Interaction between Monetary policy and stock prices: A comparison between the Caribbean and the US*

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ABSTRACT

We analyze the interaction between monetary policy and stock prices in Barbados, Jamaica and Trinidad and Tobago (T&T), both individually and jointly as the Caribbean countries using structural VARs as proposed in Bjornland and Leitemo (2009). Annual and monthly frequencies are used for Barbados while, due to data availability constraints, only annual data is employed for Jamaica and T&T. *First*, our results show that in Barbados with monthly (and annual) data, a monetary policy shock that increases the Treasury bill rate by 100 basis points causes stock prices to increase by 0.038 (and fall by 0.06) %; while a stock price shock that increases stock prices by 1% results in an increase in the Treasury bill rate of 30 (and 190) basis points respectively. For Jamaica, a monetary policy shock causes stock prices to fall by 0.3%; while a stock price shock that increases stock prices by 1% results in an increase in the Treasury bill rate of 400 basis points. Likewise for T&T; a shock to monetary policy causes stock prices to fall by 0.1% and a shock leading to a 1% increase in real stock prices causes the Treasury bill to increase by 330 basis points. When we analyse the three Caribbean countries jointly; a positive 1% stock price shock causes the Treasure bill rate to increase by 700 basis points and a positive monetary policy shock cause stock price to fall by 0.027%.

Therefore, our results in relation to the signs of the relationships with annual data are similar to those of the USA in Bjornland and Leitemo (2009), however the magnitudes are substantially different. The effect of a monetary policy shock is greater in the US; while the effect of a stock price shock is smaller in the US than in our Caribbean We argue that this reflects clear differences between the USA and Caribbean economies. Caribbean countries have slower information channels for example by targeting the thirty day certificate of deposit (COD) rate instead of the overnight Treasury bill rate as in the US. This supports our results that only with annual data we find similar relationships as in the US with monthly data. Moreover, the higher economic instability in the Caribbean is clearly observed in the larger effect that a stock price increase has on interest rates versus the USA.

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1 Introduction

The Global Financial Crisis has encouraged various researches on the interdependence between monetary policy and assets prices worldwide. The damage to the world economy caused by the unexpected increase in asset prices beyond their true values, spiralled out of control, partly due to insufficient monitoring of asset price movements in developed and developing countries. There was a general increase in global asset prices including stock prices beyond their real values; the Jamaican Stock index increased by 275% between the years 2000 and 2005, the Barbados index increased by about 88% and the T&T stock index increased by 142% during the same period of time, which should have indicated to the market that the price bubble is ominous; see figure 1. These increases in stock prices have an impact on the macro economy via two channels; first through the wealth effect and second through its effect on the level of investment.

Stock prices affect households through the wealth effect. If the value of the stocks owned by a particular household increases this has a direct positive effect on the net worth of the households, so the household will consume more and vice versa. The extent of the wealth effect depends significantly on the proportion of household in the country that own stock. There should be a positive correlation between stock ownership in a country and the effect of stock prices on the household's wealth. The higher the percentage of households that own stock, the greater the effect of stock prices on the household's wealth. For example; Results from Boone, Giorno and Richardson (1998) indicated that a 10% fall in stock prices result in a minimum of 0.45% reduction in consumption in the United States, United Kingdom and Canada after a year. Stock prices influence firm's ability to finance investment projects. Firms with higher stock values are in a better position to receive more equity, see Rigobon and Sack (2001).

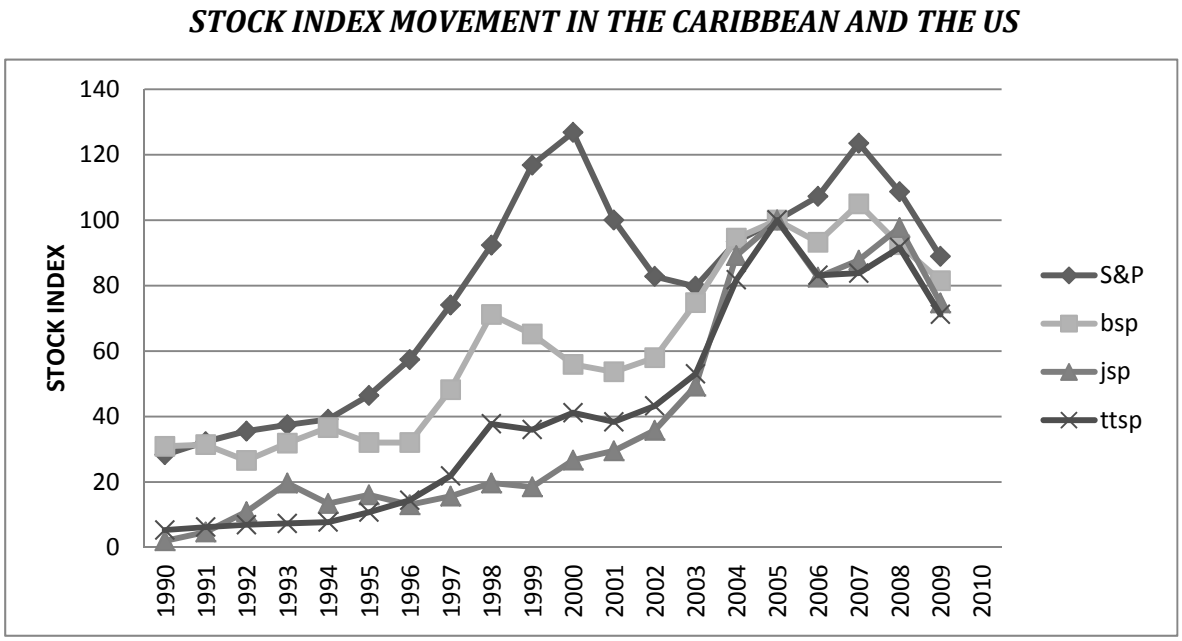


Figure 1: Movement in the annual stock price index for Barbados (bsp), Jamaica (jsp), Trinidad and Tobago (ttsp) and the US (S&P)

Similarly, there are two avenues through which monetary policy may transfer to stock prices in any economy. The first of these is through interest rates which has direct effect on the demand for loans. High interest rates mean high cost of borrowing so firms invest less. If firms cannot invest it means that the present value of their future cash flows will also decline and this has a direct negative impact on firms' stock prices. The second avenue is through availability of credit. If government uses tight monetary policy then there is less credit available and economic activity slows down. A fall in the money supply relative to money demand will lead to a fall in interest rates which inevitably will result in an increase in stock prices. In theory, increase in money demand means that economic agents will sell assets to satisfy their liquidity needs, the sale of assets means a fall in asset prices which is associated with an increase in interest rates. The central bank however, would want to increase interest rates to offset any increases in stock prices. Therefore, any model used to estimate the relationship between stock prices and interest rates would have to accommodate any simultaneity which may exist between both variables. If

this is not accounted for, the results of any model that seeks to estimate the level of interaction between the two variables may be biased.

There are different methods to solve this problem arising from simultaneity. Rigoban and Sack (2001) for example, use a technique based on the heteroskedasticity of stock price shock to identify their model. Their results show that a 5% increase in the S&P five hundred is associated with an increase in the Treasury bill rate of at least 25 basis points in the US. They claim the Federal Reserve steadily responds to increase in stock prices only to the level of its impact on the macro economy. Bjornland and Leitemo (2009) suggest a Structural VAR model instead; their results indicate great interdependence between stock prices and interest rate setting in the United States. It is this methodology that we will employ here.

These analyses are concentrated on the US, there is no research on the interaction between monetary policy and stock prices in developing countries which are also victims of financial crisis in recent years. Figure 1 shows that the movement of the stock indices in the US is similar to the movement of stock prices in Barbados, Jamaica, and Trinidad and Tobago. In all four countries, stock prices increased steadily up to 2007 and started fall after the credit crunch in 2008. However, figure 2 shows that the level of interest rates is different in all four countries. This paper seeks to explore if the same interdependence exist between the stock price and monetary policy in these three countries from the Caribbean as it is in the US. More specifically, we investigate the interaction between monetary policy and stock prices in Jamaica, Barbados, Trinidad and Tobago (T&T) and the Caribbean as a whole, using structural VARs and compare this to the level of interaction in the US.

ANNUAL TREASURY BILL RATES IN THE CARIBBEAN & THE US

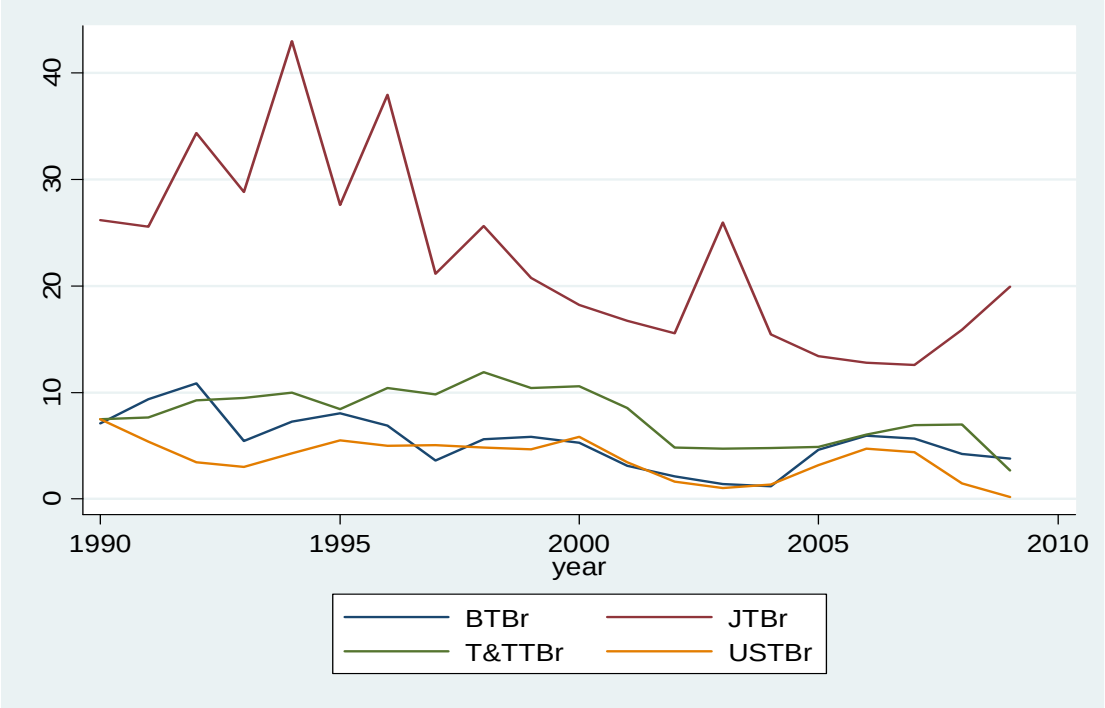


Figure 2: M*ovement in the annual Treasury bill rate for Barbados (BTBr), Jamaica (JTBr), Trinidad and Tobago (T&TTBr)and the USA (USTBr)*

Figure 2 shows that the annual Treasury bill rate is higher on average in the Caribbean countries than the US. These higher interest rates compensate for high macro economic instability in these economies. The situation is very different in the US and the UK and other developed countries that are low interest rate regimes given their economies are relatively more stable. The difference in the type of interest rate regimes in between the Caribbean and the US may affect the level of interaction between interest rates and stock prices comparatively.

Additionally, the information channels in the Caribbean are slower; the Bank of Jamaica for example, targets the thirty day Treasury bill rate instead of the overnight Treasury bill rate targeted by US and England. These Caribbean countries do not practice intraday interest rate monitoring, so the 180day Certificate of Deposit (COD) rate is the signal rate for monetary

policy, which has little or no influence on the private overnight money market rate. Monetary policy largely focuses on price and exchange rate stability which is heavily influenced by the behaviour of the overseas markets. It is easier for developed countries to effectively administer monetary policy because they are less influenced by external economies and other currencies (exchange rate). The differences in monetary policy and the information channels between developed and developing countries may result in different levels of interaction between monetary policy and asset prices between the two. Therefore, this research is further justified because the transmission channels in developing countries are slower and less effective than developed countries due to inferior technology and more asymmetries in the former. Research on the subject in developing countries is therefore necessary since the transmission channels are slower due to greater asymmetric information.

The remainder of the paper is organised as follows, section two gives an extensive literature review of previous research done on monetary policy and asset prices mainly in developed countries. Section three outlines the structural VAR employed in this research, section 4 summarize the data, data sources, and the results for the different VARs analysed for each individual country and all three countries collectively. Section 5 concludes and Appendices 1, 2 and 3 collect the figures and tables.

2 Literature Review

A wide variety of theoretical and empirical models have been employed to analyse the relationship between monetary policy and stock prices in developed countries. These have provided some evidence to justify that monetary policy can impact stock prices and vice versa. Theoretically, Bordo and Jeanne (2002) assess the relationship between monetary policy and asset price. They analyse the importance of proactive monetary policy in a situation where a bust in asset price bubble will result in a decline in output growth or even negative output growth.

Stylised facts from developed countries reveal that boom – bust scenarios are more customary in housing prices than stock prices. Historically there has been 24 booms in stock prices in developed countries and from this only 4 has resulted in a bust; Finland (1989), Italy (1982) Japan (1990) and Spain(1980).[1] They analyse proactive monetary policy in a model with collateral constraints in the productive sector. The findings reveal that the optimal policy depends on the nature of the specific economy in a non linear manner.

The optimal policy rule basically depends on a trade off between short term economic targets and long term economic depression. If monetary authorities believe that negative effects of the financial crisis will be greater than the negative effects of current short term neglect to economic targets then it is better to implement the correct policy to handle the economic crisis and focus less on short term targets. However, if neglecting the short term goals will result in greater harm to the economy then the government should focus its short term objectives. Bordo and Jeanne (2002) provide alternative policy strategies depending on the natural relevance and importance of the crisis. Their policy recommendations should be considered as suggestions because they do not give an estimate of the magnitude of the economic losses under alternative policy strategies.

