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MONETARY POLICY, CENTRAL BANKS AND ECONOMIC PERFORMANCE IN THE CARIBBEAN

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Abstract

There is a growing consensus that monetary policy occupies a primary position in macroeconomic management. In this study we analyse how monetary policy performed in a sample of Caribbean countries and examines the question of the benefits of a single currency institutional framework. We establish the basis for short run effects of monetary policy a Clarida, Gali & Gertler (1999) framework. Although important lessons may be learnt from this model, within developing countries the institutional context and the channels through which monetary policy work are much more complex, because of the large differences between countries.

In a descriptive statistics analysis, framed within the discretion versus rules debate, we argue that there is not only an association between monetary policy, inflation and economic performance but also that the institutional contexts provided varying degrees of constraints on policy.

We use a univariate analysis on the price variables to conduct a comparative analysis on inflation and examined the background to the relationship between mean inflation and inflation persistence. The coefficients in univariate representation reflect feedbacks through other variables. To investigate these feedbacks we used Vector Autoregressions (VARS) and considered two forms: unrestricted VARs, and secondly we used a long-run cointegrating VECM relationship.

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Monetary Policy, Central Banks and Economic Performance in the Caribbean

1. Introduction

Since the 1990s there has been a growing consensus among academics and policy practitioners that monetary policy occupies a primary position in macroeconomic management. There has been considerable advance both theoretically and in the application of economic policies aimed at stabilising economies both in terms of prices and real variables. There has developed a substantial view in the literature that policy rules have major advantages over discretion in improving economic performance. There is now a substantial view that low inflation should be promoted to the primary objective and increasingly regarded as the important precondition for economic growth and development for open economies.

The quest for financial stabilisation in both developing, and the emerging market economies, has given rise to a resurgence of interest in the institutional framework of currency boards. This has formed a part of the corner solution or bipolar view of exchange rate regimes as a conditional choice between a hard peg (through a currency board arrangement, a currency union or some form of dollarization) and a float (Fischer 2001). The establishment of the European Monetary Union has also focussed attention on the effect of currency unions and renewed interest in the many, mostly small, currency unions that have been established for some time (Honohan & Lane 2000, Rose 2000).

We examine how monetary policy performed in this sample of Caribbean countries and what light this shed on the question of the benefits of a single currency institutional framework. In section 2 we establish the monetary policy framework with which the analysis will take place, in section 3 we analyse the macroeconomic framework, institutional structure, policy and performance of the twelve Caribbean economies in our sample group. In section 4 we present a univariate analysis of price inflation; in section 5 we discuss the set of variables to be used in the estimations that

follow and examine causality relations between them. In section 6 we carry out unrestricted and cointegrating vector autoregression analyses and section 7 presents the conclusions of the study and a comment on follow up work.

2. Monetary Policy Framework

Since, at least Theil and Tinbergen, economic policy has been analysed within a standard framework of five elements: objectives, instruments, model, forecasts and implementation. The policy maker, who we will call the Central Bank (CB) has certain **objectives** in terms of target variables that it wishes to influence and certain **instruments**, variables that the CB can control. The CB has a **model** of the economy, in this case of the monetary transmission mechanism, how the instruments influence the targeted variables. The CB and other agents make **forecasts** of each other's actions and exogenous shocks. The CB then **implements** what it considers the optimal setting of the instruments, other agents respond and outcomes are observed. This is a useful framework that we shall use, but it is important to recognise that it operates within an institutional context and this institutional context shape the choices available. For instance, even if central bank can develop optimal policies they may not be able to implement them because of political constraints on its independence. Nonetheless it is worth beginning with the standard account of how monetary policy is set in industrialised countries.

Below we follow the model as set out in Clarida, Gali, Gertler (1999), CGG.
It is usually assumed that the CB's objective is a discounted sum of some function, usually quadratic, of current and expected future deviations of inflation, π_t from its target and the output gap, x_t (the difference of log output from its natural rate). For instance, it may minimise a loss function of the form:

$$L = E_t \sum_{i=0}^{\infty} \beta^i \left(\alpha x_{t+i}^{\ 2} + \beta \pi_{t+i}^{\ 2} \right)$$

Where E_t denotes expectations formed at time t and β is the discount factor. There is a considerable literature on why the objective function takes this form and whether it imparts an inflationary bias to the economy. The instrument is usually assumed to be the short-term interest rate, r_t. The transmission mechanism involves two equations.

In the first, the interest rate influences, perhaps with a lag, the output gap (the difference between output and its natural rate), through an aggregate demand (IS) curve. The CGG form of the relationship is

$$x_t = -\phi(r_t - E_t\pi_t) + E_t x_{t+1} + g_t$$

where g_t is a demand shock determined by government expenditure. In the second, the output gap influences inflation, again perhaps with a lag, through an aggregate supply (Phillips) curve. The CGG form of the relationship is

$$\pi_t = \lambda x_t + \beta E_t \pi_{t+1} + u_t$$

where u_t is a cost-push shock. An LM curve could be added to this model to determine money demand, but it is not necessary since the interest rate rather than the money supply is the policy instrument. The shift from treating money supply as the instrument to treating interest rates as the instrument reflects instability in money demand functions because of financial innovation. This account assumes that the CB by shifting the short rate can influence the long-rate, which is what should appear in the aggregate demand curve. Both CB and the private sector make forecasts using rational expectations, making use of information at time t. An important issue here is whether the CB can influence the forecasts of the private sector, and thus the long rate of interest, through commitment to a target or a rule. It can do this if it has credibility with the private sector. Finally, the implementation of the optimal policy is often expressed in terms of a Taylor Rule, by which the short-term interest rate adjusts slowly to a desired value which is a function of (expected or actual) deviations of inflation from target and the output gap. For instance, assuming target inflation is zero and the rule is based on actual rather than expected values, the rule takes the form:

$$r_t - r_{t-1} = \mu(r_t^* - r_{t-1})$$
$$r_t^* = \gamma_0 + \gamma_1\pi_t + \gamma_2 x_t$$

For stability, we require $\gamma_1 > 1$.

