



## **Investigating the link between Financial Dollarization and Inflation: Evidence from Jamaica**

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September 2005

### ***Abstract***

This paper utilizes VAR analysis to investigate the role of financial dollarization in the dynamics of inflation in Jamaica. Descriptive analysis suggests that macroeconomic instability as well as institutional factors have shaped the development of financial dollarization. The empirical findings confirm the relevance of financial dollarization in influencing the inflation outcome. The results indicate that shocks to financial dollarization lead to an initial reduction in the monetary base, as investors substitute foreign currency for domestic currency. The positive exchange rate response to the increase in foreign money holdings also confirms the high elasticity of substitution between domestic and foreign currency. Additionally, the fiscal authorities try to compensate for the decline in the inflation tax due to the reduction in base money, by increasing administered prices. Further, results from the VAR analysis do not support the theory by Ize and Levy-Yeyati (1998), which argues that increases in real exchange volatility vis-à-vis inflation volatility is an effective policy measure in substantially limiting financial dollarization. Rather, the empirical evidence suggests that a substantial reduction in financial dollarization in the Jamaican economy is associated with a relatively stable or appreciating exchange rate. Therefore, within a floating exchange rate regime such as Jamaica, policy options to reduce dollarization should be primarily geared at tighter foreign exchange market management.

**JEL Classification Numbers:** C52; E5; G11

**Keywords:** Financial dollarization; inflation; VAR

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<sup>1</sup> The views expressed are those of the author and do not necessarily reflect those of The Bank of Jamaica.

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## 1. Introduction

Dollarization, which can either be official or unofficial, involves the replacement of a country's domestic currency with the currency of another country, typically the US dollar. Official dollarization or currency substitution is an advanced stage of dollarization which involves a complete conversion from the domestic currency to a foreign currency, under the directive of the Government. According to Gulde et al (2003), unofficial or partial (de facto) dollarization occurs when the local currency remains the exclusive legal tender but transactions are allowed to be denominated in US dollars, effectively facilitating a bi-currency system.<sup>2</sup>

Financial dollarization is one form of unofficial dollarization and reflects economic agents' efforts to protect the value of their wealth and income, in the context of deteriorating financial conditions that have an adverse effect on the expected return on domestic money holdings relative to foreign money holdings.<sup>3</sup> Financial dollarization (asset or liability substitution) induces foreign currency mismatches, which can result in gaping exposures in the event of sharp exchange rate depreciations. As such, the increasing share of US dollar intermediation in the banking system of many developing and emerging market economies has sparked growing concerns among policymakers.<sup>4</sup> These concerns are grounded in the pervasive influence of financial dollarization in the financial and exchange rate crises of the late 1990s. Seminal work by Levy-Yeyati (2004) provides evidence that financial dollarization jeopardizes financial stability.

Financial dollarization also raises concerns regarding the effectiveness of monetary policy. Bahmani-Oskoe and Domac (2002) investigated the importance of dollarization in the inflation dynamics of Turkey. They found that dollarization reduces the domestic money component of money supply and generates inflation increases for a given budget deficit, adding complexity to the implementation of monetary policy. As such, the presence of dollarization impairs the central bank's ability to moderate credit and output cycles. Despite the channels discussed, dollarization has not been presented as the cause of inflation. Rather, dollarization is a response of economic agents to economic instability, including high and volatile inflation rates. As such, the presence of dollarization could stimulate further inflationary impulses, influencing additional portfolio shifts by these agents. This paper augments existing studies on the dollarization process in Jamaica, by

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<sup>2</sup> Throughout the rest of the paper, the term financial dollarization and dollarization are used synonymously. The term official dollarization is used when referring to a country's complete conversion to a foreign currency.

<sup>3</sup> See Domac et al (2002)

<sup>4</sup> See, for example, Gulde et al (2004)

investigating the influence of financial dollarization on inflation. US dollar intermediation in the Jamaican banking system has its origins in the liberalization process of the late 1980s and early 1990s. At this juncture, financial institutions exhibited a significant expansion in their foreign exchange exposures, as the soaring inflation rates contributed to foreign currency liabilities of the banking system outpacing foreign currency assets. At present, foreign currency deposits as a proportion of total deposits in Jamaica is currently around 39.0 per cent, which is 9.0 percentage points higher than the international minimum dollarization benchmark.<sup>5</sup>

Given the high incidence of dollarization in the domestic economy, the purpose of the empirical investigation is two-fold. First, the paper utilizes VAR analysis to investigate the impact of financial dollarization on inflation dynamics in Jamaica. Second, this study assesses whether, based on the thesis by Ize and Levy-Yeyati (1998), increases in real exchange rate volatility relative to inflation volatility is an effective policy tool in limiting the growth of financial dollarization in the domestic economy. Based on findings by Ize and Levy-Yeyati (1998), this policy measure will discourage financial dollarization as economic agents make portfolio shifts to safeguard their income.

The remainder of the paper is organized as follows: Section 2 presents an overview of the literature. Section 3 provides a descriptive analysis of the factors influencing the evolution of financial dollarization in Jamaica. The empirical methodology and the results of the monetary policy analysis are discussed in sections 4 and 5. The policy implications of the results and the conclusion are presented in section 6.

## **2. Literature Review**

The phenomenon of dollarization has been studied since the 1970s. These early studies could not distinguish between the motives of currency and asset substitution, because of the assumption of only two assets: domestic and foreign currency. This assumption was considered reasonable within a framework of restricted capital mobility. Early models, including Calvo and Rodriguez (1977), primarily considered the implications of currency substitution for money demand, exchange rate determination and the conduct of monetary policy. Calvo and Rodriguez (1977) developed a two-sector model of exchange rate determination for a small open economy where residents held both the domestic and foreign currency, had rational expectations and prices were

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<sup>5</sup> The ratio was computed using Jamaican banking system data at end December 2004.

fully flexible. Residents maximized real financial wealth  $W$ , in the foreign currency:  $W=M/E + M^*$ , where  $M$  is the domestic currency,  $M^*$  is foreign money and  $E$  is the nominal exchange rate.<sup>6</sup>

Later research re-examined the currency substitution issue by specifying asset portfolio balance models. These models improved on the earlier work by explicitly assuming the existence of bonds denominated in each currency. Cuddington (1983) outlined that domestic residents' demand for foreign money was distinct from their demand for foreign non-monetary assets. The demand for the non-monetary asset was specified as a function of real income and the real return of the asset. As a result, Cuddington's model facilitated the empirical estimation of domestic money demand with the inclusion of both currency and asset substitution. A shortcoming of the model, however, was the inability to explain the relevance of currency substitution, particularly in the context where interest-bearing bonds were available.

Seminal work by Thomas (1985) involved closer scrutiny of the properties of currency and asset substitution. Thomas developed a liquidity services model where economic agents determine currency substitution based on transaction costs and nominal interest rates, while unofficial dollarization was influenced by real return differentials, assets' risk characteristics and economic agents' attitude to risks. The model assumes perfect financial markets, where economic agents can borrow and lend on both the domestic and international markets without constraints. The model allows for the possibility of portfolio balance motives for currency substitutability. Thomas (1985) argued that expected-utility-maximizing agents respond to changes in inflation or exchange rate expectations by adjusting non-monetary assets or liabilities to mitigate the risks associated with money holdings. The model's assumption of unrestricted access to international capital markets is a limitation in assessing dollarization in emerging and transition economies.