Others, like Gilchrist and Leahy (2002) evaluate the appropriate policy response with two types of shocks that may affect the way asset prices impact the economy. The first of these shocks is those that affect the economy through expectations of future growth. The second are those that affect net worth; the ability of firms to borrow and the ability of consumers to lend. They perform two separate experiments to analyse the effect of these shocks on the effectiveness of monetary policy of influence asset prices. The results indicate that there is no rationale to consider asset prices when determining optimal monetary policy. This result is not realistic considering the fact that stock market is a transmission mechanism for monetary policy in any economy.

[1] Eichengreen and Bordo (2002)

Empirically, many economists have examined the issue to fully ascertain the level of interaction between the two variables. Thorberke (1997) examines how the federal monetary policy shocks affect stock prices in the US. He employed Vector Auto- regressive (VAR) system with impulse response and variance decomposition to analyse the causality between the federal funds rate, monthly stock returns, federal funds rate and growth in output. Thorberke (1997) use monthly data which is sufficient for the empirical analysis. The Freidman Schwartz (1963) index is employed as the means to identify monetary policy shocks. His results show that monetary policy shocks only account for a small proportion of stock price changes, as stock prices respond with significant delays. His analysis along with those of Lee (1992) and Patelis (1997) are constrained by the ordering of the variables in the VAR. Interest rates is ordered before stock prices in the VAR which means that stock prices react instantaneously to monetary policy shocks but monetary policy react with a delay to stock price movements due to the recursive nature of the Cholesky decomposition used. This procedure eliminates any simultaneous interaction between the variables which is important for policy recommendations.

Mann, Atra and Dowen (2004) also address the issue empirically, they analyse the short term sensitivity of six international stock indices (the Standard and Poor 500 (S&P 500), the Morgan Stanley Capital international (MSCI) European stock index, the MSCI pacific stock index, and three MSCI country stock indices: Germany Japan and the United Kingdom) to changes in the US discount rate and the federal funds rate from 1970 to 2001. The distinguish the federal fund rate under three different categories; average federal fund rate, changes in the federal fund rate and the spread of the federal fund rate to a 10 year treasury note yield. The finding reveal that not all monetary policy in all monetary operating periods stimulates stock returns. They advise that it is not effective to use monetary policy to forecast or predict returns on stocks in the US or internationally. Their results may be biased since it only examines unidirectional causality from monetary policy to stock prices but not vice versa. This shows again

that there is more work to be done on the issue given that the theory hypothesises that monetary policy can indeed impact stock prices and stock prices can impact monetary policy.

Cassola and Morana (2004) investigate the role of the stock market in the transmission mechanism of monetary policy in the Euro area. They used a cointegrated Vector Auto Regressive (VAR) to analyse the interdependence between real GDP, inflation, real M3, short term interest rates, bond yield and real stock prices. The Augmented Dickey fuller test for unit root is employed and all the variables were integrated I(1) processes. The error variance composition was also forecasted and the impulse response functions to analyse the different shocks among variables using 2 lags as the maximum order for the VAR. The results from the paper suggest that the interest rate and the asset price channels are significant to the transmission of monetary policy in the Euro area. There is no evidence to support any direct significant impact of stock prices on inflation. The research however identifies that permanent productivity shocks contribute significantly to the cyclical behaviour of stock prices and monetary policy can contribute to stock market price stability in the long run. This is good because it highlights the importance of monetary policy to stability in asset prices in the long run, however in this research, we will focus mainly on short run interactions between variables.

Rigobon and Sack (2004) did not use the VAR approach, instead, the use a simultaneous equation identification technique based on the heteroskedasticity of stock market returns to analyse the causality between monetary policy and stock prices in the United States. The dynamic interaction between stock returns, interest rate is analysed using a Vector error correction model. The research employ daily data on three month Treasury bill rate and daily return on the S&P 500 index and data on interest rate shocks and stock returns shocks from March 1985 to December 1999. Interest shocks, stock return shocks and other macro economics shocks are measured by monthly movements in macro economic variables including core consumption price index (CPI), the national Association of Purchasing manager survey (NAPM), nonfarm payrolls (NFPAY), the core producer price index (PPI) and retail sales (RETL). The results

indicate that monetary policy responds significantly to stock market movements with a 5% increase (decrease) in the S&P 500 index increasing the probability of a tightening (easing) by approximately a half.

Ioannidis and Kontonikas (2007) analyse the effect of monetary policy on stock returns in 13 OECD countries for the period 1972 – 2002. They use monthly stock price data, nominal stock returns and interest rate data for the G7 countries (United States, United Kingdom, Japan, Germany, Italy France and Canada) and six other European countries (Belgium, Finland, Netherlands, Spain, Sweden and Switzerland). The analysis does not employ the usual money supply variables M1, M2 or M3 instead they use short term treasury bill rate and dummy variables to capture changes in the central banks' discount rate. The research also accounts for the non normal distribution of the stock market returns and also any correlations between international stock markets. The findings of the research indicate that contractionary monetary policy is coupled with reduction in stock returns for more than 80% of the countries investigated. Ioannidis and Kontonikas (2007) believe that these findings can be directly linked to the present value model where increases in interest rates results in lower stock prices through higher discount rates and lower cash flows. The key element of the research is that monetary policy can have an impact on stock market whether directly or indirectly in developed economies. This investigation along with many others only investigate the issue of monetary policy transmission through the stock market in major developed economies and neglect any analysis of the economies of developing countries. To assume that the said holds for the latter cannot be conclusive without the necessary research, because the level of asymmetric information is higher in developing countries which may reduce the ability of the stock market to transfer information and reduce the efficiency of this transition mechanism.

Basistha and Kurov (2008) examine the cyclical variation in the effect of the federal policy on stock prices. They do the same as Kuttner (2001) Bernanke and Kuttner (2005) and use changes in the implied rate of the current rate fed funds futures on the day of the of the fed

policy decision. They use an event study approach employing data from 1990 to 2004 that includes 130 announcements made by the Federal Open Market Committee (FOMC) regarding the federal target rate. They used Ordinary least Squares to analyse the effect of interest rates on stock returns. Given the presence of outliers, weighted least squares was also used to maintain robustness. The findings imply that the effect of unanticipated changes in the federal fund rate on stock prices depends heavily on the state of the business cycle and on the availability of credit. The response of stock to monetary policy is twice as large in a recession than in regular periods. Also firms who face financial difficulty are keener to respond to monetary policy than firms who are financially unconstrained when there is a financial crisis. The results indicate that several of the federal rate reductions were not anticipated by the market which resulted in large increases stock prices.

Farka (2009) estimates the effect of monetary policy shocks on stock prices taking into account endogeneity and omitted variable biases and potential asymmetries. They use a GARCH model with high frequency data set comprising of daily changes in the S&P 500 and the spot month federal futures to account for problems that may arise due to endogeneity and omitted variables. The results show that it is necessary to account for these shocks because it reduces the effect of policy shocks on the level and volatility of stock returns. The results also indicate the level of volatility of stock returns respond asymmetrically to the type of policy shock and also the type of policy action. Farka (2009) fail to capture the interdependence between the variables given that it only estimate the effects of monetary policy on stock prices and it does not address the effect of stock market shocks on monetary policy which is important for policy recommendations.

Bjornland and Leitemo (2009) analyse the interdependence between monetary policy and stock prices in the US in a structural Vector Auto-regression (VAR) system. The VAR is analysed empirically using monthly data from January 1983 to December 2002 on stock prices from the Standard and Poor (S&P) 500, the annual change in the log of consumer price index,

the annual change in the log of the commodity price index in the US, the log of the detrended industrial production Index and the federal funds rate. The model improves on previous VAR's as it is designed to better accommodate the interaction between monetary policy shocks and stock prices, and stock price shock and monetary policy by imposing restrictions such that stock prices and monetary policy can respond contemporaneously to each other. They put the federal funds rate and stock prices last in the sequence of variables in the VAR so they can absorb all the shocks from the other variables. The model uses traditional Cholesky decomposition but imposes a combination of short run and long run restrictions to maintain the qualitative properties of monetary policy shocks required to solve the identification problem arising from simultaneity (see section 3 below for more details). The results show great interdependence between interest rates and real stock prices in the US. A monetary policy shock that increases the federal funds rate by 100 basis points induces real stock prices to fall by five to seven percent. While a stock price shock increasing stock prices results in an increase in federal funds rate by approximately 4 basis points. This suggests there is dual causality between both variables in the US.

The question remains; what is the level of interaction between monetary policy and stock prices in the Caribbean given the results observed in developed countries? This paper answers this question using similar methodology to that used Bjornland and Leitemo (2009) due its advantages over the other VAR's. It will also allow us to analyse the dual contemporaneous interaction between monetary policy and stock prices which is not possible using other techniques.

3 The structural VAR model

A structural VAR model is employed for each country in the study to understand the interdependence between monetary policy and stock prices. First, monthly data is used for

Barbados. Secondly, we use annual data on the same variables except we replace Industrial Production Index (IPI)[2] with real GDP for Jamaica and Trinidad and Tobago.

Let A_t be the vector of macroeconomic variables with the following order[3] similar to Bjornland and Leitemo (2009)

$$A_t = \left[y_t , \pi_t , \Delta s_t , r_t \right]' ,$$

where y_t is log of the detrended industrial production index (IPI), π_t is changes in the log of consumer price index (CPI), Δs_t is changes in the log of the stock index for the specific country deflated by the CPI and r_t the central bank's Treasury bill rate. Assuming the VAR is stable it can be inverted and rewritten in the following moving average (MA) formation

$$A_t = B(L)u_t , \qquad (1)$$

where u_t is a (4×1) vector of reduced form errors, and

$B(L) = \sum_{j=0}^{\infty} B_j L^j = I + b_1 L + b_2 L^2 + b_3 L^3 + \ldots + b_\infty L^\infty$ is a convergent matrix polynomial in the lag operator L. The vector of reduce form residuals u_t, can be written as a linear combination of the innovations e_t, which is identically independently distributed with mean zero and positive definite covariance matrix Ψ, such that $u_t = Qe_t$, where $e_t = \left[e_t^y , e_t^\pi , e_t^s , e_t^r \right]'$ is the vector of uncorrelated shocks; e_t^s is the stock price shock e_t^r is the monetary policy shock, e_t^y output shock and e_t^π is the shock from inflation and Q is a lower diagonal (4×4) contemporaneous matrix. Substituting for u_t in equation (1) expresses it in terms of structural shocks as follows:

[2] Real GDP is used instead of the IPI as a measure of real output because IPI was not available for Jamaica and Trinidad and Tobago

[3] The ordering of the variables is important due to the effect of the Cholesky decomposition; macroeconomic variables are placed before policy variables in the VAR.

$$A_t = C(L)e_t, \qquad (2)$$

where $C(L) = B(L)Q$. Q can be identified if it is assumed that e_t is normalised with variance 1. The model assumes that output and inflation respond with a lag to monetary policy and stock price shock[4] while stock prices and monetary policy can respond contemporaneously to each other. Given this assumption, we can identify the monetary policy shock by putting output and inflation before interest rates and stock prices in the VAR and impose two zero restrictions on the relevant coefficients in the third and fourth columns of the Q matrix below

$$\begin{bmatrix} y_t \\ \pi_t \\ \Delta s_t \\ r_t \end{bmatrix} = B(L) \begin{bmatrix} Q_{11} & 0 & 0 & 0 \\ Q_{21} & Q_{22} & 0 & 0 \\ Q_{31} & Q_{32} & Q_{33} & Q_{34} \\ Q_{41} & Q_{42} & Q_{43} & Q_{44} \end{bmatrix} \begin{bmatrix} e_t^y \\ e_t^\pi \\ e_t^s \\ e_t^r \end{bmatrix} \quad . \qquad (3)$$

This allow output (y_t) and inflation (c_t) to respond with a lag to shocks to stock prices and monetary policy, while monetary policy and stock prices can respond immediately to a monetary policy shock and a stock price shock, i.e. $Q_{34} \neq 0$, allowing for any contemporaneous interaction between the two variables. This is different from other structural VAR literature where it is assumed that $Q_{34} = 0$, such that stock prices respond with a lag to monetary policy or the other way around depending on which variable precedes the other in the VAR. Given our assumption, we need an additional restriction to identify the model. We follow Bjornland and Leitemo (2009) by imposing the restriction that monetary policy has no effect on real stock prices in the long run. We apply this restriction by setting an infinite number of lag coefficients in equation (2).

[4] There is no evidence to suggest that these variables respond simultaneously to a stock price or monetary policy shock.

Such that in the long run $\sum_{j=0}^{\infty} B_j Q = \sum_{j=0}^{\infty} C_j$, this facilitates the additional restriction that $\sum_{j=0}^{\infty} C_{34,j} = 0$. More specifically the equation

$$B_{31}(1)Q_{14} + B_{32}(1)Q_{24} + B_{33}(1)Q_{34} + B_{34}(1)Q_{44} = 0 \ . \quad (4)$$

Considering that $Q_{14} = Q_{24} = 0,$ then equation (4) becomes

$$B_{33}(1)Q_{34} + B_{34}(1)Q_{44} = 0 \quad . \quad (5)$$

With this restriction the system is now identified, standard Cholesky decomposition can be applied. The parameters for the monetary policy and the stock price equation systems from equation (3) are identified given the long run restriction that $\sum_{j=1}^{\infty} C_{34} = 0$, i.e., we assume that output and inflation do not respond immediately to the stock price shock and the monetary policy shock, while allowing for immediate interaction between monetary policy and stock prices. Following the Generalization of Christiano et al (1999), we show in appendix 2 that the ordering of the first two variables (output and inflation) does not affect the interaction between monetary policy and stock prices in the Structural VAR. the next section give the data, data sources and analyse the interaction between stock prices and monetary policy in the Caribbean compared to the US.

