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The Effectiveness of Monetary Policy in Small Open Economies: An Empirical Investigation

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The Effectiveness of Monetary Policy in Small Open Economies: An Empirical Investigation

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Abstract

This paper examines the relative effectiveness of the use of indirect and direct monetary policy instruments in Barbados, Jamaica and Trinidad and Tobago, by estimating a restricted Vector Autoregressive model with Exogenous Variables (VARX). The study assumes that the central bank conducts monetary policy using a Taylor-type rule and it evaluates the effects of a reserve requirement policy. The results show that although a positive shock to the policy interest rate has a direct effect on commercial banks' interest rates, there is a weak transmission to the real variables. Furthermore, an increase in the required reserve ratio is successful in reducing private sector credit and excess reserves, while at the same time alleviating pressures on the exchange rate. The findings therefore indicate that central banks in small open economies should consider using reserve requirements as a complement to interest rate policy, to achieve their macroeconomic objectives.

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I. Introduction

Monetary policy is a key element of macroeconomic management and its effectiveness is an important issue in economic policy analysis. To successfully conduct monetary policy, policymakers must have an accurate assessment of the effects of their policies on the economy. A crucial element that can determine how monetary conditions can influence the economic performance of a country is the choice of the policy instrument used. In developed countries, which have more sophisticated financial systems, there is a general consensus on the use of indirect instruments—particularly a short-term interest rate—to effect monetary policy. Indeed, widespread empirical evidence has shown that in those countries, the short-term interest rate is an effective tool for controlling inflation and influencing output growth. By contrast, in developing countries, the monetary authorities typically operate two main policy instruments to achieve desirable macroeconomic objectives—a short-term policy interest rate and the required reserve ratio.[1] However, since early 2000s central banks in those countries have gradually deemphasized reserve requirements in favour of a market-based style of monetary policy which have focussed more on controlling a short-term interest rate. This decision has gained tremendous favour because previous research has shown that the interest rate channel is particularly important in the transmission mechanism of monetary policy in developing countries.

In small open developing economies, the transmission of monetary policy operates differently because of weak institutional frameworks and shallow financial markets (Davoodi et al. (2013)).[2] In addition, those countries typically face macroeconomic challenges related to imperfections in the financial sector. For instance, in Caribbean countries, credit market imperfections are prevalent because the limited competition among banks has led to oligopolistic pricing practices[3] and market segmentation. Also, in most of those countries, the banking system has high persistent liquidity which has hindered the effective transmission of monetary policy to key macroeconomic variables.[4] In light of the presence of structural impediments, the key issue is whether the monetary authorities in those countries should rely solely (or mainly) on indirect instruments to conduct monetary policy. Previous research has shown that in countries with structural excess liquidity and credit market imperfections, the short-term interest rate is limited in effecting monetary policy. At the same time, there has been contrasting views on the

[1] It has been observed that reserve requirements are generally higher in developing countries, when compared to developed countries. Therefore, less attention is paid to the use of the required reserve ratio as a policy tool in developed countries.

[2] It should also be noted that in an interconnected world, small open economies are exposed to developments in the global economy that can hinder the effective transmission of monetary policy.

[3] The commercial banks in Barbados, Jamaica and Trinidad and Tobago operate under an oligopoly market structure. See, for instance, Khemraj (2007b) for futher discussions.

[4] Several researchers have examined the issue of excess bank liquidity in various Caribbean countries. See Maynard and Moore (2005), Khemraj (2007a, 2009), Anderson-Reid (2011), Jordan et al. (2012), Primus (forthcoming) and Primus et al. (2014).

effectiveness of the required reserve ratio in transmitting monetary impulses to key macroeconomic variables. Nonetheless, because changes in reserve requirements have a direct influence on liquidity conditions, central banks in many developing countries have had to resort to this instrument in recent years. For example, between 2008 and 2010, the central banks of Jamaica and Trinidad and Tobago increased the required reserve ratio to absorb excess liquidity and effect monetary policy. This therefore shows that indirect policy instruments should be complemented with direct policy tools in order to achieve desired macroeconomic objectives.

To analyze the effect of monetary policy in the Caribbean, several researchers have held formal discussions on the monetary transmission mechanism in Barbados (see Baksh and Craigwell (1997) and Moore and Williams (2008)), Jamaica (see Robinson and Robinson (1997) and Urquhart (2006)), and Trinidad and Tobago (see Watson (1996, 2003), Ramlogan (2007), Cheong and Boodoo (2008), and International Monetary Fund (2011)). These studies focus on evaluating whether money, credit or the exchange rate is the principal conduit of monetary policy impulses, and the strength of these channels in the transmission process. Although it is crucial to determine the importance of various channels in transmitting impulses from the financial sector to the real sector, the critical issues are which monetary policy tools are more effective in facilitating such transmission, and how different policy instruments affect key macroeconomic variables.

This paper therefore closes the gap in the literature by estimating a macroeconometric model to evaluate the relative effectiveness of the use of indirect and direct tools of monetary policy in three of the largest English speaking Caribbean countries—Barbados, Jamaica and Trinidad and Tobago. In all three countries, the financial system has been plagued with structural excess reserves and the financial market is underdeveloped.[5] See for instance, Ramlogan (2004, 2007), Holden and Howell (2009), and Birchwood (2011), who also noted that the financial market in the Caribbean is underdeveloped. In light of these characteristics, it is important to investigate how a market-based style of monetary policy would affect key macroeconomic variables in the short-run. This is an important issue because the monetary authorities in those countries have shifted their policy stance to rely more on indirect policy tools (so they adjust the short-term interest rates frequently) to effect monetary policy. Notably, this research represents an essential contribution as there has been no previous attempt to assess the effects of different types of policy instruments in those countries.

To conduct the analysis, a restricted Vector Autoregressive model with Exogenous Variables (VARX) is used to provide empirical evidence on the relative effects of interest rate and reserve

[5]In most Caribbean countries, the financial sector can be considered "developed" if the indicator used is the ratio of financial assets to GDP. However, financial development considers financial institutions and financial markets, the latter of which is underdeveloped in the Caribbean. In a recent study, the International Monetary Fund (2015) used a broad-based index to measure financial sector development. In their study, financial sector development was subdivided into financial institutions and financial markets. The index showed that in general, financial markets are underdeveloped in the Caribbean.

requirement policy shocks. In the experiments, the policy interest rate is specified in the form of a conventional Taylor-type rule, whereas the reserve ratio depends only on its past value. The model considers the essence of the economies in the Caribbean as it includes variables that capture the dynamic interaction of the real, banking and external sectors, as well as the monetary and fiscal authorities. The extent of the impact of the two policy instruments is captured through impulse response functions and variance decompositions. The results show that there is a weak transmission of an increase in the short-term interest rate to output growth in Jamaica and Trinidad and Tobago. Also, in all three countries, a rise in the policy interest rate is not successful in reducing inflation, implying therefore that indirect policy tools may not be effective for price stability. Moreover, when the required reserve ratio is used as the policy instrument, a contractionary monetary policy shock helps to alleviate pressure on the exchange rate in Barbados and Trinidad and Tobago, and is successful in reducing credit demand in Jamaica and Trinidad and Tobago.

The rest of this paper is organized as follows. Section II provides some background information on monetary policy in Barbados, Jamaica and Trinidad and Tobago. Section III presents the model and Section IV discusses the econometric results from the impulse response functions and variance decompositions. The final section provides some concluding remarks and suggestions.

II. The Caribbean Context

The objectives of monetary policy in the Caribbean are centred on price stability, ensuring stability of the exchange rate, maintaining an adequate level of foreign exchange reserves and financial system stability. The monetary authorities are faced with challenges to achieve these objectives because the open nature of these countries make them susceptible to external shocks.[6] Also, primarily because of the small size—as well as the distorted financial systems to a lesser extent— domestic and external shocks that affect these economies tend to be magnified. Therefore, in formulating monetary policy, the central banks in those economies must take into consideration prevailing and prospective developments in the macro economy, as well as emerging external sector developments.

The economies of Barbados, Jamaica and Trinidad and Tobago have similar financial structures. In each country, the commercial banking sector is the largest segment of the financial market, as it accounts for the majority of the financial system assets. This sector is dominated by a few commercial banks and they operate under an oligopoly market structure. Moreover, there are some differences in the exchange rate policy pursued by the monetary authorities in

[6] These shocks can arise from fluctuations in energy prices, spikes in food prices, natural disasters, and capital account shocks.

those countries. Barbados has maintained one of the longest fixed exchange rate regimes since the 1980s (Worrell et al. (2003)). By contrast, Jamaica has a floating exchange rate regime, and Trinidad and Tobago has a managed float. Quite often, in these economies, extensive central bank intervention in foreign exchange markets is needed to smooth volatility and protect the value of the currency.

There are two key factors of the financial system that impede the transmission of monetary policy. First, capital markets in each country are at an embryonic stage. Thus, although the financial sector of the three countries improved over the last two decades, the financial market remains underdeveloped. Second, managing excess bank liquidity in a small open economy with a fragmented market is a key issue for many central banks in the Caribbean. High persistent excess liquidity has been a permanent feature of the banking system in Barbados, Jamaica and Trinidad and Tobago; and over the last decade, the level of excess liquidity has risen to record levels. In Barbados, Maynard and Moore (2005) noted that the macroeconomic environment, interest rate policy and money creation by the government are the main factors that contributed to the build-up of excess reserves. Anderson-Reid (2011) found that in Jamaica an increase government spending—which is facilitated by money creation or borrowing—is associated with an increase in bank deposits and excess reserves. In the case of Trinidad and Tobago, the main source of excess liquidity in the economy is the monetization of government deposits at the Central Bank—which represent tax payments from energy sector companies. Thus, a significant component of such liquidity has been "involuntary" (see Primus et al. (2014)). In light of these two issues, the policymakers in those countries have been using a number of strategies to affect monetary policy.

Several monetary policy tools have been used by the respective central banks. In Barbados, the monetary policy instruments used are the required reserve ratio, the discount rate, Open Market Operations (OMOs), moral suasion, and the Central Bank's policy rate which is the minimum deposit rate. In 2013, the Central Bank of Barbados initiated a shift in policy whereby the Treasury bill rate was used as the key tool to influence interest rates in the banking sector (see Central Bank of Barbados (2013)). Further, in 2015, the Bank ceased stipulating a minimum rate of interest on savings deposits at commercial banks. In so doing, the Central Bank's activity in the financial market, which will influence the Treasury bill rate, will provide guidance for other interest rates in the banking sector. This therefore shows greater commitment to indirect policy instruments to conduct monetary policy. To a lesser extent, the Central Bank of Barbados also stipulates reserve requirements on local deposits, foreign deposits and government securities, in order to influence economic policy.

In the case of Jamaica, the two main operational tools are OMOs and reserve requirements. The Bank of Jamaica sets an open market interest rate on OMOs to guide market interest rates. The reserve ratio includes a cash reserve requirement on local currency liabilities and a liquid assets ratio, which stipulates the percentage of deposit liabilities to be held as risk-free assets

in the form of Government of Jamaica securities of maturities of up to one year (Lattie (2000)). In addition, for the cash reserve ratio and the liquid assets ratio, a requirement is specified for foreign currency liabilities.

The Central Bank of Trinidad and Tobago uses a short-term interest rate, OMOs and reserve requirements to effect monetary policy. OMOs were introduced in 1996 and from 1998 the Bank started de-emphasizing reserve requirements, while increasing recourse to OMOs (Central Bank of Trinidad and Tobago (2004)). In 2002, the Central Bank officially changed its stance of monetary policy towards a more market-based monetary policy style as the 'repo' policy rate was introduced as the principal instrument to effect monetary policy (Central Bank of Trinidad and Tobago (2005)). The Central Bank specifies a primary reserve requirement and a secondary reserve requirement as a percent of commercial banks prescribed liabilities.[7] Unlike Barbados and Jamaica, commercial banks in Trinidad and Tobago are not subject to reserve requirements on government securities and foreign currency liabilities.

The above discussion highlights the fact that both the central banks of Barbados and Trinidad and Tobago have changed their monetary policy regime to rely more on indirect policy tools to effect monetary policy. The Bank of Jamaica has not explicitly indicated greater reliance on the open market rate to effect monetary policy. However, an inspection of the data shows that the Bank mainly manipulates this rate to indicate its stance. Also, with the exception of the period 2008-2010, the required reserve ratio in Jamaica has been decreasing since the late 1990s.[8] Moreover, it has been observed that against the backdrop of high financial system liquidity, changes in the short-term interest rate have not been effective in influencing real variables and bank liquidity; as a result, the central banks had to use other measures. This therefore underscores the importance of empirically evaluating the effectiveness of the short-term interest rate (the key indirect policy tool), in comparison to the reserve requirement ratio (the main direct policy instrument) to determine how each instrument can help to guide monetary policy in these three small open economies.

III. Econometric Methodology

This section uses the VARX methodology to examine the transmission of a contractionary monetary policy shock using the short-term interest rate and the required reserve ratio in Barbados, Jamaica and Trinidad and Tobago.

[7] Prescribed liabilities represent total demand, savings and time deposits, short-term credit instruments with a maturity up to and including one year and all fund raising instruments maturing within or beyond one year of the reporting date.

[8] For instance, the cash reserve ratio and the liquid asset ratio of commercial banks on local currency deposits were reduced from 21 percent and 43 percent, respectively in 1998, to 12 percent and 26 percent, respectively in 2014.

A. The Standard VARX Model

According to Lütkepohl et al. (2006), the structural form of the VARX model can be written as,

$$y_t = A_1 y_{t-1} + ... + A_p y_{t-p} + B_0 x_t + ... + B_q x_{t-q} + C.D_t + u_t, \quad (1)$$

where $y_t = [y_{1t}, ..., y_{Kt}]'$ is a vector of K observable endogenous (fully and partially interactive) variables, $x_t = [x_{1t}, ..., \ x_{Mt}]'$ is a vector of M observable exogenous variables, D_t contains all deterministic variables, which includes a constant, a linear trend and seasonal dummy variables, and $u_t = [u_{1t}, ..., u_{Kt}]'$ is a K-dimensional unobservable zero mean white noise process with positive definite covariance matrix. The A, B and C are parameter matrices of suitable dimension.

In the VARX framework, restrictions are imposed in the interactions between variables on the basis of a priori economic reasoning. Therefore, the VARX system allows for asymmetries between variables so the number of parameters to be estimated is reduced. This helps to increase the number of degrees of freedom, as well as improve the efficiency of those parameters to be estimated. Furthermore, the VARX specification allows the modeler to calculate impulse response functions and variance decompositions associated with innovations on those variables that are *partially* endogenous.

B. A VARX for Barbados, Jamaica and Trinidad and Tobago

Consider a VARX model which contains three blocks of variables:

- a block of fully interactive endogenous variables, the parameters of which are not subject to restrictions;
- a block of partially interactive endogenous variables, the parameters of which are subject to restrictions; and
- a block of strictly exogenous variables.

B.1. Fully Interactive Variables

This block consists of two variables:

The first variable is the growth rate of real GDP, $output\_growth_t$, which is used as an indicator of changes in aggregate demand and economic activity. This variable is measured by the change in the logarithm of real GDP. Because GDP data are not available on a monthly

basis, the Lisman-Sandee procedure is used to generate a monthly series from the quarterly series for all countries. This exercise is carried out using the ECOTRIM software.[9] As the quarterly data for Trinidad and Tobago is in the form of an index, the data for Barbados and Jamaica were also converted into an index before the series were interpolated;

The second variable is the inflation rate, $infl_t$, which is measured as the year-on-year percentage change in the logarithm of the Consumer Price Index (CPI), or Retail Price Index (RPI) for Trinidad and Tobago.[10] This variable is a target of monetary policy.