Following work done by Thomas (1985), Ize and Levy-Yeyati (1998) developed a Capital Asset Portfolio Model (CAPM) formulation to explain the dollarization process from both sides of a financial intermediary's balance sheet. The model assumed that investors could minimize the variance of their portfolio returns by holding foreign currency and local currency in proportions determined by the relative volatility of the inflation and real exchange rate. As such, banks and depositors hedge against inflation and foreign exchange risks in order to achieve minimum variance portfolio equilibria in the loanable funds market.

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<sup>6</sup> See Piontkovsky (2003)

Ize and Levy-Yeyati (1998) argued that investors' equilibrium dollarization fluctuates around the level of dollarization at which the whole portfolio has minimum variance, thus influencing the level of dollarization within the economy.<sup>7</sup> They found evidence to support this theory for a broad sample of countries. The dollar share of the optimal investment portfolio, which reflects the minimum variance portfolio, has the following specification:

$$I^* = \frac{Var(\mathbf{p}) + Cov(\mathbf{p}, s)}{Var(\mathbf{p}) + Var(s) + 2Cov(\mathbf{p}, s)}$$

where  $\mathbf{p}$  = domestic inflation and  $s$  is real depreciation

Based on the above expression, increases in the variance of inflation for a given variance of real exchange rate depreciation, is associated with increases in dollarization.

Ize and Levy-Yeyati (1988) found evidence that the equilibrium portfolio largely approximates actual dollarization for a broad sample of countries. The model suggests that asymmetries between depositors' and borrowers' portfolios could generate deviations from this equilibrium.

Recent studies have typically investigated the vulnerabilities associated with increased financial dollarization. Levy-Yeyati (2004) augmented previous work by Ize and Honohan (2003) which found evidence that financial dollarization increases solvency and liquidity risks of the banking sector. Domac and Bahmani-Oskooee (2002) summarized pertinent concerns in the literature related to the impact of dollarization on the implementation and effectiveness of monetary policy. They outlined that dollarization jeopardizes the effectiveness of the transmission mechanism by: (i) reducing the yield of the inflation tax, resulting in higher and more volatile inflation, for a given budget deficit, (ii) reducing the monetary authorities' control over domestic liquidity both by inducing shifts away from local money holdings and increasing the volatility of domestic money demand, (iii) affects the choice of exchange rate regime and (iv) increases the exposure of the banking system to additional risks on account of uncovered foreign liabilities, complicating the intermediation channel for effecting monetary policy.

### **3. Determinants of Financial Dollarization in Jamaica: A descriptive analysis**

Financial dollarization in the Jamaican economy was spawned from the economic liberalization process of the late 1980s and early 1990s. The liberalization process involved financial system and foreign exchange market reforms, including the elimination of exchange controls to allow

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<sup>7</sup> See Piontkovsky (2003)

residents to hold foreign currency. Since liberalization, growth in dollarization has been facilitated by a confluence of macroeconomic and institutional factors. High and volatile rates of inflation, a depreciating exchange rate, the financial crisis of the mid-1990s and high fiscal deficits were the major macroeconomic factors influencing the growth in foreign currency holdings by domestic residents.<sup>8</sup> Institutional factors primarily affected the dollarization process through under-developed capital markets and changes in agents' expectations regarding future international and political developments.

### **3.1 Contribution of Macroeconomic & Institutional Factors to the Dollarization Process**

Severe foreign exchange demand pressures and mounting foreign exchange market instability prompted the Jamaican authorities to liberalize foreign exchange market trading in September 1990. This was accomplished through the establishment of an interbank trading system. The liberalization of the foreign exchange market precipitated episodes of exchange rate depreciation between late 1991 and early 1992. Given the high import content of domestic production, the depreciation in the exchange rate translated into higher domestic prices and created further challenges for maintaining and achieving monetary stability.<sup>9</sup> The shock to import costs, as well as the expansionary monetary and fiscal policies accompanying liberalization translated into domestic inflation of as high as 107.9 per cent in April 1992.<sup>10</sup>

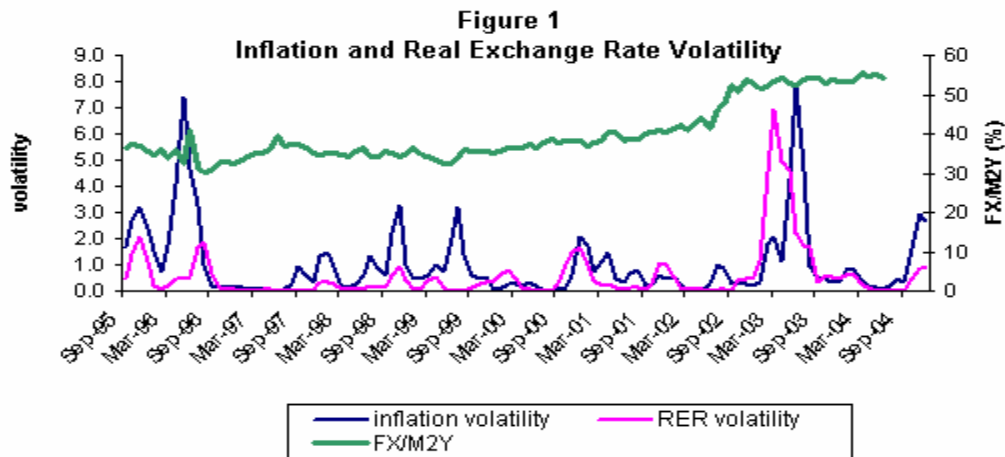
During the 1990s, high annual average inflation of 23.94 per cent, due to the liberalization process, translated into periods of excess inflation volatility vis-à-vis real exchange rate volatility. During this period, there were shifts in portfolio composition as residents became increasingly concerned with the capacity of the national currency as a store of value (see Figure 1). An underdeveloped capital market that presented limited outlets for domestic investments also fostered strong growth in dollarization during the initial post-liberalization period. This was reflected in a steady growth in foreign currency deposits in the post-liberalization era.

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<sup>8</sup> It has been widely observed that economies become dollarized during periods of economic instability and high inflation. This has been the experience in highly dollarized economies such as Argentina and Turkey.

<sup>9</sup> Inflationary episodes in Jamaica have been primarily influenced by changes in the exchange rate regime and the fiscal policy stance.

<sup>10</sup> The sharp episodes of depreciation were due to the initial over valuation of the exchange rate.