The institutional context of such a description assumes floating exchange rates and fairly free movement of capital in and out of the country. The exchange rate is not a target, though it may play a role in the transmission mechanism from interest rates to output and inflation. Within the standard structure it is impossible to have an

independent monetary policy, fixed exchange rates and free movement of capital. At least one of these three elements must be dropped. One can have fixed exchange rates and an independent monetary policy, as under Bretton Woods, if the exchange rate is protected by controls on capital movements. In principle, one can have free movements of capital and a fixed exchange rate if monetary policy is devoted to maintaining the exchange rate target. In practice, this may be difficult to achieve, since the monetary policies required may not be feasible. The institutional context also assumes fairly thick financial markets in which interest rate changes have effects on the real economy. The structure of financial markets and the role of government debt within the financial system will influence objectives, instruments, transmission mechanism and implementation of policy. The institutional context also assumes a solvent public sector which does not need to print money to finance its deficit through seignorage.

This is explicitly a short-run model, designed to analyse the impact of policy at cyclical frequencies. It abstracts from the long-run relationships, which operate at much lower frequencies. These would determine the growth of the natural rate of output, the equilibrium real interest rate and real exchange rate in the economy. In industrialised economies these can be assumed to be close to their equilibrium values and the analysis of growth and cycles can be disentangled to some extent.

Although important lessons may be learnt from the model it is not directly applicable to many developing countries. In the standard model described above, one can ignore money; the central bank just supplies whatever is demand at the policy determined interest rate. In many developing countries, however, interest rates are less effective as a policy instrument and the money supply process is crucial. Money supply may be determined by the government budget constraint, where the deficit has to be financed by issuing bonds and/or money or it may be determined by the balance of payments constraint where there are currency board arrangements. In either case a money supply equation replaces the Taylor rule determining interest rates.

Within developing countries the institutional context and the channels through which monetary policy work are much more complex, because of the large differences between countries. The objective then will be to identify the differences in policy and

the transmission mechanism and use this to shed light on the qualitative differences in institutional context. These would determine the growth of the natural rate of output, the equilibrium real interest rate and real exchange rate in the economy. In developing countries it is also much less plausible to assume that the long-run real variables are close to their equilibrium values, thus the analysis of growth and cycles cannot be as easily disentangled. To provide some background to this we provide a brief review of the literature on objectives, instruments and transmission mechanism for monetary policy in developing countries, before surveying some empirical studies.

3. Macroeconomic Performance and Institutional Framework

In a comparative examination of the monetary transmission mechanism there are historical and institutional reasons that make the English speaking Caribbean countries particularly interesting. These countries share a common colonial institutional background in that they were all British colonial territories that prior to their independence were governed within a fairly common institutional economic framework. From the early 1960s they gradually became politically independent and are able to pursue independent economic policies. They all at first adopted fixed exchange regimes at first pegged to the £ but from the 1970s they are all pegged to the US$.

In this study there are twelve Caribbean countries. Six of the countries belong to the Eastern Caribbean Central Bank (ECCB) group. These are the six island states of: Antigua & Barbuda, Dominica, Grenada, St. Kitts & Nevis, St. Lucia and St. Vincent & The Grenadines. The ECCB monetary union consists of eight countries (Anguilla and Montserrat are excluded from this study due to the unavailability of data). The six non-ECCB countries in the study are The Bahamas, Barbados, Guyana, Belize, Jamaica and Trinidad & Tobago. Three of these countries have significant physical resources: Guyana with agricultural and various mineral resources; Jamaica with bauxite; and Trinidad and Tobago with oil and gas. In spite of their resource advantages, however, Guyana and Jamaica record the lowest per capita incomes relative to the other countries, see Table 1.1 below.

Post independence the countries have developed independent monetary institutions. Six of the smallest island states developed a **currency union** with a single monetary

authority, the East Caribbean Central Bank (ECCB). The other six developed stand alone central banks for their individual states, following largely the model of the Bank of England but developing individual characteristics. This sets the institutional contexts of monetary policy and provides the constraints within which macro policy takes place.

The countries of the ECCB group are micro-states in both geographical and population terms. St. Lucia has the largest ECCB population of 152,000 people. The two ECCB countries excluded from this study have between them the smallest population and the smallest land area: Montserrat and Anguilla. The ECCB sample, therefore, we take to be representative of that population.

The ECCB populations are mainly rural populations. Most of these countries are less than 40% urbanised and rely heavily on revenues from international tourism. Tourism receipts for 1998 in the ECCB islands ranged between 30% and 76% of their total exports, see Table 1.1. By way of comparison, for the same year, the tourism receipts as a percentage of total exports for the UK and USA with important tourism sectors were 6% and 8%, respectively. There is, therefore, a very heavy reliance on international tourism revenues. These islands do not earn any significant revenues from particular mineral resource endowment, such as oil, bauxite or diamonds.

Table 1

COUNTRY CHARACTERISTIC VARIABLES, 1998

	Total Population	Urban pop (% of total)	Int Tourism Receipts (% of exports)	GDP (per capita) PPP (curr int $)	% growth of GDP per capita (1980 – 1998)
ECCB					
Antigua and Barbuda	66,860	36	60	9277	7.3
Dominica	73,000	70	30	5102	6.9
Grenada	96,200	37	44	5838	6.9
St. Kitts and Nevis	40,820	34	53	10672	8.6
St. Lucia	152,000	38	76	5183	6.4
St. Vincent & Grenadines	113,220	52	46	4692	7.0
Non-ECCB					
The Bahamas	294,000	88	74	14614	2.9
Barbados	265,630	49	55	.....	
Belize	238,500	53	30	4566	4.7
Guyana	849,180	37	9	3403	3.1
Jamaica	2,576,000	55	35	3389	3.3
Trinidad and Tobago	1,285,140	73	7	7485	2.3
United Kingdom	59,055,000	89	6	20336	5.0
United States	270,299,008	77	8	29605	4.8

.. not available from wdi 2000, obtained from .....

