The Contribution of the US Monetary Policy in the Caribbean Business Cycles

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Abstract. Recent studies have shown that economic fluctuations in small open economies are driven by external shocks (Cushman, Zha (1995), Hoffmaister, Roldos, Wickham (1997)). Using Caribbean countries as case study (Antigua and Barbuda, Belize, Barbados, Dominica, Dominican Republic, Saint-Kitts and Nevis, Saint-Vincent, Barbados, Saint-Lucia, Jamaica, Suriname and Trinidad and Tobago), we specify and estimate a panel vector autoregressive model for GDP, real exchange rate, consumer price index and world interest rate. We have divided the in two groups to take into account the diversity of the exchange rate regimes. The resulting impulse functions are consistent with traditional open economy theory and highlight the importance of real exchange rate as transmission channel.

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1 Introduction

Caribbean countries will face numerous economic and political challenges for the next years. One of them, is that probably these small open economies will react differently to the Fed and European Central Bank monetary policy. For instance, unexpected strong real growth in the US economy might lead to increase both exports and tourism product in the area.

A series of recent research has pointed out the significance of the factors in explaining the features of macroeconomics fluctuations for industrialized countries. For instance, Blanchard and Quah (1989) specified a small VAR (output and unemployment) that tries to identify aggregate demand and supply shocks. They assumed that supply shocks can have permanent effect on the level of output while demand shocks can have only temporary effects. Shapiro and Watson (1988) used a system that included real output, total labour hours, inflation and real interest rate. This set of variables allowed them to identify four different disturbances, two to aggregate supply they identified as shocks to labour supply and technology and two to aggregate demand they referred to IS and LM shocks. These authors found that aggregate demand shocks had a smaller impact on real GDP than Blanchard and Quah did. Cushman and Zha (1995) offered an empirical evidence by using a larger system with eleven variables[3] for the identification of Canadian monetary policy. The estimated impulse functions are consistent with the general view of existing monetary analyses under flexible exchange rate.

However less attention has been paid to the sources of business cycles in developing countries. In a recent paper, Watson (1996), has analysed the monetary mechanisms for Trinidad and Tobago throughout a vector autoregressive model that contains exchange rate, loan rate, loans, total deposits, GDP, unemployment, treasury bill rate and retail price index. Following Watson (1996) : *monetary transmission mechanism works more through the credit rather than through the money channel.*

Agenor, Mcdermott and Prasad (1999) analysed the cross-correlation between domestic industrial output and several macroeconomic variables. Regional fluctuations are examined by using several univariate detrending procedures[4]. The results indicated : *many similarities between*

[3] They have used : the US dollar price of Canadian currency, the monetary aggregate M1, the consumer price index, the total exports to the US, the total imports from the US, the US industrial production, the US consumer price index and the world total exports commodity price index.

[4] For an overwiew of detrending techniques, see Baxter and King (1995).

macroeconomic fluctuations in developing and industrial countries[5] *and some differences*[6].

We extend the discussion to the case of small open economies and particularly the case of Caribbean countries. Their choice brings some answers to the empirical verification about economies which are particularly sensitive to both domestic and foreign shocks. This paper seeks to understand the role of the US monetary policy in the regional fluctuations. We focus on 12 Caribbean countries. In the light of our analysis[7], we did in 1999 and in which we used a classification based on OECS and non OECS countries, we distinguish the countries by considering a group with fixed exchange rate and an other with flexible exchange rate. This work helps to analyse the stylized facts on regional evolutions using a panel vector autoregressive framework for output, exchange rate, consumer price index and world interest rate.

The rest of this paper is organised as follows. Section 2 briefly discusses the analysis of economics policy effect in existing open economy models. In section 3, the procedures used to estimate the model are discussed with particular emphases on the treatment of identifying restrictions. The simulations of the model follow in section 4.

2 Background

2.1 A theoretical foundation : the Mundell-Fleming Model

The theoretical frame most used for the analysis of the fluctuations in open economy is the Mundell-Fleming model. This model studies the consequences of economic policies measures (fiscal and monetary) on the economic activity. The structure of the economy generally retained is described by five basic relationships. Three of them describe the conditions for internal balance (the good market, and the money market) and for the external balance characterised by the variations of the reserves of change (or the balance of payments). The fourth one integrates the prices movements whereas the last one is the money supply. The use of this model for economic policy permits to analyse several cases which can be summarised in three points:

The first one is that of regulation policies, for instance, a fiscal shock generated by an increase of the government expenditure, leads to an

[5] Procyclical real wages, countercyclical variation in government expenditure.