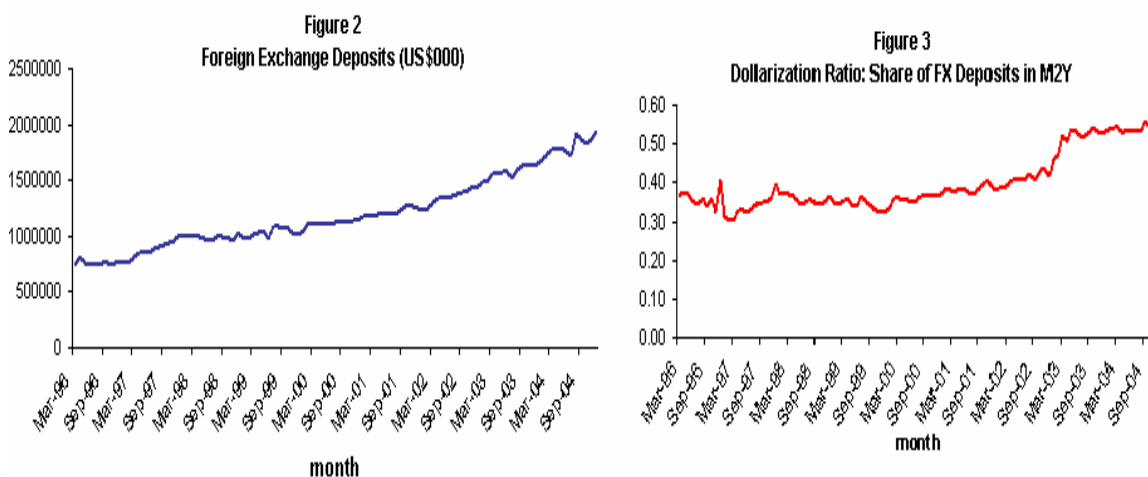


The process of financial sector reforms during the early 1990s engendered rapid growth and development of the Jamaican financial system, which were outpaced by the appropriate legislative changes. The liberalization process also facilitated significant expansion in bank credit that was collateralized by rapid appreciation in real estate and stock prices, without the necessary risk assessment.<sup>11</sup> In 1995, the Central Bank introduced more restrictive monetary policy to constrain money supply growth and restore stability to the financial markets. The stabilization of domestic prices created liquidity problems for many financial institutions. The fallout in the financial system during 1996 and the consequent increase in Government’s debt burden weakened investor confidence and further promoted the growth of dollarization in the domestic economy. Figure 2 shows a steady upward trend in foreign currency deposits during the financial crisis period of the latter half of the 1990s. Moreover, the share of foreign currency deposits to M2Y (FX/M2Y), a widely used indicator of dollarization, averaged approximately 36.0 per cent during 1996 (see Figure 3).<sup>12</sup>

<sup>11</sup> Financial sector expansion was channeled into high yielding financial assets and, as such, was not accompanied by strong real sector growth.

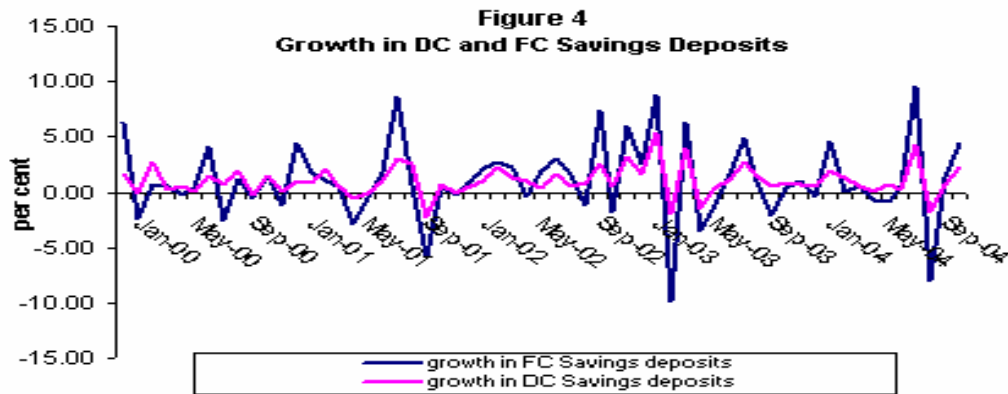
<sup>12</sup> The average was computed for March 1996 – December 1996. M2Y= M2 + foreign currency deposits, where M2 includes currency in circulation and domestic time, savings and demand deposits.





The efforts by the monetary authorities to restore stability to the financial markets resulted in a moderation in dollarization, with the indicator declining to 31.0 per cent at end March 1997 from 37.0 per cent at the start of the financial sector crisis. Notwithstanding, foreign exchange market management was constrained in the second half of 1997 by an upsurge in foreign currency demand. The upsurge in demand was precipitated by capital transfers and sustained by further depreciation expectations in anticipation of the upcoming general elections. In this context, the ratio of foreign currency deposits to M2Y increased to 40.0 per cent by the end of 1997.

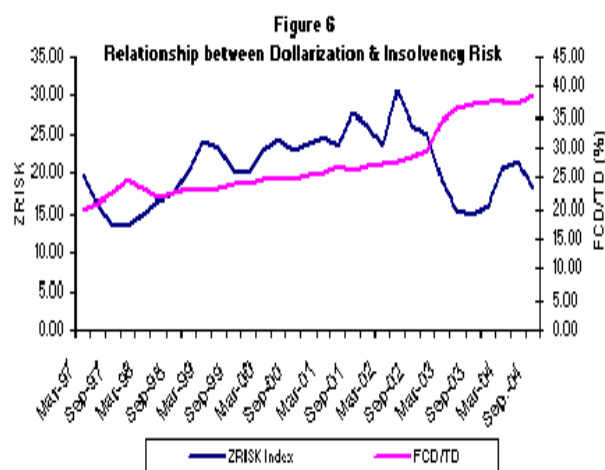
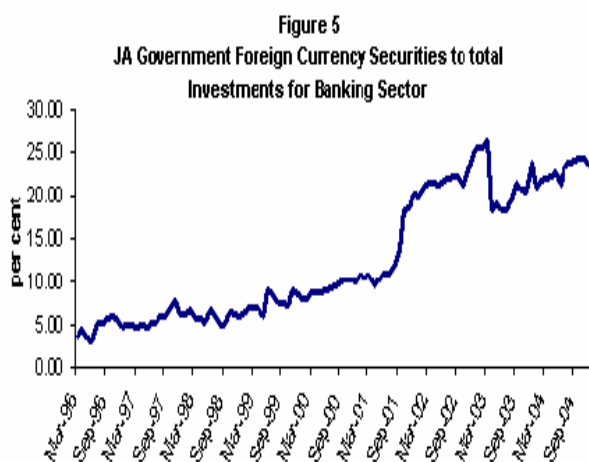
During the first half of 1998, improved macroeconomic performance provided the scope for the relaxation of the Bank’s monetary policy. In this context, dollarization declined but remained at relatively high rates, consistent with the memory of past economic instabilities; in particular, high inflation episodes. However, in August 1998, adverse developments in the international capital market led to renewed pressures in the foreign exchange market and increased holdings of US dollar denominated debt. The Bank contained the temporary resurgence of instability by supplementing foreign exchange flows to the market. The subsequent restoration of macroeconomic stability contributed to a lowering of foreign currency holdings by economic agents in early 1999. Stability during latter half of the year was interrupted by episodes of foreign exchange market instability in anticipation of shortfalls in Government’s foreign currency financing needs. Nonetheless, the overall stability in the macroeconomic environment continued into 2000, resulting in stable foreign exchange rates and lowered inflation expectations. These positive macroeconomic developments resulted in the ratio of foreign currency deposits to total deposits in the banking system remaining relatively stable during the year.



