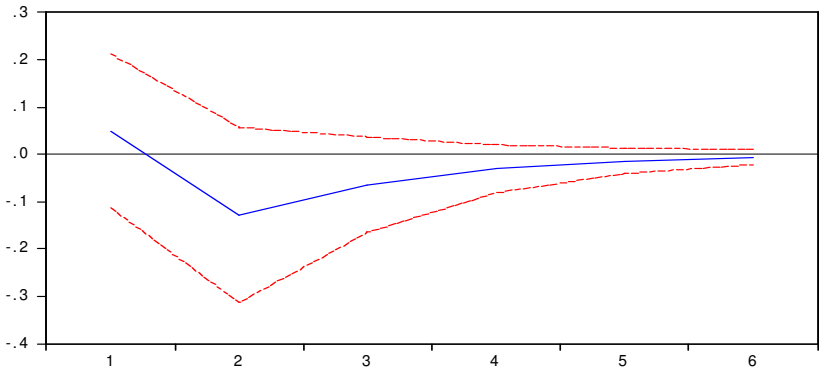


Figure 10, Guyana: US$ (mill) response of ΔFA to generalized one standard deviation FC innovation

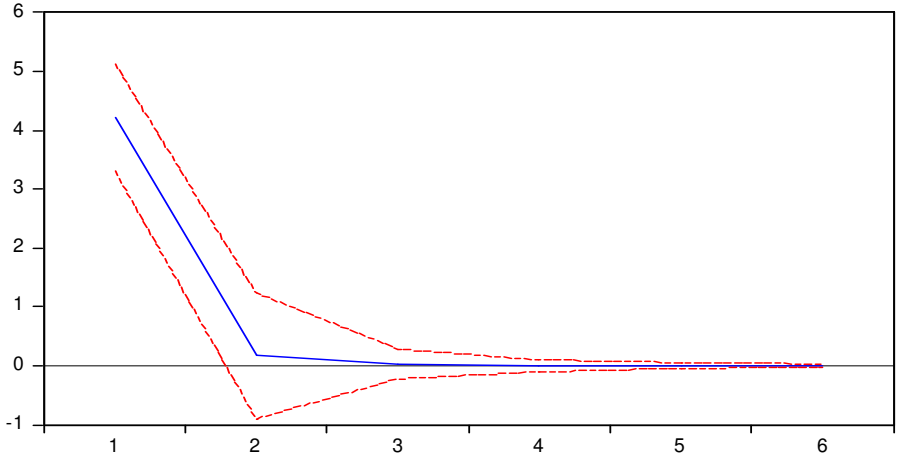
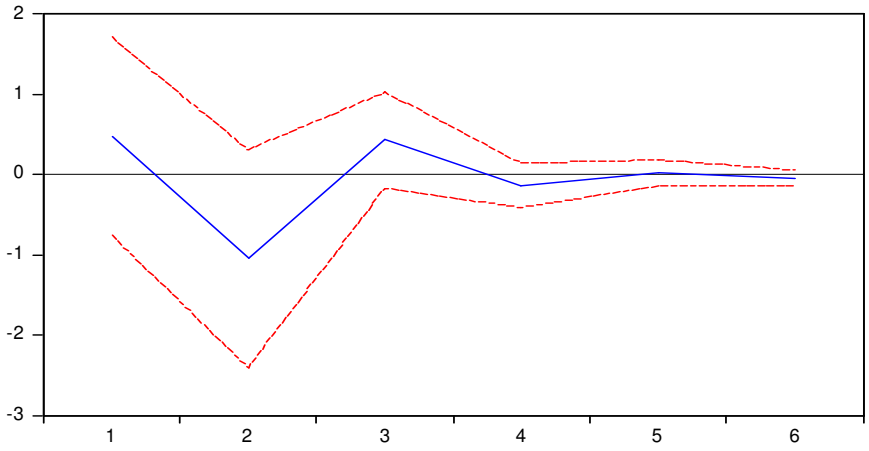


Figure 11, Guyana: US$ (mill) response of ΔLP to generalized one standard deviation FC innovation



The Jamaican results for the response of each variable given a one standard deviation shock to FC are strikingly similar to the Guyana results (figures 12 to 16). There is a positive response to ΔFA of about US$ 8 million to the one standard deviation shock to FC in the first month. After two months the effect of the initial shock declines sharply over the third month before settling around zero at the fourth month. The initial response of ΔLP is also positive at approximately US$ 2 million. This is substantially below the response in ΔFA to the same one standard deviation shock.