Source: World Bank, World Development Indicators, wdi 2000, CD-ROM.

As a group, the countries are fairly homogenous.

- They are small open economies;
- both groups remain importantly rural, with the exception of The Bahamas that has 88% urbanised population;
- with the exception of Guyana and Trinidad and Tobago, all the countries rely on international tourism.

The growth experience of these countries provides insight into the dynamics of their economic activity. In the graph below real GDP is re-based so that 1980=100 for all countries the slope of the line indicates the rate of growth. The four countries with the flattest line indicating the slowest rate of growth since 1990 are Trinidad and Tobago, Guyana, Barbados and Jamaica. These are the four major economies of the English speaking Caribbean and with the notable exception of Barbados, the most highly resource endowed countries. The bunching of lines with the steeper slopes are ECCB countries and Belize. The growth experience suggest of the sample suggest one group a record of consistent growth and another very low and inconsistent growth record, Atkins & Boyd 1998.

The growth in output is inversely associated with the inflation experience of the countries, discernible from Figure 2, and the inflation rate is positively associated with the rate of growth in the broad money supply as can be observed in Figure 3 where a linear associated is clearly observable.

Figure 1

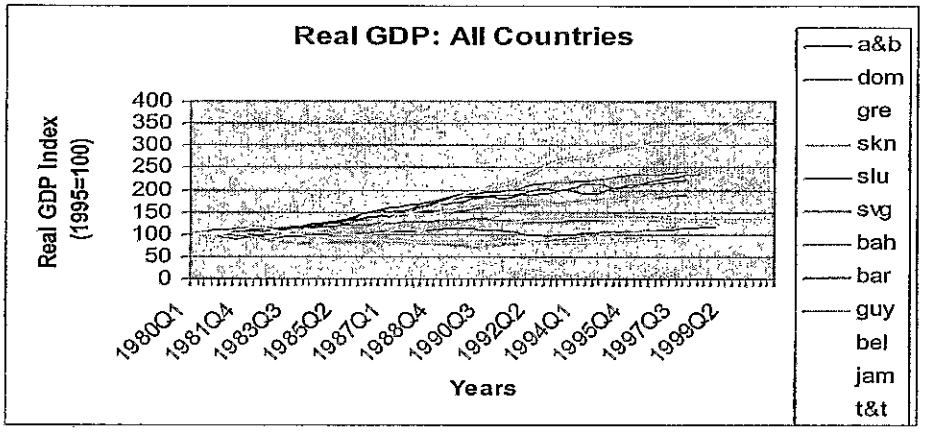


Figure 2

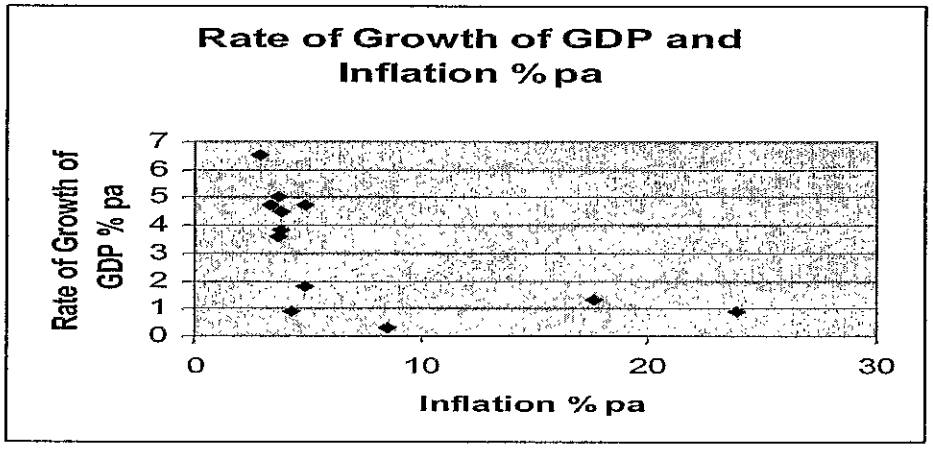
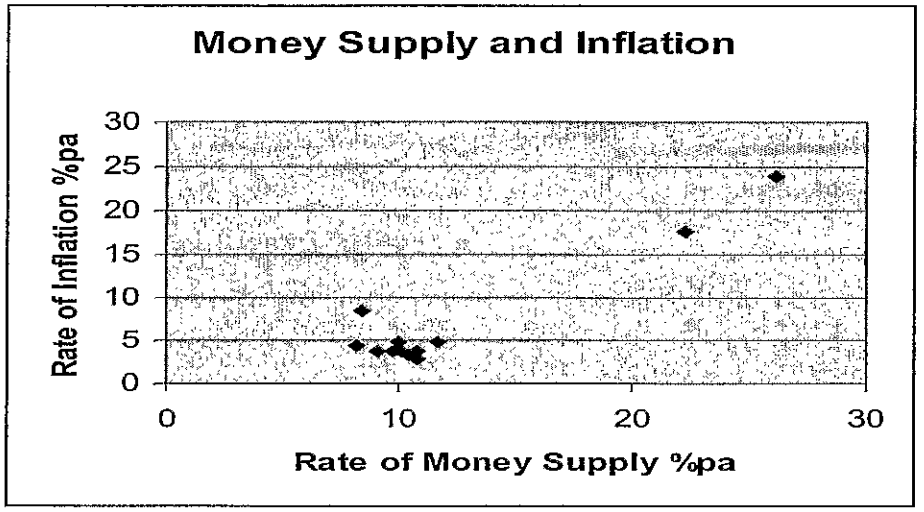


Figure 3



In the relatively low inflation countries real interest rate were, on average positive over the period while in the cases of Guyana, Jamaica and Trinidad and Tobago average real interest rates were negative. Nominal exchange rates for the ECCB, Bahamas, Barbados and Belize were constant over the period while the Guyana, Jamaica and Trinidad and Tobago underwent significant devaluations associated with prolonged balance of payments and foreign exchange crises.