B.2. Partially Interactive Variables

This block consists of nine variables:

The first variable is the monetary policy instrument. In the baseline case, a short-term interest rate, $policy\_rate_t$, is used to represent the indirect instrument. The policy interest rate is the minimum savings rate for Barbados, the OMOs 30 day open market interest rate for Jamaica, and the 'repo' rate for Trinidad and Tobago. In the macroeconometric model, the central bank sets a short-term interest rate using a Taylor-type rule in which the policy rate depends on the inflation rate, output growth, and its past value.[11] In the next experiment, the reserve requirement ratio, rrr_t, is used to represent the direct instrument of monetary policy. Thus, this experiment considers a systematic increase in the required reserve rate, which reacts directly to its past value. This variable is measured using the minimum required reserve ratio on domestic currency deposits for all countries except Barbados. Over the period of the study the reserve requirement rate for Jamaica and Trinidad and Tobago was adjusted several times. The required reserve ratio was last changed in 2010 in Jamaica (from 14 percent to 12 percent) and in 2008 in Trinidad and Tobago (from 15 percent to 17 percent). In the case of Barbados, the required reserve ratio for both local deposits and government securities—which, in combination, was last changed from 17 percent to 15 percent in 2007—is considered.[12]

The second variable is the prime lending rate, plr_t, which is used to represent commercial banks' loan rate. The prime lending rate interacts with all the variables in the model except non-fuel world CPI and world oil prices;

[9] ECOTRIM is a program that supports temporal disaggregation of high frequency data from low frequency data.

[10] All indices were rebased to 2000.

[11] The short-term interest rate rule is referred to as a "Taylor-type" rule because it is the conventional form of the original Taylor (1993) policy rule.

[12] As mentioned in Section II, the Central Bank of Barbados specifies a reserve ratio for local currency deposits, foreign currency deposits and government securities. Over the period of this study, the reserve ratio on local currency deposits did not change. As a result of this, the statutory ratio on government securities was considered, in addition to the requirement on local currency deposits.

The third variable is the interest rate spread, $spread_t$, which is measured as the difference between commercial banks' prime lending rate and the deposit rate. This variable captures features of Caribbean countries in which wide interest rate spread reflects the oligopoly influence, risk and liquidity in the banking sector. The spread interacts with all the variables in the model except non-fuel world CPI and world oil prices;

The fourth variable is the real exchange rate, $exch\_rate_t$. To measure this, the nominal rate (Bds$/US$; J$/US$; TT$/US$) is deflated by U.S. CPI to obtain the real effective rate. The exchange rate interacts with all the variables in the model except non-fuel world CPI and world oil prices;[13]

The fifth variable is the change in private sector credit, $credit_t$, which is used to capture the role of credit in funding economic activities. Except for non-fuel world CPI and the world price of oil, private sector credit also interacts with all the variables in the model;

The sixth variable is the growth rate of government expenditure, $govt\_exp_t$, which is included to capture demand pressures associated with public expenditure. This variable reacts with output growth, the policy interest rate, the exchange rate, world non-fuel CPI, world oil prices and its past value. Total expenditure is used because changes in monetary policy can affect interest payments on domestic debt, and subsequently overall government expenditure;

The seventh variable is the ratio of excess reserves to total reserves, $ertr_t$, which is used as a measure of excess liquidity in the banking system. This variable interacts with all the others in the model except non-fuel world CPI and the world price of oil;

The eight and ninth variables—non-fuel world CPI, $world\_CPI_t$, and the world price of oil, oil_price_t—are included to control for the influence of external factors on the domestic economy. The non-fuel world CPI accounts for the fact that because the economies are small and open, inflation is strongly influenced by foreign inflation; and the annual (year-on-year) rate of change in the world price of oil captures the effects of changes in energy prices on the domestic economy. The non-fuel world CPI depends on its past value and the oil price, while the world price of oil only depends on its past value and is not influenced by any domestic variables.

The lagged values of all the variables in the Partially Interactive block affects the variables in the Fully Interactive block.

[13]The Real Exchange Rate (RER) is derived using the following formula: RER=NER(US CPI/CPI for each country); where NER is the Nominal Exchange Rate. Watson (2003) also used a similar approach in his empirical study to capture the dynamics of the exchange rate channel in the monetary transmission mechanism of Trinidad and Tobago.

B.3. Strictly Exogenous Variables

This block consists of three variables:

A constant term;

A time trend; and

Eleven seasonal dummies are included to capture the effect of seasonality on the variables.[14]

B.4. Relationship of Variables

All the variables in the model are important to capture the characteristics of small open economies and to examine the transmission of monetary policy. The two key instruments used in the Caribbean to effect monetary policy are a short-term interest rate and the reserve requirement ratio. Usually, central banks adjust the short-term interest rate taking information on inflation and output growth into account. Therefore, a policy rule, that takes the form of a conventional Taylor-type rule is used in the framework. Changes in the short-term interest rate are expected to have a direct impact on the term structure of interest rates in the banking sector. This effect is expected to be captured through the loan rate and the interest rate spread. Also, owing to the fact that in the Caribbean commercial banks are the dominant source of credit to the private sector, this is accounted for through the ratio of private sector credit to GDP. The reserve requirement ratio is included to capture the effects of a direct policy instrument. It is important to include a measure of excess bank liquidity because the banking system in the Caribbean has persistently recorded high excess reserves, which impairs the transmission of monetary policy. It has been observed that quite often reserve requirements are adjusted to alleviate liquidity pressures.

The real exchange rate is included because in an open economy, monetary policy is transmitted through the exchange rate channel. Therefore, higher domestic interest rates should result in an increase in demand for the local currency and an inflow of capital. It is important to include a proxy for the fiscal authority in the model because the effectiveness of monetary policy can be constrained by the actions of the government—to some extent. For instance, as previously noted, it has been observed that the governments' fiscal operations have contributed to excess bank liquidity in Barbados, Jamaica and Trinidad and Tobago. Also, changes in domestic interest rates and the exchange rate have an impact on government expenditure because

[14]The series which displayed seasonality were deseasonalized using the X-12-ARIMA seasonally adjustent method. An estimation of the model for each country using the deseasonalized series shows no significant difference in comparison to the results from the model with seasonal dummies. This indicates that the findings are robust.

they affect interest payments on domestic and external debt. Furthermore, the small and very open nature of these economies make them susceptible to external shocks, particularly related to high food prices and the volatility of energy prices. To control for the influence of external factors on the domestic economy, the non-fuel world CPI and oil prices are included. Domestic inflation, output growth and government expenditure are directly affected by international food prices and energy price shocks.

Overall, the model includes the dynamic interaction of the main sectors: (1) the real sector, proxied by growth in real output and the inflation rate; (2) the (commercial) banking sector, which is proxied by a measure of credit, the ratio of excess reserves to total reserves, the prime lending rate and the interest rate spread; (3) the external sector represented by the real exchange rate; (4) the monetary authority, whose action is proxied by the short-term interest rate and the required reserve ratio; and (5) the government's fiscal operations, which are captured by the change in government expenditure.

The sample comprises monthly data from May 2002 to September 2014. Data were constrained to this period because the policy rate was implemented in Trinidad and Tobago in 2002. Also, during the period, the central banks relied more on market-based tools to effect monetary policy. The main data sources are The Central Bank of Barbados, The Central Bank of Jamaica, The Ministry of Finance of Jamaica, and The Central Bank of Trinidad and Tobago.

To determine the stationarity properties of the individual time series, the Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests were used. In addition, seasonality tests were conducted on each variable. The results from these tests are summarized in Table 1. The optimal endogenous lag length is two based on the Akaike Information Criterion and Final Prediction Error. Thus, using two lags on all endogenous variables, the reduced form of the VARX model used in this study can be given by,

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + C.D_t + u_t. \tag{2}$$

In the baseline case, where the $policy\_rate_t$ is the instrument of monetary policy, the A matrix is restricted such that:

$$\begin{bmatrix} \alpha_{1,1} & \alpha_{1,2} & \alpha_{1,3} & \alpha_{1,4} & \alpha_{1,5} & \alpha_{1,6} & \alpha_{1,7} & \alpha_{1,8} & \alpha_{1,9} & \alpha_{1,10} & \alpha_{1,11} \\ \alpha_{2,1} & \alpha_{2,2} & \alpha_{2,3} & \alpha_{2,4} & \alpha_{2,5} & \alpha_{2,6} & \alpha_{2,7} & \alpha_{2,8} & \alpha_{2,9} & \alpha_{2,10} & \alpha_{2,11} \\ \alpha_{3,1} & \alpha_{3,2} & \alpha_{3,3} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \alpha_{4,1} & \alpha_{4,2} & \alpha_{4,3} & \alpha_{4,4} & \alpha_{4,5} & \alpha_{4,6} & \alpha_{4,7} & \alpha_{4,8} & \alpha_{4,9} & 0 & 0 \\ \alpha_{5,1} & \alpha_{5,2} & \alpha_{5,3} & \alpha_{5,4} & \alpha_{5,5} & \alpha_{5,6} & \alpha_{5,7} & \alpha_{5,8} & \alpha_{5,9} & 0 & 0 \\ \alpha_{6,1} & \alpha_{6,2} & \alpha_{6,3} & \alpha_{6,4} & \alpha_{6,5} & \alpha_{6,6} & \alpha_{6,7} & \alpha_{6,8} & \alpha_{6,9} & 0 & 0 \\ \alpha_{7,1} & \alpha_{7,2} & \alpha_{7,3} & \alpha_{7,4} & \alpha_{7,5} & \alpha_{7,6} & \alpha_{7,7} & \alpha_{7,8} & \alpha_{7,9} & 0 & 0 \\ \alpha_{8,1} & 0 & \alpha_{8,3} & 0 & 0 & \alpha_{8,6} & 0 & \alpha_{8,8} & 0 & \alpha_{8,10} & \alpha_{8,11} \\ \alpha_{9,1} & \alpha_{9,2} & \alpha_{9,3} & \alpha_{9,4} & \alpha_{9,5} & \alpha_{9,6} & \alpha_{9,7} & \alpha_{9,8} & \alpha_{9,9} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \alpha_{10,10} & \alpha_{10,11} \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \alpha_{11,11} \end{bmatrix} \begin{bmatrix} output\_growth_{t-p} \\ \inf l_{t-p} \\ policy\_rate_{t-p} \\ plr_{t-p} \\ spread_{t-p} \\ exch\_rate_{t-p} \\ credit_{t-p} \\ govt\_\exp_{t-p} \\ ertr_{t-p} \\ world\_CPI_{t-p} \\ oil\_price_{t-p} \end{bmatrix}$$

Notes: $\alpha_{ij}(ij = 1, 2...)$, are the coefficients on the vector of endogenous variables; $p = 1, 2$ in this model; In the second case, the rrr_t is included in the model as the instrument of monetary policy and it depends only on its past value. Regarding its order, the rrr_t is placed after the $policy\_rate_t$.

IV. Econometric Results

This section discusses the dynamic impact of a one-standard deviation positive shock to the policy rate and the required reserve ratio using Lütkepohl, Krätzig and Boreiko's impulse response functions and variance decompositions.[15] The solid lines in figures 1, 3, 5, 7, 9, and 11 (see Appendix) show the impulse response functions, while the dotted lines are the associated 95 percent upper and lower confidence bands calculated using the bootstrap method.[16] In the baseline case, the policy interest rate follows a Taylor-type rule where it responds to output growth, inflation and its past value. In the alternative experiment, the required reserve ratio is included in the model and it responds only to its previous value.

A. Shock to the Policy Rate

In summary, the results show that in Barbados an increase in the short-term interest rate is not successful in reducing output growth and inflation. Also, although a higher policy interest rate has a direct positive effect on the loan rate and it lowers the interest rate spread, it is not

[15] See Lütkepohl and Krätzig (2004) and Lütkepohl et al. (2006).

[16] The JMulTi econometrics software was used to estimate the model.

successful in reducing credit growth. In Jamaica, a shock to the policy rate leads to a significant (temporary) fall in both output and excess reserves. The shock, however, has no significant effect on the loan rate and the interest rate spread, implying therefore that there can be other factors that influence how banks determine their interest rates. In the case of Trinidad and Tobago, an increase in the policy rate has a weak transmission to output growth and it is not successful in reducing inflation. Also, a higher short-term interest rate leads to an exchange rate appreciation and it has an immediate positive effect on the loan rate. Further discussions of the results are presented below.

A.1. Barbados

Figure 1 shows the results of a one-standard deviation shock to the policy rate. The impulse response functions show that output growth contracts insignificantly at first, then fluctuates over the period.[17] Initially, inflation falls marginally before increasing significantly. This result is consistent with other studies which have noted that interest rate changes in Barbados have little or no effect on prices (see for instance, Worrell et al. (2012)). Nonetheless, changes in the policy rate leads to a direct increase in the prime lending rate. Because the policy rate is the minimum deposit rate, an increase in this rate reduces the interest rate spread by 0.26 percent. One reason attributed for this is because banks hold excess liquidity, they can be less inclined to increase loan rates. Further the increase in domestic interest rates leads to an increase in demand for local currency and causes a statistically significant appreciation of the real exchange rate in the second month following the shock. This effect is not persistent, and so the exchange rate returns to its long run equilibrium level after the fifth period. Although the prime lending rate increases, credit falls marginally in the first period following the shock; this response however is not significant. Also, an increase in the policy rate causes government expenditure to rise significantly by 0.14 percent, but the effect of the shock quickly dissipates. This result is consistent with the findings from Moore and Skeete (2010) which noted that because of the positive correlation between interest rates on government paper and those set by the Central Bank of Barbados, a positive monetary policy shock can increase domestic debt servicing costs. The ratio of excess reserves to total reserves falls significantly after 5 months as a higher short-term interest rate causes banks to reduce demand for excess reserves.

The variance decompositions of the domestic variables are presented in Figure 2. The results show that fluctuations in real GDP account for about 87 percent of its own innovations, and 6 percent of world oil prices. Variations in inflation contributes between 95 percent and 40 percent of its own innovation, about 20 percent of non-fuel world CPI and 15 percent of world oil prices. This provides evidence that foreign prices determine domestic inflation in small open economies. Also, inflation is affected to a lesser extent by output growth and the policy rate.

[17] Similarly, the findings from a study on Nigeria by Onyukwu and Nwosu (2011) showed that under a market-based policy, a monetary policy shock leads to persistent volatility in output growth.

Changes in the prime lending rate are influenced primarily by both its own shock (45 percent) and the policy rate (50 percent). The results for the interest rate spread show that its past value accounts for 40 percent of the fluctuations, while the policy rate and the prime lending rate account for 30 percent and 25 percent of the fluctuations, respectively. For the real exchange rate, about 50 percent of the fluctuations can be attributed to its own innovation and inflation accounts for 40 percent. To a lesser extent, variations in the policy rate also affect the real exchange rate, implying therefore that an increase in domestic interest rates can induce demand for local currency, thereby influencing capital flows. Furthermore, own innovations contribute mainly to changes in private sector credit growth, as well as excess liquidity and the policy rate, to a smaller extent. Government expenditure is determined mainly by its previous value, 85 percent, and the policy rate accounts for about 8 percent of the changes. Finally, variations in the ratio of excess reserves to total reserves mainly result from its own innovation (95 to 85 percent), and to a lesser extent, government expenditure and the policy rate.