Similar to Guyana, a positive shock to FC produces a decline in excess reserves by just above one point. In the second month, the ratio drops further by about four points and then increases steadily towards zero throughout the six-month horizon. Again similar to the Guyana situation, the initial response from the FC shock is a depreciation of the J$/US$ nominal exchange rate. This result can be explained by the historical tendency for commercial banks in Jamaica to excessively build foreign currency inventories even in times of foreign currency surplus, putting upward pressure on the exchange rate. This behaviour could also signal profit taking by the traders. Over the following two months, however, the foreign exchange rate moves back to equilibrium.

Figure 12, Jamaica: US$ (000) response of ΔFA to generalized one standard deviation FC innovation

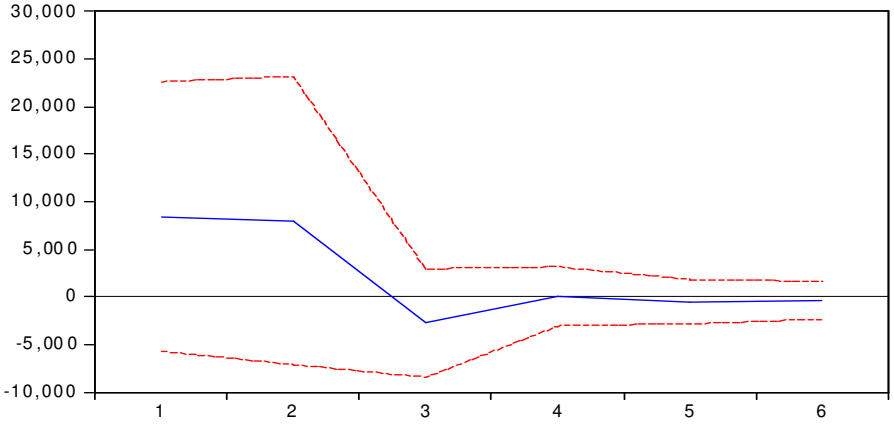


Figure 13, Jamaica: US$ (mill) response of ΔLP to generalized one standard deviation FC innovation

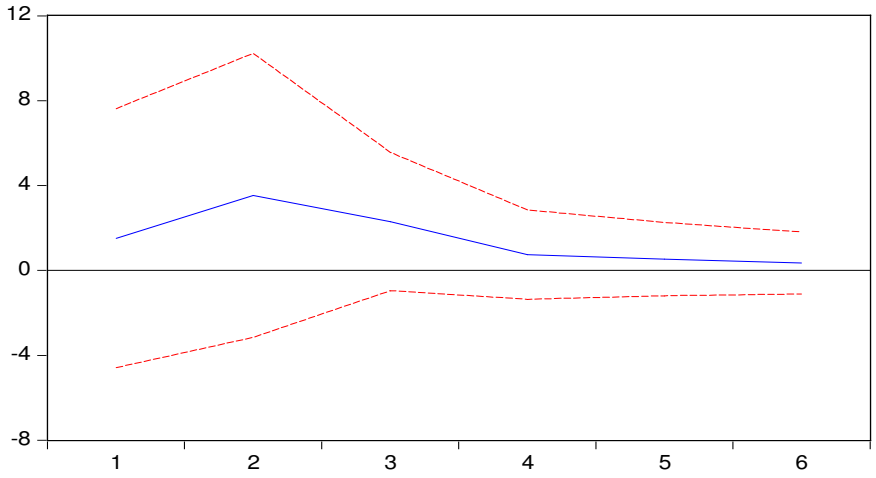


Figure 14, Jamaica: percentage response of ER to generalized one standard deviation FC innovation

