Dynamic interactions of bank assets in two foreign currency constrained economies

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Abstract

This is an exploratory study that seeks to uncover how shocks to a particular measure of the foreign currency constraint engender dynamic adjustments in commercial banks' – which are also foreign exchange traders – asset holdings. We found a consistent pattern of asset adjustments in Guyana and Jamaica. A positive shock to the foreign currency constraint elicits a negative response in excess bank liquidity, a positive response in foreign asset holdings and a relatively small positive response in loans to the private sector. The initial exchange rate response is different – the Guyana results show an initial appreciation while the Jamaica results suggest an immediate depreciation.

1. Introduction

Commercial banks play a pivotal role in financial intermediation and the monetary transmission mechanism in Caribbean economies. 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 very sceptical 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, Gozzi and Schmukler (2007). The latter authors noted that equity markets in the developing world are being adversely affected by delisting and just a few stocks

dominate market capitalization and trading. Thus, equity markets are not yet set to seriously challenge the banking sector in developing economies.

Given the important place of commercial banks in the financial system, this article examines how foreign exchange shortages or surpluses – which we call the foreign currency constraint – affect commercial banks' dynamic asset allocations. In other words, the paper sets out to study how shocks to the foreign currency (or foreign exchange) constraint elicit dynamic responses in 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.

There is an established literature that connects foreign exchange gaps or constraints with economic growth and development. 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) underscored the role of foreign capital – within the context of a two-gap model framework – in Caribbean economic development.

[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.

However, we hope that this paper could make a contribution to the literature as it seeks to analyze how a specific measure of the foreign exchange constraint affects commercial bank asset allocation and thus financial intermediation in developing economies. Moreover, the study utilizes the dynamic vector autoregression technique so as to account for the inherent endogenous relationship between FC and bank behaviour[2]. In order to achieve its objective, 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 (Khemraj 2009). Therefore, our measure comes from trading volumes in the foreign exchange market instead of the broad macroeconomic measure used in papers focusing on the gap measure of the constraint.

The economy earns foreign currencies through exports of goods and services, remittances and other sources. 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.

For instance, when FC > 0 the constraint is non-binding and as such we expect to witness an increase in foreign assets in the contemporaneous period. The latter results from the fact that banks possess a surplus of foreign currencies – meaning the banks

[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), the determinants of housing price volatility (Hossain and Latif 2007), and the monetary transmission mechanism (Morsink and Bayoumi 2001; Watson 2003; Georgopoulos 2009).

purchased more foreign exchange than they sold in time period *t*. Therefore, does this non-binding constraint in periods *t* lead to the 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[3] 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 open market operations and/or another liquidity management tools[4]. On the other hand, when the constraint is binding – that it FC < 0 resulting from the fact that the banks have sold more than they have purchased – does it lead to enhanced financial intermediation in the form of increased loans to the private sector? Is the increase in loans to the private sector associated with the fact that FC is binding and banks have to increase domestic investments?

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.

2. Background Information

The Guyana and Jamaica foreign exchange markets reflect remarkably similar histories. The exchange rate regime for both economies – were 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

[3] The study of excess bank liquidity, in recent times, has been in focus by several researchers. See for instance Khemraj (2009), Saxegaard (2006) and Fielding and Shortland (2005).

[4] In both Guyana and Jamaica the method of financial programming is used to manage excess bank liquidity.

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 Egoumé-Bossogo *et al* (2003). A similar piece of background information on Jamaica can be found in Bullock, Shaw and Robinson (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).

In Guyana commercial banks dominate foreign exchange trading, accounting for 90% of all foreign exchange purchases in 2008. The latter 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 trades in both countries while the relative trading percentages of the other currencies have changed over time.

[5] The banking sector in both countries comprises six commercial banks within the sample period.

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

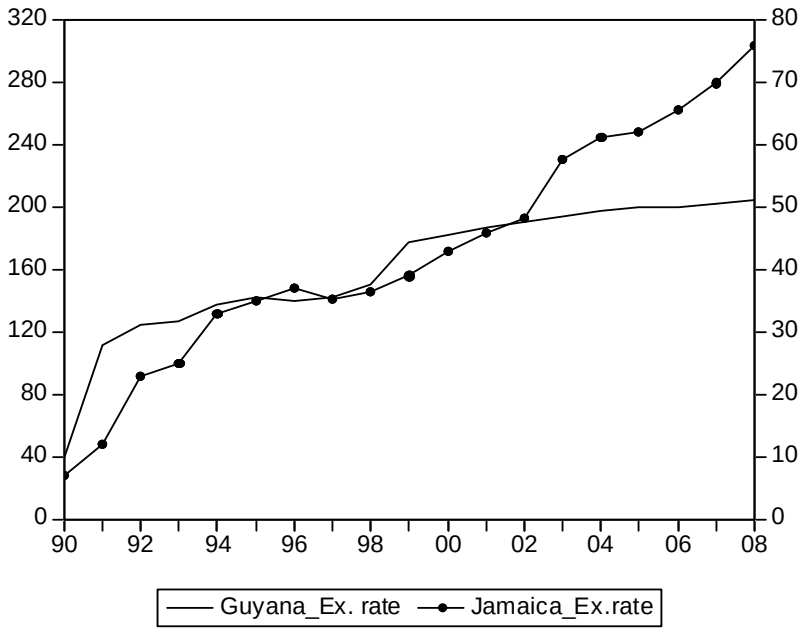


Figure 2, Guyana commercial banks' foreign currency assets and liabilities – G$ mill