A.2. Jamaica

Figure 5 shows the results of a one-standard deviation shock to the policy rate, which in this case is the 30 day open market rate. An increase in the policy rate under a Taylor-type rule leads to a marginal decline in output by 0.03 percent. Inflation also declines, but this effect is not significant. Similar to the case of Barbados, the interest rate spread falls because the increase in the deposit rate is greater than the rise in the prime lending rate. However, in this case, the effect on the prime lending rate and the interest rate spread is insignificant. Interestingly, following the shock, the real exchange rate depreciates by 0.05 percent. Although this result is contrary to a priori expectations, it is possible because in the presence of credit market imperfections, a positive monetary policy shock can lead to an exchange rate depreciation (see Agénor and Montiel (2007) and Sen Min (2008) for similar results). It should also be noted that during the period of this study, there has been a significant depreciation of the nominal exchange rate in Jamaica. This can therefore imply that the interest rate must be increased substantially to induce the demand for local currency. Additionally, on impact of the shock, private sector credit increases before decreasing, and the fall in private sector credit is significant during the fifth to seventh months, and after the eleventh month. The slow change in credit growth can be due to the fact that borrowers may be unable to find alternative sources of funding, and will therefore continue to borrow at relatively higher interest rates. It has also been noted that in small open economies, an increase in bank loan rates does not cause loan demand to fall substantially (see Worrell (1995)). Consistent with the results from Barbados, government expenditure increases significantly after 4 months. As a higher policy rate causes banks to reduce demand for excess reserves, the quantity of liquidity falls by 0.07 percent in the second month. This result is similar to a study by Primus (forthcoming) that found a contractionary monetary policy shock, resulting from an increase in short-term interest rates, raises the opportunity cost of holding excess reserves, thereby, lowering the level of excess liquidity in the banking system.

Figure 6 illustrates the corresponding variance decompositions of a shock to the policy rate. The findings reveal that fluctuations in output account for 100 percent of its own innovation in the first month and declines gradually over the period to 75 percent. Also, world oil prices and the policy rate can explain 8 percent and 6 percent, respectively of the variation in output. For inflation, changes are due solely to its past value in the first period, and this contribution declines consistently thenceforth. In addition, variation in world oil prices and the ratio of excess reserves to total reserves contribute to changes in domestic prices. This therefore indicates that higher excess liquidity can put pressure on prices in Jamaica. Changes in the prime lending rate are mainly the effects of its own innovations (82 percent), as well as the interest rate spread and output growth. Given that the policy rate does not contribute substantially to fluctuations in loan rates, this can explain why its effect is insignificant in the impulse response function. Also, the prime lending rate is responsible for approximately 75 percent of the variation in the interest rate spread. Fluctuations in the exchange rate contribute to 85 percent of its own innovations in the first period, but then decline gradually to about 45 percent. Changes in the exchange rate can also be explained by the policy rate, inflation and output growth. Furthermore, the findings reveal that growth in private sector credit are due mainly to its own innovation (65 percent), and to a lesser extent, the policy rate and the ratio of excess reserves to total reserves. For government expenditure, variations arise mainly because of its past value (86 percent), while changes in the policy rate and world oil prices both account for approximately 4 percent of the changes. Regarding the ratio of excess reserves to total reserves, about 70 percent of the fluctuations can be explained by its own innovation, as well as the policy rate, world oil prices and government expenditure, to a smaller extent.

A.3. Trinidad and Tobago

Figure 9 shows the simulations of a one-standard deviation shock to the policy rate. If there is an increase in the 'repo' rate, output growth rises before declining significantly during the tenth and fourteenth months. Thus, there is a slow transmission of changes in the policy rate to output. Interestingly, following the shock, it is observed that inflation rises and remains significant during the fifth and tenth months, before declining gradually. The hump-shaped pattern is consistent to what is described as the price puzzle effect which is common in VAR models. See Walsh (2010) for a discussion on the price puzzle effect and Davoodi et al. (2013) for similar findings in the East African community. Also, a higher policy rate has an instantaneous effect on commercial banks prime lending rate, which rises by 0.09 percent following the shock. Although the prime lending rate increases, the deposit rate does not rise in tandem, causing the interest rate spread to widen—amid high excess liquidity. As reported in the International Monetary Fund (2011), deposit rates in Trinidad and Tobago are more responsive to cuts in the 'repo' policy rate, than increases. Similarly, as shown in Lebedinski (2007) and Agénor and El Aynaoui (2010), because banks hold excess liquidity, deposit interest rates are more sticky upward.

The inflow of capital resulting from a higher policy rate, increases demand for the local currency, and in turn leads to a significant appreciation of the exchange rate in the second period. The appreciation dissipates after the sixth period, so the exchange rate returns to its equilibrium level. This result is similar to a study by Watson (2003) that found an increase in the Treasury bill rate in Trinidad and Tobago is accompanied by a real exchange rate appreciation. In addition, private sector credit falls in the first month following the shock, albeit insignificantly. This can be attributed to the fact that because commercial banks are the main intermediaries, credit demand is not severely affected by changes in the prime lending rate. Government expenditure increases 2 months after the shock by 0.06 percent as a higher policy rate raises interest rates on government paper, thereby resulting in increased interest payments and overall expenditure. Also, changes in the policy rate lead to a decline in the ratio of excess reserves to total reserves, but this effect is not significant.

The variance decompositions of the domestic variables are presented in Figure 10. The results indicate that fluctuations in real output are initially due to 100 percent of its own innovations but declines consistently to 55 percent, whereas the contribution of inflation is more apparent after the seventh month. GDP growth is also affected by changes in the policy rate and the ratio of excess reserves to total reserves. For inflation, fluctuations are mainly because of its own innovations, as well as the policy interest rate and changes in world oil prices. The results for the prime lending rate show that its own shocks contribute to about 60 percent of the variations overall, and approximately 25 percent is due to changes in the policy interest rate. To a lesser extent, changes in private sector credit and the ratio of excess reserves to total reserves affect the prime lending rate. Fluctuations in the interest rate spread account for approximately 55 percent of its own innovation, 30 percent of the prime lending rate and 12 percent of the policy interest rate. Changes in the exchange rate results from 50 percent fluctuations in its own innovations and 40 percent in inflation. Notably, although changes in the policy rate affect capital flows, its contribution to the movement in the exchange rate is not substantial (less than 10 percent). Variations in private sector credit reflect mostly its own shocks (about 85 percent) and, to a small extent, changes in the prime lending rate, the policy interest rate, and output growth. Regarding government expenditure, its own innovations contribute 85 percent to the changes, while the policy rate is responsible for about 9 percent. For the ratio of excess reserves to total reserves, approximately 80 percent of the fluctuations depends on its past value, 10 percent is due to inflation and the exchange rate is responsible for 5 percent. It is important to note that although the government's fiscal operations is a key contributory factor to excess liquidity in Trinidad and Tobago (see Primus et al. (2014)), government expenditure accounts for less than 5 percent of the changes in excess reserves.

B. Shock to the Reserve Requirement Ratio

Overall, the results show that in the case of Barbados, a higher required reserve ratio is successful in reducing inflation, implying therefore that more direct policy tools can help to contain inflationary pressures in Barbados. In Jamaica, although higher reserve requirements has no effect on output, it leads to a significant reduction in inflation during the first period following the shock. In Trinidad and Tobago, an increase in the required reserve ratio leads to an immediate significant drop in output growth. The reserve requirement shock is also successful in reducing both private sector credit and excess reserves. The rest of this section provides further discussions of the results.

B.1. Barbados

Figure 3 presents the effect of a one-standard deviation shock to the required reserve ratio. The impulse response functions show that output growth contracts temporarily after 4 months before rising, but similar to the baseline case of a shock to the policy rate, the effect on output is not significant. By contrast to the results in Figure 1, higher reserve requirements leads to a significant fall in inflation after 9 months. Also, the prime lending rate increases in the first period as the baseline case. However, the effect is insignificant under the shock to the required reserve ratio. Furthermore, in this case, on impact of the shock the interest rate spread increases by 0.17 percent because higher reserve requirements causes banks to reduce their deposit rates and increase their loan rates. This finding is similar to other studies that found a positive shock to the required reserve ratio acts as a tax on banks so the spread between lending and deposit rates increases; see for instance Montoro and Moreno (2011), Glocker and Towbin (2012), Tovar et al. (2012), and Primus (forthcoming). The real exchange rate depreciates significantly after 7 months. It is important to note that an increase in the required reserve ratio does not have a significant effect on credit demand and government expenditure. Also, contrary to what is expected, the ratio of excess reserves to total reserves increases one month after the shock by 0.09 percent before declining; however, the fall in excess reserves is not significant. In Barbados, a higher required reserve ratio on local currency deposits is more likely to be caused by an increase in the security requirement. Under this circumstance, commercial banks are likely to demand more excess reserves as this can be an opportunity for them to switch excess idle funds to interest earning securities.

The corresponding variance decompositions of a shock to the required reserve ratio are shown in Figure 4. An examination reveals that in most cases, the results are similar to the baseline case of a positive shock to the policy rate (Figure 2). For output growth, world oil prices account for a marginally smaller share of the fluctuations (less than 5 percent). In this case, variations in inflation are attributed to about 2 to 4 percent in the required reserve rate after the seventh period, whereas the policy rate can explain 2 to 8 percent of inflation in the

baseline experiment. The contribution of own innovations to the prime lending rate is similar under both experiments (45 to 52 percent). Further, in this experiment, changes in the interest rate spread can be explained less by the required reserve ratio (10 percent), as opposed to the baseline case in which 30 to 38 percent of the variation is attributed to the policy rate. It should be noted that movements in the exchange rate and private sector credit can be attributed less to the required reserve ratio, than the policy rate—when it is the instrument of monetary policy. Similarly, the results show that changes in government expenditure depend to a lesser extent on the policy instrument in this case, as only 3 percent is determined by the required reserve ratio, compared to 8 percent in Figure 2. In comparison to the shock to the policy rate, reserve requirements account for a larger share of the movement in the ratio of excess reserves to total reserves (22 percent), implying therefore that this is an appropriate policy tool that can influence bank liquidity.

B.2. Jamaica

The impulse response functions of a one-standard deviation shock to the reserve requirement ratio are presented in Figure 7. The impulse response functions indicate that output falls following the shock, but unlike the baseline case of a shock to the policy rate (Figure 5), this effect is insignificant. Also, on impact of the shock, inflation falls by 0.4 percent, but only remains significant in the first period. Although the effect on inflation is short-lived, this result indicates that reserve requirements can be used as a policy tool for price stability. The interest rate spread falls by 0.09 percent as a higher required reserve ratio reduces the deposit rate, but does not increase the lending rate significantly. Similar to the results in Figure 5, if there is an increase in the required reserve ratio, the exchange rate depreciates and credit falls from the second month. Furthermore, government expenditure falls in the first period and then rises almost significantly after 4 months. In the second month following the shock, the ratio of excess reserves to total reserves falls by marginally more than the baseline case, implying therefore that changes in the reserve requirement ratio have a stronger effect on bank liquidity.

Figure 8 shows the variance decompositions of a shock to the required reserve ratio. An inspection of the results show that they appear similar to the case of a shock to the policy rate (Figure 6). For output growth, the required reserve ratio can explain less than 0.5 percent of the fluctuations, in comparison to the baseline case in which the policy rate accounts for approximately 6 percent. Regarding inflation, changes in world oil prices can explain a slightly lower share of its fluctuations under a shock to reserve requirements, whereas the contribution of non-fuel world CPI is about the same under both shocks. In addition, the results show that more of the variations in the prime lending rate, the interest rate spread, and government expenditure, can be explained by the required reserve ratio, as compared to the policy interest rate. However, reserve requirements contribute to a slightly lower share of the variation in the exchange rate. Similarly, for private sector credit, the required reserve ratio can only

explain about 3 percent of its fluctuations, as opposed to the baseline case in which the policy rate accounts for about 10 percent of its changes. Also, when there is an increase in reserve requirements, government expenditure contributes a slightly lower share to the movements in the ratio of excess reserves to total reserves in comparison to the baseline case.

B.3. Trinidad and Tobago

Figure 11 presents the results of a one-standard deviation shock to the required reserve ratio. In this case, in the second month, output falls significantly by 0.05 percent, in contrast to an increase of 0.07 percent with a shock to the policy rate (Figure 9). Inflation also rises in this experiment but the effect is insignificant. Both the prime lending rate and the interest rate spread increase in the third month, in comparison to an increase in the first month in the baseline case. Further, an increase in the required reserve ratio does not have a significant effect on the real exchange rate and government expenditure. However, private sector credit contracts by 0.05 percent in the second month following the shock. Importantly, if there is an increase in reserve requirements, the ratio of excess reserves to total reserves falls by 0.18 percent in the second month, contrary to the baseline case where an increase in the policy rate did not lead to a significant reduction in the ratio of excess reserves to total reserves.

Figure 12 shows the variance decompositions of a one-standard deviation shock to the reserve requirement ratio. Overall, the results do not differ significantly to the shock to the policy interest rate. In this case, world oil prices can explain about 1 percent in the real output growth, unlike the baseline case (Figure 10) in which it accounted for up to 5 percent of the fluctuations. The contribution of the required reserve ratio to changes in output and inflation is far less substantial, in comparison to the policy rate. This finding is contrary to a study by Ramlogan (2007) that found reserve requirements are important in explaining variations in output and inflation. Also, for the prime lending rate, the interest rate spread, the real exchange rate and government expenditure, the reserve requirement ratio accounts for less of the fluctuations, as compared to the policy interest rate in the baseline experiment. For instance, in Figure 12, regarding the interest rate spread, the required reserve ratio contributes to less than 5 percent of the variations, whereas in the baseline case, the policy rate accounts for 12 percent of the changes. However, the results for private sector credit and the ratio of excess reserves to total reserves show that the required reserve ratio can explain more of the fluctuations (about 7 percent and 8 percent, respectively), in comparison to the shock to the policy rate where it is only responsible for 3 percent and 0.9 percent, respectively of the changes.

V. Conclusion and Policy Implications

The purpose of this study was to investigate the relative effectiveness of indirect and direct monetary policy tools in transmitting monetary impulses in Barbados, Jamaica and Trinidad and Tobago. A Taylor-type short-term interest rate was used as the indirect policy instrument and the required reserve ratio represented the direct policy tool. To conduct this analysis, the study estimated a restricted Vector Autoregressive model with Exogenous Variables (VARX), which incorporated the various sectors of the economy. The model also accounted for the imperfections in the financial sector in those countries—in particular, excess bank liquidity and credit market imperfections.

Overall, the results show that there is a weak transmission of changes in the policy interest rate because of high financial system liquidity. An analysis of the impulse response functions reveals that although an increase in the short-term interest rate has an instantaneous effect on commercial banks' loan rates in Barbados and Trinidad and Tobago, this effect does not translate into a significant fall in private sector credit. Also, higher domestic interest rates leads to an appreciation of the real exchange rate and an increase in government expenditure in both countries. By contrast, in Jamaica, a higher policy rate leads to a real exchange rate depreciation, and a marginal significant increase in government expenditure after 5 months. The findings also show that in all three countries, the shock has a muted effect on inflation, which indicates that changes in the short-term interest rate are not sufficient to achieve price stability. Following the shock, output contracts immediately in Jamaica, but it takes 10 months for a fall in output to be realized in Trinidad and Tobago.