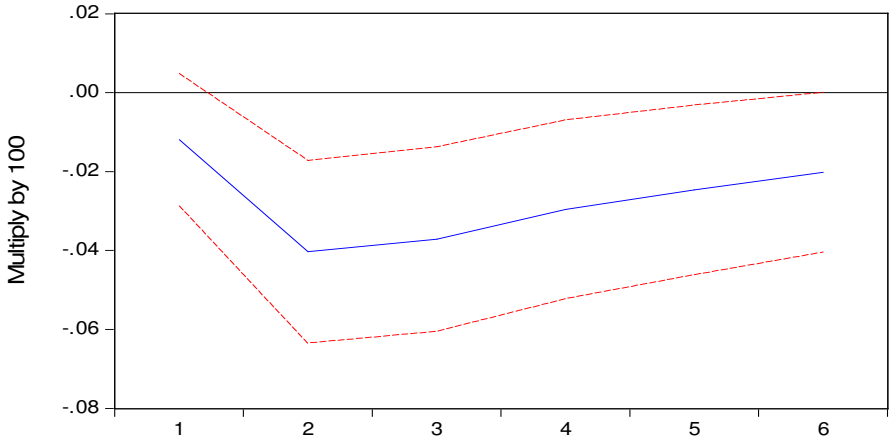
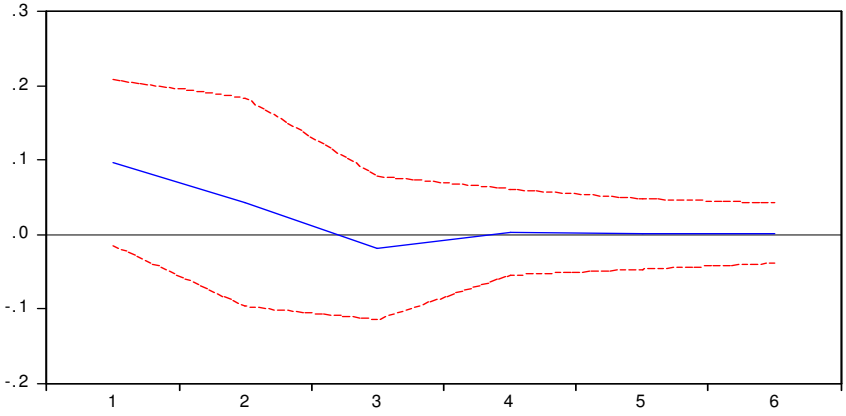


Figure 15, Jamaica: J$/US$ response of ΔEXR to generalized one standard deviation FC innovation



4. Conclusion

This paper examined the dynamic adjustments in commercial bank asset portfolio given shocks emanating from the foreign currency constraint, which was measured using realized foreign exchange trading data. This line of inquiry is interesting given that commercial banks are not only agents of financial intermediation, but also traders of foreign exchange. The results for the two economies suggest a similar pattern of asset adjustments in Guyana and Jamaica given the shock in the foreign exchange market. In particular, a positive shock to the constraint elicits a larger positive response in foreign asset holdings than credit to the private sector. The response in non-remunerated excess reserves is negative for both economies. Therefore, one could conclude the positive shock (a surplus) in the foreign exchange market leads to a relatively larger conversion of excess reserves into foreign assets compared with private sector credit. The exchange rate adjustments show a similar pattern. A positive shock (a surplus) leads to a contemporaneous depreciation instead of an appreciation. This behaviour could stem from the fact that the licensed foreign exchange dealers operate on both the supply and the demand side of the market. This allows them to hoard surplus foreign currencies for a short time for profit taking.

The analysis might be useful to central banks wishing to influence the foreign currency constraint through interventions in the market. Our results could also be pertinent to the wider literature of financial intermediation and economic development. The results suggest that a positive foreign currency shock results in higher investments in foreign assets rather than domestic currency loans to the private sector. We recognize that the paper uncovers some stylized evidence regarding the interaction of bank assets and the foreign exchange market in two developing economies.

However, a weakness of the paper is it does not embed these results into a model of the foreign exchange market. That will have to be the task of a future effort.