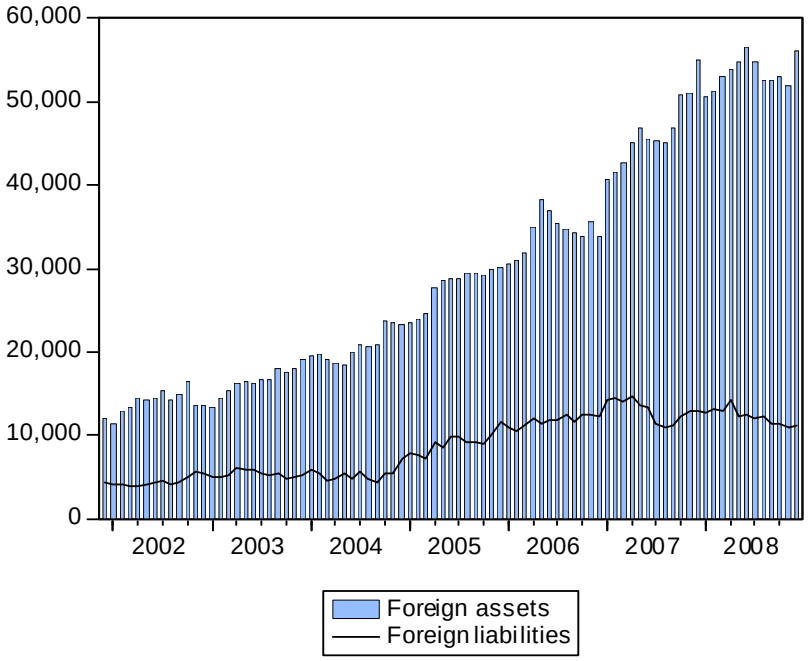


Figure 3, Jamaica commercial banks' foreign currency assets and liabilities – J$ mill