In 2001, increased dollarization in the domestic economy was fueled by the events of September 11. The uncertainties in the international environment promoted an upsurge in foreign currency demand. This translated to higher growth rates in foreign currency savings deposits, as economic agents substituted domestic currency savings deposits for a safer store of value (see Figure 4).

Despite the containment of instability in the first part of 2002, there was a stronger than anticipated increase in foreign currency demand during the second half of the year. The increased demand for foreign currency emanated from uncertainty regarding the prospects for tourism, and persisted due to anxieties regarding the increase in Government's borrowing requirements. Figure 5 shows a significant increase in Government's foreign currency borrowing during 2001 – 2002. The macroeconomic uncertainties which emerged in 2002, persisted into 2003 resulting in a significant increase in the dollarization ratio to 54.0 per cent in October 2003 relative to 36.0 per cent during the crisis period of October 1996. Figure 6 indicates that the significant dollarization of banking sector deposits during 2003 was associated with increased banking sector fragility, where fragility is measured by a decline in the ZRISK index.<sup>13</sup> Additionally, the onset of banking sector fragility weakened investor confidence and fueled increased dollarization.

<sup>13</sup> The ZRISK measures the risk of financial institution insolvency by calculating the number of standard deviations of unexpected losses which would lead to a complete erosion of the institution's capital base (See Hannan and Hanweck 1988).



The challenges to macroeconomic stability during 2002 to 2004 primarily emanated from instability in the international environment due to the unrest in the Middle East, adverse supply conditions in the international commodity markets and uncertainties regarding public sector financing. Since then, dollarization has remained at relatively high levels, with the ratio of foreign currency deposits to M2Y averaging 54.0 per cent for 2004.

#### 4. Empirical Analysis of the link between Dollarization and Inflation

##### 4.1 Data

The study utilizes the key variables influencing dollarization and inflation dynamics in Jamaica, in order to investigate the impact of dollarization on inflation dynamics.<sup>14</sup> The empirical analysis is conducted using a vector autoregression (VAR) model that incorporates monthly data on the exchange rate, CPI, base money, an index of public sector prices (PSP) and the dollarization ratio (FX/M2Y) as its endogenous variables. The sample period spans March 1996 to December 2004, in order to provide a reasonable sample size for the analysis. The PSP index is computed as government expenditure per capita and is deflated using 1995 values. All series, except the PSP index, were logged to adjust for scaling differences. The PSP and base money variables are indicative of policy stances by the relevant authorities. Exchange rate data are the weighted average nominal exchange rates of the Jamaica currency vis-à-vis the U.S. dollar, where the U.S. dollar is the currency of the country's major trading partner. A dummy variable is included to

<sup>14</sup> Inflationary episodes in Jamaica have been influenced by changes in the exchange rate regime, uncertainties regarding public sector financing and balance of payments developments.

capture the financial crisis that occurred during the second half of the 1990s. In examining the policy options available to the Central Bank for limiting dollarization, the study incorporates the 3-month lagged ratio of real exchange rate volatility to inflation volatility, as an endogenous variable. The impact of this variable on the dollarization dynamics in Jamaica is examined in section 5.2.

## **4.2 Methodology**

The dynamic relationships among the variables in a VAR model are analyzed using impulse response functions and variance decompositions.<sup>15</sup> The VAR framework accounts for this dynamic interaction among variables in the system by expressing each variable as a linear function of its own past value and past values of all the variables being considered. The error terms in these regressions are the ‘surprise movements’ in the variables, taking past values into account. The study utilizes generalized impulse response analysis, which is a technique originally developed by Koop (1996) and Pesaran and Shin (1998). Unlike traditional impulse response analysis, generalized impulse response analysis is invariant to the ordering of the variables in the VAR, resulting in a unique solution. As a result, it is possible to examine the initial impact of responses of each variable to shocks to any of the other variables. Generalized impulse response analysis takes account of the historical pattern of correlation observed among the different shocks.<sup>16</sup> The approach is useful for the purposes of this study because it accounts for the possibility of a strong correlation of the VAR residuals.

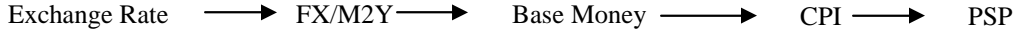
The variance decomposition analysis is performed by orthogonalizing the underlying shocks in the VAR model using the Cholesky decomposition of the variance-covariance matrix of errors, which is a pre-specified ordering of the variables in the VAR.<sup>17</sup> The ordering shown below is based on a priori expectations and indicates that exchange rate changes influence dollarization through portfolio adjustments by economic agents. Changes in the level of dollarization in turn influences base money and domestic liquidity. Domestic liquidity conditions impact the CPI which affects public sector prices.

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<sup>15</sup> The VAR model treats each variable as endogenous, where each variable is expressed in terms of its own lagged values and the lagged values of all other variables in the system. Impulse response analysis measures the time profile of the effect of a shock on the future values of the variables in the system while variance decompositions determine the movement in a sequence due to its own shock versus shocks to other variables.

<sup>16</sup> See Dua (2004) and Domac et al (2002)

<sup>17</sup> The Cholesky decomposition or orthogonal factorizations was utilized since non-orthogonal factorizations yield decompositions that do not satisfy an adding up property.



**VAR Model Setup**

The estimated VAR model takes the following form:

$$X_t = \mathbf{a}_1 X_{t-1} + \mathbf{a}_2 X_{t-2} + \mathbf{e}_t \quad (1)$$

where  $X_t$  is a vector of 5 x 1 endogenous variables,  $\mathbf{a}_1$  and  $\mathbf{a}_2$  are parameter matrices and  $\mathbf{e}_t$  is a vector of innovations or surprise movement in the variables. The vector  $X_t$  includes the endogenous variables; base money, exchange rate, public sector prices, CPI and FX/M2Y. The vector  $X_t$  is a VAR (2) process, where the general VAR (p) process can be written as:

$$x_t = \sum_{i=1}^p \Phi_i x_{t-i} + \mathbf{e}_t, \quad t = 1, 2, \dots, T \quad (2)$$

where  $x_t = (x_{1t}, x_{2t}, \dots, x_{mt})'$  is an  $m \times 1$  vector of jointly determined dependent variables and  $\{\Phi_i, i = 1, 2, \dots, p\}$  are  $m \times m$  coefficient matrices and  $E(\mathbf{e}_t) = 0$  and  $E(\mathbf{e}_t \mathbf{e}_t') = \Sigma = (\mathbf{s}_{ij})$ . In order to obtain the Generalized Impulse Response Function,  $x_t$ , which is assumed to be covariance stationary, can be re-written as:

$$x_t = \sum_{i=0}^{\infty} A_i \mathbf{e}_{t-i}, \quad t = 1, 2, \dots, T \quad (3)$$

where the  $m \times m$  coefficient matrices  $A_i$  can be obtained from the recursive relations:

$$A_i = \Phi_1 A_{i-1} + \Phi_2 A_{i-2} + \dots + \Phi_p A_{i-p}, \quad i = 1, 2, \dots,$$

with  $A_0 = I_m$  and  $A_i = 0$  for  $i < 1$

The generalized impulse response for  $x$  based on an arbitrary shock to the  $j$ th element of  $\mathbf{e}_t$  is denoted by:

$$GI_x(n, \mathbf{d}_j, w_{t-1}) = E[X_{t+n} / \mathbf{e}_{jt} = \mathbf{d}_j, w_{t-1}] - E[X_{t+n} / w_{t-1}] \quad (4)$$

for  $n = 0, 1, \dots$

Given that  $e_t$  has a multivariate normal distribution, i.e.,  $\mathbf{e}_t \sim N(0, \Sigma)$  then:

$$E(e_t / e_{jt} = \mathbf{d}_j) = (\mathbf{s}_{1j}, \mathbf{s}_{2j}, \dots, \mathbf{s}_{mj})' \mathbf{s}_{jj}^{-1} \mathbf{d}_j = \sum e_j \mathbf{s}_{jj}^{-1} \mathbf{d}_j \quad (5)$$