The monetary institutional framework of the economies provides a basis for explaining the variation in the economic performances. The single currency central banks that were established among these Caribbean countries were all products of their colonial heritage and, by design, modelled on the Bank of England. They, however, right from the start developed individual features driven by national forces.

The movement toward political independence came to fruition during the 1960s and gave rise to the development of a new set of monetary institutions by the newly independent states. Jamaica established a central bank in 1962, Trinidad & Tobago, Guyana in 1965 and Barbados in 1972. These were modelled along the lines of the Bank of England marking a significant break with the previous currency board arrangements underlying monetary policy in these countries. As with the Bank of England at that time, these central banks did not operate independently of the government but rather served essentially as a department of central government.

In 1965 the East Caribbean Currency Authority (ECCA) was established replacing the British Caribbean Currency Authority (BCCB) responsible for the Eastern Caribbean dollar (EC$).[1] This had headquarters in Barbados serving that country as well as the states of the remaining Caribbean islands – effectively the current members of the ECCB. Unlike the newly established central banks above, the ECCA retained not

[1] The governing colonial monetary institutions of the Caribbean was along established currency board system (/Schuler 1992) and whilst it evolved, it essentially remained in place well into the post World War II era. The British Government established the British Caribbean Currency Authority (BCCA) in 1950 as the central monetary authority for British colonies in the Caribbean. The BCCA functioned as a currency board and colonial authorities could only issue new currency against the equivalent holding of sterling securities in London (Blackman 1998).

only the currency union aspect of its predecessor, the BCCB, but also the currency board element of its operations - for commercial banks to obtain cash they had to continue to deposit the sterling equivalent with the Authority's agents in London. So that at its start, the ECCA currency, the Eastern Caribbean dollar (EC$) was 100% backed by sterling (ECCA 1982). Overtime as the role of the Authority developed and it began lending to member governments the 100% foreign asset backing was reduced to requiring it to maintain a minimum of 60% external assets backing of the currency in circulation and other demand liabilities.

In time Barbados left to establish its own currency and central bank and the Eastern Caribbean Central Bank (ECCB) was established in 1983 replacing the ECCA. The ECCB, however, retained the important features of the ECCA. So that, whilst the ECCB developed as a central bank that can and does function much as any central bank in the support of member countries economic and monetary policies, it has continued the currency union and currency board institutional arrangement of the old British Caribbean Currency Authority and retained the currency board aspect to its operations - the 60% backing of the currency introduced by the ECCA. Moreover, this regulatory 60% minimum foreign assets backing of the EC$ understates the real backing of the EC$ that tend more towards 100% - for instance, in March 2002 the backing was 97%.

The Central Bank of The Bahamas (CBB) established in 1974, like the ECCB, has also retained a currency board element as it evolved from a colonial currency board institution, through to a monetary authority and into a central bank. Moreover, monetary stability is the primary constitutional role of the CBB and it is required to ensure that external reserves are maintained at a minimum of at least 50% of the value of total notes and coins in circulation and demand liabilities of the Bank. Like the ECCB the CBB generally report reserves in excess of this minimum.

The low inflation and exchange rate stability of the ECCB and The Bahamas can be seen as importantly influenced by the currency board aspect to their institutional structure that enforced monetary and fiscal discipline. This in turn promoted stability in their output and external accounts and nominal exchange rate.

In the cases of Barbados and Belize, although they have the institutional features of the non-independent stand alone central bank, monetary stability was an essential feature of their operations. An important feature of the Barbados currency stability success arises from the prudence that characterise its operations and the policy credibility that rapidly developed with the establishment of the Central Bank of Barbados. So whilst the currency board framework constrained the ECCB and CBB to prudent monetary policies, the prudence in the case of Barbados and Belize resulted from conservative discretionary policy choices. Commitment to an anti-inflationary policy and the credibility of policy pursuant to that objective underlie the successful economic performance of Barbados.

The poor monetary policy performance of Guyana, Jamaica and Trinidad and Tobago may be seen as resulting from imprudent discretionary policy choices largely as a result of accommodating their central government debts. Those debts being incurred in the hope that they could be repaid by future growth and resource earnings.

There is growing agreement that the choice of how to conduct monetary policy has important consequences for aggregate activity. There is a growing literature on optimal monetary policy frameworks that are reasonably general in their applicability. The CGG (1999) approach described above provides a reasonably general starting point from which to analyse these economies. The approach rests on the notion that temporary nominal price rigidities provide the key friction that gives rise to non-neutral effects of monetary policy. Within this approach, developed in the main with reference to industrial economies, the primary monetary policy instrument is a short-term interest rate. An important aspect of this approach, as distinct from its IS/LM predecessor, is that, private sector behaviour depends on expected as well as current monetary policy. Thus, since expectations concerning future policy also determine current behaviour, the credibility of monetary policy becomes relevant, and this is borne out by the attention this attracted in the recent literature. One way of enhancing policy credibility is through policy rules, as in the Taylor rule or through certain established monetary policy reaction function, embedded in what Courtney Blackman, among others, would call conservative monetary policy, and this seems to underlie the credibility of the Barbadian monetary policy experience. Another way of enhancing credibility is to adopt a monetary policy institutional framework that

constrains policy far more rigidly than a Taylor rule or conservative monetary policy, such as the currency board arrangements found in the Eastern Caribbean Central Bank and the Central Bank of The Bahamas. This latter seems useful in the cases of particularly vulnerable small open economies (Repse 1999).