Moreover, a contractionary monetary policy shock via a higher required reserve ratio is successful in reducing credit demand and it leads to an instantaneous fall in excess reserves in Jamaica and Trinidad and Tobago. Also, in Trinidad and Tobago, higher reserve requirements can help to reduce output growth faster, and it does not create pressure on the exchange rate. Furthermore, in Barbados, an increase in the required reserve ratio has no effect on the government's interest payments and it leads to a significant depreciation of the exchange rate after the seventh period.

These results therefore reveal that the central banks of Barbados, Jamaica and Trinidad and Tobago should use a combination of indirect and direct policy tools to effect monetary policy. Thus, although the monetary authorities in those countries are employing market-based measures, indirect policy instruments are not sufficient to transmit monetary impulses to key macroeconomic variables. Furthermore, the monetary authorities should adjust reserve requirements on local currency deposits more frequently as this has a direct effect on credit demand and excess reserves—and this action is not associated with an increase in interest costs. This result can be particularly important for Barbados, as that country has not changed the requirement on local currency deposits for over a decade. Also, similar to Barbados and Jamaica, the

Central Bank of Trinidad and Tobago should consider implementing reserve requirements on securities. This is because by manipulating the requirement on securities, the Central Bank can influence other short-term rates, and help to better manage liquidity conditions.

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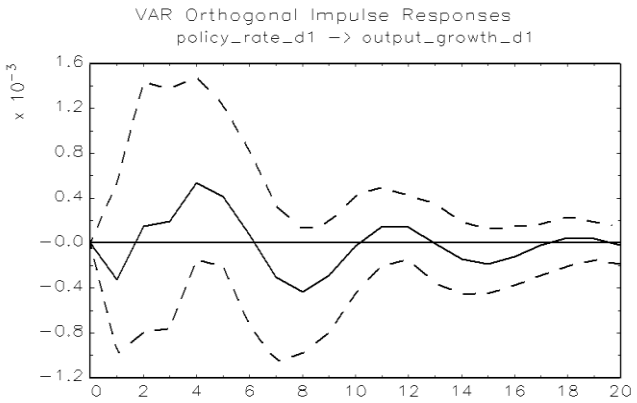
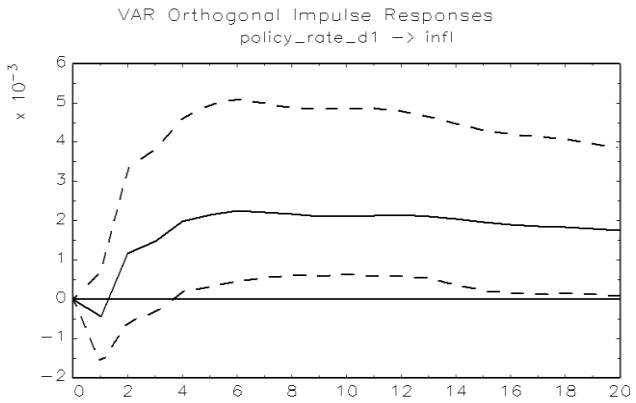
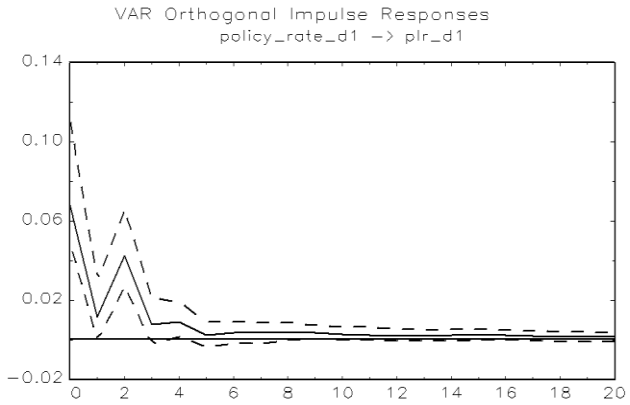
Table 1. Unit Root and Seasonality Tests

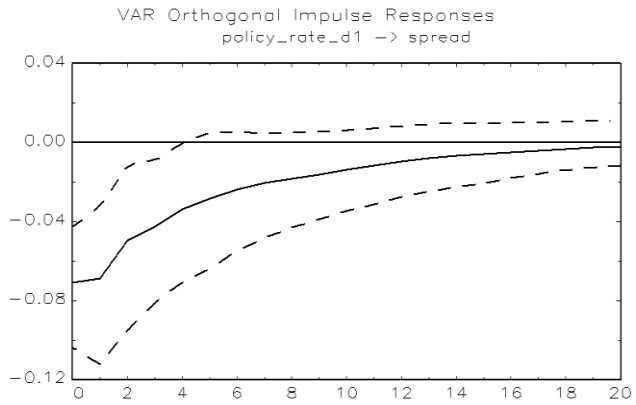
	Barbados			Jamaica			Trinidad and Tobago		
Variable	**Order of Integration**	**Seasonal Dummies**	**Trend**	**Order of Integration**	**Seasonal Dummies**	**Trend**	**Order of Integration**	**Seasonal Dummies**	**Trend**
output_growth	I(1)			I(1)			I(0)		✓
infl	I(0)			I(0)			I(0)		
policy_rate	I(1)			I(1)			I(1)		
rrr	I(0)			I(1)	d7		I(1)		
plr	I(1)	d10		I(1)			I(1)		
spread	I(0)			I(0)		✓	I(1)	d11	
exch_rate	I(1)	d1, d3, d8		I(0)		✓	I(1)	d3	
credit	I(1)			I(1)			I(1)		
govt_exp	I(0)			I(0)		✓	I(0)		
ertr	I(1)			I(0)		✓	I(0)	d9	
world_CPI	I(0)			I(0)			I(0)		
oil_price	I(0)			I(0)			I(0)		

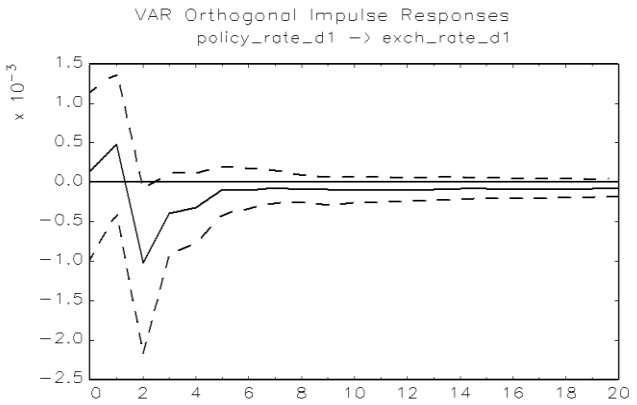
Barbados
One-Standard Deviation Shock to the Policy Interest Rate
Figure 1. Impulse Response Functions

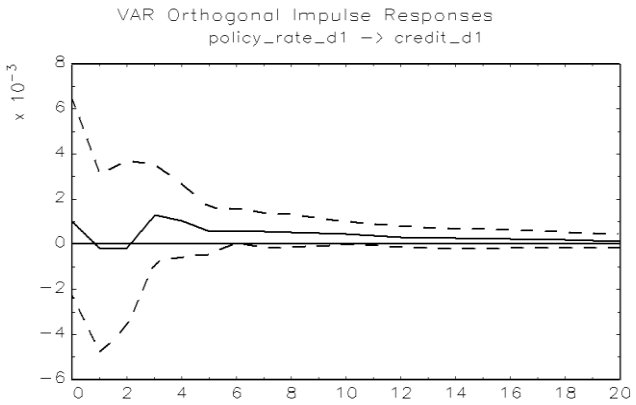


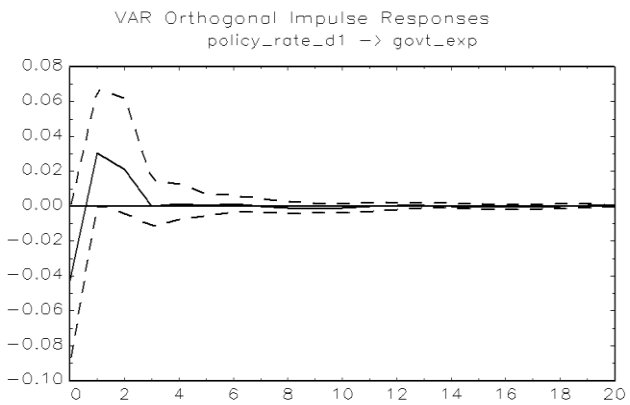


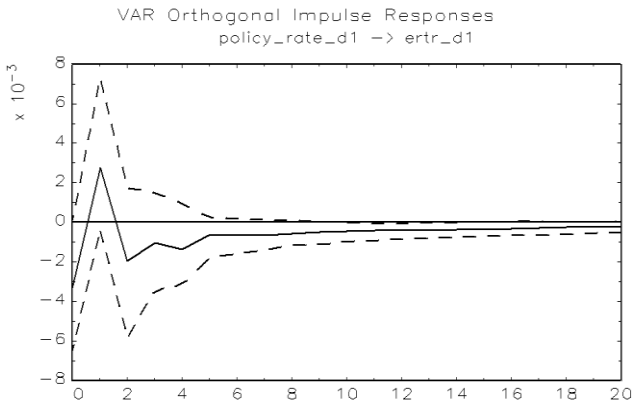




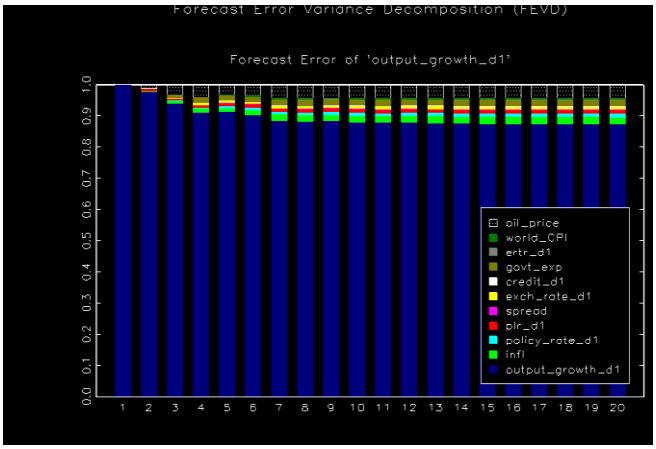


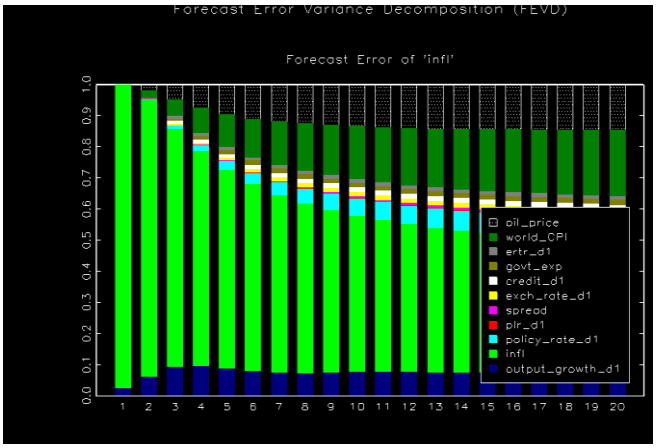


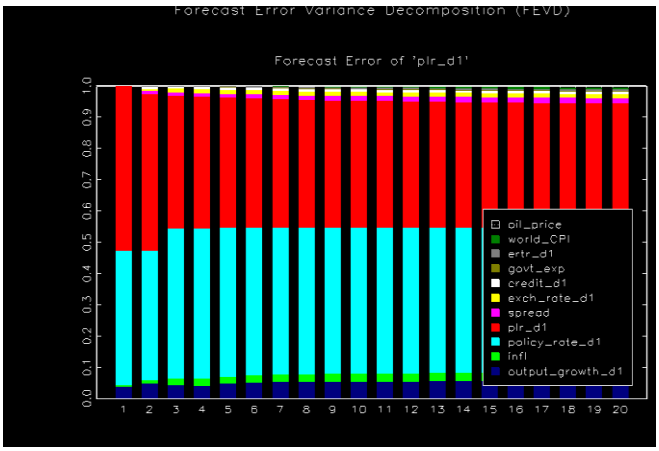


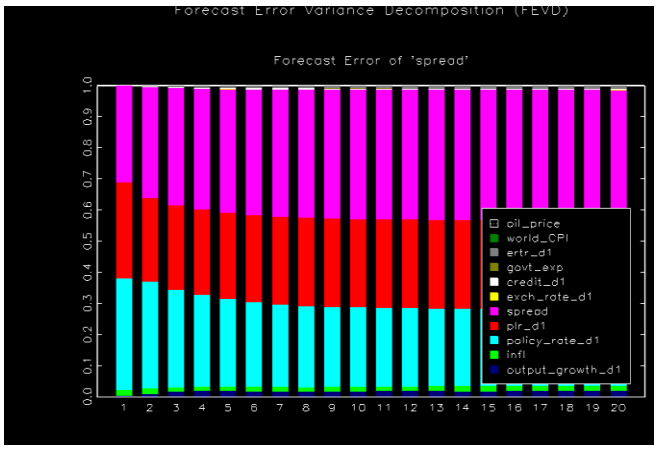


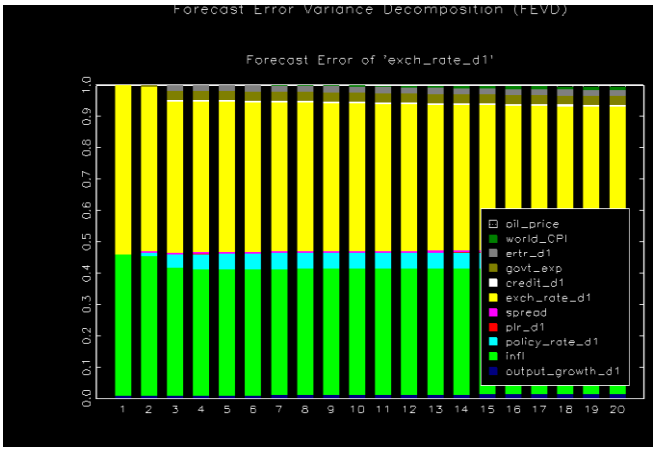
Barbados
One-Standard Deviation Shock to the Policy Interest Rate
Figure 2. Variance Decompositions