[6] Countercyclical variation in the velocity of monetary aggregates.

[7] See Borda and Montauban (1999).

increase of the economic activity and of the interest rate due to the eviction effect. Two opposite effects then appear : the increase of the income on the first hand deteriorates the trade balance if the propensity to import from domestic country is high ; and on the other hand, the increase of the interest rate generates an increase of capital flows. In this model the impact of exogenous shocks is conditioned both by the exchange rate regime and the capital mobility. In *flexible exchange rate* system with a weak capital mobility, the deficit of trade balance caused by expansionist fiscal shocks lead to a depreciation of the exchange rate improving the trade balance. In case of perfect capital mobility, the home interest rates are determined by the world interest rate. So, in this case, any change in economic policy leads to an increase of the interest rate which appreciate the exchange rate and so increase the capital flows. This movement associated with the prices increasing compensate the positive effect of the expansionist policy. In *fixed exchange rate system*, a weak capital mobility implies that a fiscal shock leads to a reduction of money supply, which leads to an increase of the interest rates. the current account deficit caused by this shocks is compensated by the purchase of change reserves. If the capital is perfectly mobile the eviction effect of public expenditure upon private ones is alleviated. An obvious conclusion is inspired by this last remark : any change of economic policy is all the more efficient as the capital mobility is strong in case of fixed exchange rate. Expansionist fiscal shock with a weak capital mobility have temporary impact on the output because of the decrease of real exchange rate.

The second point concerns the role of prices in macroeconomic adjustment. The model supposes that their evolutions are driven by the domestic demand and the exchange rate variations. The main results about the efficiency of the economic policy are not modified. Indeed, in the fixed exchange rate regime whatever the importance of the capital mobility the expansionist policy generates inflation which reduces the agents wealth. The domestic goods are then forgotten for foreign goods, provoking thus a deficit in the trade balance. However, in the flexible exchange rate system an expansionist fiscal policy proved to be efficient in presence of a weak capital mobility.

At last, the third concerns the role of supply policy. This can be possible by the introduction of supply which could be assimilated to technologic shock. Also, in a small open economy, supply shocks could be assimilated to an increase in input prices. Generally, positive supply shocks lead to an increase in output and real interest rate which leads to a fall in prices variations. The impact of such a shock on the trade balance remains undetermined ; on one hand, the fall in prices stimulates imports

because of the dependence of the economic activity on equipment and the other hand, these shocks stimulate exports because of the increase of output (supply). Thus, in the Mundell-Fleming Model, the channel monetary transmission occurs thought an exchange rate effect.

This model has been extended to exchange rate expectations known as the Dornbusch *overshooting* model. In this model a negative money supply shock increases the interest rate throughout the liquidity effect and appreciates home currency to maintain uncovered interest parity in the short run before other variable can adjust. A foreign disturbance can affect the home economic throughout the price channel. But in contrast to the main conclusion of the Mundell-Fleming model Svensson and Wijnbergen (1989) have shown that a fall in the world interest rate can cause a net expansionary effect on home economy through the intertemporal substitution.

As we mentioned in the introduction, recent empirical research on the issues has provided some mixed evidence concerning the exchange rate effect. Using the joint behavior of exchange rate, interest rate, money and price of five major industrial countries, Sims (1992) has noted several puzzles : positive interest rate shocks are associated with persistent increase in home price and depreciation of home currency. Gilli and Roubini (1993) have used a similar technique to analyse the G-7 countries. Following these authors, a positive home interest shock affects the home currency in all other G-7 countries except the US economy.

2.2 Some basic facts

Before proceeding with the analysis of regional macroeconomic fluctuations in the Caribbean countries, it is interesting to examine some basic facts on key macroeconomic variables. Figures display the behaviour of real output growth rate and world interest rate (fed funds rate) for 12 Caribbean countries. The picture that emerges from these figures is that for some countries, such as Saint-Kitts and Nevis, Antigua and Barbuda and Trinidad and Tobago, the real output has a little correlation between the fed funds (see figures 3, and 4) while for Saint-Lucia, Saint-Vincent and Dominica there is one particularly change in output that is the recession of 1979. This fact represents the high increase of US real interest rate (about 15 %). We can notice also that these data display a few large changes probably due to various shocks. The most significant ones, were caused mainly by modifications of trade argrements and the variations of external financing. As a matter of fact, for the external trade, Caribbean countries exports were concentrated on a small number of primary goods and benefited from trade agree-

ments for import markets. Yet, in the context of liberalisation, these exportations are being questioned. Concerning the external financing, the Caribbean countries debt level conditions their fiscal and monetary policies. Then the main consequence for these countries is subtantial decline in domestic demand, which has negative impact on growth rate.