4 Data and Results

4.1 Data

The model is estimated using monthly data for Barbados from March 1990 (1990M3) to December 2009 (2009M12). The sample size is chosen according to the availability constraints that we have. The same is done for Barbados, Jamaica and Trinidad and Tobago using annual[5] data[6] from 1990 to 2009. Table 1 presents some summary statistics for each of the time series. We also aggregate the annual data for each variable for all three counties to estimate VARs for all three countries together; we refer to this group as the Caribbean. Even though interest rates in the Caribbean are high given the nature of the economies; using aggregated interest will not disrupt the validity of the results. The IMF's International Financial Statistics (IFS) provide the monthly data on the Industrial production Index (IPI), the Treasury bill rate and the Consumer price index for Barbados. The IMF's IFS also provide the annual data on the real GDP index, annual the Treasury bill rate and the consumer price index (CPI) for all three countries. While data on the stock market index for each country is provided by their respective stock exchange; data on the Barbados' stock index is provided by the Barbados stock market, data on Jamaican stock index is provided by the Jamaican stock exchange and data on Trinidad and Tobago stock index is provided by the Trinidad and Tobago stock exchange. The Augmented Dickey Fuller (ADF) (1979) and the Phillips Perron (PP) (1988) unit root tests are used to ensure that the variables are stationary, which is a necessary condition to guarantee that the MA representation of the VAR model converges. The null hypothesis of a unit root for Barbados' monthly CPI, detrended IPI, stock prices and Treasury bill rate could not be rejected. These variables are all stationary after first differencing. Stock prices and CPI displayed clear linear time trends which are accounted for in the unit root tests. Lag selection is done using the regular criterion[7]. All

[5] Annual data is employed because there is no monthly data available to measure output in Jamaica and Trinidad and Tobago.
[6] DATA collected from the International Monetary Fund IMF (IFS) and the Stock exchange from each country
[7] Choose a reasonable lag and drop one lag at a time until it remains significant

variables are assessed at the 5% level of significance for both unit root tests. The variables also show no sign of autocorrelation or heteroskedasticity in the residuals. The annual data for all four variables for Barbados are also nonstationary in their levels. Once again CPI and Stock prices display linear time trends, thus accounted for in the unit root test. All variables are stationary after first differencing except detrended output is stationary after differencing twice.

For Jamaica, CPI and detrended output are also stationary after second differencing, however, Treasury bill rate and stock prices only had to be differenced once to become stationary. All variables (CPI, output and stock prices) except Treasury bill rates for both Jamaica and Trinidad displayed linear time trends which are accounted for in the unit root tests. For Trinidad and Tobago, CPI and stock prices had to be difference twice to become stationary, while Treasury bill rate and output are stationary after first differencing. For the Caribbean as a whole, output, CPI and stock prices all displayed linear time trends and are non stationary in their levels, this is expected given that they are summations of the variables from all three individual countries. For the Caribbean as whole, the aggregated Treasury bill rate is stationary after first differencing while, output, CPI and stock prices are stationary after differencing twice. The post estimation diagnostic test indicates no autocorrelation or heteroskedasticity for Jamaica, Trinidad and Tobago annual data and the Caribbean as a whole.

4.2 Empirical Results

This section gives the details of the results from the impulse response functions using Cholesky decomposition for the Treasury bill rate, the real stock prices, inflation, and detrended output to a stock price shock and a monetary policy shock. Tables 2-4 provide the impulse response estimates (in Appendix 3) and Figures 3-5 (Appendix 1) the corresponding figures. Section 4.2.1 gives the results using both monthly data and annual data for Barbados. Section 4.2.2 gives the results for Jamaica using only annual data. Section 4.2.3 gives the results for Trinidad and Tobago using only annual data as well, section 4.2.4 gives the results for the Caribbean as a

whole which is a summation of the variables from all three countries again using annual data and section 4.2.5 explain the reason why our results for the Caribbean may be different from the results for the US found in the current literature.

4.2.1 Barbados

4.2.1.1 Monthly data

The results for Barbados monthly are shown in figure 6 (see appendix 2); a monetary policy shock that increases the Treasury bill rate by 100 basis points causes stock prices to increase initially by 0.038% in the first month, decrease by 0.5 percent in the second month and increase again in the third months as the effect gradually disappears. The theory postulates that an increase in the Treasury bill rate will result in an increase in the discount rate of stocks such that, the net present value of the stock must fall in the short run. This is supported by evidence from the US, see Bjornland and Leitemo, (2009) and Rigobon and Sack, (2004); a positive monetary policy shock causes stock prices to fall in the short run and increase in the long run in the USA. The short run effect of a monetary policy shock on stock prices is different in Barbados; however, the long run effect is similar (see section 4.2.1.2). The results for Barbados may be due to the fact that the stock market is smaller and less proportion of households own stocks. The information channels are also slower which may weaken the effect of monetary policy. Nevertheless, the convergence of the impulse response function to its true mean is quicker; real stock prices decline for about two months then it increase and maintains its average after about 5 months as the effect of a monetary policy shock disappears.

A shock to monetary policy in Barbados results in decline of approximately 25 basis points in the Treasury bill rate which dies out over the first 6 months. This result is contrary to that found in Bjornland and Leitemo (2009) where there is a temporary increase in federal funds rate in response to a monetary policy shock, although the general impulse response for the USA and Barbados look parallel to each other; Bjornland and Leitemo (2009) showed that after the

initial increase in the first two months, the USA federal funds rate decline significantly in response to a monetary policy shock and converged within 2 years. For Barbados the convergence pattern is less than a quarter of the time. Output decreased by approximately 0.003 percent as a result of a positive monetary policy shock, this is consistent with theory, less investment is expected given an increase in the Treasury bill rate. There is no presence of a 'price puzzle'; inflation falls immediately in response to a positive monetary policy shock, although it increases after the second month as the effect disappears by the end of the fourth month.

The lower half of figure 6 shows the effects of a stock price shock; a positive stock price shock that increase stock prices by one percent, leads to an increase in Treasury bill rate of 30 basis points after the first two months and a further 14 basis points after the first 4 months. This is similar to results for the USA found in Bjornland and Leitemo (2009) where stock price shock causes the interest rates to increase by just less than four basis points initially and to seven basis points after a year. This result is also consistent with other research done on the US by Rigobon and Sack (2004). A stock price shock reduces output and inflation initially in the first month, after which, they both increase to their mean values by the fourth period. This result is different from the results found in Bjornland and Leitemo (2009) where a positive shock to stock prices result in an increase in output and inflation immediately in the short run arguably due to the wealth effect. It appears that the true effect of stock price shock is slower to register in Barbados than in the US. The initial decline in output and inflation may be due to the increase in interest rates which cause a reduction in investment spending; however, as the effect of the increase stock prices registers in the second month, output and inflation increases in Barbados due to the wealth effect. It appears that the effects of a stock price shock takes a longer time to register in Barbados than the US due to inferior information channels. A shock to stock prices has no significant effect on the other variables in the long run in Barbados using monthly data, because the percentage of households that own stocks is small compared to the US.

4.2.1.2 Annual data

Annual data is used to reconcile our results, in an effort to fully understand the effects of a monetary policy shock and a stock price shock in Barbados. The results are given in figure 7 (Appendix 2). A monetary policy shock that increases the Treasury bill rate by 100 basis points causes a 0.06 percent decline in real stock prices in the short run, but increases after the first year in the long run. This result is more consistent with the results from US. The magnitude is also greater than the results from using monthly data, but is still less than the effect in the USA; where a monetary policy shock decrease stock prices by five to seven percent immediately in the short run but increases it over time in the long run (see Bjornland and Leitemo, 2009). Barbados has a very small stock exchange relative to the USA, so the effect of a stock price shock is expected to be smaller. Of more importance is the negative relationship between the two, which coincides with the theory; an increase in interest rates is expected to reduce the present value of the stock due a fall in the value of dividends expected in the future. After the initial decrease, real stock prices increase after the second period as it gradually reverts to its mean by the end of fourth year. This result is also similar to the results for the US found in Bjornland and Leitemo (2009), where real stock prices gradually revert to its mean after 12 months.

A monetary policy shock reduces interest rates in the first year, after which it gradually reverts to its mean within the next four year. The minor difference between this and the results for the US found in Bjornland and Leitemo (2009) is that a monetary policy shock in the US increases interest rates initially in the first 5 months, after which it starts to decline. Monetary policy shock that increases interest rates by 100 basis points induces a 0.008 percent increase in inflation. This increase is a popular price puzzle which may arise as a result of the cost channel of interest rates (see Bjornland and Leitemo, 2009; Ravenna and Walsh, 2006).

Output increases by 0.006 percent after the first year in response to a positive monetary policy shock. This may seem odd at first glance as it goes against the normal theory that a

positive monetary policy shock should cause output to fall. However, after close examination, the results from Bjornland and Leitemo (2009) indicate that output declines initially and reaches its minimum after a year and six months, after which it starts to increase as well. Recall our results for monthly data indicates that a monetary policy shock causes an initial decrease in output during the first three months after which the effect dies out and output starts to increase. By using annual data we are able to capture this initial decrease that would have occurred over the first couple months. The frequency of the annual data does not allow us to monitor the shock on a monthly basis, the effect over 12 month intervals can be analysed. Therefore, the increase in output after a year, due to a monetary policy shock is consistent with the results of Bjornland and Leitemo (2009) as well. Kuzluk and Merotra (2008) also find a positive relationship between monetary policy shock and output in the Philippines using quarterly data.

A positive stock price shock that increases real stock prices by 1 percent cause output to increase by 0.033 percent in the first year; which is realistic and goes in accordance with the wealth effect. As is already mentioned, the information channels in developing countries are slower so the agents take a longer time to respond to changes in fundamental variables. Inflation responds insignificant to begin with, decreasing by only 0.0004 percent after the first year, and then it slowly increases in the second year as the effect of stock price shock disappears by year 6. A stock price shock also has a negative effect on real stock prices using annual data as well for Barbados; a positive stock prices shock reduces real stock prices by 0.25% in the first two years, with a further decline of about 0.1 percent in the third period.

Treasury bill rates, on the other hand, respond positively to a shock to real stock prices. A stock price shock that increase real stock prices by 1 percent, cause interest rates to increase by up to 190 basis points over the first two years. This result is consistent with previous research in terms of the positive nature of the relationship (see again Bjornland and Leitemo, 2009) however the magnitude of the effect is greater in Barbados. This may be due to the smaller size of the economy in Barbados has less filter channels hence a greater effect. It is clear, that there exist

high interdependence between monetary policy and stock prices in Barbados. The next step is to assess Jamaica, Trinidad and Tobago and then the Caribbean as whole to see if the same level of interaction exists.

4.2.2 Jamaica

Figure 8 (Appendix 2) illustrates the impulse response functions to Cholesky decomposition for Jamaica using annual data[8]. The variables response to a monetary policy shock are given in the first four graphs as usual while the effect of the stock price shock given in last four graphs in the lower section. As expected, Output falls by 0.8% in the first year as a result of monetary policy shock in Jamaica. Increases in the Treasury bill rate pushes up the cost of borrowing, resulting in a negative effect on investment expenditure which cause aggregate output to fall. A monetary policy shock that increases the Treasury bill rate by 100 basis points causes inflation to increase slightly by 0.003 percent in the first year. This 'price puzzle' is similar to what happened in Barbados and the USA as well (see Bjornland and Leitemo, 2009). Also similar to the results using Barbados and the existing literature, a monetary policy shock causes stock prices to fall by 0.4 percent in Jamaica in the short run and increases in the long run as it gradually reverts to mean over time. An increase in the interest rates coupled with lower levels of output reduces the expected future value of dividends in Jamaica which automatically cause stock prices to decline. A monetary policy shock temporarily reduces interest rates in Jamaica which is contrary to the existing literature.

The results for the effect of a stock price shock in Jamaica shows that a positive shock to stock prices increasing real stock prices by 1 percent increases output by 0.35% in the first year, again the wealth effect in Jamaica corresponds with the existing theory. The magnitude of the wealth effect is greater than in Barbados but smaller than in the US. This may be due to the fact that the Jamaican stock market is larger than the Barbados stock market both of which are

[8] Data constraints do not allow us to analyse Jamaica on a monthly basis as we did for Barbados.

considerably smaller than the stock market in the USA. A positive stock price shock increases inflation by approximately 0.03 percent. This is the opposite of what happens in Barbados but similar to the results from the US. However, like Barbados and unlike the other existing literature, a stock price shock has negative effect on stock prices initially. A positive stock price shock reduces real stock prices by 0.4% after the first year after which it increases a little, then falls again as the effect fade away by year 5. As usual the Treasury bill rate responds positively to a positive stock price shock; it increases by 400 basis points as a result of a 1% increase in stock prices due to a shock to real stock prices. Barbados and the US both show a positive response in interest rate to a stock price shock but the magnitudes less. It appears that a stock price shock has a greater effect on interest rates in smaller economies. Let us now see what happens in Trinidad and Tobago.

4.2.3 Trinidad and Tobago

The results of the effect of a monetary policy shock and stock price shock for Trinidad and Tobago are given in figure 9 (Appendix 2), as usual monetary policy shock is given in the upper half while the effects of a stock price shock is given in the lower half. A positive Monetary policy shock has negative effect on output, stock prices and the Treasury bill rate in T&T and a positive effect on inflation. A shock to monetary policy decreases the Treasury bill rate immediately by 120 basis points and reduces output by 0.01 percent in the first year. The fall in output is due to a fall in investment spending arising from the increase in interest rates. This result is expected as it similar to Jamaica and the US (see Bjornland and Leitemo, 2009).