Equation 5 represents the predicted shock in each error given a shock to  $\mathbf{e}_{jt}$ , based on the typically observed correlation between the errors, where the economy's history up to period  $t - 1$  is denoted by the non-decreasing information set,  $w_{t-1}$ . This differs from the case where the disturbances are orthogonal and the shock only changes the  $j$ th error as follows:

$$E(\mathbf{e}_t / \mathbf{e}_{jt} = \mathbf{d}_j) = \mathbf{d}_j e_j$$

As such, the  $m \times 1$  vector of the generalized impulse response of a shock in the  $j$ th equation at time  $t$  on  $x_{t+n}$  is given by:

$$\left( \frac{A_n \sum e_j}{\sqrt{\mathbf{s}_{jj}}} \right) \left( \frac{\mathbf{d}_j}{\sqrt{\mathbf{s}_{jj}}} \right) \text{ for } n = 0, 1, 2, \dots$$

By setting  $\mathbf{d}_j = \sqrt{\mathbf{s}_{jj}}$  in equation 5, i.e. measuring the shock by one standard deviation, the generalized impulse response function can be re-stated as:  $\mathbf{y}_j^g(n) = \mathbf{s}_{jj}^{-\frac{1}{2}} A_n \sum e_j$ ,  $n = 0, 1, 2, \dots$

## 5. Estimation Results

### 5.1 Inflation Response to Dollarization

The Lag order of the VAR was selected based on several information criteria. As such, an optimal lag length of 2 was determined based on the results of the LR test statistic, final prediction error and Akaike information criterion (see Table 1).<sup>18</sup>

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<sup>18</sup> The issue of whether the variables in a VAR need to be stationary is widely discussed in the literature. Sims (1980) proposed that the variables in a VAR model should not be differenced even if they contain unit root, since differencing would distort the interrelationships among the variables and the natural co-movements in the data. See Sims et al (1990) for more on this. Following this argument, the variables included in the model were not differenced. Additionally, unit root tests showed that the variables were integrated of different orders, with no cointegrating relations being imposed on the system.

**Table 1 - VAR Lag Order Selection Criteria**

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-22.86	NA	7.18E-08	0.58	0.73	0.64
1	602.67	1163.49	5.44E-13	-11.21	-10.12*	-10.77*
2	646.19	75.73*	4.72E-13	* -11.36*	-9.33	-10.54
3	666.48	32.87	6.58E-13	-11.05	-8.08	-9.85
4	690.55	36.11	8.67E-18	-10.81	-6.90	-9.23
5	704.62	19.42	1.43E-12	-10.37	-5.53	-8.41
6	735.63	39.07	1.74E-12	-10.27	-4.49	-7.93

\* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

### (i) Generalized Impulse Response Analysis

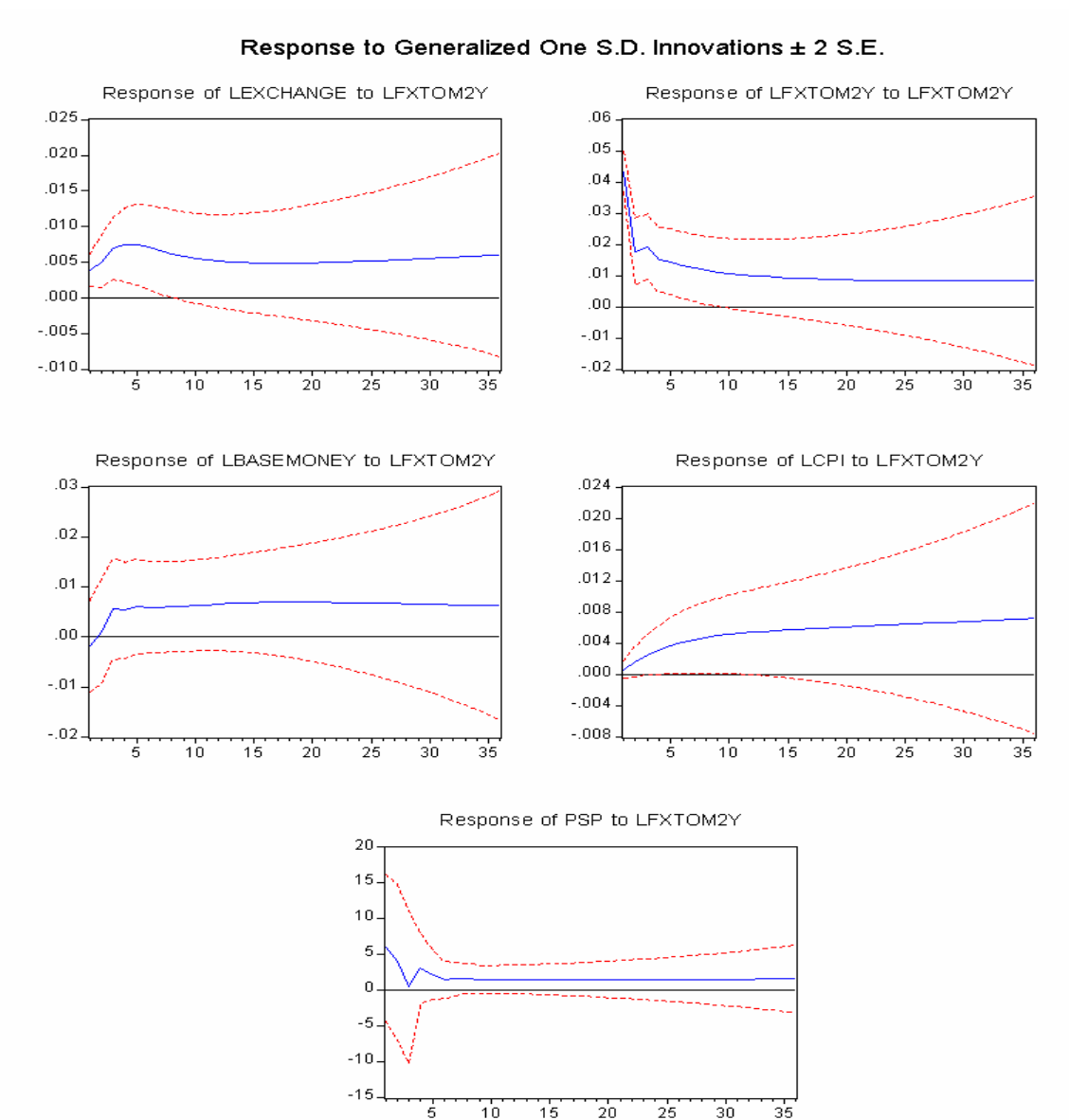
Figure 7 plots the impulse responses of CPI, base money, exchange rate, public sector prices, and the dollarization ratio (FX/M2Y) with respect to a one standard deviation increase in FX/M2Y over a horizon of thirty-six months. The VAR coefficients and standard errors from the model are calculated by the Monte Carlo method with 1000 repetitions (of  $\pm 2$  standard deviations). The strong positive response in the exchange rate within the first 3 months is consistent with the increased foreign currency holdings by domestic residents and typifies the high elasticity of substitution between the domestic and foreign currency based on the Jamaican experience. The impulse response suggests that shocks in FX/M2Y result in an initial decline in base money. This initial impact is consistent with a priori expectations that shocks to dollarization result in a decline in base money as the public switches from domestic to foreign money holdings. Subsequent to its initial decline, base money increased stimulating further upward movement in the CPI. Notwithstanding, base money reverts to a downward trend from month 20, which lasts beyond the forecast horizon.