Explaining macroeconomic fluctuations will be the goal of our paper, we will seek to know whether regional fluctuations are due to US monetary policy and whether movements in output are related to domestics supply shocks and domestic demand shocks. To do this, we will analyse the joint behaviour of output and other variable ; this allows to us to compare the impulses response functions.

Figure 1. Saint-Lucia

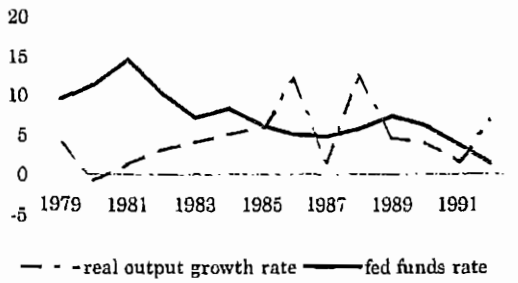


Figure 2. Saint-Vincent

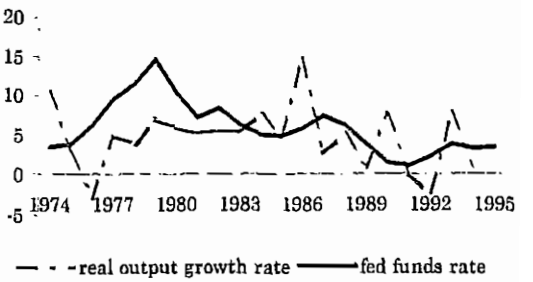


Figure 3. Saint-Kitts & Nevis

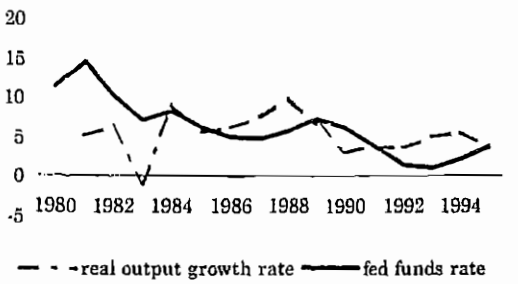


Figure 4. Trinidad & Tobago

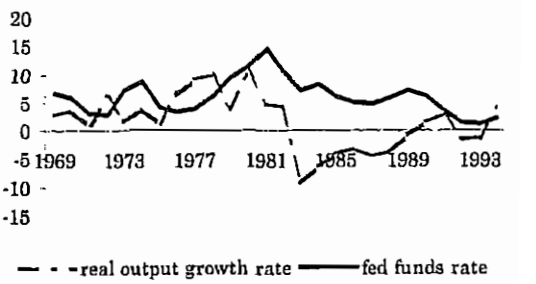


Figure 5. Suriname

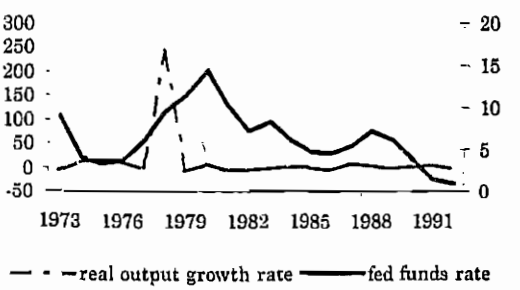


Figure 6. Belize

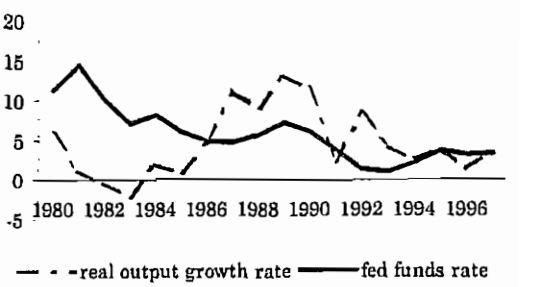


Figure 7. Barbados

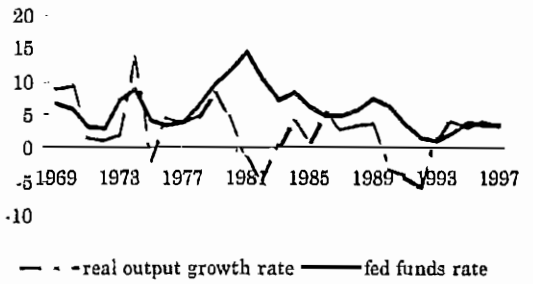


Figure 8. Dominica

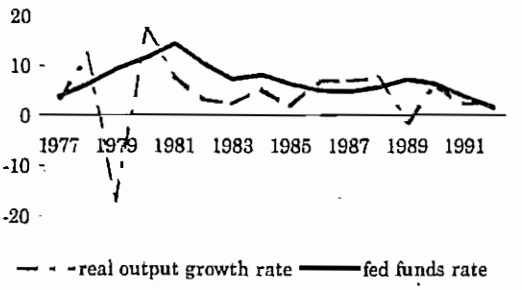


Figure 9. Antigua & Barbuda

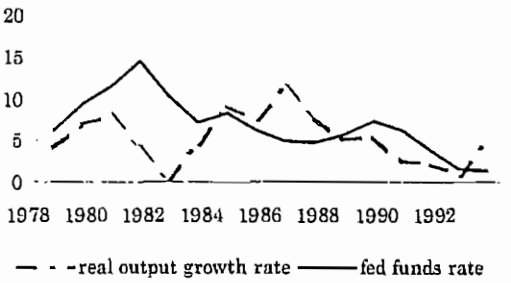
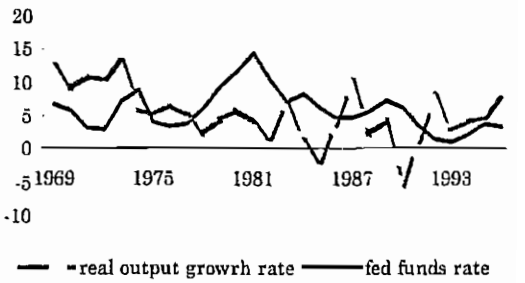


Figure 10. Dominican Republic



3 A structural VAR model

In this section, we present the specification of the model estimated in this paper. We begin with a discussion of the variables included in the model followed by a discussion of the structure of the VAR model and how we resolve the identification problem.

3.1 Specification and identifying restrictions

Our model contains 4 variables : output, consumer price index, real exchange rate and world interest rate. These variables should capture the economics relationship that determines the behavior of small open economies. For instance, movements in real exchange rate are likely to be correlated with domestics supply shocks and demand shocks from abroad. Given the