There is a growing literature that suggests that there may be gains from making binding commitments over the course of monetary policy or, alternatively, making institutional arrangements that accomplish that same purpose. The issue of whether there may be some simple institutional mechanisms that can approximate the effect of the idealised policy commitment is one that is pertinent to the varied experience of the Caribbean economies and addressed in a plurality of ways. Overall, their experience appears to provide some evidence to support the CCG 1999 conclusions that "Perhaps the most useful answer to the question comes from Rogoff (1985), who proposed simply the appointment of a "conservative" central banker, taken in this context to mean someone with a greater distaste for inflation that society as a whole" (CCG 1999, p.1677). The comparative analysis indicates further, however, evidence of institutional arrangements that may work to enhance policy credibility within a framework more rigid than ones suggested my policy rules.

4 Univariate Analysis

Consider a very simple version of the three equation model used above, of Phillips Curve, IS curve and Taylor Rule, where we use lagged inflation for expected inflation.

$$\pi_t = \alpha_0 + \lambda x_t + \beta \pi_{t-1}$$
$$x_t = \phi_0 - \phi_1 (r_t - \pi_{t-1})$$
$$r_t = \gamma_0 + \gamma_1 \pi_{t-1} + \gamma_2 x_t$$

We can interpret this is the structural form. Using the last two equations we get

$$x_t = \theta\left[(\phi_0 - \phi_1\gamma_0) + \phi_1(1-\gamma_1)\pi_{t-1}\right]$$

$\theta = (1+\gamma_2\phi_1)^{-1}$ and substituting this in the first equation we get the univariate representation for inflation

$$\pi_t = \left[\alpha_0 + \lambda\theta(\phi_0 - \phi_1\gamma_0)\right] + \left[\beta - \lambda\theta\phi_1\gamma_1\right]\pi_{t-1}$$
$$\pi_t = \pi^*(1-\rho) + \rho\pi_{t-1}$$

In this section we will examine the univariate representation, the autoregression which gives the relationship between inflation and its past values. In the next section we will examine a three equation system, similar to the structural form, though using money supply rather than interest rates. In the autoregression, ρ, measures the persistence of inflation, while π^* is the steady state rate of inflation. Notice that both parameters are complicated functions of the underlying structural coefficients, including the coefficients of the policy rule. The persistence of inflation is of some interest, because it has often been argued that it is a function of monetary policy or exchange rate regime, e.g. Alogoskoufis and Smith (1991) argue that persistence will be lower under fixed exchange rates, and there is a large subsequent literature about the interaction between inflation and monetary policy regimes.

We need to allow for rather more complicated dynamics than a simple autoregression and we will use an Augmented Dickey Fuller type univariate equation for inflation

$$\Delta p_t = a + bp_{t-1} + c\Delta p_{t-1} + d\Delta^2 p_{t-1} + et + \varepsilon_t \qquad (1)$$

where p_t is log price level and $\Delta p_t = \pi_t$, inflation. This nests a number of interesting cases. If b=0, there is a unit root in the price level and inflation is I(1). If b=0 and e=0; then c is a measure of the persistence of inflation, equivalent to ρ above and the equilibrium inflation rate is $\pi^* = a/(1-c)$, which is likely to be close to the mean inflation since the mean of $\Delta^2 p_{t-1}$, the average acceleration in inflation, is likely to be close to zero. In the estimates of equation (1) above, not reported[2], the hypothesis of a unit root can be rejected in Gre[3], Slu, SVG, Bar and there is some evidence against a unit root in Bel – the ADF statistics is marginally below the critical value.

These results raise a modelling issue that will recur. The ADF tests suggest we should use different models for different countries, treating the variables as I(0) in 4 cases and I(1) in the rest. However, if we have different models for different countries, we lose comparability. Therefore, where different specifications appear appropriate in different countries, we will estimate the alternative models for all countries. In this

[2] These results and the full text of the working manuscript can be found at http://homepages.uel.ac.uk/D.A.C.Boyd/Eccb%20complete%20manuscript%2014July2003.doc

[3] Country names abbreviations are used in the tables and texts: Antigua & Barbuda (AB), Dominica (Dom), Grenada (Gre), St. Kitts & Nevis (SKN), St. Lucia (Slu), St. Vincent & the Grenadines (SVG), The Bahamas (Bah), Barbados (Bar), Guyana (Guy), Belize (Bel), Jamaica (Jam), Trinidad & Tobago (TT).

case, the alternatives are the trend stationary model, which we estimated above and the unit root model.

The unit root restriction was imposed to give a second order autoregression in the inflation rate

$$\Delta p_t = \alpha + \rho \Delta p_{t-1} + \gamma \Delta^2 p_{t-1} + \varepsilon_t \qquad (2)$$

This was estimated for all 12 countries and Table 2 gives mean inflation (percentage per annum), the persistence of inflation ρ and its standard error and the estimate of the standard error of the regression, SER, σ, which measures the average size of the inflation shocks, the t statistic for $\rho = 1$ and the t statistic for $\rho = 0$; γ which is not reported was negative for all countries but Jamaica. Except for Jamaica, an acceleration in inflation, tends to be followed by a fall in inflation, stabilising the system.

Table 2 **Restricted ADF Estimates**

Countries	mean inflation[a]	Persistence ρ	se(ρ)	Ser %, σ	ADF, t	t
ECCB						
AB	4.94	0.8156	0.0774	0.53	-2.38190	10.5323
DOM	3.6	0.1516	0.1475	1.31	-5.75186	1.027797
GRE	3.8	0.5648	0.0796	0.87	-5.46734	7.095477
SKN	3.24	0.3171	0.1318	0.98	-5.18134	2.405918
SLU	3.6	0.2227	0.1507	1.58	-5.15793	1.47777
SVG	3.76	0.2554	0.1535	1.37	-4.85147	1.663192
Non-ECCB						
BAH	4.84	0.4835	0.1275	0.66	-4.05098	3.792157
BAR	4.28	0.2316	0.1489	1.55	-5.16398	1.556452
GUY	23.92	0.5633	0.1221	8.48	-3.57658	4.613432
BEL	2.88	0.3894	0.1252	1.15	-4.877	3.110224
JAM	17.68	0.7529	0.0695	2.34	-3.5554	10.83309
TT	8.44	0.3839	0.1416	1.35	-4.35099	2.711158

[a] Mean inflation measured as percentage per annum.