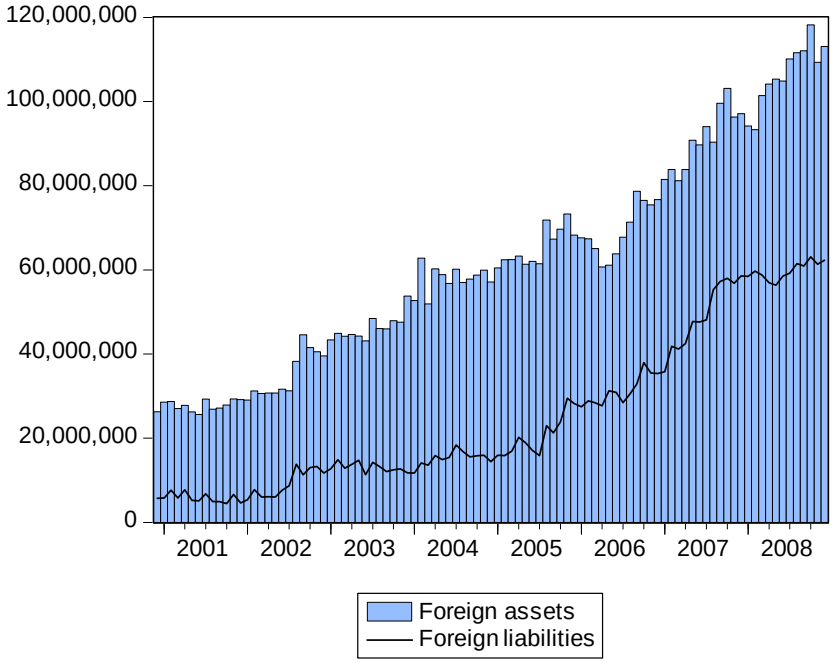


Figure 4, Jamaica commercial banks' domestic currency assets and liabilities

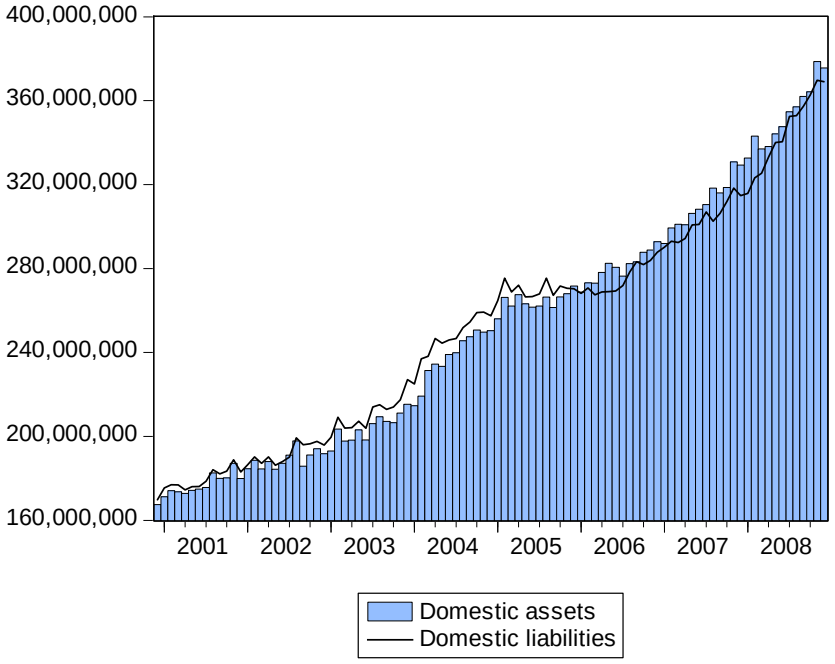


Figure 5, Guyana commercial banks' domestic currency assets and liabilities

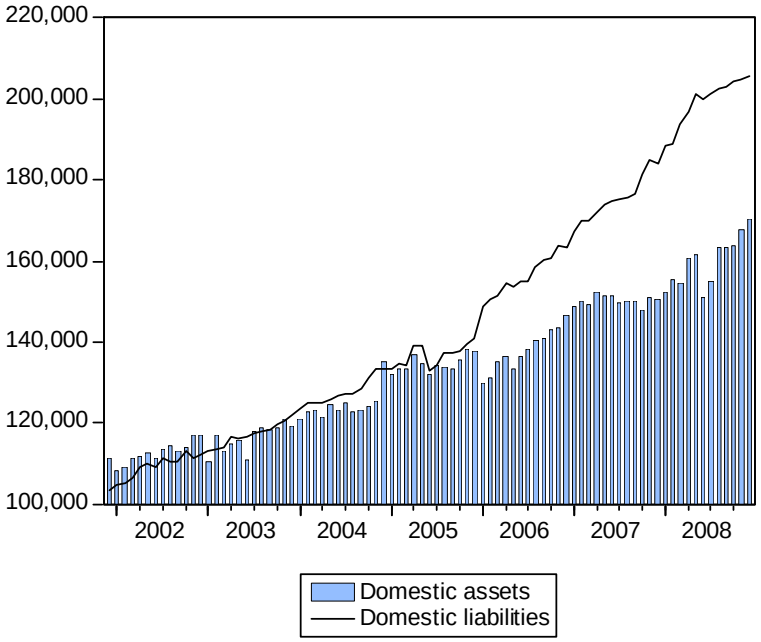


Figure 6, Guyana foreign currency constraint (US$ mill) – monthly data 1996 to 2008

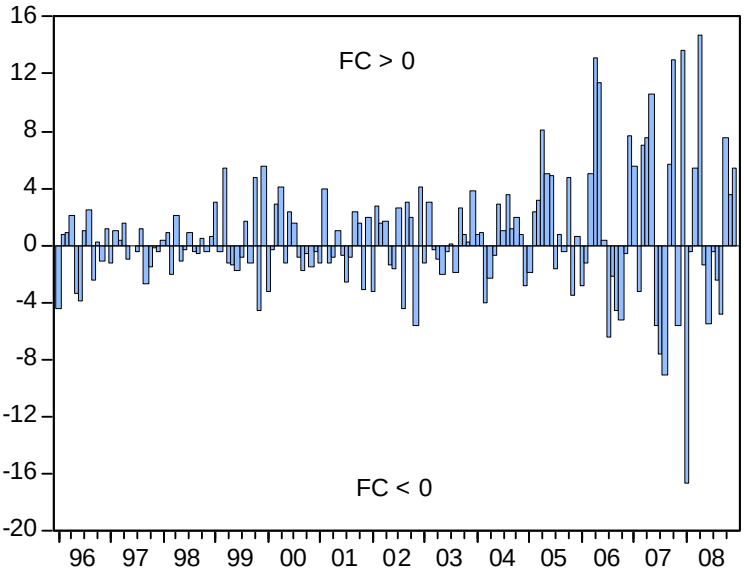
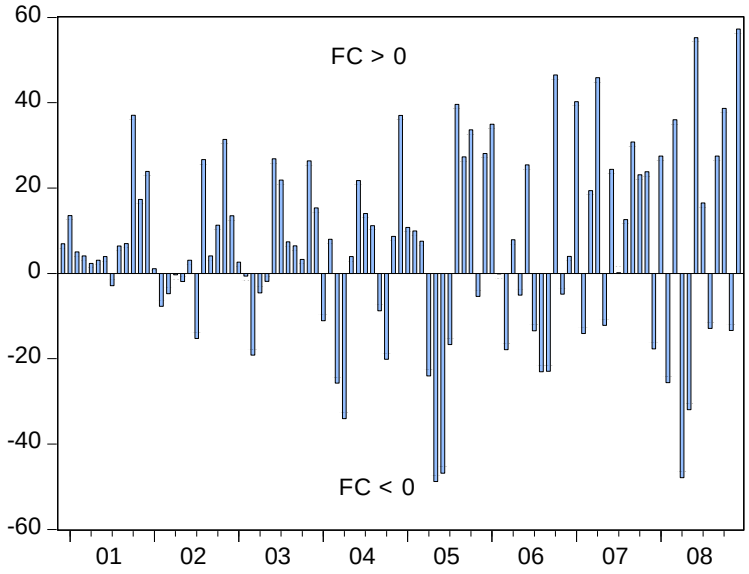


Figure 7, Jamaica foreign currency constraint (US$ mill) – monthly data 2001 to 2008



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 in domestic currency. We will also examine how the exchange rate adjusts to these shocks.