growing importance of international trade and capital flows (globalization) to the Caribbean countries, it is necessary to incorporate the effects of shocks from abroad. Thus, we include as foreign variable, the world interest rate. We use a vector autoregressive model similar to Cushman and Zha (1995). The evolution of these variables is described by :

$$B(L)\Delta x_t = \epsilon_t \tag{1}$$

where Δx_t is a vector of observations, $B(L)$ is a matrix polynomial in the lag operator L and ε_{it} is the vector of innovations, with :

$$\Delta x_t = \begin{pmatrix} \Delta x_{1i,t} \\ \Delta x_{2,t} \end{pmatrix}, \quad B(L) = \begin{pmatrix} B_{11}(L) & B_{12}(L) \\ 0 & B_{22}(L) \end{pmatrix}, \quad \epsilon_t = \begin{pmatrix} \epsilon_{1i,t} \\ \epsilon_{2,t} \end{pmatrix} \tag{2}$$

We can keep these well known hypotheses :

$$E(\epsilon_t) = 0 \text{ and } E(\epsilon_t \epsilon_t^{'}) = \sum = (\sigma_{ij})$$

The small open economy assumption provides the restriction $B_{21}(L) = 0$. This implies that the second block $\Delta x_{2,t}$ is exogenous to Δx_{1it} (the first block). For the model, we let : $\Delta x_{1i,t} = \left(\Delta y_{i,t}, \Delta p_{i,t}, \Delta e_{i,t}\right)'$ and $\Delta x_{2,t} = \left(\Delta i_t^*\right)'$. $\Delta y_{i,t}$, $\Delta p_{i,t}$, $\Delta e_{i,t}, \Delta\ i_t^*$ are respectively output, consumer price index, real exchange rate and world interest rate. $\epsilon_{1i,t}$ can be interpreted as domestic innovations whereas $\epsilon_{2,t}$ is assimilated to foreign innovations. The reduced form of (1) is a model that describes how the historical data contained in Δx_t. By rewriting (1) as a moving average representation and assuming that B_0 which is the coefficient matrix of L_0 is non singular:

$$\Delta x_t = B(L)^{-1}\epsilon_t = C(L)\epsilon_t \tag{3}$$

To obtain the dynamic responses of the endogenous variables, it's useful to orthogonalize the vector of innovations ϵ_t such as :

$$\epsilon_t = S(L)\nu_t \qquad with \sum = SS' \tag{4}$$

Equation (3) can also be expressed as :

$$\Delta x_t = D(L)\nu_t \qquad \nu_t = \left(\nu_{iy,t}\, \nu_{ip,t}\, \nu_{ie,t}\, \nu_{ii^*,t}\right)' \tag{5}$$

where $\nu_{iy,t}$, $\nu_{ip,t}$, $\nu_{ie,t}$, $\nu_{ii^*,t}$ can be interpreted respectively as domestic supply shocks, domestic demand shocks (or nominal), real exchange rate shocks and world interest rate shocks. The long run equilibrium implies two additional restrictions : short-run movements in output are driven

by domestic demand shocks (or foreign shocks). However, these shocks are permitted to have only temporary effects on the level of output. Demand shocks cause real exchange rate to deviate temporally from its long run equilibrium, but are permitted not to have a long run effect. These assumptions are in accordance with the long run neutrality in nominal shocks[8]. These considerations suggest the following restrictions:

$$D_{yp}(1) = D_{ep}(1) = 0 \tag{6}$$

Where $D_{ij}(1) = 0$, means that the long-run effect of j on i is null.

3.2 Data and estimation issues

Our model contains 12 Caribbean countries and most of variables come from the International Financial Statistics. The Federal Fed funds rate was chosen as an indicator of US monetary policy (Bernanke and Blinder (1992)). The sample was divided in two panel of annual observations[9]. The first panel contains 5 countries : Trinidad and Tobago, Jamaica, Guyana, Dominican Republica and Suriname from 1979 through 1993. The second one, contains 7 countries : Saint-Kitts and Nevis, Antigua and Barbuda, Barbados, Saint-Vincent, Saint-Lucia, Dominica and Belize from 1979 through 1994. We have estimated the previous VAR in differences with two lags for the first one and three lags for the second one. We also find an evidence of country specific intercepts and thus, we add them into the model. Time specific effect is taken into account by the world interest rate that has the same value for each country.

As we mentioned above, the VAR contains 4 variables that are the real output growth rate, consumer price growth rate and world real interest growth rate. The small open economy restriction[10] implies that estimates are based on seemingly-unrelated-regressions technique.

4 What drive regional fluctuations ?

In this section, we begin with a discussion of the relative importance of external shocks and domestic shocks followed by the analyse of the variance decomposition.

[8]Real business cycles school believes that aggregate-supply shocks are the driving forces of output fluctuations.

[9]The countries were put together according to the exchange rate, which justifies the use of two samples.

[10]The world real interest growth rate is treated as exogenous block .

4.1 Dynamic adjustment of output

In long-run, positive domestic supply shocks lead to a permanently raise of output in the flexible exchange rate countries (figure 11) because these shocks cause a currency depreciation that increases the consumer price index. The decline in real exchange rate leads to a (positive) shifts demand toward home goods. In contrast, real exchange rate shocks have contractionary effects ; the decline in output is accompanied by an immediate and permanent appreciation of the Caribbean currency (see figure 15). In such a case, the currency appreciation raises Caribbean term of trades and thus, home competitiveness worsens and demand shifted to foreign final goods from domestics goods. By construction, nominal shocks effects are temporary. Thus, the impact of domestic demand shocks on the output die out in about two years. From a theoretical view, this effect can be explained by the following manner : when a positive demand shock occurs, supply instantaneously increases. At the same time, prices respond positively. High inflation lowers real output and raises the relative price of home final good. This result is consistent with the newclassical view of aggregate fluctuations. The real output in the first group reacts negatively to world interest shocks ; the reason is that high interest rate raises the real exchange rate ; this movement increases the real price of intermediate inputs. Since the amount of input fall, we conclude that supply falls as well. The associated variance decomposition (table 1) shows that variation of output has been dominated by real exchange rate shocks. Supply shocks play a more important role in short-run. In contrast, real output is not driven by world interest rate (accounting for only 3.68% of the variation). In this case, these Caribbean economies experience a recession in response of a tight US monetary policy.