Like the USA, Jamaica and Barbados, the usual 'price puzzle' is present in Trinidad and Tobago, a monetary policy shock that increase in the treasury bill rate by 100 basis points instantly increases inflation by 0.007 percent after which it gradually falls as the consequence of contractionary monetary policy takes effect. As it relates to stock prices; a monetary policy shock that increase the Treasury bill rate by 100 basis points causes real stock prices to fall immediately

by 0.01 percent in the short run and increase over time in the long run. This goes in accordance with the results from the existing empirical and theoretical literature; where an increase in interest rates reduced the net present value of the stock due to a fall in the stock dividends expected in the future. However, the magnitude of the effect in T&T is smaller than Jamaica (see section 4.2.2) and also smaller than the results of Bjornland and Leitemo (2009) for the US. This may be due to the smaller stock market and smaller economy in the Caribbean.

A stock price shock has an initial negative effect on output in T&T contrary to the theory on the wealth effect where an increase in stock prices should result in an increase in output because of the increase in the wealth of consumers that own stock. It is however similar to the results found in Barbados using annual data (see section 4.2.1.2). This may be due to the slow information channels that exist in Trinidad and Tobago; economic agents receive the information late so they take longer to react or maybe consumers are more cautious with their earnings. Notwithstanding this, the more important result is its effect on of stock price shock on monetary policy. The Treasury bill rate increase by 330 basis points in the first period in response to a stock price shock that increase real stock prices by 1 percent. This result looks similar to the results for Jamaica and Barbados but is once again extremely larger than the results for the US. A stock price shock in T&T causes inflation to increase by 0.01 percent in the first period; this is similar to the other Caribbean countries which are all relatively smaller to the effects in the US. In spite of this, the general results show that there is good interaction between monetary policy and stock prices in Trinidad and Tobago. Next, the annual data from all three individual countries are aggregated to evaluate the interaction between monetary policy and asset prices in the Caribbean as a whole. The results are given in the section below.

4.2.4 The Caribbean countries

The results for all three Caribbean countries together in total are given in figure 10. The impulse response functions for the Cholesky decomposition for the Caribbean as a whole show that a

monetary policy shock that increases the Treasury bill rate by 100 basis points cause output increase by 0.005 percent after the first year, similar to what has occurred in Barbados using annual data. Once more, this does not coincide with the theory and the results from Jamaica and Trinidad and Tobago, see sections 4.2.2 and 4.2.3, but it is justified since Barbados monthly analysis shows that output fall in the first three months due to an increase in treasury bill rate, which cannot be captured using annual data because the frequency does not permit this. The same situation like Barbados more or likely exists for the Caribbean as whole. Although, research by Kuzluk and Merotra (2008) indicates a positive relationship between monetary policy shock and output in the Philippines, so a result like this has occurred before.

A positive monetary policy shock increases the overall inflation rate in the Caribbean by 1.8 percent initially; the usual 'price puzzle' again exist for the Caribbean as it does for Barbados annual data, Jamaica, Trinidad and Tobago and the existing literature. Inflation however, falls in the second year as the true effect of an increase in the Treasury bill rate take impact. A monetary policy shock that increases the Treasury bill rate by 100 basis points causes stock prices to decrease by 0.027 percent initially and increases overtime as it approaches it mean in the long run. Again this result corresponds to the general theory and the results from each individual country. Similarly, a monetary policy shock for the Caribbean has a negative impact on the aggregate Treasury bill rate as it does for each individual Caribbean country.

A positive stock price shock that increases real stock prices by 1 percent cause output to fall by 0.003. A stock price shock has negative effect on inflation as well. A positive stock price sock that increases real stock prices by 1 percent triggers a 0.3 percent initial decrease in inflation in the first year for the Caribbean as whole, and then it meanders and looses effect by year 6. The fundamental relationship between stock price shock and the Treasury bill rate is maintained in the Caribbean as a whole. A stock price shock that increases real stock prices by 1 percent induces an immediate increase the Treasury bill rate by approximately 700 basis points.

Comparisons of the effects of a monetary policy shock and a stock price shock in all three countries and the Caribbean are given in tables 5 and 6. Fundamentally, the stock market continues to be an important transmission mechanism for monetary policy even though a few minor relationships are unusual and does not coincide with the existing literature. The effect of a shock to monetary policy to the stock market and other variables in the Caribbean is very similar to that of the US and other developed countries apart from a few exceptions, although the effects are smaller in magnitude and slower in effect due to smaller stock markets in the Caribbean and slower information systems as well. The next section will analyse the difference in economic structure of the Caribbean in comparison to the US to justify these differences in results.

4.3 The Caribbean economies compared to the US

The differences in the magnitude of our results in comparison to the US can be attributed to difference in the size of the economies, the economic structure and the fact that the US is a developed economy while the Caribbean economies are just developing. Table 7 provides a comparison of some basic characteristics and economic indicators in Barbados, Jamaica, Trinidad and Tobago and the US. The population of the US is over three hundred million when compared to Barbados just under three hundred thousand, Jamaica just under three million and Trinidad and Tobago approximately one million five hundred thousand citizens. The labour force in the US is over 150 million people while the labour force in the Caribbean countries together is just under 2 million citizens. No wonder GDP per capita in the US is more than two times greater than GDP per capita in Barbados and Trinidad and Tobago and more than four times larger than GDP per capita in Jamaica. There are more stock indices in the US than the Caribbean with by far much more traded volumes; the market value of publicly traded shares in the US is over 19 trillion US dollars while the highest in the Caribbean is Trinidad and Tobago with just over 12 billion US dollars. There is no comparison between the size of the economy

and the size of the stock market in the US and the Caribbean. As a result, monetary policy shock will have a greater impact on the stock markets in the US than in the Caribbean.

The US economy has been much more efficient in terms of how well monetary policy pursues and achieves its desired objectives. The economy is relatively more stable, the exchange rate is relatively less volatile[9] and the information channels from the central bank to investors is much smoother, more rapid and more transparent than in Caribbean countries. The Federal Reserve Bank in the US is able to target the overnight interest rates on a daily basis because they have the facilities in place to practice intraday interest rate monitoring and announcements publicly. Whereas, in the Caribbean, the information channels are less efficient which makes it is difficult for these central banks to target the overnight interest rates. There is no system in place to practice intra-day liquidity management, which is a disadvantage. Monetary policy cannot transmit to the stock market as effectively and as efficiently like in the US because information is not fused into the market mechanism instantaneously.

[9] Even though Barbados has fixed there exchange rate 2:1 with the US, this mean the Barbados Central bank has to implement sterilization policies to maintain this fixed exchange rate, which has an adverse effect on other objective of monetary policy in the country

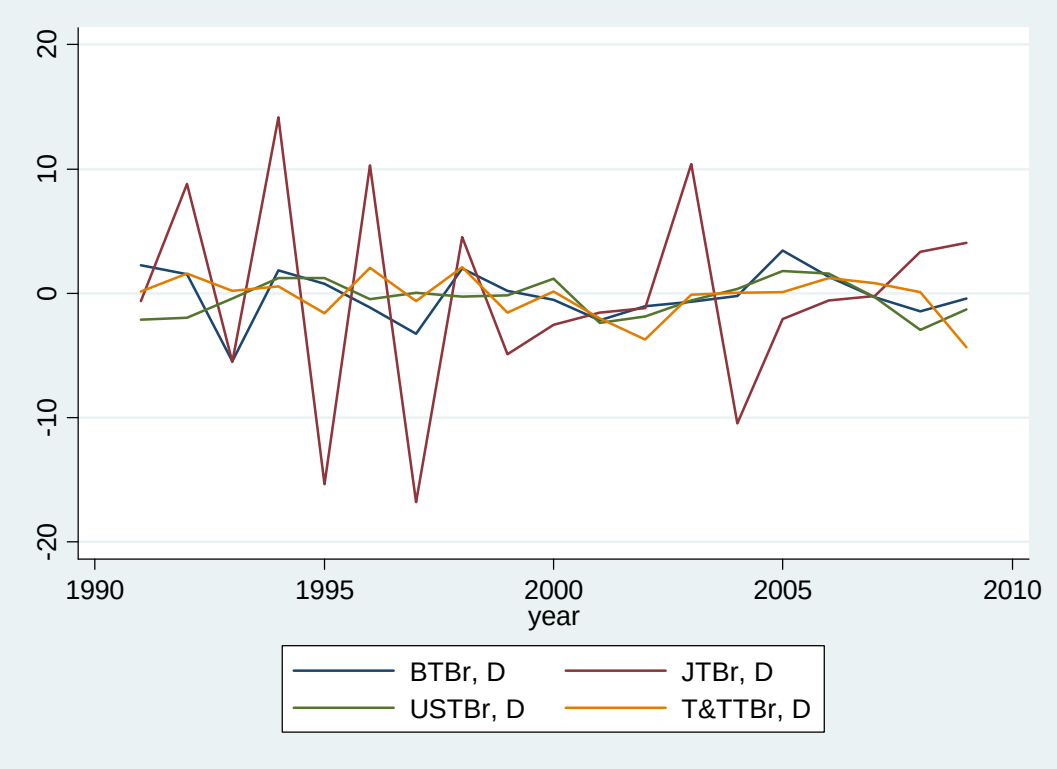


Figure 11: First Difference of the annual Treasury bill rate for Barbados (BT-L), Jamaica (JT-L), Trinidad and Tobago(TT-L) and the USA (US-L)

Figure 11 shows the first difference of the annual Treasury bill rate for Barbados, Jamaica, Trinidad and Tobago and the Caribbean. Changes in the annual Treasury bill rate in the US are smaller and more stable than the Caribbean countries. For Barbados the difference ranges from a low of -544 basis points to a high of 342 basis points over the 19 year period. For Jamaica it ranges from a low of -1681 to high of 1413 basis points. Trinidad and Tobago rang from a low of -432 to a high of 210 basis points. While the US just fluctuates between -295 and 178 basis points.

Table 8 gives the corresponding summary statistics for the first difference Treasury bill rate for all four countries. The standard deviation for the USA is approximately 141 basis points which is relatively small compared to the Caribbean islands. The standard deviation for Barbados is approximately 209 basis points, for Jamaica its 808 basis points and for Trinidad and Tobago its 173 basis points. Statistically, this provides a clearer understanding why interest rates are more

reactive to a stock price shock in the Caribbean in comparison to the US. Observe the standard deviation of the Treasury bill rate itself in all four countries; the US still deviates less in comparison to all the other three countries, see figure 11. Our results are supported by the fact that US interest rates change by less on average compared to the Caribbean where interest rates fluctuate by larger amounts. This is why a stock price shock has such huge impact on monetary policy in the Caribbean when compared to the US.

5 Conclusion

In this paper, structural VARs are used to examine the interaction between monetary policy and the stock market in Jamaica, Barbados and Trinidad and Tobago individually and jointly as the Caribbean countries. Annual data is used for Jamaica, Trinidad and Tobago and the Caribbean, while annual and monthly data is used for Barbados due to data availability constraints. Our results show that a positive monetary policy shock has a negative effect on stock prices in Jamaica, Barbados, Trinidad and Tobago and the Caribbean using annual data. The increase in interest rates decreases the expected future dividends payable on stocks which decreases its present price. This effect is well known in the theory and the literature; the results from Bjornland and Leitemo (2009) also found a negative relationship between monetary policy shock and stock prices in the USA. The increase in Treasury bill rate due to a monetary policy shock causes an immediate increase in prices in all three countries individually and jointly. The usual price puzzle is no surprise as it exists also in the US and other studies (see Bjornland and Leitemo, 2009). Annual output in Jamaica and Trinidad and Tobago decreases due to a contractionary monetary policy; a reduction in the money supply as a result of positive monetary policy shock -which pushes up the Treasury bill rate- causes a fall in investment spending. For Barbados and the Caribbean jointly, annual output increases due to an increase in the interest rates. Although, the Barbados monthly analysis, show that output did in fact decrease in the first

three months immediately after a positive monetary policy shock, which could be captured using annual data frequency.

A stock price shock has a positive effect on the Treasury bill rate in Barbados (using annual and monthly data), Jamaica, Trinidad and Tobago and the Caribbean. The sign of the relationships are consistent with the theory, the existing literature and the results for the USA (see Bjornland and Leitemo, 2009), but the magnitude of the effect of a monetary policy shock on stock prices is smaller than in the US, mainly due to difference in of size of the economies and economic structures. A positive stock price shock instantly increases the output in Jamaica and Barbados using annual data due to the wealth effect. This is delayed by approximately three months in Barbados when monthly data is used, delayed by approximately 4 years in Trinidad and Tobago as an increase in stock prices causes a fall in the output for the first three years; gradually the effect of the increase in consumers' wealth starts to show by year four, in Caribbean as whole, the wealth effect is delayed by a year. The average economic agent takes a longer time to react in the Caribbean due to slower information systems.

Generally, our results for the Caribbean countries individually and jointly, in relation to the signs of the relationships with annual data are similar to those of the USA in Bjornland and Leitemo (2009), however the magnitudes are substantially different. We believe that this is a reflection of the clear differences between the economies in the USA and the Caribbean countries. The information channels in the Caribbean are slower because the Central Banks can only target the thirty day COD rate instead of the overnight Treasury bill rate as in the US. For this reason primarily, our results with annual data find similar relationships as in the US with monthly data. Furthermore, the higher economic instability in the Caribbean is clearly shown in the larger effect of a stock price increase on interest rates in the Caribbean countries versus the US.