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 bank credit to the private sector (LP); (ii) the change in commercial banks' foreign assets (FA); (iii) excess reserves (ER); and (iv) the change in nominal exchange rate (EXR). [6] Therefore, the VAR method allows us to study the dynamic interactions between bank portfolio allocations and the foreign exchange

[6] 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.

market. It is also a useful method given the underlying endogeneity between the various markets.

The paper utilizes the relatively new 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[7], 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).

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 Jamaica. While data is available for earlier periods for 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.

The data were pre-tested to make sure each variable is stationary in the VAR (Table 1). There is some debate whether a VAR should be estimated in levels or in differences (Enders, 2004: p. 270). However, our analysis is institutional and inductive and seeks to uncover whether a stylized dynamic relationship exists between the foreign exchange market and bank asset allocations. Therefore, we have decided to enter each

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

variable in its stationary form in the VAR model. For Guyana and Jamaica, FC is stationary given the ADF unit root test results. We have created a stationary variable – given the ADF unit root test – 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 form. All Jamaican data are 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. 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 12 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 over G$ 800 million. After two months, however, the effect of the initial shock to 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 tepid level of approximately G$ 150 million. However, after one month it drops to zero and negative levels and oscillates with a dampening path to zero.

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***
Δexr	2	-4.69*	8	-3.5*
Δfa	0	-13.1*	4	-8.48*
Jamaica				
er	0	-2.85***	0	-2.80
fc	0	-8.81*	0	-8.81*
Δexr	1	-2.98**	1	-3.07**
Δfa	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.

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 3 points. By the second month, however, the ratio moves into positive territory and persists for six months. This result is consistent with the results from the ARDL model of excess reserves that was estimated for the Guyana banking system by Khemraj (2009). The response of the nominal exchange rate (ΔEXR) is negative (Figure 9). This signals the G$/US$ rate appreciates from a positive shock to the foreign currency constraint (FC). This is expected as a surplus in the foreign exchange market ought to lead to an appreciation. After two months the exchange rate appears to move back to equilibrium. A positive shock to FC engenders a positive response in ΔFA – an intuitive and expected result (Figure 10). The latter implies an easing of the foreign currency constraint leads to more investments in foreign positions, which amounts to just over G$ 800 million initial response. Interestingly, the response in ΔLP is just over G$150 million to the same one standard deviation shock in FC (Figure 11).

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

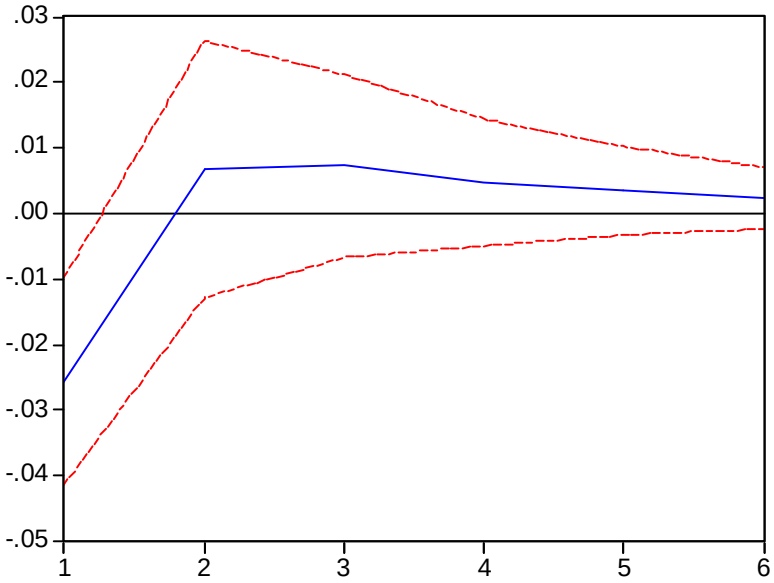


Figure 9, Guyana: response of ΔEXR to generalized one standard deviation FC innovation

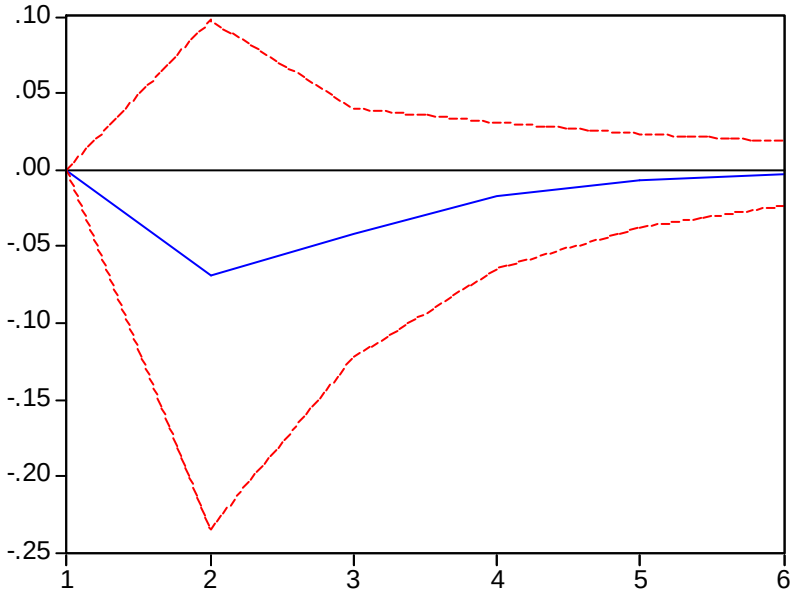


Figure 10, Guyana: response of ΔFA to generalized one standard deviation FC innovation