Turning to the fixed exchange rate regime (the second group), we notice that domestic supply shocks have persistence effects and demand shocks have insignificant effects on real output. Interestingly, we find that world interest rate has positive implications for GDP in short-run. The impulse response function becoming negative about five years after. How do we explain this result ? A positive real interest rate shock has a negative effect on US price level. In such case, lower price in US economy leads to a fall in domestic price that creates a currency depreciation in short run . The home depreciation raise home output. The gradual appreciation, leads in turn to contrationary effect on real output. An exchange rate appreciation leads to an contractionary output about 1.6% (versus 4.6% for flexible exchange rate countries).

Regarding the variance decomposition of output, we notice that supply shocks are the most important factor in explaining variation in real

output in both short-run and long-run, and thus accounting for 79.36 to 69.78 percent of the variation (see table 2). These findings are in accordance with recent studies on the relative importance of supply shocks as sources of business cycles in European and US economies.

Figure 11. GDP (flexible exchange rate regime)

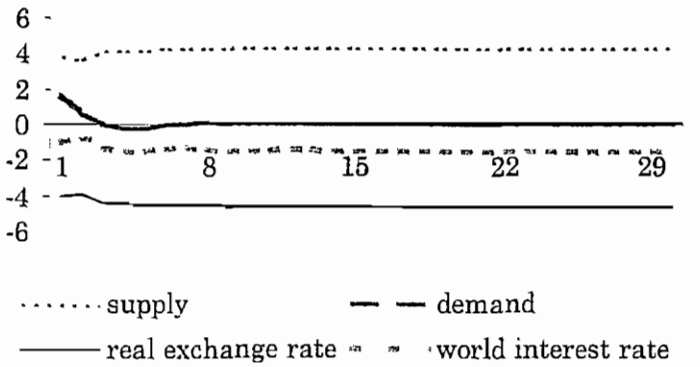


Figure 12. GDP (fixed exchange rate regime)

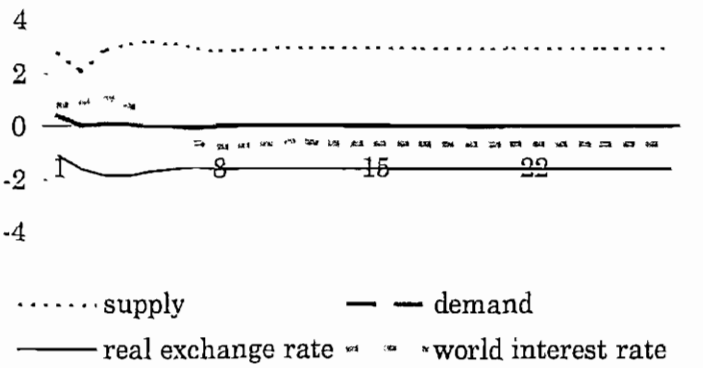


Table 1. Percentage of the variance of output due to
(flexible exchange rate regime)

horizon	$\nu_{iy,t}$	$\nu_{ip,t}$	$\nu_{ie,t}$	$\nu_{ii^*,t}$
1	41.89	8.08	47.43	2.58
5	38.08	11.32	47.03	3.55
10	38.00	11.37	46.94	3.67

Table 2. Percentage of the variance of output due to
(fixed exchange rate regime)

horizon	$\nu_{iy,t}$	$\nu_{ip,t}$	$\nu_{ie,t}$	$\nu_{ii^*,t}$
1	79.36	1.58	12.55	6.49
5	72.96	4.34	12.75	9.93
10	69.78	4.32	12.21	13.97

4.2 Dynamic adjustment of price

All response functions (see figures 13 and 14) have the expected shapes: consumer price in the Caribbean countries are driven by nominal shocks. Thus, change inflation rate are explained mostly by domestic factors rather than external factors. Contrary to countries with a flexible exchange rate, the interest shocks increase the price level. The differences responses to the shocks could be due to the fact that exchange rate is mainly responsible for the external shocks adjustment. In short, countries with fixed exchange rate are more vulnerable to inflation than countries with flexible exchange rate. This observation substantiates the idea put forward previously, which is that stabilization of prices should be one of government's main priorities.

However, world interest rate shocks have greater positive implications for fixed exchange rate countries. This result appears to be consistent with the real exchange rate variations (see figures 15 and 16).