The exchange rate reflected a consistent increase from month 20, with the impulse persisting beyond the forecast horizon. The depreciation in the exchange rate contributed to a continuous increase in the CPI due to the relatively high exchange rate pass-through to inflation. The impact of the decline in base money on prices is tempered by an increase in government expenditure per capita, which represents the proxy for administered prices. Increases in administered prices

mirrors the initiatives of the fiscal authorities to cushion the decline in the inflation tax associated with a decline in the domestic money component of the money supply.

Overall, the results are consistent with previously discussed channels through which dollarization complicates monetary policy implementation. The evidence collaborates the view that dollarization complicates the efficacy of the transmission mechanism. The results suggest that sudden increases in dollarization in the Jamaican economy are associated with inflationary pressures for a given budget deficit.

**Figure 7**





**(ii) Variance Error Decomposition**

The results from the variance decomposition suggest that, FX/M2Y accounts for the largest proportion of the error in forecasting its own variation. Over a thirty-six month horizon, the variable contributes to 37.5 per cent of its own variation lending support to the hypothesis of hysteresis in the dollarization process observed in other countries. The results show that dollarization accounts for a significant, but declining proportion of its own variation over time. This result is consistent with the findings from the descriptive analysis, which indicate that dollarization has remained high even in a context of lower domestic inflation rates. The findings also indicate that the exchange rate is critical in explaining the variation in the dollarization indicator. The variable accounts for 39.9 per cent of the variation in dollarization over a 36-month horizon. This suggests that deviations in the level of the exchange rate is a critical factor in influencing the level of dollarization in the domestic economy. The results also show that the CPI also accounts for a relatively large share of the forecast error variance in the dollarization ratio.

Overall, the results indicate that, over a thirty-six month horizon, shocks to FX/M2Y explain approximately 21.3 per cent of the variation in the CPI. This finding confirms the importance of dollarization in the inflation process. Consistent with the dynamics of inflation in Jamaica, over a 36-month horizon, the exchange rate accounts for 23.4 per cent of the variation in the CPI.

Table 2: Percentage of the Variance of Exchange Rate Explained by

Months	Exchange Rate	FX/M2Y	Base Money	CPI	Public Prices
6	92.9777	3.5683	1.4369	0.2262	0.0244
12	82.3701	7.6783	1.9309	4.9797	0.0167
24	63.0725	12.6710	1.2813	20.4345	0.0267
36	50.6075	16.0935	1.1791	30.3533	0.0590

Table 3: Percentage of the Variance of FX/M2Y Explained by

Months	Exchange Rate	FX/M2Y	Base Money	CPI	Public Prices
6	35.1630	55.9085	0.4710	2.4838	0.4545
12	39.1471	46.6029	0.3672	2.1573	0.4609
24	40.5073	40.3961	0.3659	4.6085	0.4500
36	39.8564	37.4865	0.4738	8.8798	0.4274

Table 4: Percentage of the Variance of Base Money Explained by

Months	Exchange Rate	FX/M2Y	Base Money	CPI	Public Prices
6	0.7548	4.6717	74.0983	7.0785	0.8840
12	0.8375	6.6951	60.0289	8.0506	0.8940
24	3.8996	8.0624	48.1121	7.5981	0.8747
36	6.9518	9.0744	43.1005	7.9097	0.8444

Table 5: Percentage of the Variance of CPI Explained by

Months	Exchange Rate	FX/M2Y	Base Money	CPI	Public Prices
6	5.3907	7.2523	0.6224	84.1726	0.1054
12	13.3423	14.2411	1.2898	69.7268	0.1153
24	20.2365	19.5296	1.4277	57.6309	0.1499
36	23.4225	21.3030	1.4192	52.3955	0.1713

Table 6: Percentage of the Variance of Public Prices Explained by

Months	Exchange Rate	FX/M2Y	Base Money	CPI	Public Prices
6	2.3808	1.4201	1.6996	3.0664	90.4871
12	2.6604	1.6146	1.6959	3.2030	89.6509
24	3.2227	1.9707	1.6893	3.6096	88.1204
36	3.7647	2.3656	1.6824	4.1968	86.5141

## 5.2 Dollarization Response to excess Real Exchange Rate Volatility vis-à-vis Inflation Volatility

A lag length of 2 was chosen based on the overall results of the tests reported in Table 7.

**Table 7 - VAR Lag Order Selection Criteria**

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-161.74	NA	8.23E-08	3.55	3.74	3.63
1	471.50	1159.82	3.76E-13	-8.75	-7.24*	-8.14*
2	523.51	87.60*	3.58E-13	* -8.81*	-5.99	-7.67
3	562.23	59.51	4.64E-13	-8.59	-4.45	-6.92
4	591.95	41.29	7.54E-13	-8.19	-2.73	-5.98
5	622.23	37.61	1.28E-13	-7.79	-1.02	-5.06
6	665.33	47.19	1.81E-13	-7.67	0.42	-4.40
7	731.28	62.48	1.75E-13	-8.03	1.38	-4.23
8	794.50	50.58	2.10E-13	-8.33	2.40	-3.99

\* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

### (i) Generalized Impulse Response Analysis

Figure 8 shows the response of the respective variables to a 1.0 unit shock in 3-month lagged ratio of real exchange volatility to inflation volatility over a 36-month period. The lagged impact of the ratio is considered given the absence of immediate adjustments by economic agents in response to the ratio. The results suggest that shocks to the ratio have a negative initial impact on the exchange rate within the first 3 months. There is also an appreciating impulse in the exchange rate that continues beyond the forecast horizon, with the largest impact occurring for the fifth month. The increase in real exchange rate volatility without a commensurate increase in inflation volatility promotes an appreciation in the exchange rate, since economic agents limit their conversion to foreign currency holdings from domestic money holdings. The exchange rate remains relatively stable for most of the forecast horizon and is suggestive of increased domestic confidence.