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Appendix 1, VAR regression results

Jamaica Results

Sample (adjusted): 2001M02 2008M12
Included observations: 95 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	ER	FC	D(EXR)	D(FA)	D(LP)
ER(-1)	0.803882	-1.174423	0.049414	21791.49	-8.764461
	-0.05098	-13.7296	-0.34097	-43105.2	-18.509
	[15.7672]	[-0.08554]	[0.14492]	[0.50554]	[-0.47353]
FC(-1)	-0.001147	0.076494	0.001894	538.6709	0.093652
	-0.00041	-0.10981	-0.00273	-344.745	-0.14803
	[-2.81227]	[0.69663]	[0.69448]	[1.56252]	[0.63265]
D(EXR(-1))	-0.056005	3.508068	0.427509	-17307.22	2.337714

Appendix I: Jamaica Results Continued

Sample (adjusted): 2001M02 2008M12

Included observations: 95 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	ER	FC	D(EXR)	D(FA)	D(LP)
D(EXR(-1))	-0.01539	-4.14556	-0.10295	-13015.4	-5.58868
	[-3.63801]	[0.84622]	[4.15241]	[-1.32975]	[0.41829]
D(FA(-1))	4.00E-08	-7.56E-05	-4.64E-06	-0.220006	8.20E-05
	-1.20E-07	-3.40E-05	-8.30E-07	-0.10551	-4.50E-05
	[0.32052]	[-2.25063]	[-5.56397]	[-2.08518]	[1.80924]
D(LP(-1))	-0.000225	0.110787	-0.000108	-60.37268	0.294192
	-0.0003	-0.08151	-0.00202	-255.912	-0.10989
	[-0.74410]	[1.35916]	[-0.05311]	[-0.23591]	[2.67725]
Constant	0.344999	4.935427	0.164902	-22586.2	26.17428
	-0.08416	-22.6621	-0.56281	-71149.6	-30.551
	[4.09955]	[0.21778]	[0.29300]	[-0.31745]	[0.85674]

Appendix I: Jamaica Results Continued

Sample (adjusted): 2001M02 2008M12

Included observations: 95 after adjustments

Standard errors in ( ) & t-statistics in [ ]

	ER	FC	D(EXR)	D(FA)	D(LP)
R-squared	0.777108	0.06983	0.35042	0.085412	0.142578
Adj. R-squared	0.764586	0.017573	0.313927	0.034031	0.094408
Akaike AIC	-2.102193	9.089375	1.698357	25.19307	9.686783
Schwarz SC	-1.940896	9.250673	1.859655	25.35437	9.84808

Appendix I: Guyana Results

Sample (adjusted): 1996M03 2008M12

Included observations: 154 after adjustments

Standard errors in ( ) & t-statistics in [ ]

	ER	FCC	D(EXR)	D(FA)	D(LP)
ER(-1)	0.666008	-2.362056	0.068678	0.381647	-18.98288
	-0.0652	-2.78332	-0.66378	-4.20777	-5.036
	[10.2150]	[-0.84865]	[0.10347]	[0.09070]	[-3.76944]
FC(-1)	0.004819	0.027514	-0.020938	0.248994	-0.216646
	-0.00261	-0.11161	-0.02662	-0.16873	-0.20194
	[1.84327]	[0.24653]	[-0.78667]	[1.47573]	[-1.07284]

Appendix I: Guyana Results Continued

Sample (adjusted): 1996M03 2008M12

Included observations: 154 after adjustments

Standard errors in ( ) & t-statistics in [ ]

D(LP(-1))	-0.001296	-0.017088	-0.000495	-0.024776	-0.304508
	-0.001	-0.04262	-0.01016	-0.06443	-0.07711
	[-1.29774]	[-0.40097]	[-0.04870]	[-0.38455]	[-3.94903]
Constant	0.424922	3.624284	0.162569	1.379242	28.13435
	-0.08458	-3.61074	-0.8611	-5.45865	-6.53309
	[5.02383]	[1.00375]	[0.18879]	[0.25267]	[4.30644]
R-squared	0.459787	0.006475	0.242507	0.023675	0.177619
Adj. R-squared	0.441537	-0.02709	0.216916	-0.009309	0.149836
Akaike AIC	-1.742351	5.765559	2.898652	6.592136	6.951493
Schwarz SC	-1.624028	5.883882	3.016975	6.710459	7.069816