Tables 3 and 4 show the variance decompositions derived from the structural VAR. We notice that the errors variance for consumer price index is dominated by nominal shocks at all horizons. As the horizon lengthens, the contribution of nominal shocks to the variance of inflation decrease while the contribution of world interest rate increase mostly for the second group of country. However, domestic supply shocks play a marginal role in explaining price movements.

Figure 13. Consumer price index (flexible exchange rate regime)

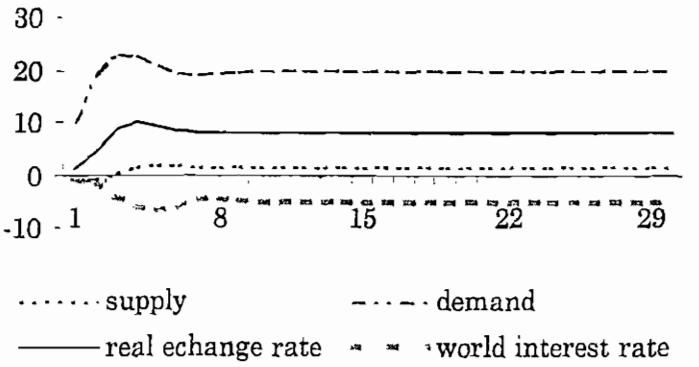


Figure 14. Consumer price index (fixed exchange rate regime)

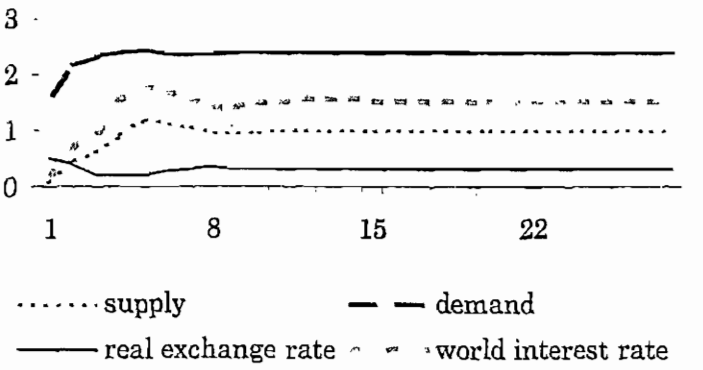


Table 3. Percentage of the variance of price due to
(flexible exchange rate regime)

horizon	$\nu_{iy,t}$	$\nu_{ip,t}$	$\nu_{ie,t}$	$\nu_{ii^*,t}$
1	0.42	98.70	0.64	0.22
5	1.52	80.07	13.13	5.26
10	1.49	79.16	13.29	6.03

Table 4. Percentage of the variance of price due to
(fixed exchange rate regime)

horizon	$\nu_{iy,t}$	$\nu_{ip,t}$	$\nu_{ie,t}$	$\nu_{ii^*,t}$
1	0.13	89.64	8.43	1.78
5	7.55	70.01	6.79	15.63
10	7.82	68.89	6.83	16.44

4.3 Dynamic adjustment of real exchange rate

As required by the identification restriction, the effects of an expansionary demand shocks on the real exchange rate is necessary temporary for first group. A positive domestic supply due to technological shock in the tradable sector, leads to a gradual depreciation (figure 15), while an exchange rate shocks cause an immediate increase in the real exchange rate. The latter converge to a new long run equilibrium (see figure 15). In contrast, a positive world interest rate shock leads to an appreciation. Moreover, this change of a permanent nature. It is interesting to note that the jump in the real exchange rate is nearly the same as that of consumer price index (figure 14). These two variables converge to their new long-run equilibrium in about 6 years. An increase in demand has a positive effect on real exchange rate. This nominal shock leads to a decline in the capital stock and causes a fall in domestic absorption. The associated variance decomposition (table 5) shows that real exchange rate is dominated at all forecast horizons by domestic supply shocks and by its own past behaviour. World interest rate and demand shocks play only small roles in the real exchange rate variations.

Regarding the fixed exchange rate group, we notice that response of real exchange rate to supply shocks are more persistent than world interest rate and demand shocks. These effects last for about 6 years before substantially dying out (figure 15). Noting that this shock leads to a real exchange rate appreciation. This is due to the fact that the wealth effect leads to a higher demand for non traded goods, which is met by a reallocation of labor to the non trade which create a reallocation of labor to the non traded sector induced by the increase in the relative price of the non traded good. The most striking of these results is that world interest rate shocks have insignificant effects on the real exchange rate movements. This result can be explained by the fact that in a fixed exchange rate regime, the exchange rate is no longer the adjustment variable to shocks.