The results suggest that policy measures aimed at reducing dollarization should be consistent with achieving lower inflation volatility relative to real exchange rate volatility. Therefore, the authorities should focus on reducing inflation volatility by channeling credit expansion into productive activities rather than consumer spending.

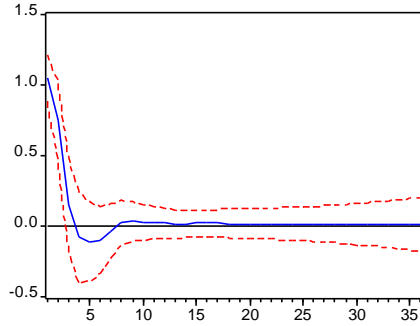
The appreciation in the exchange rate is accompanied by a sustained reduction in the CPI. The initial increase in the monetary base in the first two months is due to the reduced dollarization level in the domestic economy. The subsequent decline in the monetary base is reflective of the Central Bank's need to tighten liquidity conditions and sustain the stability of the domestic currency. The sharp initial increase in administered prices by the Government compensates for the reduction in the CPI due to the appreciation in the exchange rate. However, the subsequent reduction in the administered price index is suggestive of a lowered reliance on inflation tax by the fiscal authorities due to reduced dollarization.

In summary, the sustained reduction in dollarization is accommodated by the increase in the ratio of real exchange volatility to inflation volatility and a continued appreciation in the exchange rate.

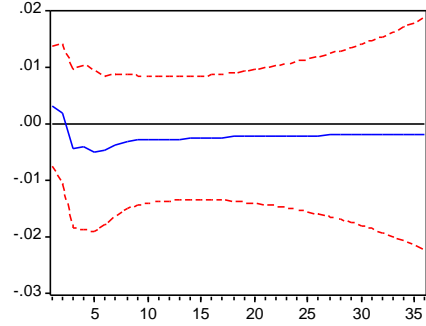
**Figure 8**

Response to Generalized One S.D. Innovations  $\pm 2$  S.E.

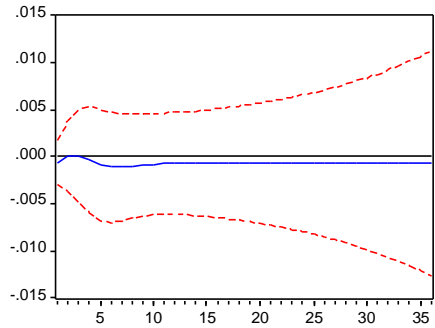
Response of EXCHANGEVOLATILITYRATIO to EXCHANGEVOLATILITYRATIO



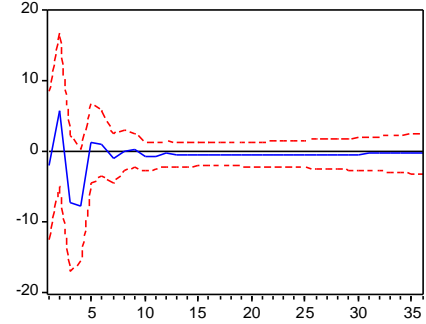
Response of LFXATOM2Y to EXCHANGEVOLATILITYRATIO



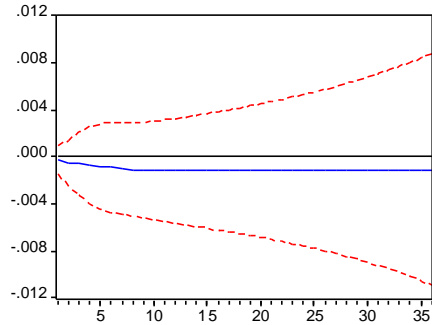
Response of LEXCHANGE to EXCHANGEVOLATILITYRATIO



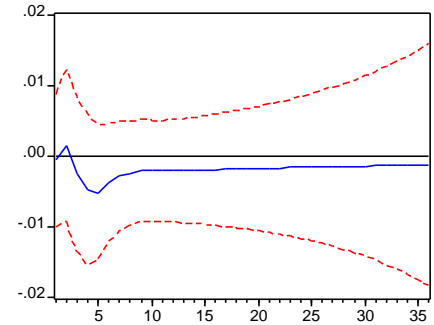
Response of PSP to EXCHANGEVOLATILITYRATIO



Response of LCPI to EXCHANGEVOLATILITYRATIO



Response of LBASEMONEY to EXCHANGEVOLATILITYRATIO



## **(ii) Variance Error Decomposition**

The results from the variance decomposition indicate that the exchange rate explains 36.3 per cent of the variation in dollarization over a 6-month horizon. More importantly, the exchange rate accounts for an increasing proportion of the variation in the dollarization indicator. This confirms the findings from the generalized impulse response analysis, that stability in the exchange rate is critical in reducing dollarization. Moreover, the results from the variance decomposition show that the volatility ratio accounts for a small proportion of the variation in the dollarization indicator overtime. The dollarization ratio accounts for a large proportion of its own variation over the 36-month period, albeit a declining share over time, supporting the inertial component to the dollarization process. Over the 36-month horizon, dollarization and the exchange rate account for the largest share of the variation in the ratio.

The results from the variance decomposition also show that the CPI accounts for a large proportion of its own variation over the 36-month period, given the observation of an inertial component to the inflation process in Jamaica. The exchange rate also explains a large proportion of its own variation as well as the forecast error variance in the CPI. The variable accounts for 70.1 per cent of its own forecast error variance and 51.4 per cent of the forecast error variance in the CPI, over a 36-month horizon. In addition, the dollarization indicator accounts for an increasing proportion of the variation in the CPI. Base money accounts for a large proportion of its own variation, which is consistent with the authorities somewhat autonomous influence on the variable.

Table 8: Percentage of the Variance of Exchange Rate Volatility Ratio Explained by

Months	Exchange Rate Volatility Ratio	Exchange Rate	FX/M2Y	Base Money	CPI	Public Prices
6	74.4979	9.7225	3.0977	1.4269	4.1755	4.0960
12	71.3763	9.4170	3.0149	2.1807	4.3002	3.9856
24	69.4983	9.4352	3.0432	2.2820	4.2191	3.9266
36	68.8887	9.7009	3.0384	2.2638	4.2482	3.9060

Table 9: Percentage of the Variance of Exchange Rate Explained by

Months	Exchange Rate Volatility Ratio	Exchange Rate	FX/M2Y	Base Money	CPI	Public Prices
6	0.1304	93.8453	1.1706	1.7112	0.3217	0.4064
12	0.1715	86.8284	2.8015	3.4334	0.9206	0.3445
24	0.2418	76.8995	4.5738	3.2312	5.9491	0.2946
36	0.3859	70.0661	6.0931	2.5650	10.9269	0.2945

Table 10: Percentage of the Variance of FX/M2Y Explained by

Months	Exchange Rate Volatility Ratio	Exchange Rate	FX/M2Y	Base Money	CPI	Public Prices
6	2.0209	36.2854	52.3307	0.6729	3.1406	1.3451
12	2.0246	44.4362	41.2484	0.7449	2.6089	1.4128
24	1.8586	53.1302	33.5446	0.9809	2.1430	1.3729
36	1.7303	56.4538	30.3166	1.10500	2.8500	1.2852