Figure 4

Mean Inflation and Inflation Persistence

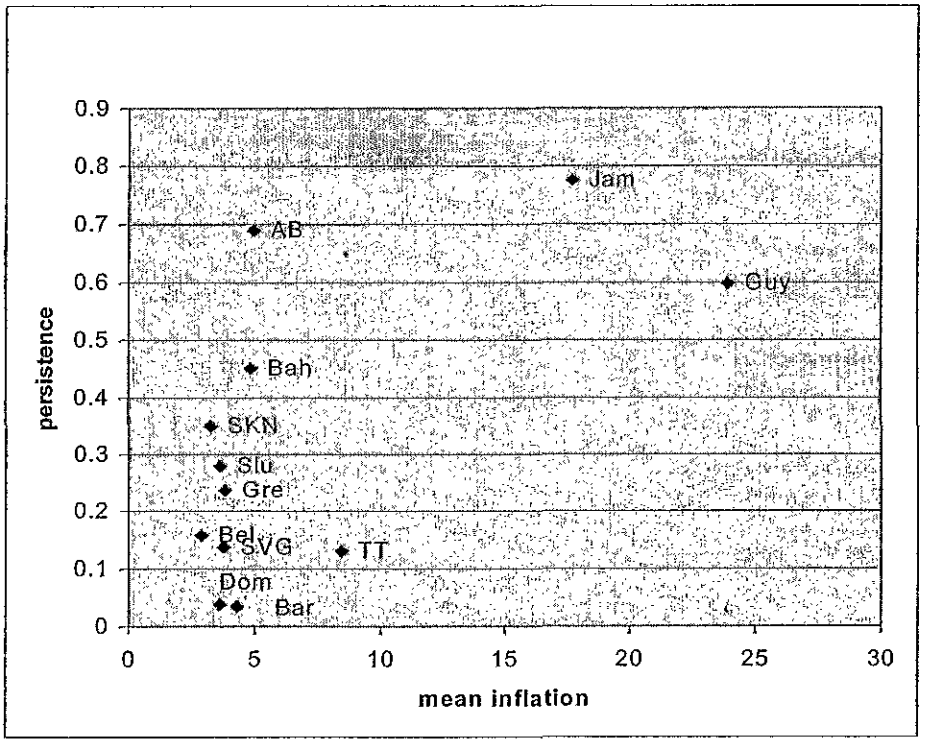
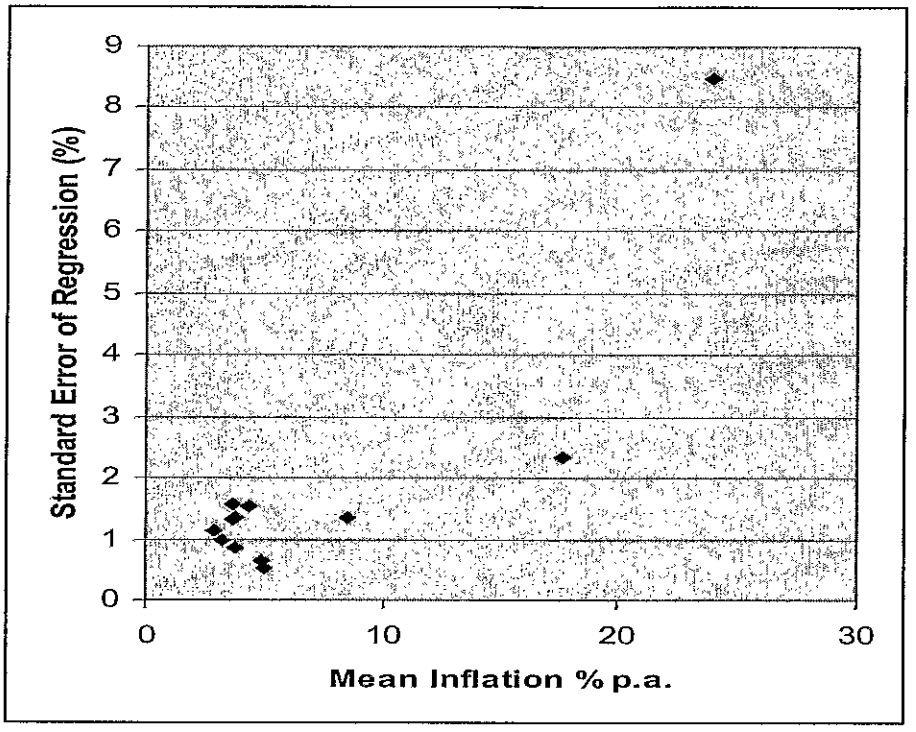


Figure 5

Mean Inflation and Inflation Variation



These results indicate that there is some tendency for countries with higher mean inflation to have higher persistence and larger variances, see Figures 4 and 5. Guyana and Jamaica, and to a certain extent Trinidad and Tobago have a different relationship to the other countries in the sample. This is in line with the results of the previous section that shows countries with either institutional restrictions on monetary policy (ECCB and The Bahamas) or conservative monetary policies (Barbados and Belize) show low inflations results, while those govern by discretionary policies (Guyana, Jamaica, Trinidad and Tobago) have higher inflation outcomes.