Appendix 1 Identification of the model

Impulse response functions show how interest rates and stock prices respond to a monetary policy shock and a stock price shock under alternative ordering of the Cholesky decomposition. Notice that the variables respond relatively the same no matter which order they are in the VAR. The outcome of the Cholesky decomposition is not affected by rearranging the variables.

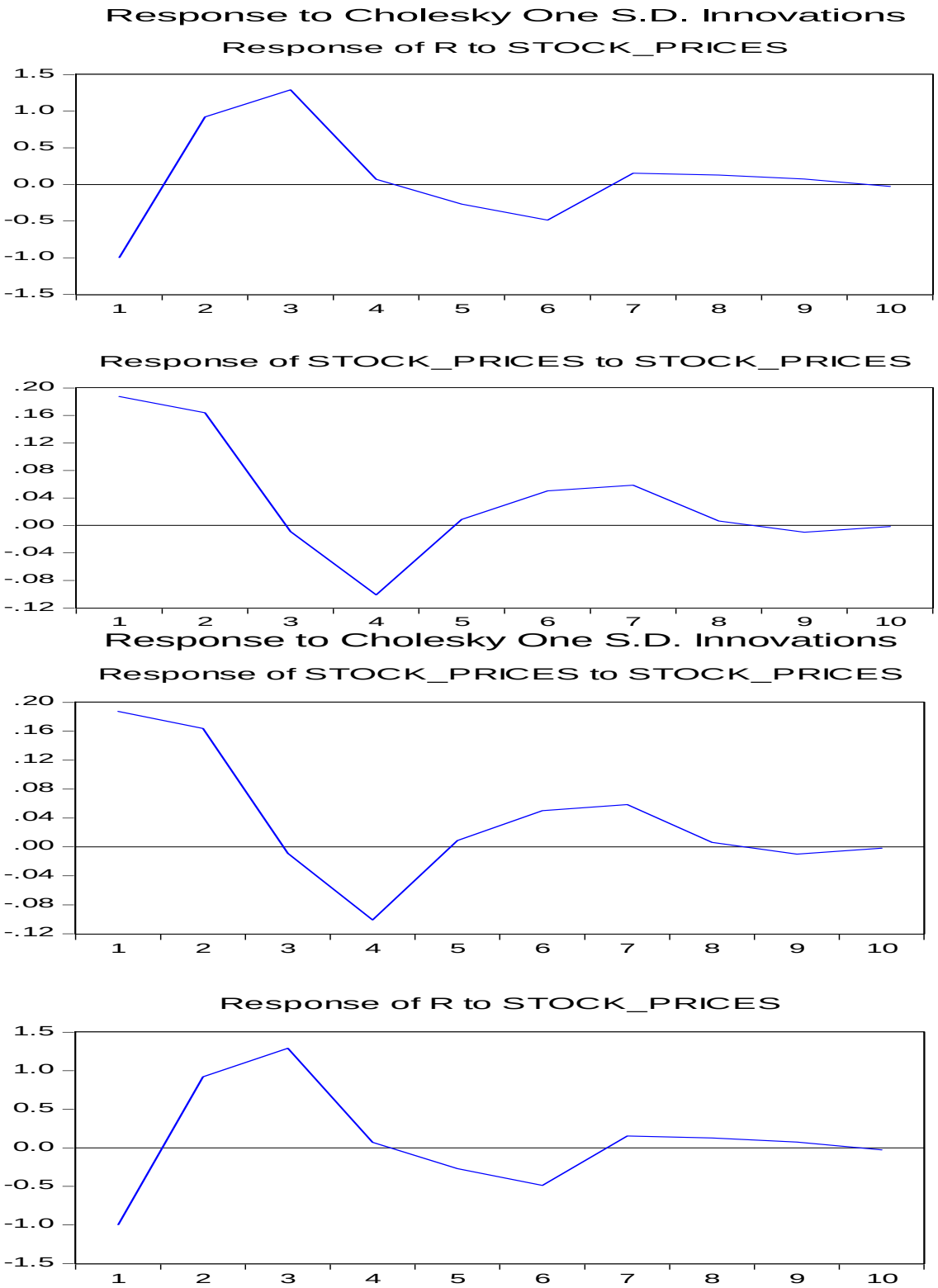


Figure 3: Barbados

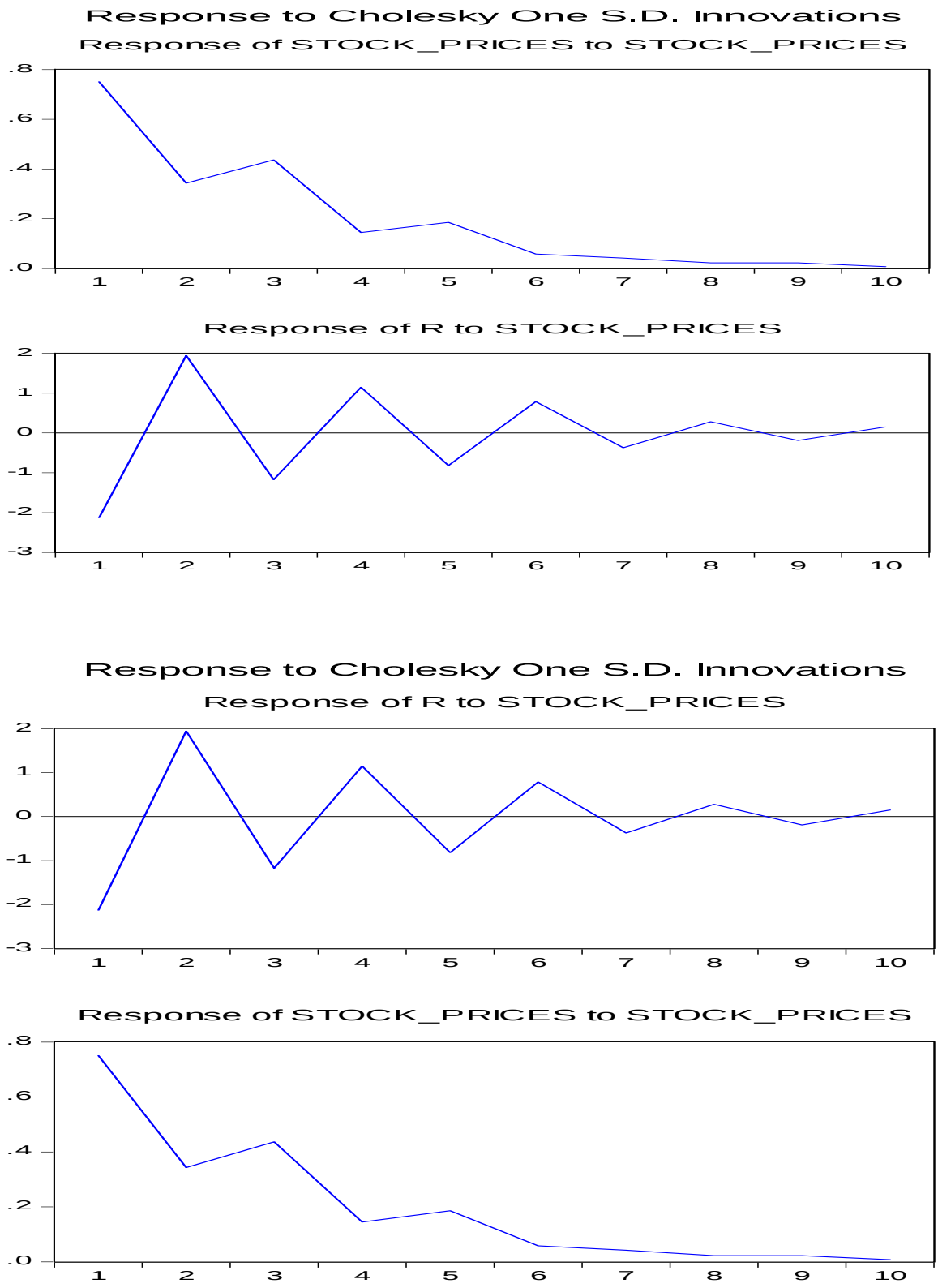


Figure 4: Jamaica

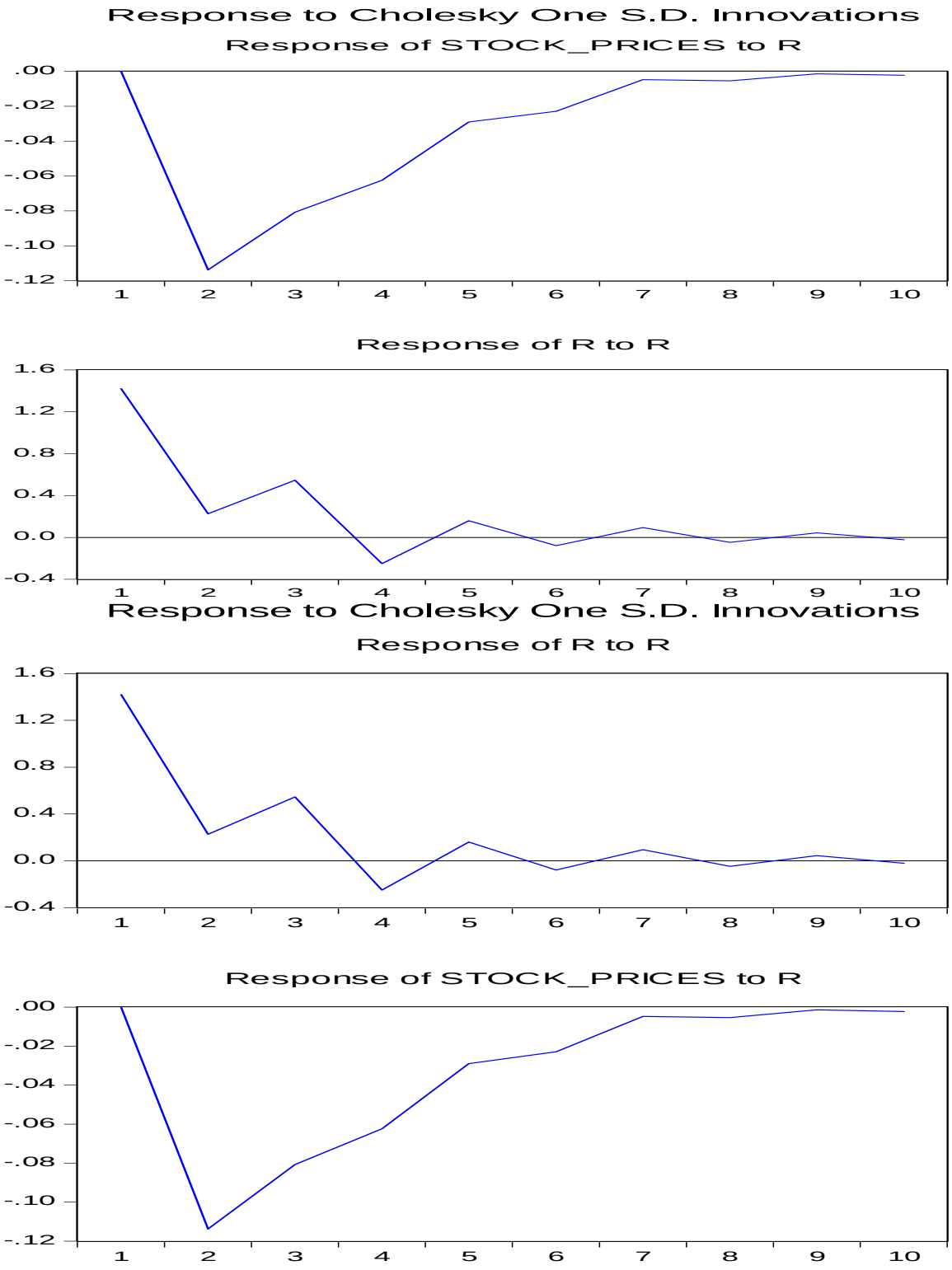
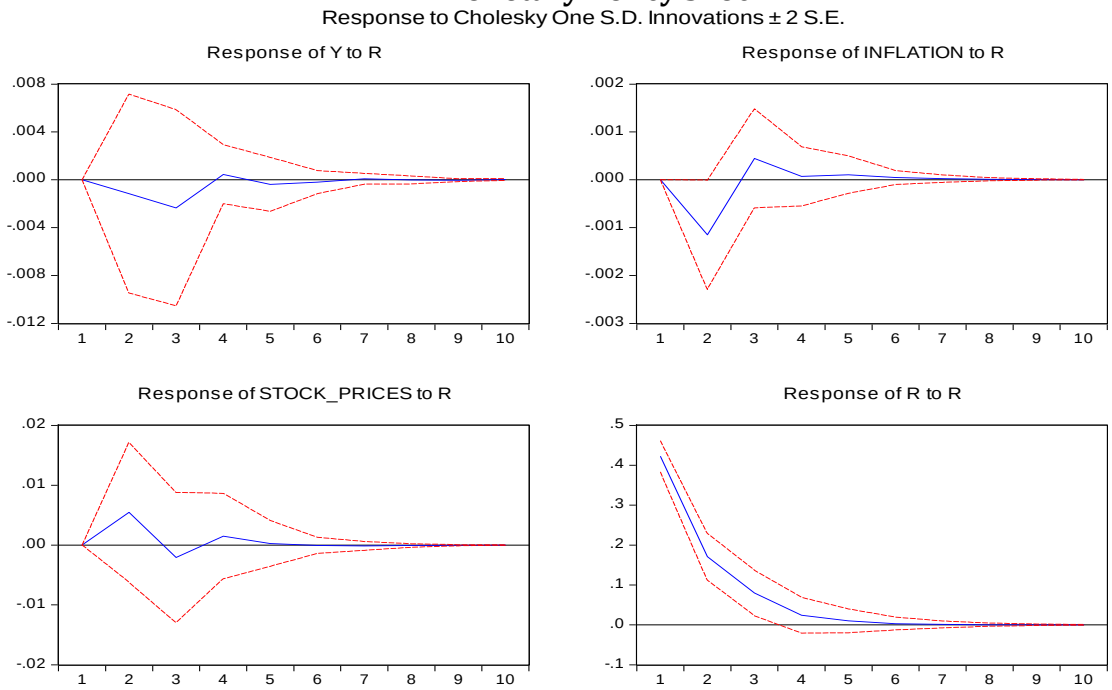