Table 11: Percentage of the Variance of Base Money Explained by

Months	Exchange Rate Volatility Ratio	Exchange Rate	FX/M2Y	Base Money	CPI	Public Prices
6	3.1849	0.8490	3.7231	72.9104	7.0127	1.2527
12	3.7834	1.2025	5.7668	59.9417	7.3230	1.3605
24	3.7953	7.4546	6.3965	48.8568	6.0561	1.5213
36	3.6298	13.4452	6.5549	44.5098	5.5362	1.5295

Table 12: Percentage of the Variance of CPI Explained by

Months	Exchange Rate Volatility Ratio	Exchange Rate	FX/M2Y	Base Money	CPI	Public Prices
6	0.8766	6.8724	4.5584	0.7121	84.4015	0.3694
12	1.5444	25.6334	8.9332	0.7650	61.3196	0.6164
24	1.6862	44.3468	11.5252	0.3876	39.8883	0.6960
36	1.5367	51.3710	11.6882	0.4032	31.9941	0.6595

Table 13: Percentage of the Variance of Public Prices Explained by

Months	Exchange Rate Volatility Ratio	Exchange Rate	FX/M2Y	Base Money	CPI	Public Prices
6	5.0979	3.4804	1.2788	1.2729	4.2123	83.7271
12	5.1019	3.8479	1.4206	1.2813	4.2531	82.9685
24	5.0579	4.9623	1.5930	1.2638	4.2942	81.6493
36	5.0025	5.9999	1.7353	1.2574	4.3979	80.4325

## **6. Conclusion and Policy Recommendations**

The paper explored the relevance of financial dollarization to the inflation process in the Jamaican economy. The findings confirm that financial dollarization influences the inflation outcome in a number of ways. Firstly, dollarization increases the inflation outcome for a given fiscal deficit, due to the substitution by economic agents away from the domestic currency. Exchange rate depreciation pressures arising from increased foreign currency holdings contributes to additional inflationary impulses, associated with the relatively high exchange rate pass-through to inflation. As such, the results show a sustained increase in the CPI due to the dollarization stimulus.

Given the potential of financial dollarization to complicate monetary policy implementation, the paper also investigated the use of policy to limit its practice in terms of influencing the relative real exchange rate and inflation rate volatilities. The results revealed that an increase in real exchange rate volatility vis-à-vis inflation volatility did not influence substantial reductions in financial dollarization in the domestic economy as implied by the Ize and Levy-Yeyati (1998) model. Similarly, the descriptive analysis indicated that higher real exchange rate volatility relative to inflation volatility was not accompanied by substantial reductions in dollarization. The key result of the empirical analysis, however, is that where increases in the volatility ratio are accompanied by a relatively stable exchange rate there is a limiting effect on financial dollarization. This result is particularly relevant in the Jamaican situation where there is a relatively high exchange rate pass-through. The key finding is that policy decisions to limit dollarization should primarily focus on achieving exchange rate stability, as well as limiting inflation volatility.

The recommended policy mix based on the results of the analysis is that the Bank could more effectively limit financial dollarization through tighter foreign exchange market management as well as adopting an inflation-targeting framework to reduce inflation volatility. Foreign exchange market management could be enhanced by strengthening current supply side policies to augment the foreign exchange flows to the market. The Bank may also have to re-evaluate its intervention strategy of limiting the sale of intervention funds to end users, even in the case of excessive foreign currency demand for portfolio reasons.



A strict reliance by the Bank on interest rate adjustments to stem demand pressures in the foreign exchange market could be constrained by both domestic debt management challenges, as well as the need to stimulate higher economic growth levels. Hence, caution should be exercised by the authorities in the use of interest rate adjustments to smooth out exchange rate fluctuations during periods of abnormally high foreign currency demand. As such, demand side policies can be complemented by encouraging the development of the domestic derivatives market so that investors are able to hedge exchange rate fluctuations and alleviate the build-up of demand pressures from certain key sectors. In addition, foreign currency flows to the market can be augmented through policy initiatives to encourage growth in export sectors.

A critical pre-requisite for an inflation-targeting framework, however, is that the Central Bank's decisions are not constrained by the need to finance the fiscal deficit. This is a drawback for many developing countries where policies to achieve a particular inflation rate may conflict with policies aimed at containing the fiscal deficit. The results from the study confirm the importance of public sector management in determining the inflation outturn. Based on these results, the achievement of a balanced budget by Government for FY2005/06 and future fiscal surpluses would obviate reliance on an inflation tax and reduce inflationary pressures in the domestic economy. An improved fiscal performance can stimulate increased investor confidence, facilitate tighter foreign exchange market management and occasion reduced dollarization in the domestic economy in the medium-term.

## References

- Bahmani-Oskooee, Mohsen, and Ilker Domac, 2002, "On the Link between Dollarization and Inflation: Evidence from Turkey", Available via the Internet: <http://www.tcmb.gov>
- Barnes, Ainsworth, 2000, "Determinants of Inflation: An Empirical and Theoretical Overview", (September), Working Paper, Bank of Jamaica
- Castro, Juan, and Eduardo Moron, 2003, "De-dollarizing the Peruvian Economy: A Portfolio Approach", Available via the Internet: <http://econwpa>
- De Nicolo, Gianni, Patrick Honohan, and Alain Ize, 2003, "Dollarization of the Banking System: Good or Bad?" Working Paper 3116, World Bank Policy Research Working Paper. Available via the Internet: <http://www.imf.org/>
- De Nicolo, Gianni, Anne-Marie Gulde, David Hoelscher, Alain Ize and David Marston, 2004, "Financial Stability in Dollarized Economies", Working Paper 230, IMF Occasional Paper. Available via the Internet: <http://www.imf.org/>
- Haughton, Andre Y., 2004, "Financial Dedollarization of the Jamaican Economy: A Portfolio Approach", (July), Working Paper, Bank of Jamaica
- Ize, Alain, and Eduardo Levy -Yeyati, 1998, "Dollarization of Financial Intermediation: Causes and Policy Implications", IMF Working Paper WP/98/28. Available via the Internet: <http://www.imf.org/>
- Levy-Yeyati, Eduardo, 2004, "Financial Dollarization: Evaluating the Consequences", Available via the Internet: <http://www.econpapers.repec.org/>
- Peraran, Hashem H, and Yongcheol Shin, 1998, "Generalized Impulse Response Analysis in Linear Multivariate Models", *Economic Letters* 58, 17-29.
- Piontkovsky, R.V., 2003, "Dollarization, Inflation Volatility and Underdeveloped Financial Markets in Transition Economies", Available via the Internet: <http://www.imf.org/>
- Sims, C., J.H. Stock, and M.W. Watson, 1990, "Inference in Linear Time Series Models with Some Unit Roots", *Econometrica* 58, 113-44.

Thomas, Lee R., 1985, "Portfolio Theory and Currency Substitution", *Journal of Money, Credit and Banking*, 17, 347 – 357. Available via the Internet: <http://www.jstor.com>