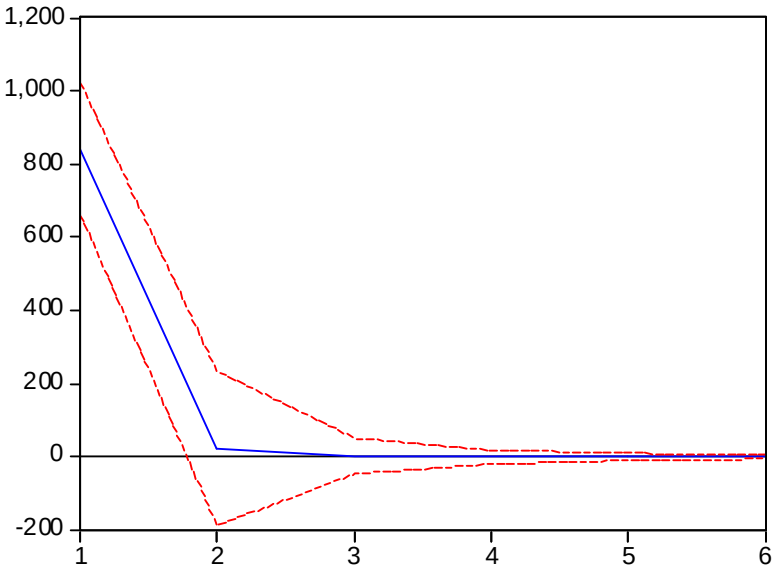


Figure 11, Guyana: response of ΔLP to generalized one standard deviation FC innovation

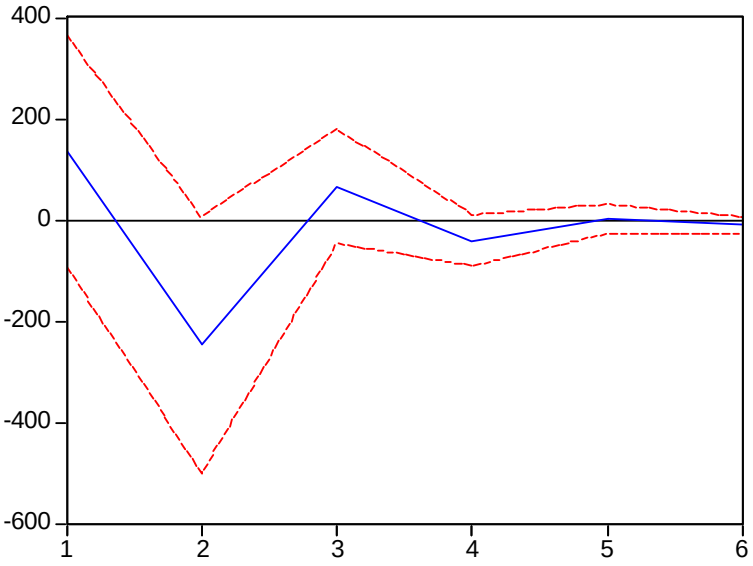
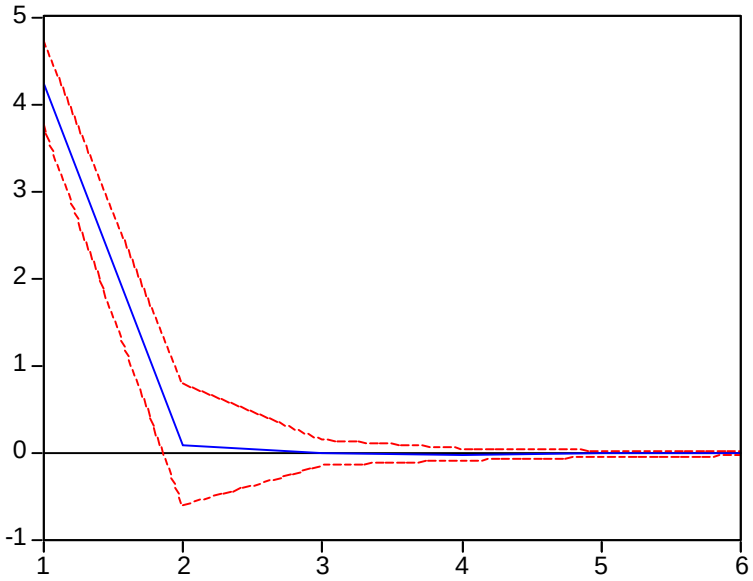


Figure 12, Guyana: response of FC to generalized one standard deviation FC innovation



The Jamaica results for the response of each variable given a one standard deviation shock to FC are strikingly similar to the Guyana results (figures 13 to 17). There is a positive response to ΔFA of about J$ 600 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. Although the effect on ΔLP is positive in the second month following the shock to FC, the increase of around J$ 100 million is significantly below the effect of the shock on ΔFA. This positive effect declines over the third and fourth months to zero.