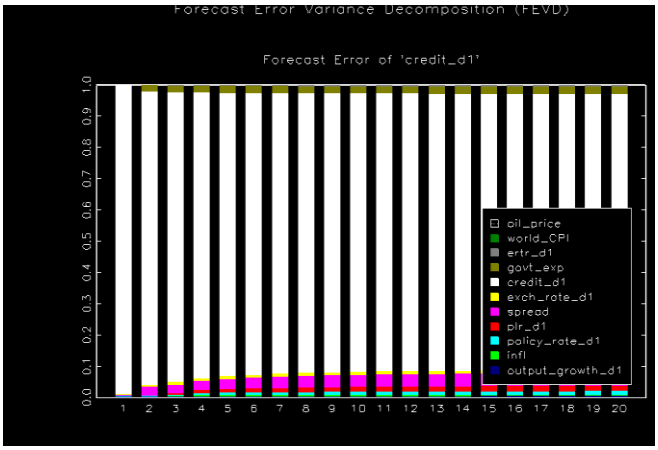


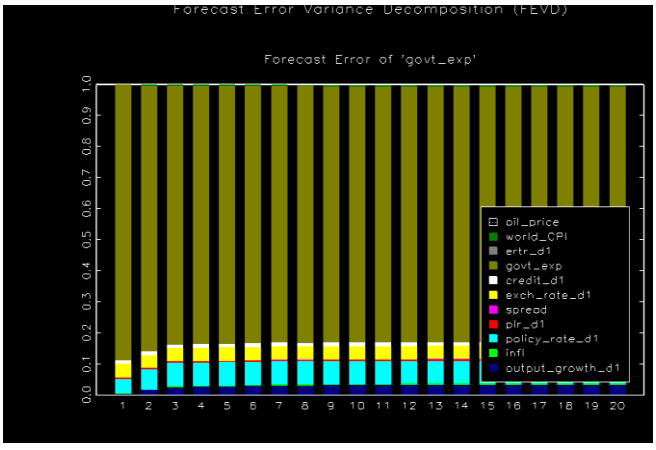


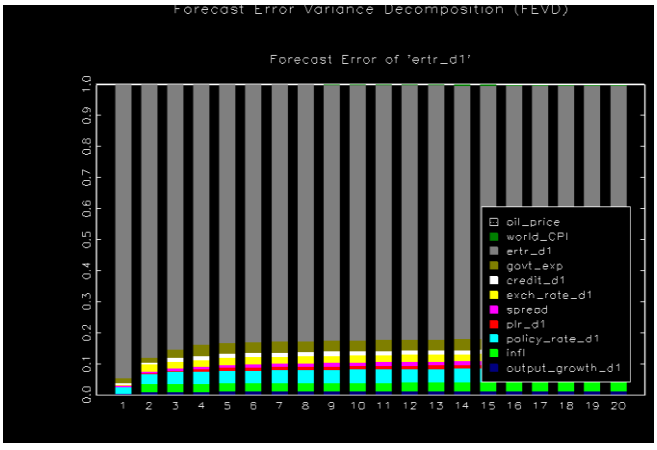




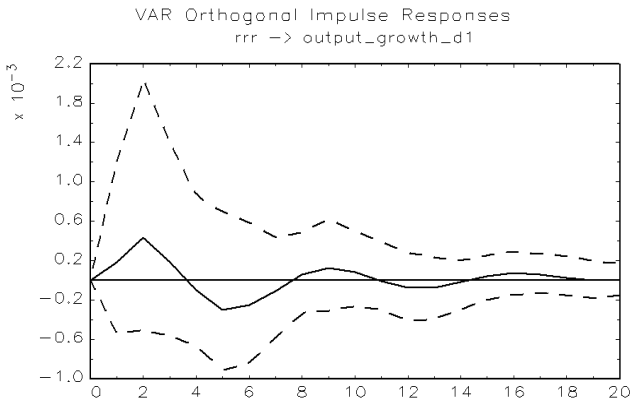


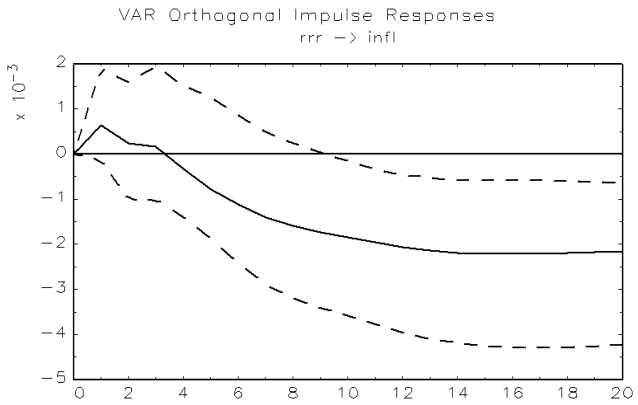


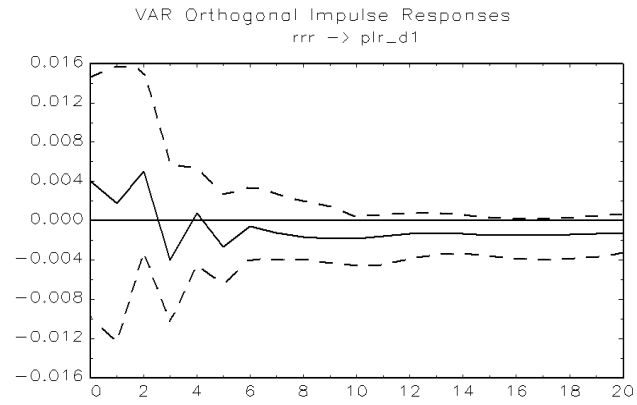


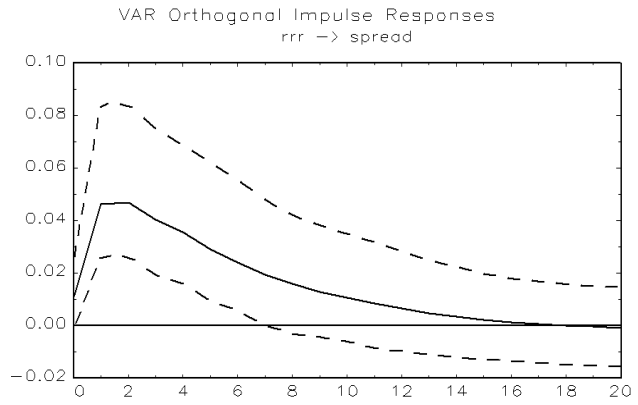


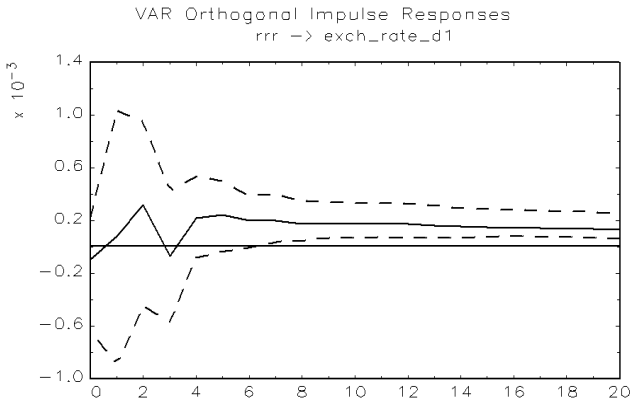
Barbados
One-Standard Deviation Shock to the Reserve Requirement Ratio
Figure 3. Impulse Response Functions

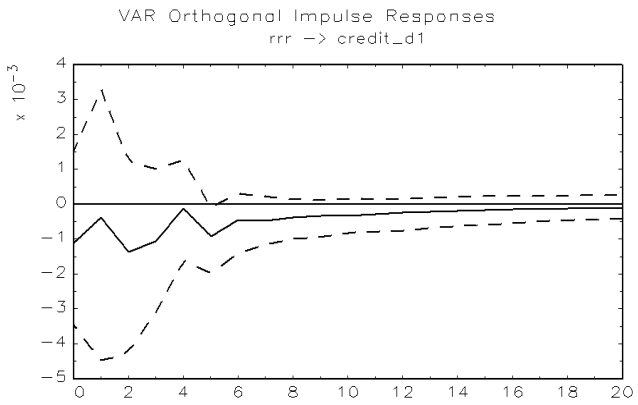


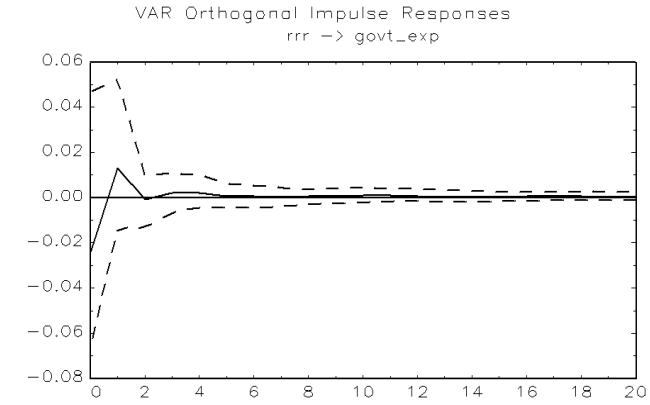


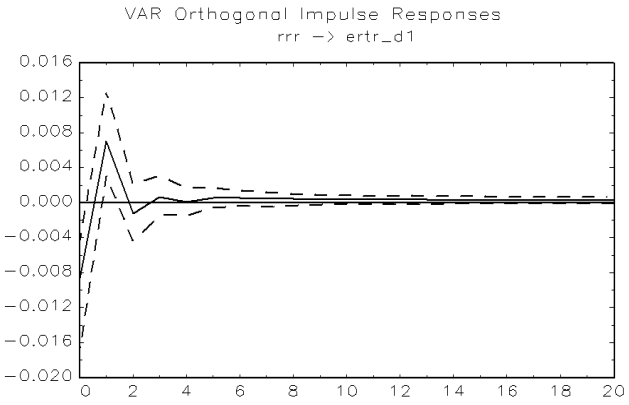




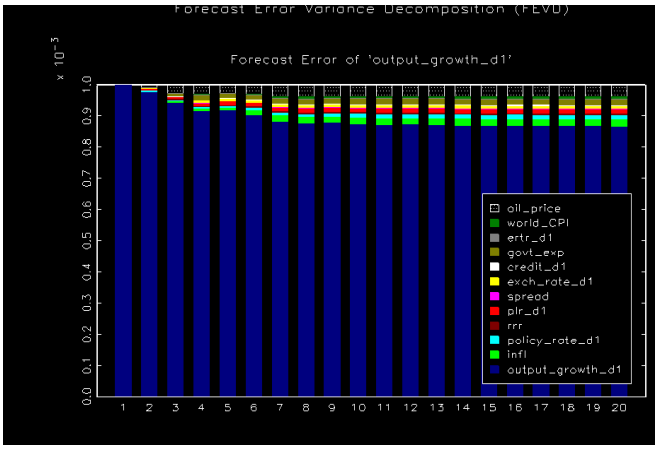


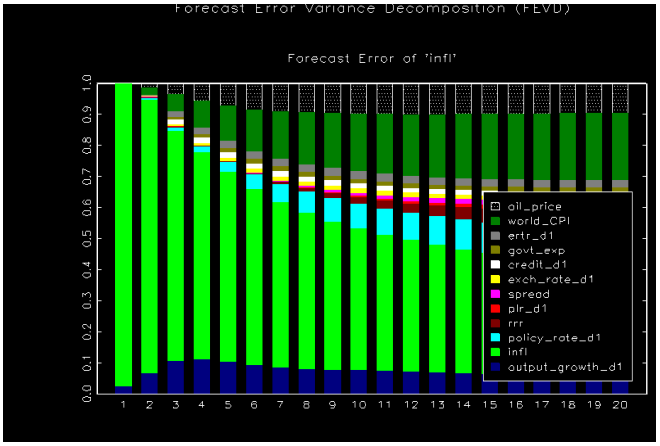


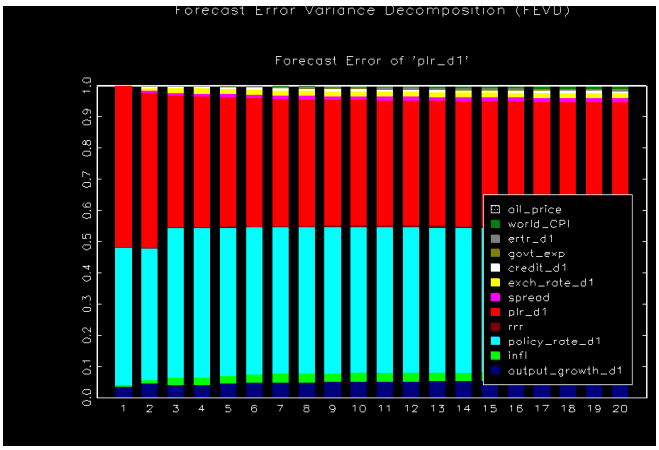


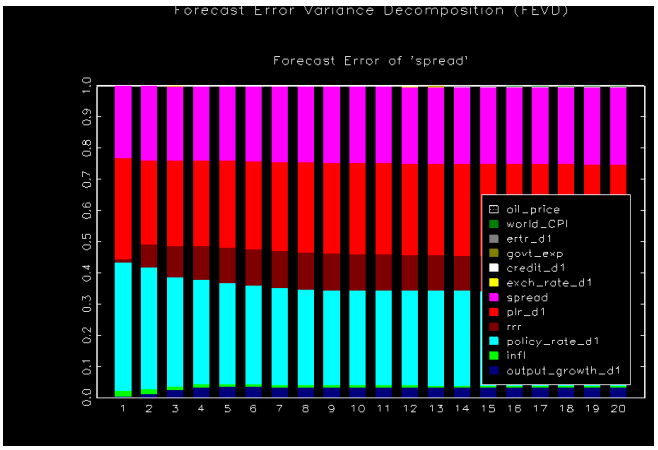


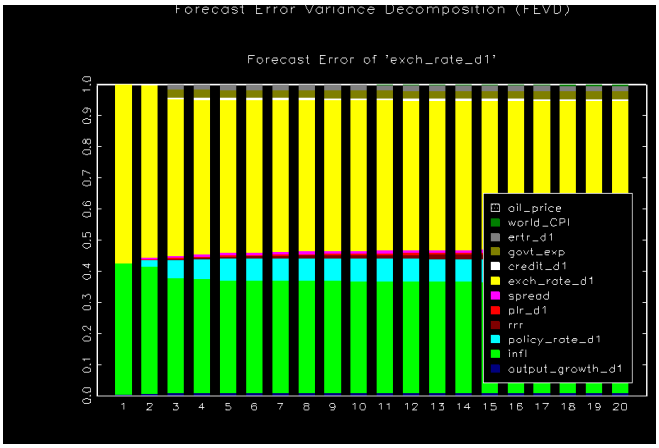
Barbados
One-Standard Deviation Shock to the Reserve Requirement Ratio
Figure 4. Variance Decompositions