The AB result with respect to inflation persistence is at odds with the rest of the ECCB countries. It has low mean inflation 4.9 % per annum, and a small variation with SER 0.5%, but has the highest measured persistence, 0.82. Also, on these estimates AB is the only case where a unit root in inflation cannot be rejected. We cannot explain this anomaly, but it may be connected with measurement issues.

Conversely, Trinidad & Tobago has higher inflation 2.1%, larger SER 1.35%, but quite low persistence 0.38. For Barbados and three of the ECCB countries, Dom SLU and SVG we cannot reject the hypothesis that inflation persistence is zero.

Overall, the results provide evidence of an association between the monetary policy framework of the countries and their inflation performance and sheds some light on the different inflation performances of the countries. All the ECCB countries, Bah, Bar and Bel show low mean inflation rates and low variation in rates and with the exception of AB, low inflation persistence. In contrast, Guy and Jam show high mean rates, high persistence and high variations in inflation.

5 Unrestricted VAR

As we saw at the beginning of the last section, the coefficients in univariate representation will reflect feedbacks through other variables. To investigate these feedbacks we will use Vector Autoregressions VARS. We will consider two simple forms, the first unrestricted, the second using a long-run cointegrating relationship. As seen above, there is also a trade-off between having a common specification versus getting the right specification for each country. Since we want to compare transmission mechanisms between the two groups it is worth starting with a common specification. The major objection to this is that in ECCB and some other countries, two variables, the exchange rate and the interest rate do not vary. In many models these variables play a major role in the adjustment process, but clearly this is not the case in many of these countries. Therefore we will begin with a small standard monetary model in 3 variables, money income and prices m_t, y_t, p_t and a trend. VARs in these three variables have been estimated for many countries. This can allow for a Phillips curve determining inflation in terms of deviation of output from its trend and a money demand curve, with inflation being taken as a measure of the opportunity cost of holding money. However in the unrestricted VAR such theoretical structure is not imposed and it is not clear that one would expect a traditional Phillips curve type relationship in these economies.

In this case the VAR takes the form

$$y_t = a_{10} + b_1 t + \sum_{i=1}^{p} a_{11i} y_{t-i} + \sum_{i=1}^{p} a_{12i} p_{t-i} + \sum_{i=1}^{p} a_{13i} m_{t-i} + u_{1t}$$

$$p_t = a_{20} + b_2 t + \sum_{i=1}^{p} a_{21i} y_{t-i} + \sum_{i=1}^{p} a_{22i} p_{t-i} + \sum_{i=1}^{p} a_{23i} m_{t-i} + u_{2t}$$

$$m_t = a_{30} + b_3 t + \sum_{i=1}^{p} a_{31i} y_{t-i} + \sum_{i=1}^{p} a_{32i} p_{t-i} + \sum_{i=1}^{p} a_{33i} m_{t-i} + u_{3t}$$

where trends are included. The first stage is to take the unrestricted VAR, with a maximum lag of four and use the AIC to determine lag length, this suggested p=2, which we use below. We can also investigate whether a particular variable is Granger-causal for the other variables. For instance if prices were Granger non-causal with respect to output then all $a_{12i} = 0$ because past values of inflation do not help explain current values of output. We test whether each variable is Granger non-causal with respect to the other two variables, so the test for prices being Granger non-causal with respect to output and money, tests both $a_{12i} = 0$ and $a_{32i} = 0$, with two lags this is four restrictions.

Table 3 gives the p values of the tests for Granger non-causality for each variable. A p value below 0.05 indicates that the column variable is a significant predictor of the other two variables at the 5% level. So for AB, money is a significant predictor of output and prices, but prices are not a significant predictor for money and output. In the case where the variables are I(1) the distributions of the test statistics are non-standard, so the tests can only be indicative, the true critical values will be different from the usual asymptotic values.

Output is significantly Granger causal for the other two variables in all but AB, SKN, SVG and BAH, the other two variables are less important for prediction. Money helps predict the other variables in only four countries: AB, Dom, SLU and BAR. Prices help to predict the other variables in five of the countries.

Table 3

Granger Non-Causality p values

Countries	m	y	p
ECCB			
AB	**0.049**	0.060	0.070
DOM	**0.041**	**0.004**	0.386
GRE	0.126	**0.033**	0.100
SKN	0.103	0.803	**0.002**
SLU	**0.004**	**0.001**	**0.014**
SVG	0.135	0.088	0.187
Non-ECCB			
BAH	0.868	0.339	0.053
BAR	**0.011**	**0.000**	**0.002**
GUY	0.412	**0.005**	**0.000**
BEL	0.179	**0.002**	0.574
JAM	0.192	**0.003**	**0.001**
TT	0.222	**0.000**	0.124

Bold figures are significantly Granger causal at 5%.

We estimate unrestricted Vars of order two and report the effect of two shocks: a money shock via orthogonalised impulse response functions and an inflation shock via generalised impulse response functions. These differ in the assumptions about the links between the shocks to different equations. The orthogonalised impulse response function assumes the variables form a causal chain in which output influences prices, and output and prices influence money, but there are no feedbacks within a period. The generalised impulse response function assumes that the correlation between the shocks is the same as it was over the sample period. Table 4 indicates that a one standard error shock to money in AB raises it by 2.5% and at the end of 50 quarters prices and output are 0.3% higher and money 0.5% higher. Table 5 indicates that a one standard error shock to prices raises them by 0.5%, and in the same period this makes output 0.1% lower and money 0.1% higher, after 50 periods the effect of this composite shock is to make prices 0.3% higher, output 0.2% higher and money 0.4% higher.