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 10-month horizon. Unlike the Guyana case, 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. Over the following two months, however, the foreign exchange rate moves back to equilibrium. Finally, a positive shock to FC stimulates a positive response in FC in a similar pattern to the corresponding Guyana result.

Figure 13, Jamaica: response of ΔFA to generalized one standard deviation FC innovation

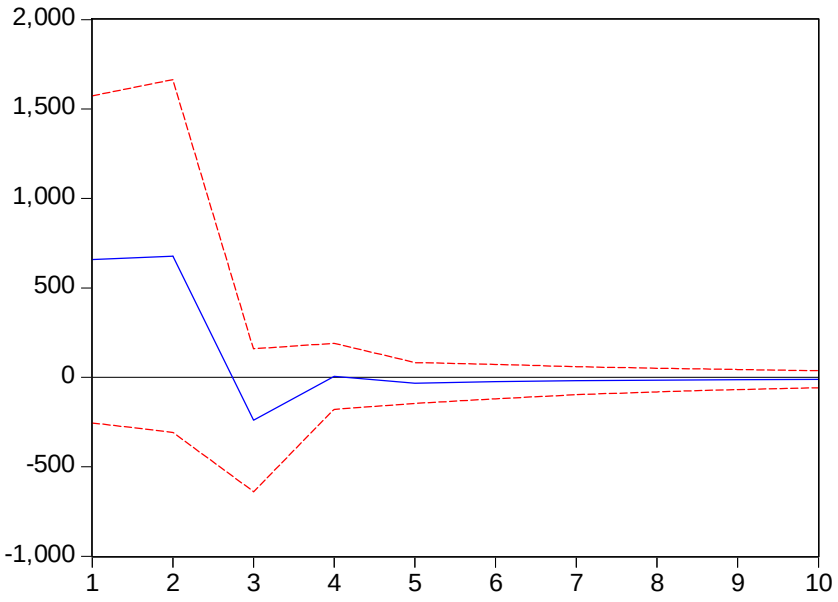


Figure 14, Jamaica: response of ΔLP to generalized one standard deviation FC innovation

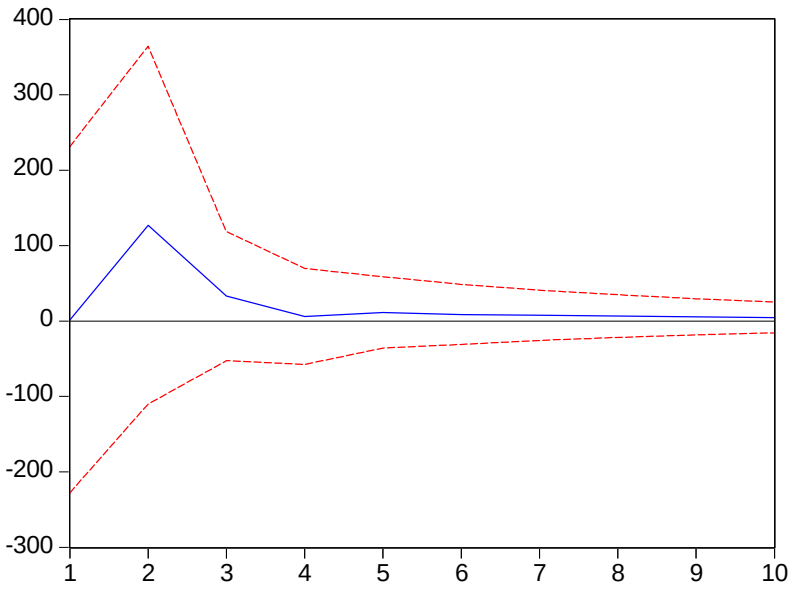


Figure 15, Jamaica: response of ER to generalized one standard deviation FC innovation

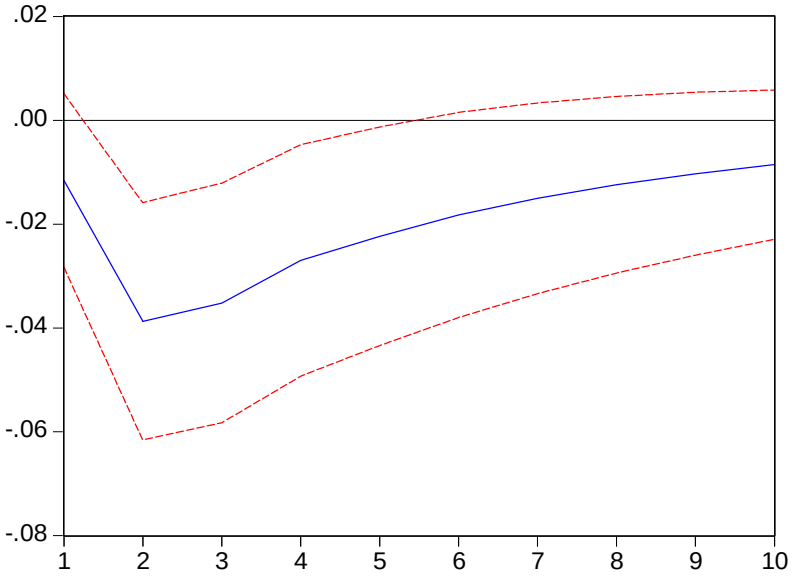


Figure 16, Jamaica: response of ΔEXR to generalized one standard deviation FC innovation