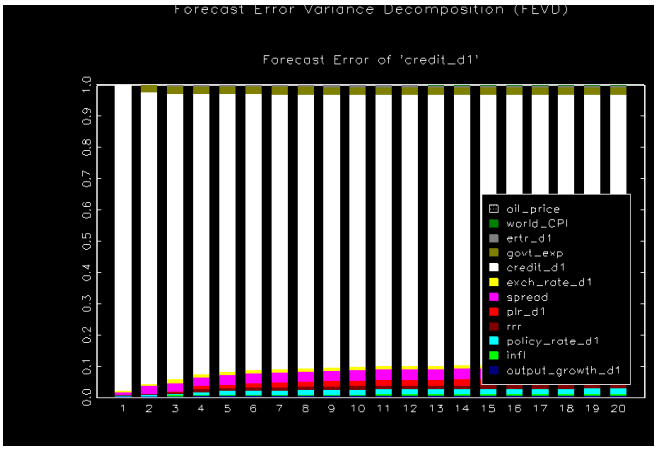


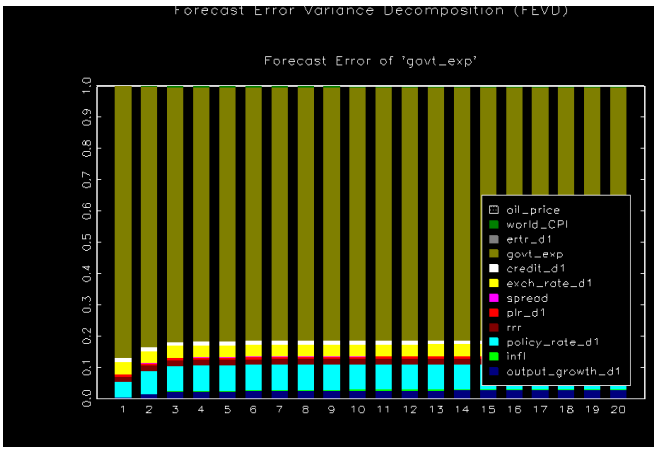


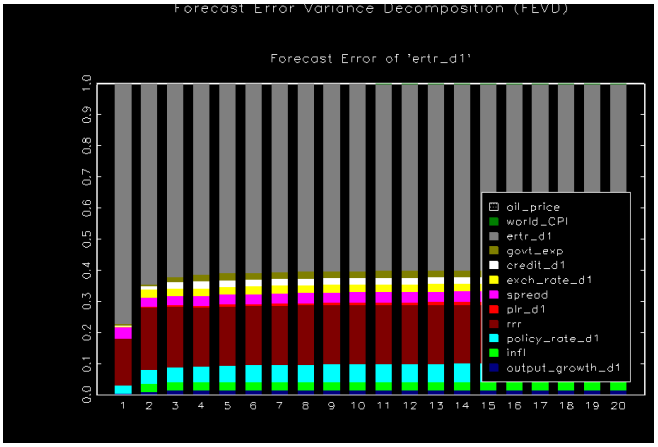




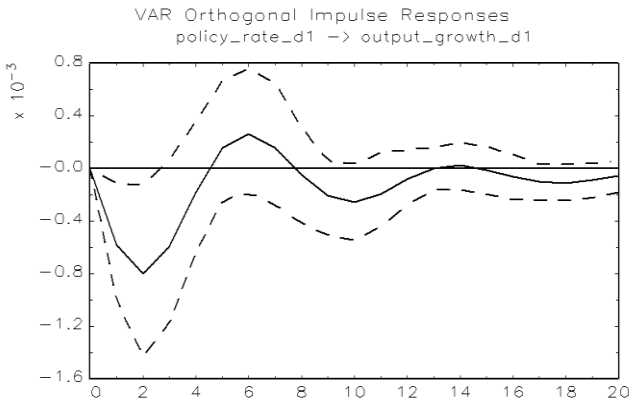


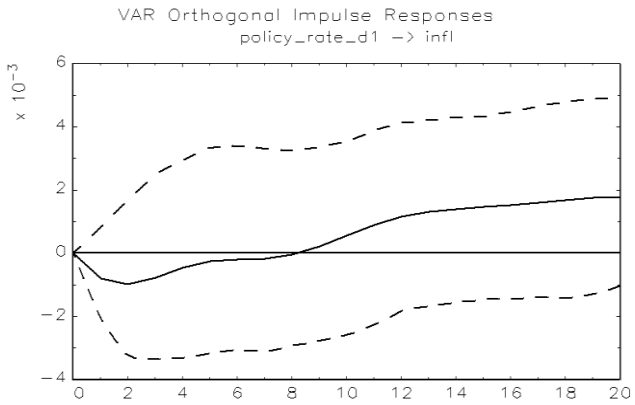


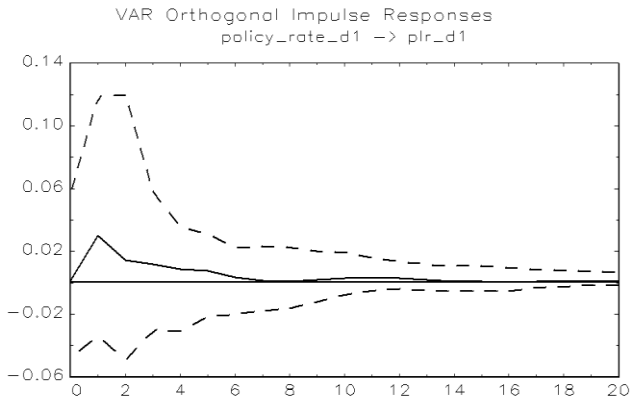


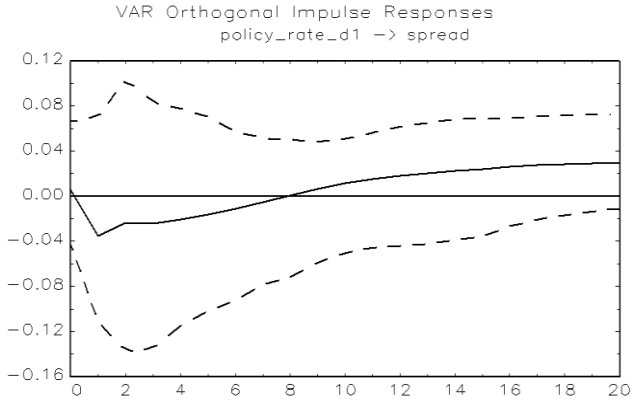


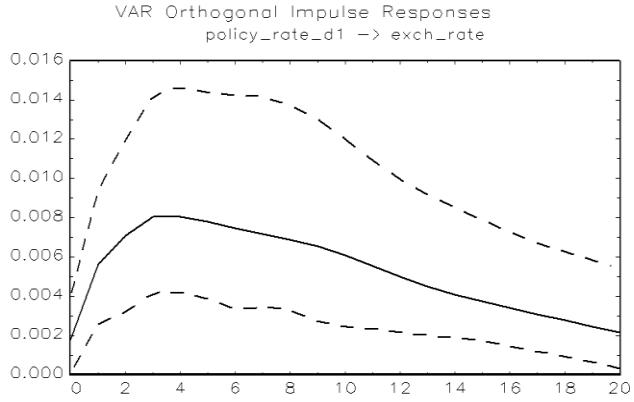
Jamaica
One-Standard Deviation Shock to the Policy Interest Rate
Figure 5. Impulse Response Functions

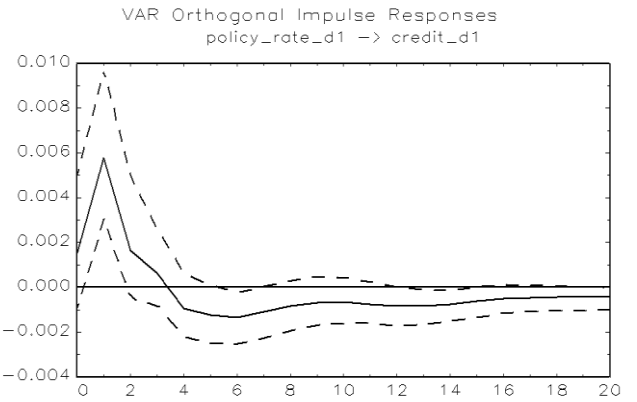


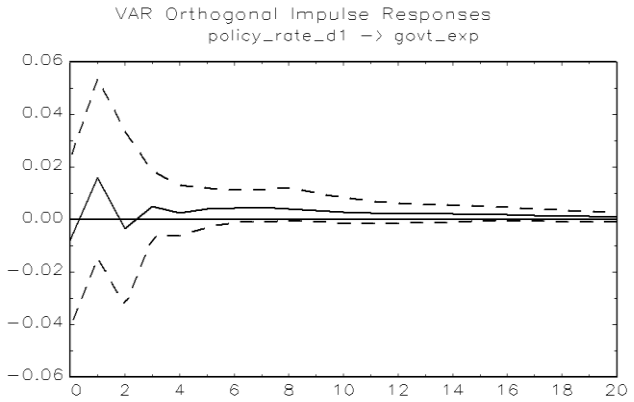


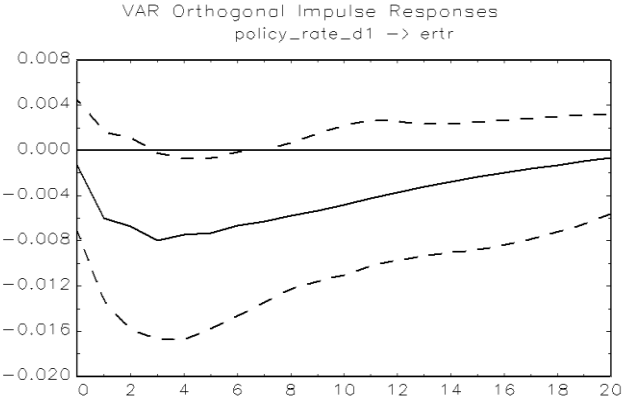




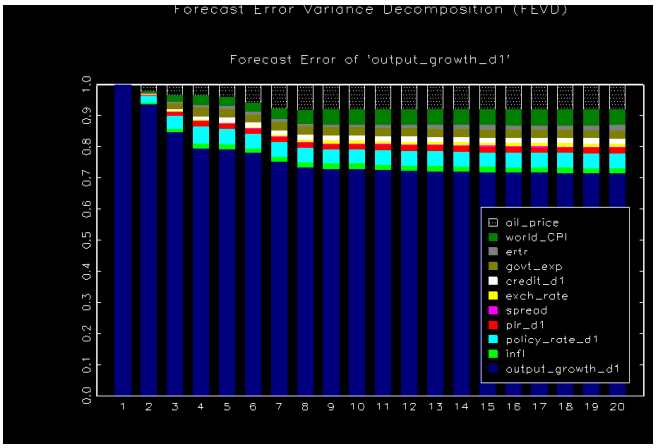


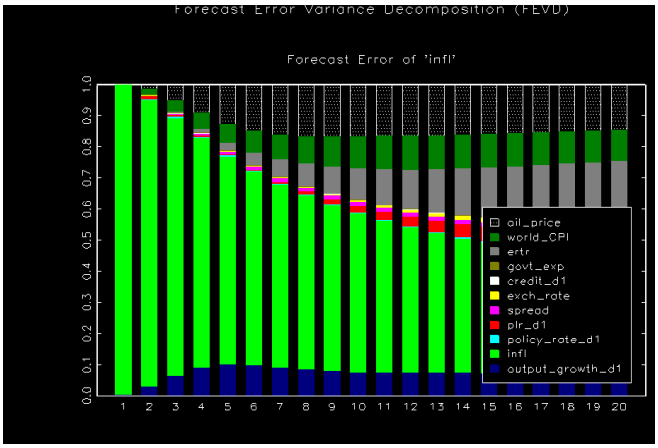


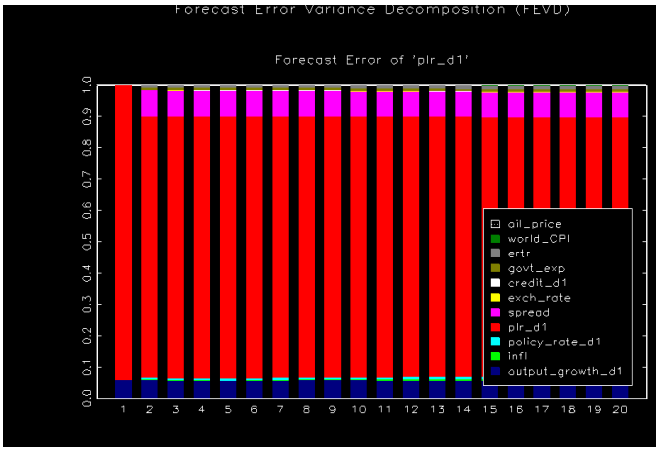


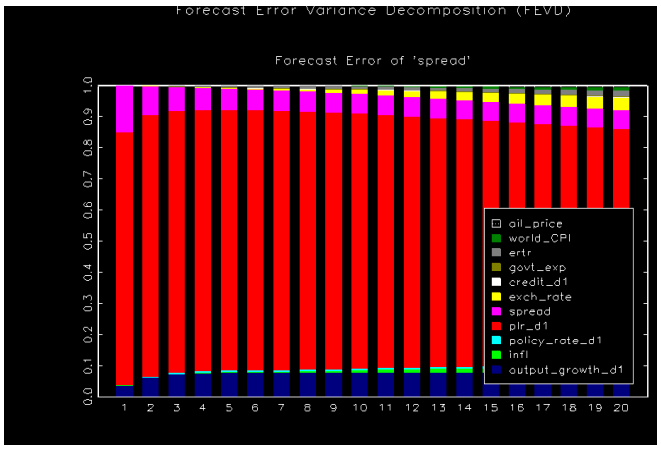


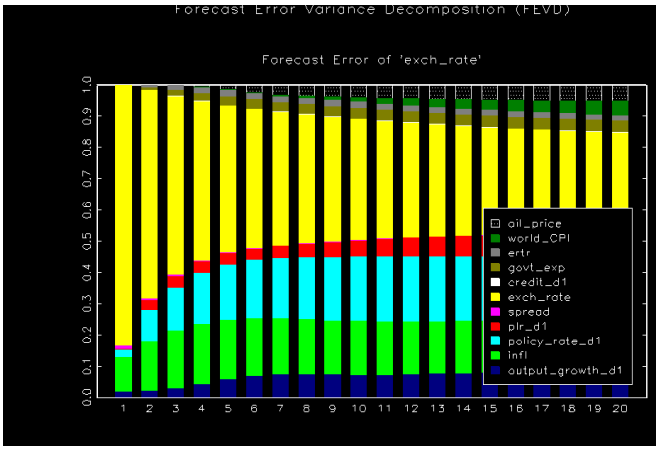
Jamaica
One-Standard Deviation Shock to the Policy Interest Rate
Figure 6. Variance Decompositions