Figure 5: Trinidad and Tobago

Appendix 2:

Impulse response functions for Barbados monthly

Monetary Policy shock



Stock Price shock

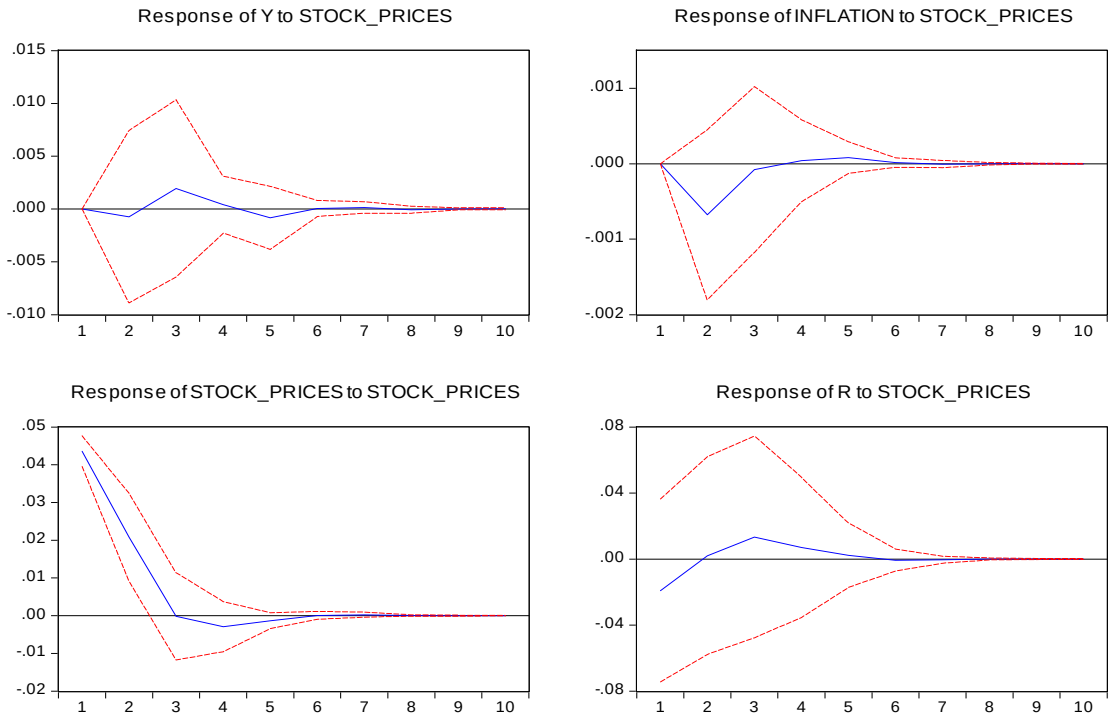


Figure 6: Barbados monthly, Impulse responses for the For the treasury bill rate (R), the real stock prices, inflation, and detrended output (Y), to a monetary policy shock (R) and a stock price sock respectively

Impulse response functions for Barbados annual

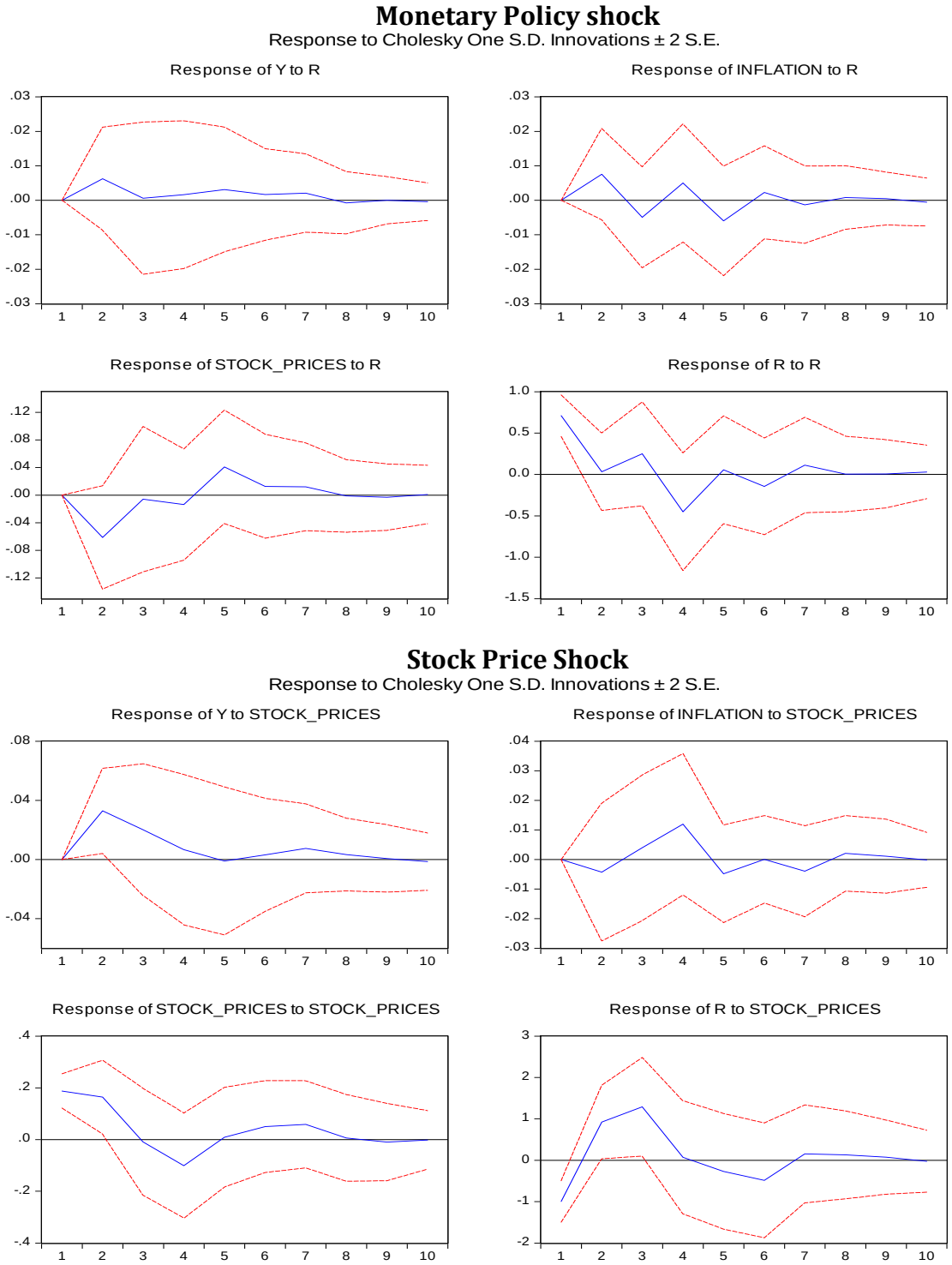
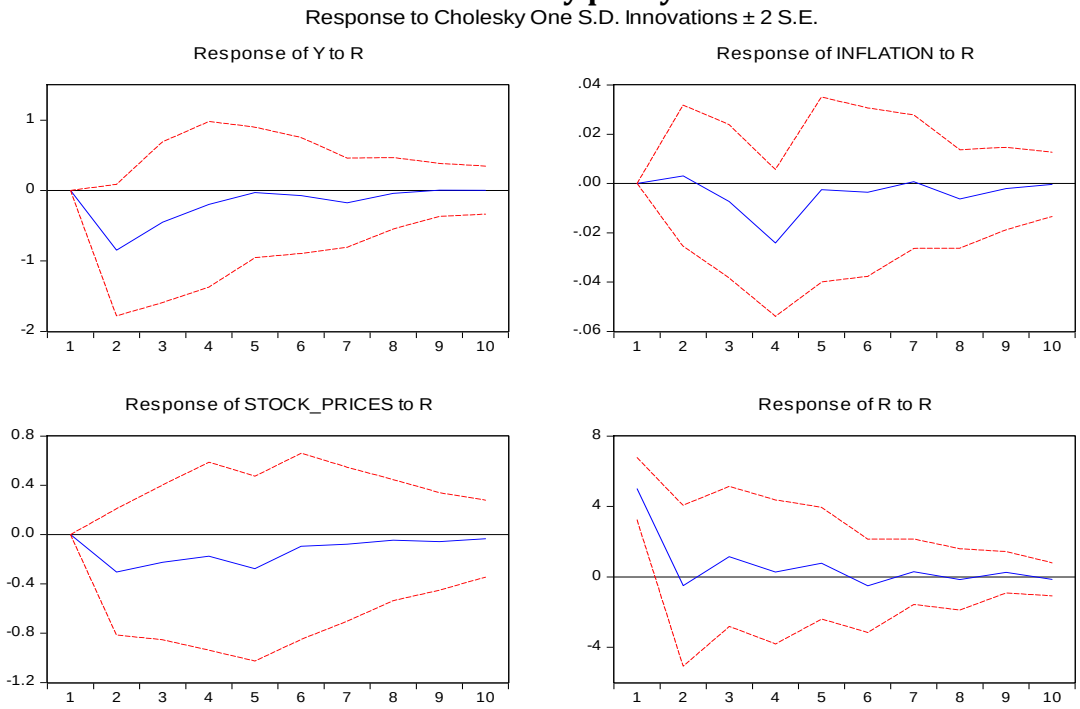


Figure 7: Barbados annual, Impulse responses for the For the treasury bill rate (R), the real stock prices, inflation, and detrended output (Y), to a monetary policy shock (R) and a stock price sock respectively

Impulse response functions for Jamaica annual

Monetary policy shock



Stock Price shock

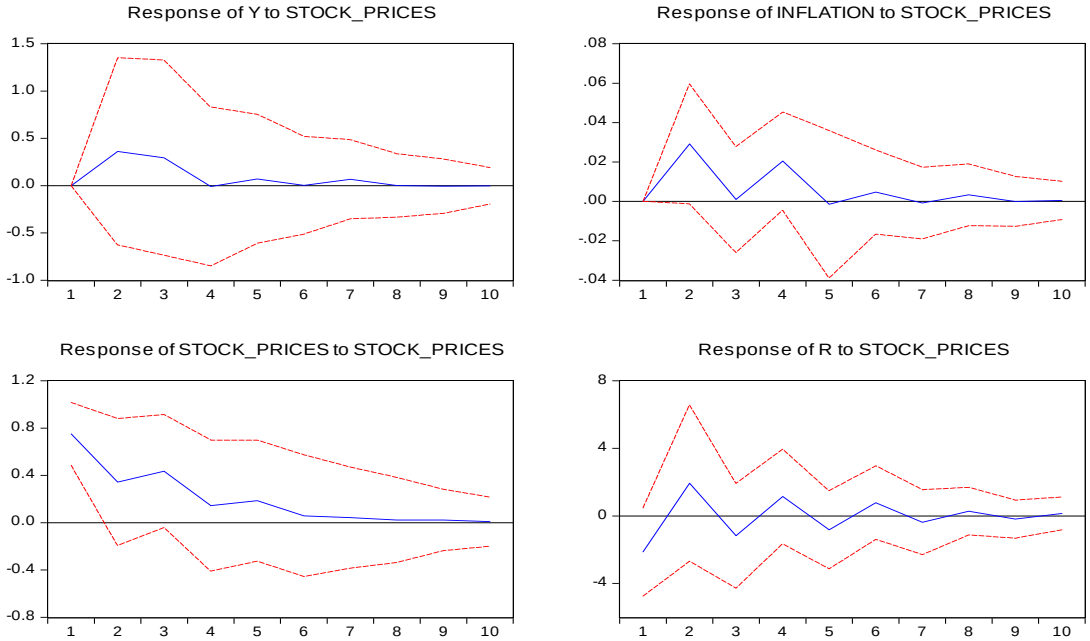


Figure 8: Jamaica annual, Impulse responses for the For the treasury bill rate (R), the real stock prices, inflation, and detrended output (Y), to a monetary policy shock (R) and a stock price sock respectively