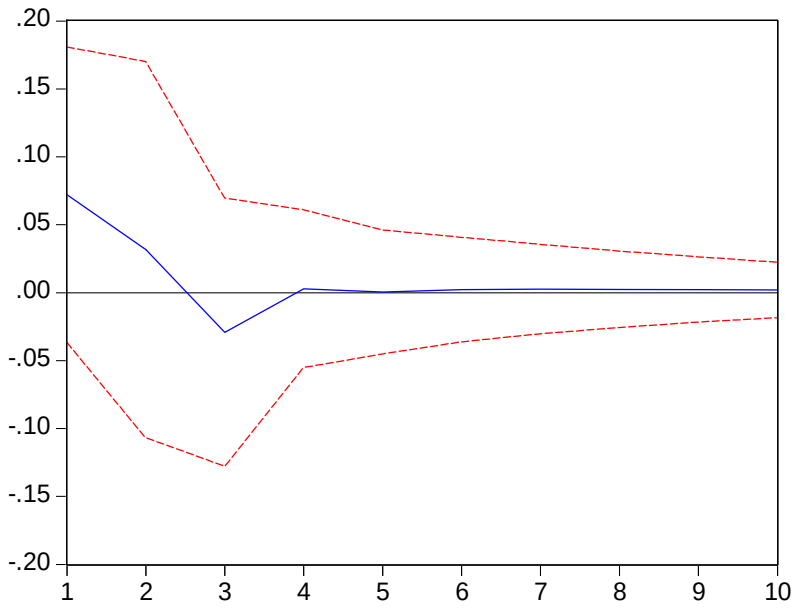
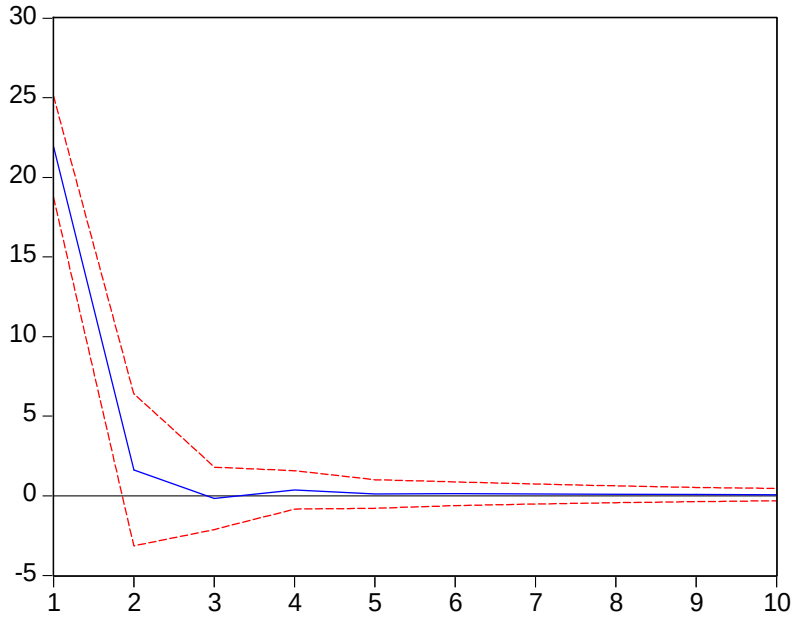


Figure 17, Jamaica: response of FC to generalized one standard deviation FC innovation



4. Conclusion

This paper examined the dynamic adjustments in commercial bank asset portfolio given shocks emanating from the foreign currency constraint. The results suggest a similar pattern of asset adjustments in Guyana and Jamaica given the said shocks. 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 excess liquidity 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 liquidity into foreign assets compared with private sector credit.

The main difference in the results was the initial exchange rate adjustment given the said one standard deviation positive shock. In the case of Guyana, the initial response was an appreciation in the nominal exchange rate; while in Jamaica there was an initial depreciation in the rate. The latter implies that a positive supply shock appreciates the G$/US$ exchange rate – in other words there is a movement along and down the foreign exchange demand curve given the outward shift in the supply curve. On the other hand, the results imply that the same positive supply shock in Jamaica elicits a contemporaneous demand shift (or shock) that leads to depreciation in the J$/US$ rate. This behaviour could stem from the fact that the license foreign exchange dealers operate on both the supply and demand side of the market.

The analysis might be useful to central banks – to the extent the central bank could engender shocks to the foreign currency constraint (via foreign exchange market interventions) might result in the dynamic responses reported above. 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.