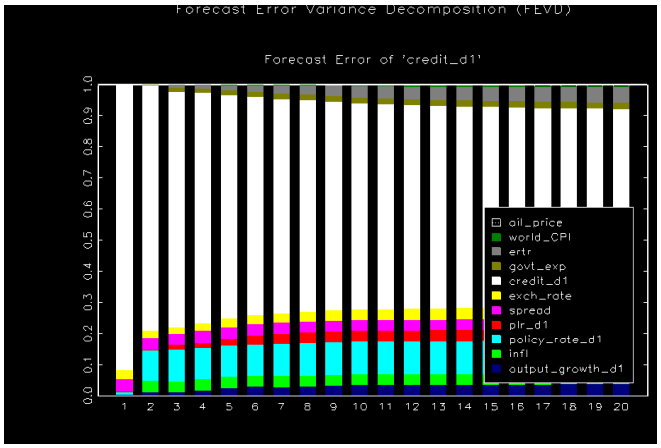


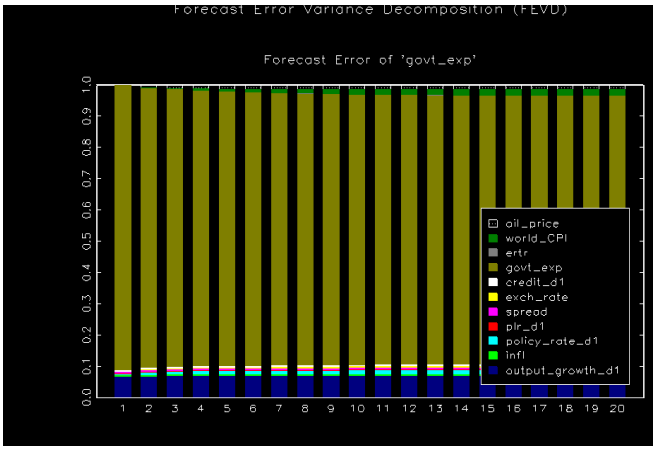


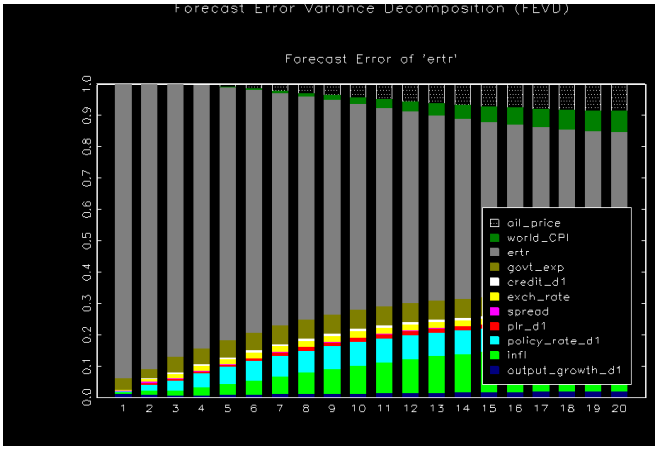




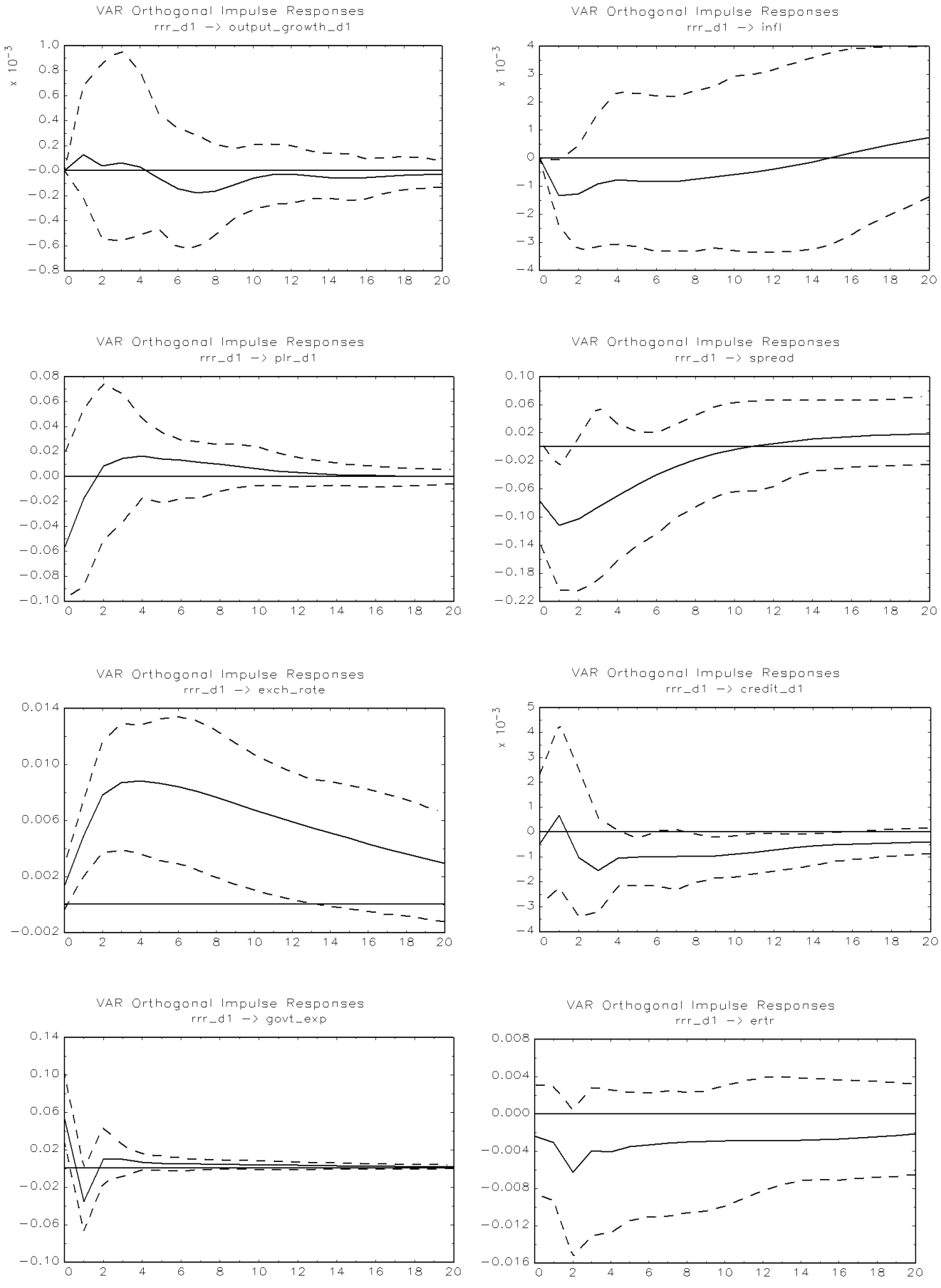




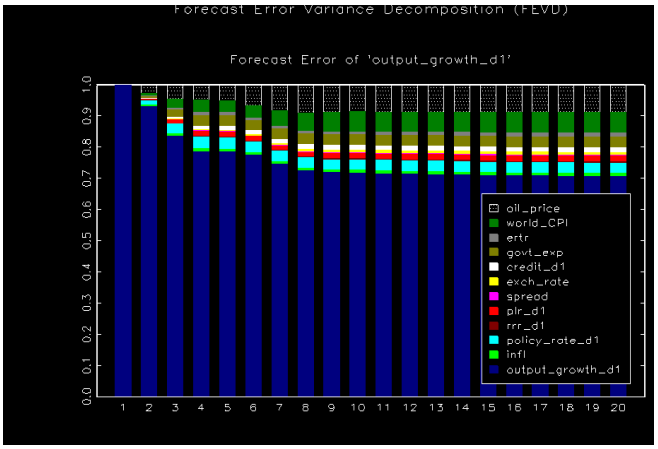


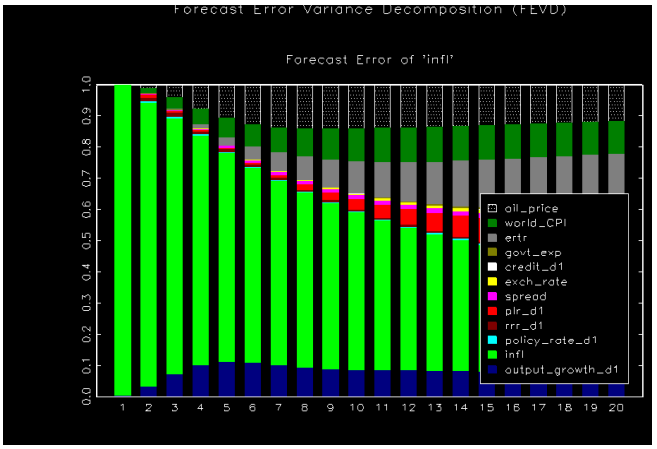


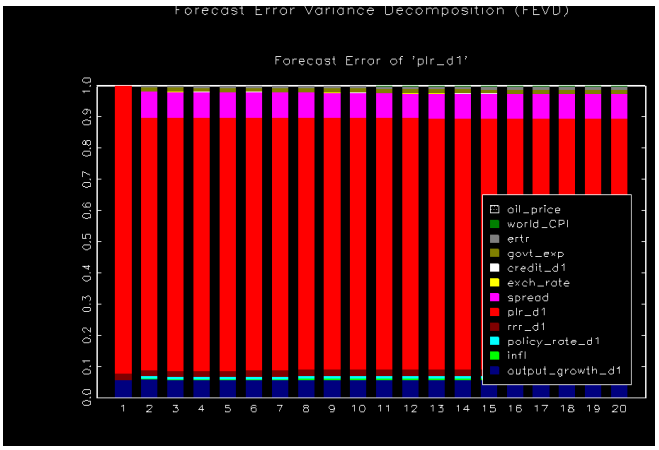
Jamaica
One-Standard Deviation Shock to the Reserve Requirement Ratio
Figure 7. Impulse Response Functions

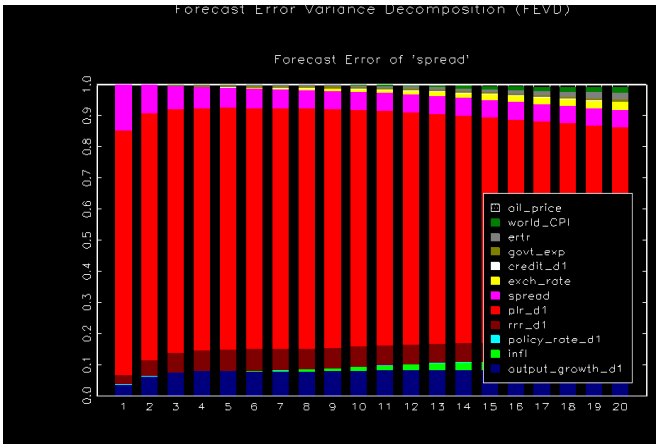


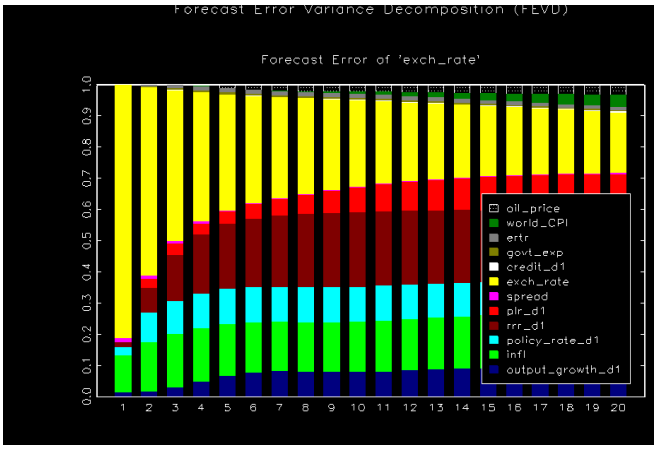
Jamaica
One-Standard Deviation Shock to the Reserve Requirement Ratio
Figure 8. Variance Decompositions