Impulse response functions for Trinidad and Tobago annual

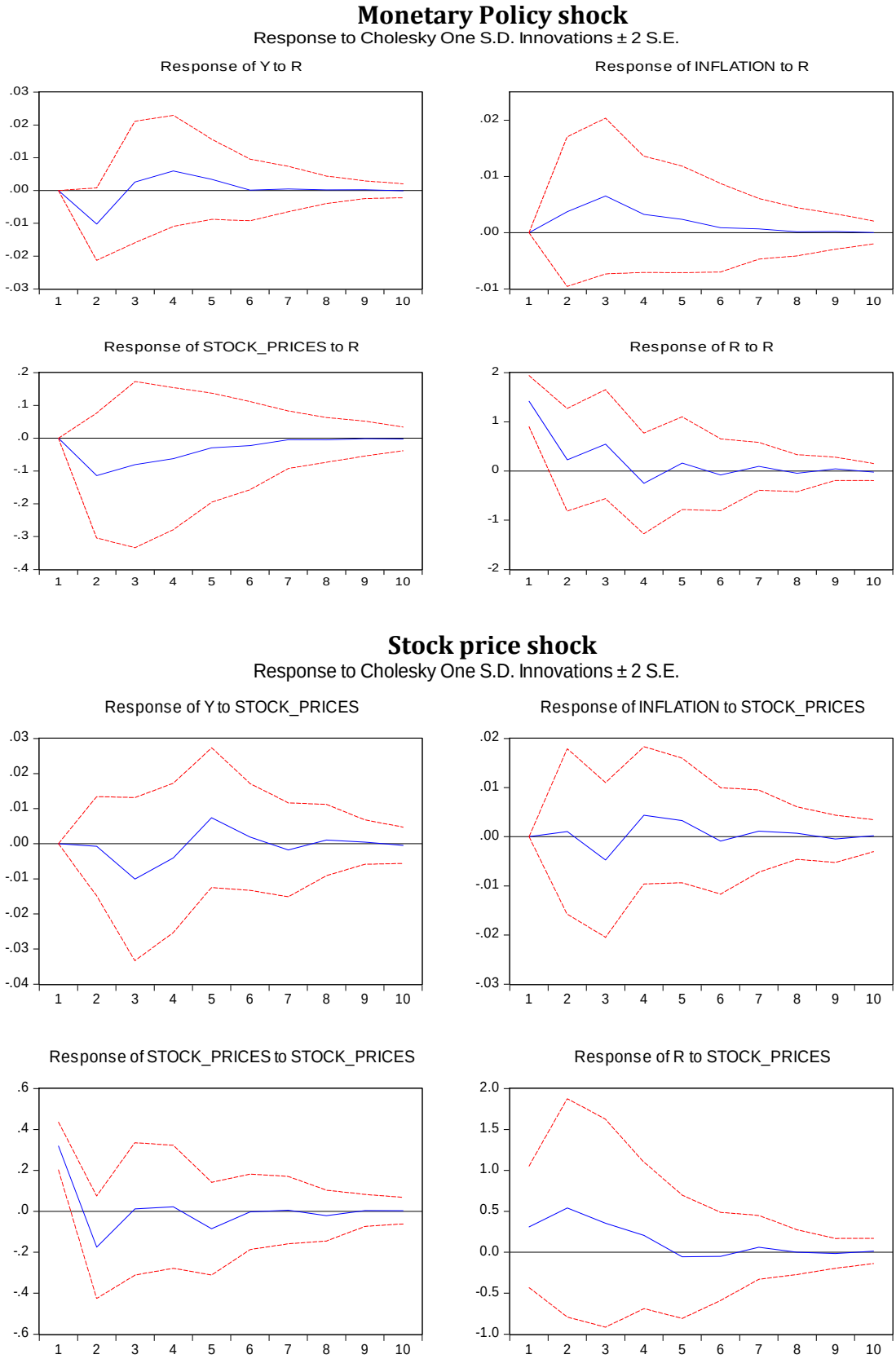
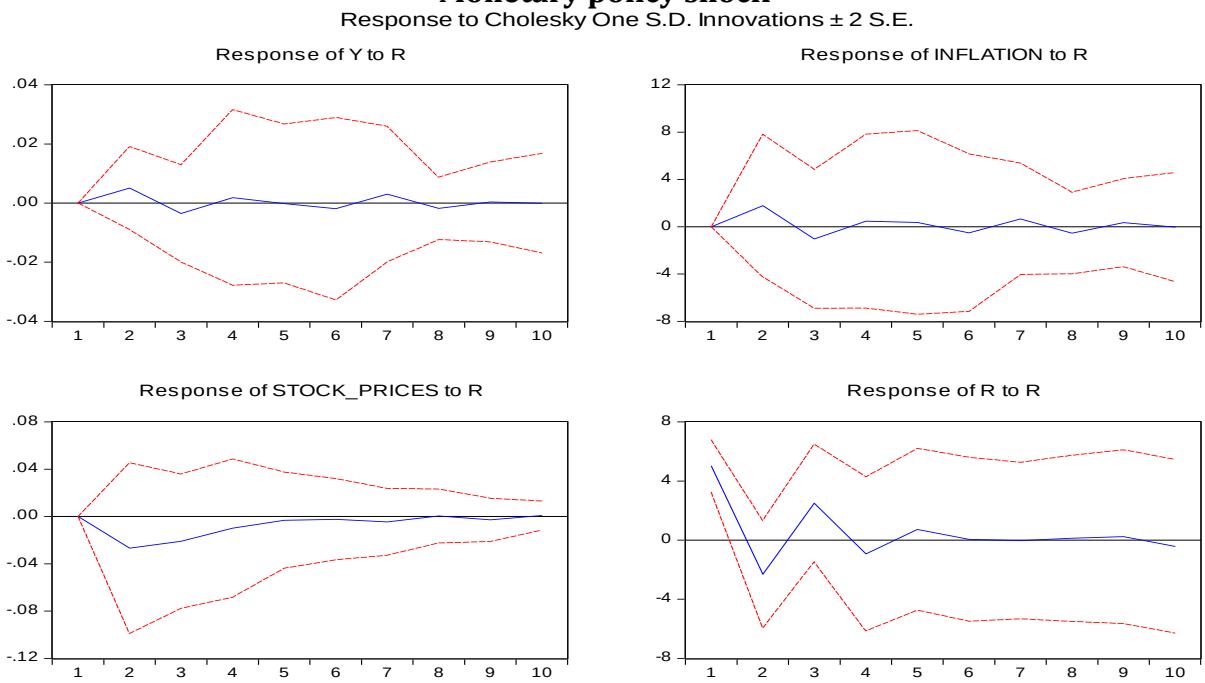


Figure 9: Trinidad and Tobago annual, Impulse responses for the For the treasury bill rate (R), the real stock prices, inflation, and detrended output (Y), to a monetary policy shock (R) and a stock price sock respectively

Impulse response functions for The Caribbean

Monetary policy shock



Stock price shock

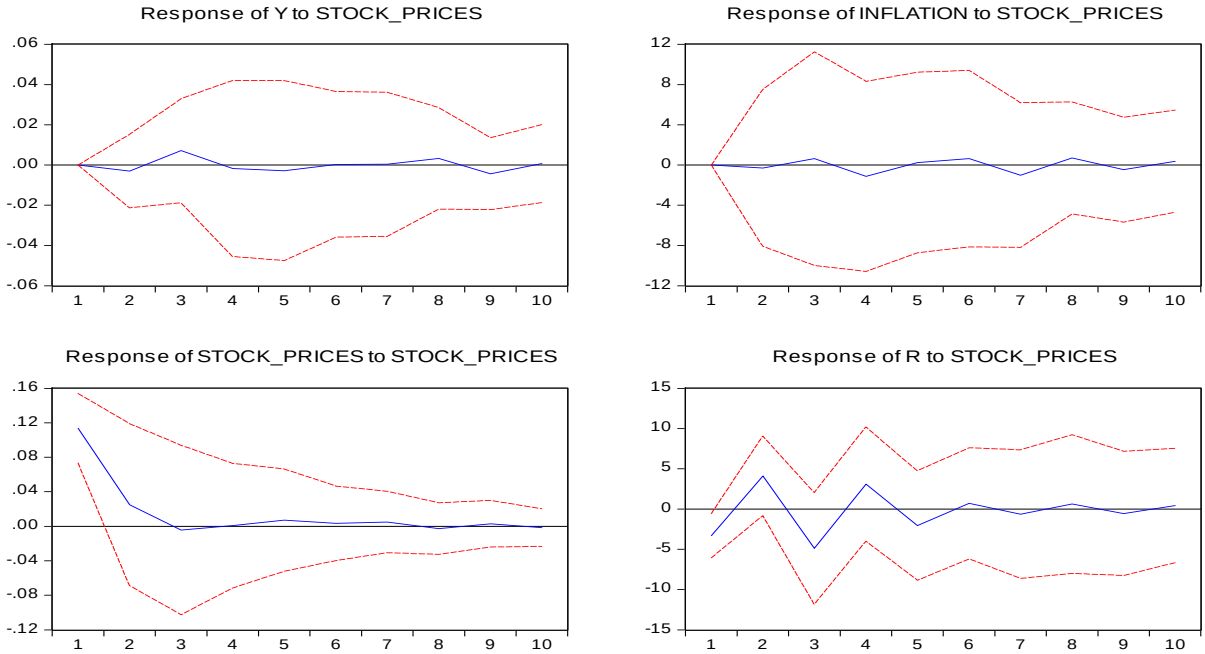


Figure 10: The Caribbean annual, Impulse responses for the For the treasury bill rate (R), the real stock prices, inflation, and detrended output (Y), to a monetary policy shock (R) and a stock price sock respectively

Appendix 3: Tables

Summary Statistics				
Barbados monthly	**Mean**	**Std. Dev.**	**Min**	**Max**
IPI	94.510	8.297	72.060	115.070
CPI	90.312	15.077	66.420	128.340
Stock index	2345.226	1048.969	1027.500	4318.550
Interest rates	5.385	2.608	0.240	13.950
Barbados annual	**Mean**	**Std. Dev.**	**Min**	**Max**
Real GDP index	94.460	6.660	81.220	103.560
CPI	90.595	15.602	67.660	124.460
Stock index	60.747	26.832	26.570	104.980
Interest rates	5.3615	2.501	1.200	10.880
Jamaica annual	**Mean**	**Std. Dev.**	**Min**	**Max**
Real GDP index	94.093	5.984	84.090	104.250
CPI	65.470	43.205	6.610	158.680
Stock index	40.345	34.380	2.020	100.000
Interest rates	22.879	8.548	12.560	42.980
T&T annual	**Mean**	**Std. Dev.**	**Min**	**Max**
Real GDP index	66.130	31.517	29.660	128.920
CPI	82.362	26.484	46.540	140.070
Stock index	42.083	32.665	5.320	100.000
Interest rates	7.793	2.513	2.690	11.930
Caribbean annual	**Mean**	**Std. Dev.**	**Min**	**Max**
Real GDP index	256.878	42.067	201.740	331.890
CPI	238.427	85.175	120.810	423.210
Stock index	143.175	92.515	38.240	300.000
Interest rates	36.033	11.709	21.440	60.240
USA	**Mean**	**Std. Dev.**	**Min**	**Max**
Interest rates	3.800	1.895	0.160	0.710

Table 1: Summary Statistics for all three countries, the Caribbean as whole and the US treasury bill rate; all indices use 2005 as the base year, except Barbados monthly does not have a base year

Barbados

Response to Y				
Period	Y	INFLATION	STOCK_PRICES	R
1	0.041	0.000	0.000	0.000
	(0.007)	(0.000)	(0.000)	(0.000)
2	0.036	0.010	0.032	0.006
	(0.020)	(0.015)	(0.014)	(0.007)
3	0.019	0.006	0.020	0.006
	(0.034)	(0.019)	(0.022)	(0.011)
4	0.012	0.015	0.006	0.001
	(0.037)	(0.017)	(0.025)	(0.010)
5	0.006	-0.002	-0.000	0.003
	(0.038)	(0.015)	(0.025)	(0.009)
6	0.008	0.003	0.003	0.001
	(0.033)	(0.013)	(0.019)	(0.006)
7	0.002	0.002	0.007	0.002
	(0.027)	(0.011)	(0.015)	(0.005)
8	-0.000	0.002	0.003	-0.004
	(0.021)	(0.009)	(0.012)	(0.004)
9	-0.001	0.002	0.000	-0.000
	(0.015)	(0.008)	(0.011)	(0.000)
10	-0.000	-0.001	-0.001	-0.000
	(0.009)	(0.007)	(0.009)	(0.002)

Response of INFLATION				
Period	Y	INFLATION	STOCK_PRICES	R
1	0.010	0.034	0.000	0.000
	(0.008)	(0.006)	(0.000)	(0.000)
2	-0.010	-0.024	-0.004	0.007
	(0.017)	(0.012)	(0.011)	(0.006)
3	0.012	0.011	0.003	-0.004
	(0.014)	(0.015)	(0.012)	(0.007)
4	-0.008	0.002	0.011	0.004
	(0.012)	(0.017)	(0.011)	(0.008)
5	-0.001	-0.002	-0.004	-0.005
	(0.012)	(0.015)	(0.008)	(0.007)
6	-0.000	0.006	0.000	0.002
	(0.010)	(0.012)	(0.007)	(0.006)
7	0.000	-0.009	-0.003	-0.001
	(0.007)	(0.011)	(0.007)	(0.005)
8	0.003	0.005	0.002	0.000
	(0.007)	(0.011)	(0.006)	(0.006)
9	-0.001	-0.003	0.001	0.000
	(0.006)	(0.011)	(0.006)	(0.003)
10	0.001	0.002	-0.000	-0.000
	(0.005)	(0.010)	(0.004)	(0.003)

Response of STOCK_PRICES:				
Period	Y	INFLATION	STOCK_PRICES	R
1	0.042	-0.061	0.187	0.000
	(0.049)	(0.048)	(0.033)	(0.000)
2	0.074	0.147	0.163	-0.061
	(0.104)	(0.082)	(0.071)	(0.037)
3	-0.008	0.015	-0.008	-0.005
	(0.142)	(0.094)	(0.103)	(0.052)
4	0.093	-0.038	-0.100	-0.013
	(0.139)	(0.083)	(0.101)	(0.040)
5	0.098	-0.012	0.008	0.041
	(0.129)	(0.082)	(0.096)	(0.041)
6	0.065	-0.012	0.050	0.012
	(0.109)	(0.068)	(0.088)	(0.037)
7	0.015	0.063	0.058	0.011

	(0.107)	(0.065)	(0.084)	(0.031)
8	-0.025	0.004	0.006	-0.001
	(0.102)	(0.058)	(0.083)	(0.026)
9	-0.008	0.014	-0.009	-0.002
	(0.084)	(0.055)	(0.074)	(0.024)
10	-0.006	-0.010	-0.001	0.001
	(0.061)	(0.048)	(0.056)	(0.021)