The corresponding analysis of errors variance decomposition shows that exchange rate variation are driven mostly by domestic supply shocks and its own shocks.

Figure 15. Real exchange rate (flexible exchange rate regime)

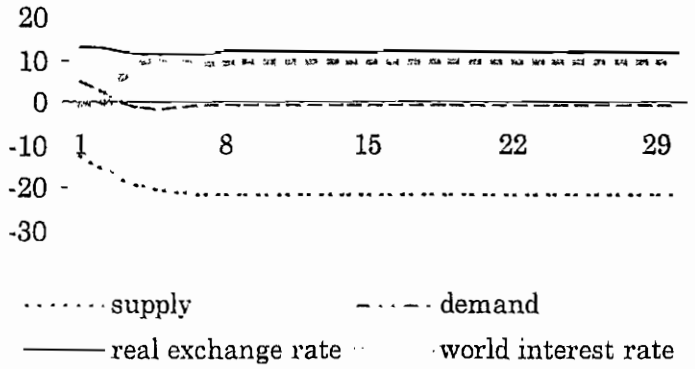


Figure 16. Real exchange rate (fixed exchange rate regime)

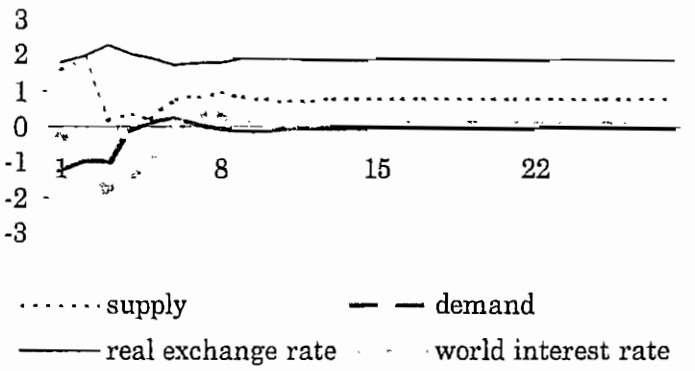


Table 5. Percentage of the variance of real exchange rate due to (flexible exchange rate regime)

horizon	$\nu_{iy,t}$	$\nu_{ip,t}$	$\nu_{ie,t}$	$\nu_{ii^*,t}$
1	42.86	8.97	48.09	0.06
5	39.32	10.41	38.65	11.07
10	39.20	10.97	38.50	11.30

Table 6. Percentage of the variance of real exchange rate due to (fixed exchange rate regime)

horizon	$\nu_{iy,t}$	$\nu_{ip,t}$	$\nu_{ie,t}$	$\nu_{ii^*,t}$
1	35.15	21.82	42.62	0.39
5	40.62	18.19	24.28	16.88
10	39.65	17.16	22.58	20.60

5 Summary and conclusions

The purpose of this paper has been to analyse the regional fluctuations of 12 Caribbean countries using a panel Vector autoregressive model. We assumed that fluctuations in real output, consumer price index, real exchange rate are the result of four types of economic forces : domestic supply shocks, domestic demand shocks, real exchange rate shocks and world interest rate shocks. Accordingly, we estimated a simple VAR driven by four exogenous disturbances which are identified so that they can be interpreted as the basic forces introduced above. Several conclusions can be drawn from this paper.

Firstly, while domestic demand shocks are relatively less important in causing short run fluctuations in real output, domestic supply shocks play a significant role in inducing long-term movements. Secondly, the analysis of response functions suggests that the sources of regional fluctuations in flexible exchange rate countries differ from the fixed exchange rate countries countries. Real exchange rate shocks have greater impact on output, inflation in flexible exchange rate countries than in fixed exchange rate countries. And thirdly, external shocks such as a raise of world interest rate, played a small role on the macroeconomic fluctuations in the second group of country countries. This result may reflect differences in the structure of the fixed exchange rate countries, for instance, in the concentration of primary exports. It suggests also that the implementation of a monetary union coupled with exchange rate arrangement prevents the real exchange rate playing any substantial role. In this case, The exchange rate is like a buffer for shocks from abroad.

In summary, the main source of output fluctuations in both the flexible exchange rate countries and fixed exchange rate countries are real, exchange rate and domestic supply shocks even in the short-run. It is interesting to note that these results are partially in accordance with those supply responses observed for other industrial countries.

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