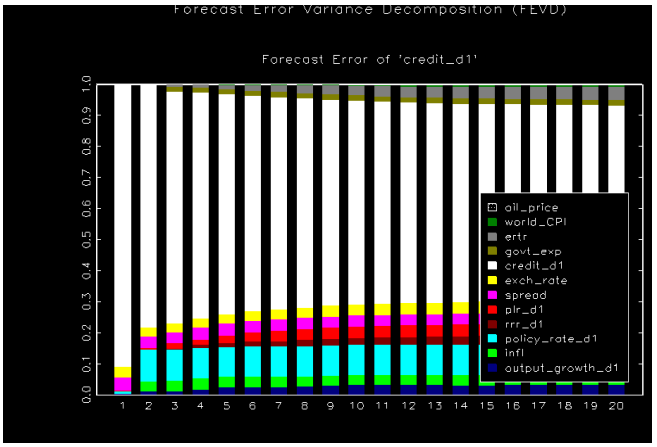


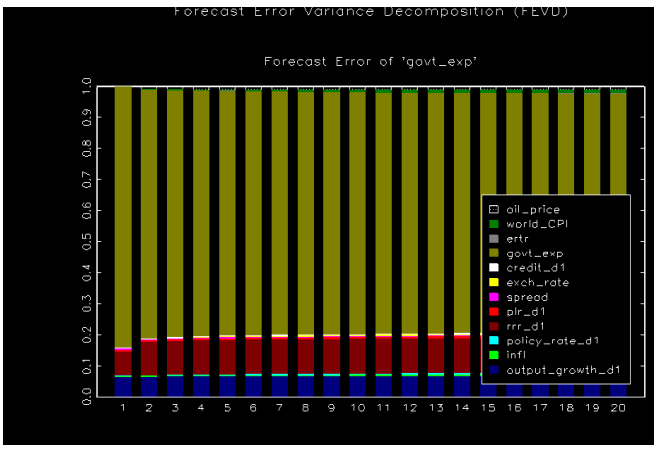


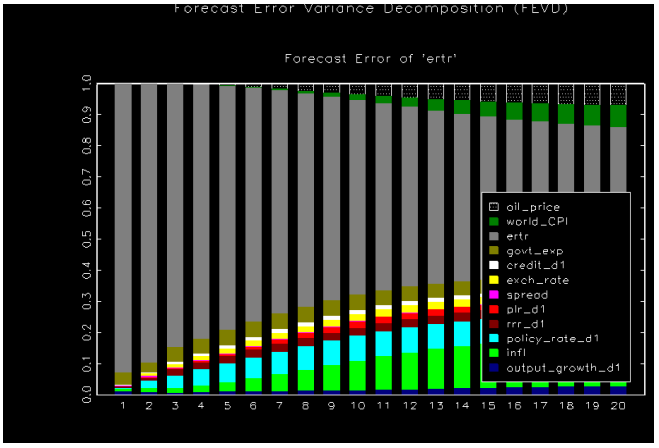




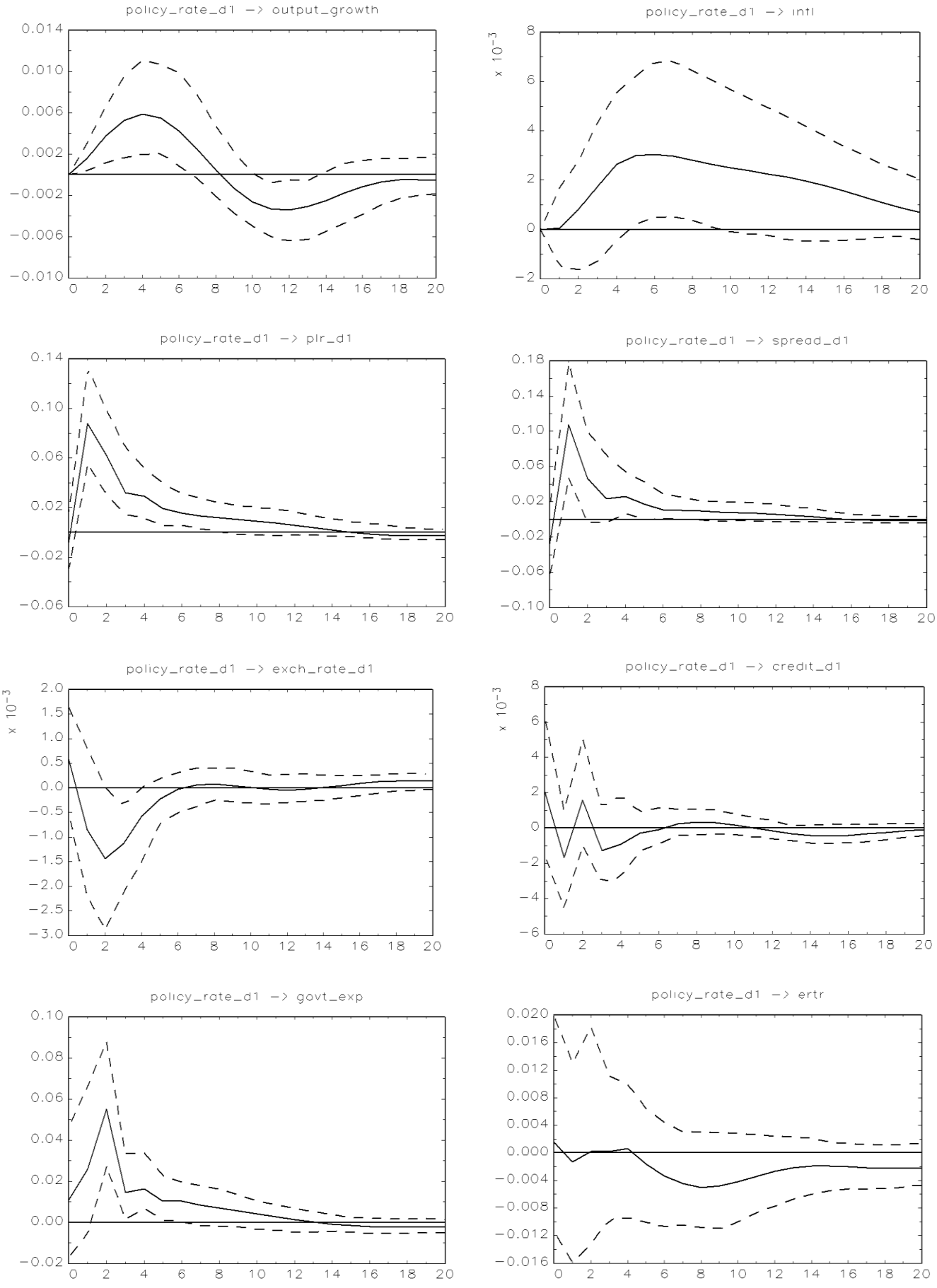




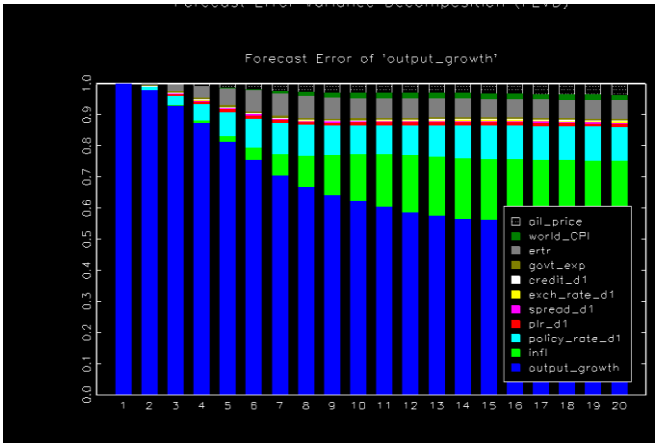


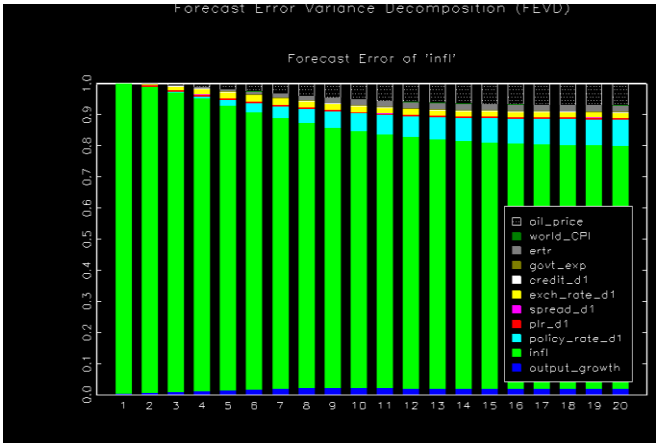


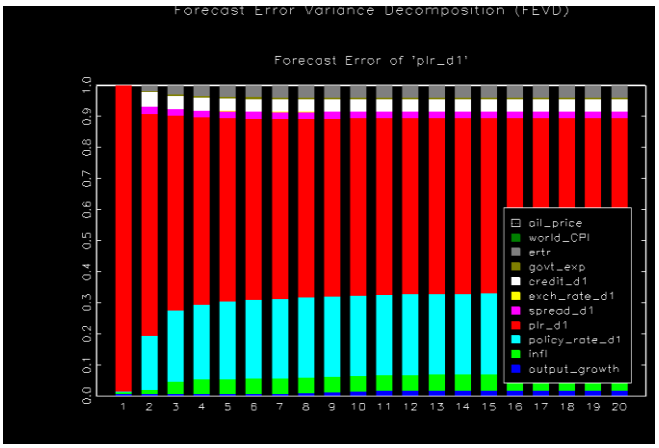
Trinidad and Tobago
One-Standard Deviation Shock to the Policy Interest Rate
Figure 9. Impulse Response Functions

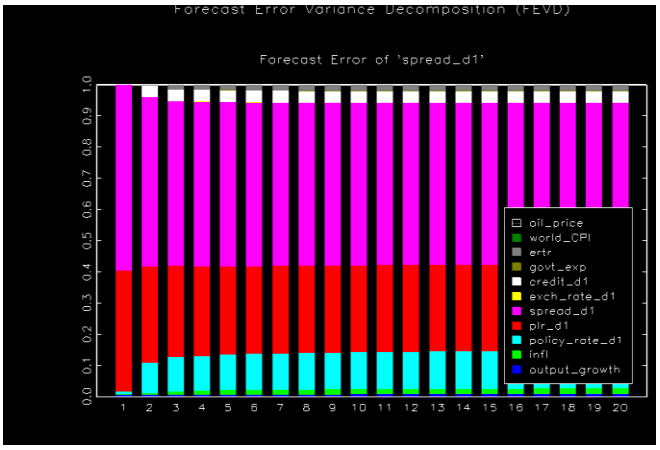


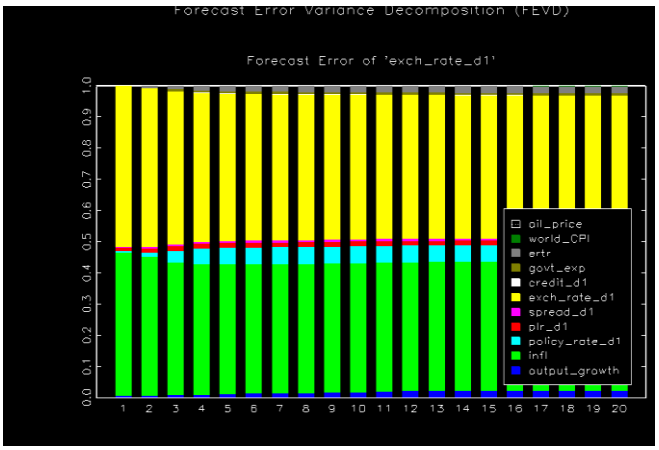
Trinidad and Tobago
One-Standard Deviation Shock to the Policy Interest Rate
Figure 10. Variance Decompositions

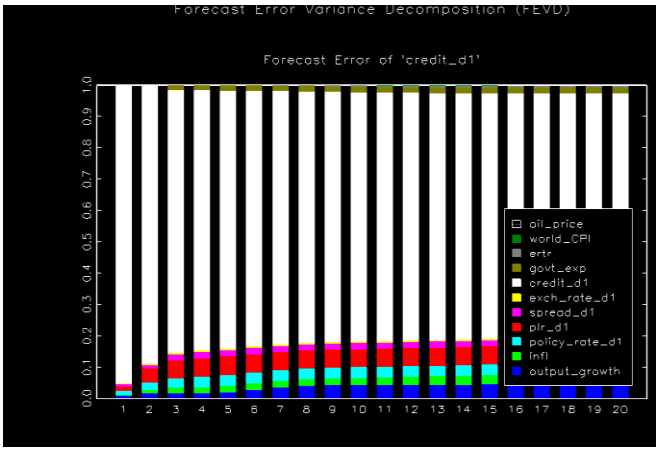


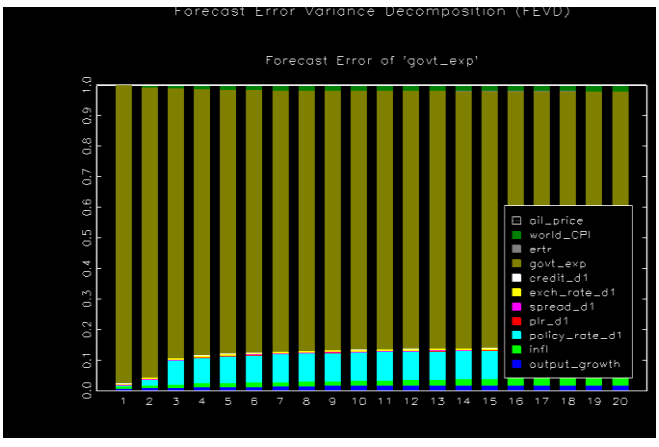


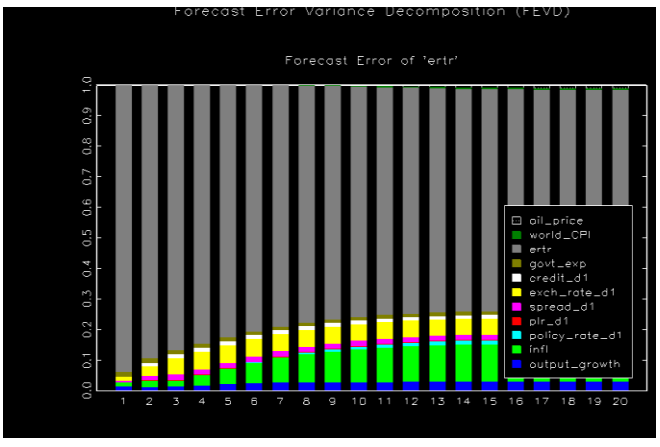




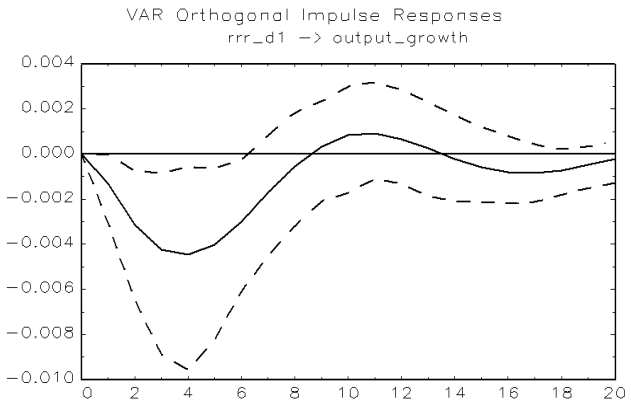


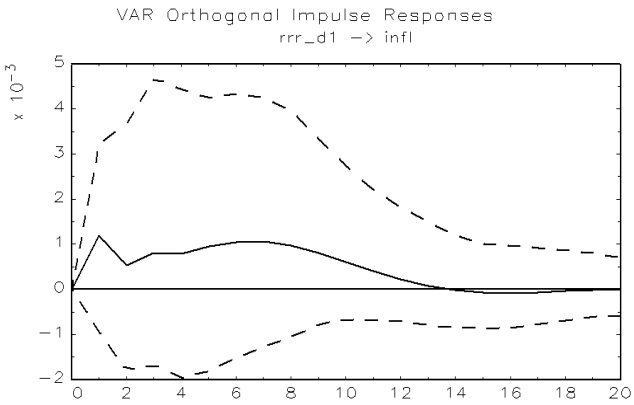


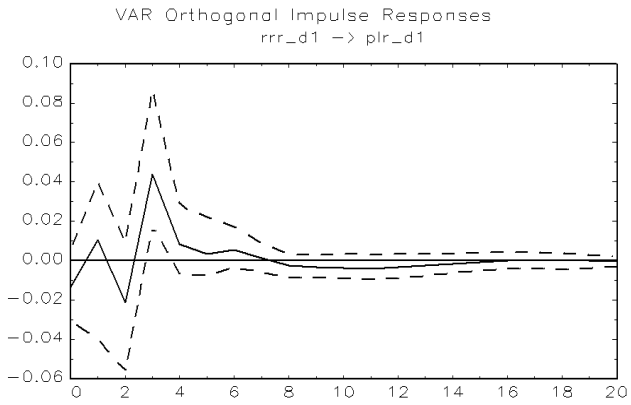


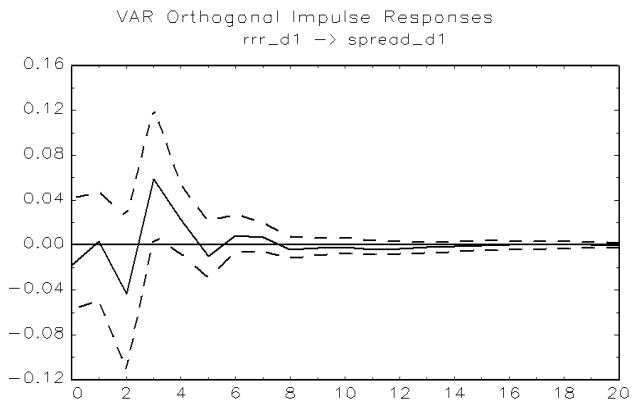


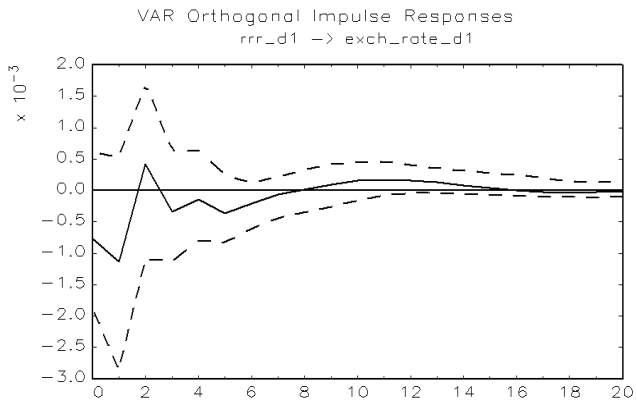
Trinidad and Tobago
One-Standard Deviation Shock to the Reserve Requirement Ratio
Figure 11. Impulse Response Functions

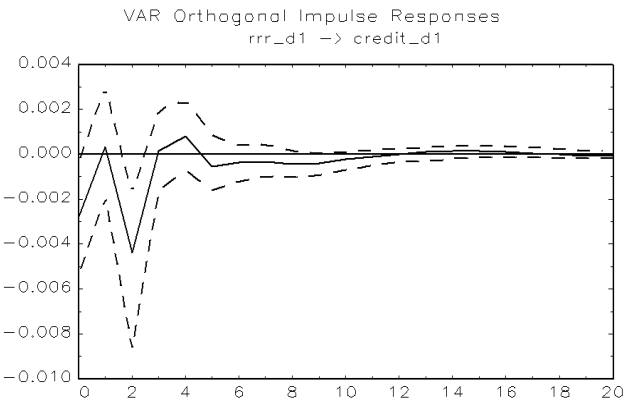


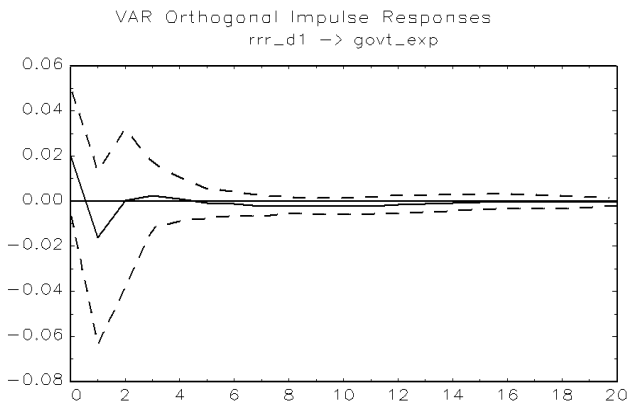


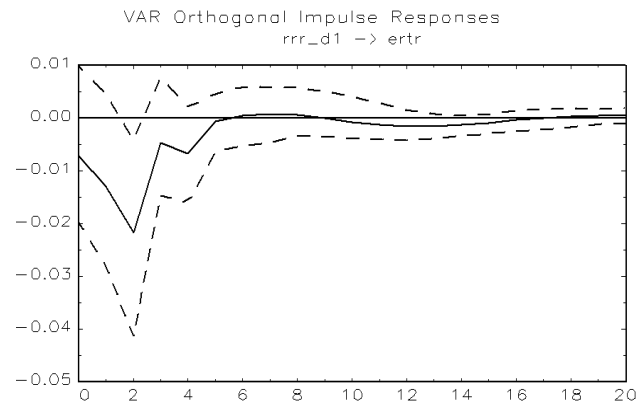












Trinidad and Tobago
One-Standard Deviation Shock to the Reserve Requirement Ratio
Figure 12. Variance Decompositions