		Response of R:		
Period	Y	INFLATION	STOCK_PRICES	R
1	0.239	-0.424	-0.996	0.710
	(0.326)	(0.315)	(0.250)	(0.125)
2	0.902	0.509	0.922	0.032
	(0.643)	(0.490)	(0.444)	(0.234)
3	-0.546	0.3083	1.291	0.249
	(0.770)	(0.702)	(0.596)	(0.314)
4	-0.320	0.502	0.070	-0.449
	(0.858)	(0.757)	(0.683)	(0.355)
5	-0.408	0.1379	-0.269	0.056
	(0.862)	(0.573)	(0.698)	(0.325)
6	0.150	-0.561	-0.487	-0.144
	(0.782)	(0.544)	(0.694)	(0.291)
7	0.334	0.168	0.153	0.112
	(0.691)	(0.490)	(0.591)	(0.288)
8	0.089	-0.190	0.128	0.004
	(0.481)	(0.479)	(0.530)	(0.227)
9	0.094	0.253	0.074	0.006
	(0.397)	(0.465)	(0.448)	(0.205)
10	-0.066	-0.071	-0.025	0.030
	(0.364)	(0.367)	(0.374)	(0.161)

Table 2: Impulse response estimates for Barbados

Jamaica

Response of Y:

Period	Y	INFLATION	STOCK_PRICES	R
1	1.386	0.000	0.000	0.000
	(0.245)	(0.000)	(0.000)	(0.000)
2	-0.390	-0.976	0.361	-0.846
	(0.509)	(0.457)	(0.494)	(0.467)
3	-0.470	-0.459	0.294	-0.450
	(0.593)	(0.503)	(0.516)	(0.570)
4	-0.092	0.149	-0.009	-0.196
	(0.534)	(0.556)	(0.419)	(0.588)
5	0.138	-0.066	0.071	-0.027
	(0.413)	(0.551)	(0.340)	(0.463)
6	0.151	-0.136	0.003	-0.070
	(0.339)	(0.478)	(0.258)	(0.411)
7	-0.167	-0.188	0.067	-0.173
	(0.286)	(0.299)	(0.209)	(0.316)
8	-0.068	0.023	0.001	-0.039
	(0.262)	(0.234)	(0.167)	(0.253)
9	0.039	0.036	-0.006	0.007
	(0.249)	(0.222)	(0.143)	(0.188)
10	0.055	-0.022	-0.002	0.003
	(0.171)	(0.214)	(0.096)	(0.170)

Response of INFLATION:

Period	Y	INFLATION	STOCK_PRICES	R
1	-0.009	0.043	0.000	0.000
	(0.011)	(0.007)	(0.000)	(0.000)
2	0.014	-0.012	0.0291	0.003
	(0.014)	(0.013)	(0.015)	(0.014)
3	0.0184	-0.005	0.0010	-0.007
	(0.016)	(0.013)	(0.013)	(0.015)
4	-0.028	-0.030	0.020	-0.020
	(0.019)	(0.017)	(0.0124)	(0.014)
5	-0.002	0.009	-0.001	-0.002
	(0.018)	(0.018)	(0.018)	(0.018)
6	0.000	-0.002	0.004	-0.008
	(0.017)	(0.017)	(0.010)	(0.017)
7	0.008	-0.001	-0.000	0.000
	(0.013)	(0.015)	(0.009)	(0.01)
8	-0.004	-0.008	0.003	-0.006
	(0.009)	(0.012)	(0.007)	(0.009)
9	-0.003	0.000	0.000	-0.002
	(0.009)	(0.009)	(0.006)	(0.008)
10	-0.000	0.000	0.000	-0.008
	(0.008)	(0.008)	(0.004)	(0.006)

Response of STOCK_PRICES:

Period	Y	INFLATION	STOCK_PRICES	R
1	-0.179	-0.140	0.750	0.000
	(0.193)	(0.189)	(0.132)	(0.000)
2	-0.093	0.133	0.343	-0.302
	(0.245)	(0.232)	(0.268)	(0.256)
3	-0.121	-0.296	0.436	-0.224
	(0.288)	(0.295)	(0.238)	(0.314)
4	0.101	-0.137	0.144	-0.174
	(0.229)	(0.355)	(0.276)	(0.381)
5	-0.210	-0.256	0.185	-0.276
	(0.182)	(0.351)	(0.256)	(0.374)
6	-0.036	-0.037	0.058	-0.094
	(0.151)	(0.307)	(0.257)	(0.377)

7	0.0027	-0.045	0.042	-0.078
	(0.120)	(0.260)	(0.213)	(0.312)
8	0.0210	-0.055	0.022	-0.045
	(0.090)	(0.211)	(0.179)	(0.245)
9	-0.020	-0.059	0.022	-0.056
	(0.068)	(0.177)	(0.129)	(0.198)
10	-0.024	-0.017	0.008	-0.033
	(0.058)	(0.126)	(0.104)	(0.155)

		Response of R:		
Period	Y	INFLATION	STOCK_PRICES	R
1	2.691	3.794	-2.126	5.001
	(1.724)	(1.515)	(1.305)	(0.884)
2	-1.568	-1.612	1.944	-0.502
	(2.071)	(1.925)	(2.311)	(2.285)
3	0.039	2.672	-1.174	1.155
	(2.419)	(1.875)	(1.551)	(1.989)
4	-0.395	-0.574	1.149	0.278
	(1.907)	(1.982)	(1.403)	(2.045)
5	1.302	1.226	-0.819	0.773
	(1.121)	(1.549)	(1.158)	(1.585)
6	-0.919	-1.131	0.788	-0.512
	(1.010)	(1.235)	(1.086)	(1.324)
7	0.237	0.671	-0.371	0.2847
	(1.072)	(1.096)	(0.958)	(0.928)
8	-0.327	-0.206	0.281	-0.151
	(0.851)	(0.907)	(0.704)	(0.870)
9	0.395	0.307	-0.191	0.257
	(0.579)	(0.826)	(0.564)	(0.583)
10	-0.134	-0.269	0.149	-0.143
	(0.452)	(0.700)	(0.486)	(0.469)

Table 3: Impulse response estimates for Jamaica

Trinidad and Tobago

Response of Y:

Period	Y	INFLATION	STOCK_PRICES	R
1	0.018	0.000	0.000	0.000
	(0.003)	(0.000)	(0.000)	(0.000)
2	-0.002	0.028	-0.000	-0.010
	(0.007)	(0.008)	(0.007)	(0.005)
3	-0.001	-0.005	-0.010	0.002
	(0.007)	(0.012)	(0.011)	(0.009)
4	0.000	-0.009	-0.004	0.005
	(0.006)	(0.012)	(0.010)	(0.008)
5	-0.001	0.004	0.007	0.003
	(0.004)	(0.012)	(0.009)	(0.006)
6	-0.000	0.000	0.001	0.000
	(0.009)	(0.010)	(0.007)	(0.004)
7	-0.003	-0.001	-0.001	0.000
	(0.002)	(0.007)	(0.006)	(0.003)
8	-0.000	0.004	0.001	0.000
	(0.001)	(0.000)	(0.005)	(0.002)
9	0.000	0.000	0.000	0.000
	(0.001)	(0.003)	(0.003)	(0.001)
10	0.000	-0.000	-0.000	0.000
	(0.002)	(0.002)	(0.002)	0.000

Response of INFLATION:

Period	Y	INFLATION	STOCK_PRICES	R
1	-0.007	0.021	0.000	0.000
	(0.005)	(0.003)	(0.000)	(0.000)
2	-0.001	0.004	0.001	0.002
	(0.004)	(0.009)	(0.008)	(0.006)
3	0.000	-0.008	-0.004	0.006
	(0.005)	(0.009)	(0.007)	(0.006)
4	-0.002	0.004	0.004	0.003
	(0.003)	(0.009)	(0.006)	(0.005)
5	-0.001	0.001	0.003	0.002
	(0.003)	(0.007)	(0.006)	(0.004)
6	-0.000	-0.001	-0.000	0.006
	(0.002)	(0.006)	(0.005)	(0.003)
7	-0.000	0.001	0.001	0.000
	(0.002)	(0.005)	(0.004)	(0.002)
8	0.000	0.000	0.000	0.000
	(0.001)	(0.002)	(0.006)	(0.002)
9	0.000	-0.002	-0.009	0.000
	(0.001)	(0.002)	(0.001)	(0.001)
10	-0.000	0.000	0.000	0.000
	(0.000)	(0.002)	(0.002)	(0.002)

Response of STOCK_PRICES:

Period	Y	INFLATION	STOCK_PRICES	R
1	0.049	0.021	0.319	0.000
	(0.083)	(0.082)	(0.058)	(0.000)
2	0.087	-0.268	-0.175	-0.113
	(0.110)	(0.144)	(0.125)	(0.095)
3	-0.021	0.105	0.011	-0.080
	(0.102)	(0.182)	(0.161)	(0.126)
4	0.037	0.037	0.021	-0.062
	(0.079)	(0.167)	(0.150)	(0.108)
5	0.035	-0.062	-0.084	-0.029
	(0.056)	(0.162)	(0.113)	(0.083)
6	-0.002	0.035	-0.002	-0.022
	(0.043)	(0.116)	(0.092)	(0.067)

7	0.006	0.002	0.005	-0.004
	(0.034)	(0.088)	(0.082)	(0.043)
8	0.008	-0.023	-0.020	-0.005
	(0.025)	(0.079)	(0.060)	(0.034)
9	-0.003	0.013	0.004	-0.001
	(0.019)	(0.053)	(0.039)	(0.026)
10	0.001	0.001	0.003	-0.002
	(0.015)	(0.035)	(0.032)	(0.018)

		Response of R:		
Period	Y	INFLATION	STOCK_PRICES	R
1	-1.075	-0.014	0.310	1.420
	(0.427)	(0.375)	(0.371)	(0.259)
2	-0.065	-0.187	0.541	0.226
	(0.403)	(0.717)	(0.666)	(0.521)
3	-0.147	-0.104	0.353	0.545
	(0.413)	(0.748)	(0.635)	(0.552)
4	-0.042	0.376	0.206	-0.250
	(0.305)	(0.584)	(0.447)	(0.511)
5	-0.058	-0.087	-0.056	0.159
	(0.238)	(0.3175)	(0.376)	(0.471)
6	0.034	-0.018	-0.051	-0.078
	(0.185)	(0.223)	(0.268)	(0.365)
7	-0.037	0.040	0.059	0.094
	(0.115)	(0.176)	(0.194)	(0.243)
8	0.017	0.006	0.000	-0.047
	(0.088)	(0.133)	(0.136)	(0.188)
9	-0.015	-0.026	-0.015	0.044
	(0.060)	(0.088)	(0.090)	(0.117)
10	0.001	0.023	0.015	-0.021
	(0.045)	(0.081)	(0.076)	(0.086)

Table 4: Impulse response estimates for Trinidad and Tobago

Economic Indicators

Monetary policy Shock

Variables	Barbados Monthly	Barbados Annual	Jamaica Annual	Trinidad and Tobago annual	Caribbean Annual total
Output	-0.003	0.006	-0.800	-0.010	0.005
Inflation	-0.001	0.008	0.003	0.007	1.800
Stock prices	0.038	-0.060	-0.300	-0.100	-0.027
Treasury bill rate	-25 bp	-70 bp	-550 bp	-120 bp	-700 bp

***Table 5: Instant effects of a monetary policy shock on the output gap, inflation, stock prices and the Treasury bill rate for Barbados monthly data, Barbados annual data, Jamaica annual data, Trinidad and Tobago annual data and the Caribbean which is the three countries jointly. bp = basis points*.**

Stock price Shock

Variables	Barbados Monthly	Barbados Annual	Jamaica Annual	Trinidad and Tobago annual	Caribbean Annual
Output	-0.001	0.400	0.350	-0.001	-0.003
Inflation	-0.008	-0.004	0.029	0.009	-0.300
Stock prices	-0.040	-0.190	-0.400	-0.500	-1.200
Treasury bill rate	30 bp	190 bp	400 bp	330 bp	700 bp

Table 6: Instant effects of a stock price shock on the output gap, inflation, stock prices and the Treasury bill rate for Barbados monthly data, Barbados annual data, Jamaica annual data, Trinidad and Tobago annual data and the Caribbean which is the three countries jointly. bp = basis points

	Barbados	Jamaica	Trinidad and Tobago	USA
Population	284,589	2,825,928	1,229,953	307,212,123
GDP per capita	$ 18500	$8,200	$23,100	$46,400
Labour force	0.175 m	1.311 m	0.629 m	154.100 m
Money supply	$3.701	$4.244	$3.506	$10,990.000
Market value of publicly traded shares	$5.599	$7.5130	$12.160	$19,950.000
Exports	$0.385	$1.422	$10.640	$994.700
Imports	$1.586	$4.625	$7.449	$1445.000

Table 7: Some basic economic characteristics for the Caribbean countries that have stock markets; Jamaica, Barbados and Trinidad and Tobago, in comparison to the US. All figures are measured in billions of USA dollars except, GDP per capita is measured in thousands and; population and labour force measured in millions[10]

First difference Treasury bill rate

	Mean	Std dev.	min	max
Barbados	-0.174	**2.091**	-5.440	3.42
Jamaica	-0.330	**8.280**	-16.815	14.13
Trinidad and Tobago	-0.253	**1.736**	-4.320	2.1
USA	-0.387	**1.416**	-2.950	1.78

Table 8: First difference Treasury bill rate Barbados (BT-L), Jamaica (JT-L), Trinidad and Tobago(TT-L) and the USA (US-L)

[10] Data collected from the CIA World Fact Book

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