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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	FCC	ΔEXR	ΔFA	ΔLP
ER(-1)	0.805412	-2.161555	0.062151	1646.001	-318.0460
	(0.05063)	(13.5515)	(0.32901)	(2768.19)	(691.796)
	[15.9062]	[-0.15951]	[0.18891]	[0.59461]	[-0.45974]
FCC(-1)	-0.001185	0.100528	0.002112	41.45352	4.905838
	(0.00040)	(0.10823)	(0.00263)	(22.1082)	(5.52504)
	[-2.92923]	[0.92884]	[0.80388]	[1.87503]	[0.88793]
ΔEXR(-1)	-0.051905	2.520099	0.509096	-130.4325	251.7054
	(0.01440)	(3.85450)	(0.09358)	(787.368)	(196.771)
	[-3.60392]	[0.65381]	[5.44019]	[-0.16566]	[1.27918]
ΔFA(-1)	5.09E-07	-0.001213	-7.72E-05	-0.307564	-0.003770
	(1.9E-06)	(0.00052)	(1.3E-05)	(0.10559)	(0.02639)
	[0.26361]	[-2.34754]	[-6.14843]	[-2.91287]	[-0.14289]
ΔLP(-1)	-6.51E-06	0.002632	4.79E-05	-0.245941	0.058502
	(7.5E-06)	(0.00202)	(4.9E-05)	(0.41207)	(0.10298)
	[-0.86371]	[1.30480]	[0.97824]	[-0.59685]	[0.56809]
C	0.343283	6.694955	0.091507	-1568.069	1361.894
	(0.08313)	(22.2492)	(0.54017)	(4544.89)	(1135.81)
	[4.12928]	[0.30091]	[0.16940]	[-0.34502]	[1.19905]
R-squared	0.777715	0.083751	0.388501	0.111635	0.040817
Adj. R-squared	0.765227	0.032276	0.354148	0.061727	-0.013070
Sum sq. resides	0.597360	42786.57	25.21977	1.79E+09	1.12E+08
S.E. equation	0.081926	21.92596	0.532323	4478.868	1119.310
F-statistic	62.27737	1.627037	11.30881	2.236806	0.757462
Log likelihood	105.9837	-425.0290	-71.80236	-930.3772	-798.6447
Akaike AIC	-2.104919	9.074295	1.637944	19.71320	16.93989
Schwarz SC	-1.943622	9.235593	1.799242	19.87450	17.10119
Mean dependent	1.605197	6.395177	0.365263	790.0694	1022.024
S.D. dependent	0.169083	22.28861	0.662383	4623.849	1112.067

Determinant resid covariance (dof adj.)	2.04E+13
Determinant resid covariance	1.47E+13
Log likelihood	-2114.161
Akaike information criterion	45.14024
Schwarz criterion	45.94673

Guyana results

Sample (adjusted): 1996M03 2008M12
Included observations: 154 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	ER	FCC	ΔEXR	ΔFA	ΔLP
ER(-1)	0.670299	-2.296755	0.070535	122.8571	-3248.931
	(0.06493)	(2.76994)	(0.66051)	(825.932)	(928.441)
	[10.3231]	[-0.82917]	[0.10679]	[0.14875]	[-3.49934]
FCC(-1)	0.005137	0.012000	-0.022113	43.70907	-45.86544
	(0.00263)	(0.11226)	(0.02677)	(33.4738)	(37.6283)
	[1.95192]	[0.10690]	[-0.82605]	[1.30577]	[-1.21891]
ΔEXR(-1)	-0.004197	-0.020744	0.478317	3.532756	-95.06740
	(0.00727)	(0.31013)	(0.07395)	(92.4732)	(103.950)
	[-0.57727]	[-0.06689]	[6.46790]	[0.03820]	[-0.91455]
ΔFA(-1)	3.76E-06	-4.72E-06	-6.71E-05	-0.188033	-0.099235
	(8.8E-06)	(0.00038)	(8.9E-05)	(0.11182)	(0.12570)
	[0.42773]	[-0.01260]	[-0.75079]	[-1.68154]	[-0.78946]
ΔLP(-1)	-6.47E-06	-5.19E-05	-3.47E-07	-0.009199	-0.337985
	(5.2E-06)	(0.00022)	(5.3E-05)	(0.06670)	(0.07497)
	[-1.23381]	[-0.23200]	[-0.00650]	[-0.13793]	[-4.50797]
C	0.419115	3.498959	0.158162	221.8135	4931.034
	(0.08408)	(3.58669)	(0.85527)	(1069.47)	(1202.21)
	[4.98481]	[0.97554]	[0.18493]	[0.20740]	[4.10165]
R-squared	0.458480	0.005501	0.241932	0.019238	0.184491
Adj. R-squared	0.440186	-0.028097	0.216321	-0.013896	0.156940
Sum sq. resides	1.464067	2664.290	151.4969	2.37E+08	2.99E+08
S.E. equation	0.099460	4.242871	1.011745	1265.128	1422.147
F-statistic	25.06097	0.163722	9.446613	0.580625	6.696337
Log likelihood	139.9750	-438.0235	-217.2547	-1315.468	-1333.485
Akaike AIC	-1.739935	5.766539	2.899412	17.16192	17.39590
Schwarz SC	-1.621612	5.884862	3.017734	17.28024	17.51423
Mean dependent	1.268057	0.553720	0.412857	338.0582	533.2013
S.D. dependent	0.132931	4.184492	1.142883	1256.429	1548.870

Determinant resid covariance (dof adj.)	2.86E+11
Determinant resid covariance	2.35E+11
Log likelihood	-3108.502
Akaike information criterion	40.75976
Schwarz criterion	41.35138