Table 4

Unrestricted VAR: Orthogonalised Impulse Response Functions

1SE shock to money, percent						
	On impact			After 50 quarters		
ECCB	p	y	m	P	y	m
AB	0.0	0.0	2.5	0.3	0.3	0.5
DOM	0.0	0.0	3.6	0.0	0.0	0.0
GRE	0.0	0.0	3.3	0.0	0.0	0.0
SKN	0.0	0.0	4.1	0.0	0.0	0.0
SLU	0.0	0.0	2.6	0.0	0.2	0.3
SVG	0.0	0.0	3.3	0.0	0.1	0.1
Non-ECCB						
BAH	0.0	0.0	1.8	0.0	0.3	0.0
BAR	0.0	0.0	2.2	0.0	0.0	0.0
GUY	0.0	0.0	3.9	0.5	-0.1	0.2
BEL	0.0	0.0	2.6	0.0	0.0	0.0
JAM	0.0	0.0	3.7	-0.3	0.1	-0.3
TT	0.0	0.0	3.1	0.1	0.0	-0.1

Table 5

Unrestricted VAR: Generalised Impulse Response Functions

1SE shock to inflation, percent						
	On impact			After 50 quarters		
ECCB	p	y	m	p	y	m
AB	0.5	-0.1	0.1	0.3	0.2	0.4
DOM	1.1	-0.1	0.3	0.0	0.0	0.0
GRE	0.8	0.0	-0.7	0.0	0.0	0.0
SKN	0.9	-0.1	0.2	0.0	0.0	0.0
SLU	1.4	-0.3	0.1	0.0	-0.1	-0.2
SVG	1.2	-0.3	-0.3	0.0	0.0	-0.1
Non-ECCB						
BAH	0.6	-0.1	-0.3	0.1	0.8	0.1
BAR	1.3	-0.1	0.2	0.0	0.0	0.0
GUY	8.0	0.2	0.1	-1.1	-0.4	-1.1
BEL	1.0	-0.2	-0.2	0.0	0.0	0.0
JAM	2.2	-0.02	0.5	0.1	0.1	0.0
TT	1.2	-0.2	-0.1	0.1	-0.1	0.3

These results provide evidence of short run output costs to inflation across virtually all the countries, so overall inflation is associated with a short run reduction in output

and is positively associated with the money supply. Table 5 shows that the short-run correlation between an inflation shock and output shock is negative, except for Gre where it is zero and Guy where it is positive; and that the short run correlation between an inflation shock and money is positive, except for Gre, SVG, Bah, Bel and TT.

The long-run impact of a monetary shock is zero on all three variables for Dom, Gre, SKN, Bar and Bel, similarly the long-run impact of an inflation shock is zero for those countries – evidence of money neutrality in these cases. The ADF tests of equation (1) suggested that the price level was I(0) for Gre, Slu, SVG, Bar and possibly Bel. This implies that inflationary shocks should die out to zero. The list of countries where the inflation shock is zero after 50 quarters are Dom, Gre, SKN, SLu, SVG, Bar and Bel; that is, the list of where the inflation shocks die out contains the subset of those indicated by our ADF tests - which suggested that they should die out in Gre, Slu, SVG, and Bar, the cases where the price level was I(0). The inflation persistence noted for AB is here associated with 0.3% inflation after 50 quarters. The shocks do not die out in the cases of Guy, Jam, TT and The Bah. Overall, the estimates are consistent with previous results, here the low inflation countries (ECCB, Bar, Bel) show evidence of inflation shock that die out. The high inflation cases of Guy, Jam and TT show markedly different responses and AB and Bah lie somewhere in between. Where they are non-zero, the long-run effects are difficult to interpret. The issue of whether one treats the variables as I(1), shocks persist, or I(0), shocks die out, is clearly crucial to the interpretation. We now examine the effect of treating the variables as I(1), shocks are persistent, and cointegrated, with a long-run money demand relationship.

To conduct the cointegration analysis we can write the VAR as a Vector Error Correction Model, VECM. We will assume that our three variables are I(1) and have a single cointegrating vector, which we will interpret as a demand for money function, where v_t is trend adjusted velocity:

$$v_t = y_t + p_t + \beta_3 t - m_t$$

Since r=1, the single, just identifying restriction that we need is to normalise the logarithm of real money to have a coefficient of –1; but we shall also impose the over-identifying restrictions that y_t and p_t have unit coefficients. We have restricted the trend to enter the cointegrating vector, but we have allowed the intercept to be unrestricted. This allows for linear trends in the data, but precludes quadratic trends. Assuming a VAR(2) the system can then be written as,

$$\Delta y_t = \mu_1 + \alpha_1 v_{t-1} + \gamma_{11}\Delta y_{t-1} + \gamma_{12}\Delta p_{t-1} + \gamma_{11}\Delta m_{t-1} + u_{1t}$$
$$\Delta p_t = \mu_2 + \alpha_2 v_{t-1} + \gamma_{21}\Delta y_{t-1} + \gamma_{22}\Delta p_{t-1} + \gamma_{21}\Delta m_{t-1} + u_{2t}$$
$$\Delta m_t = \mu_3 + \alpha_3 v_{t-1} + \gamma_{31}\Delta y_{t-1} + \gamma_{32}\Delta p_{t-1} + \gamma_{31}\Delta m_{t-1} + u_{3t}$$

The feedback coefficients α_i tell us how disequilibrium in the money demand feeds back on the three variables in the system. We would expect the lagged value of each variable to have a negative effect on its change, so $\alpha_1 < 0; \alpha_2 < 0; \alpha_3 > 0$. In systems with more cointegrating vectors, it is not simple to sign the adjustment coefficients. In this case there is a simple way to interpret the adjustment since ignoring the dynamics and errors

$$\Delta v_t = (\mu_1 + \mu_2 - \mu_3) + (\alpha_1 + \alpha_2 - \alpha_3)v_{t-1} + ...$$

and the system is stable if $0 > \alpha_1 + \alpha_2 - \alpha_3 > -1$.

The Johansen trace 10% test identified 2 cointegrating vectors in Bar, BEL and TT, one in AB, DOM, Gre, SLU, SVG, SKN and Guy, none in Bah and Jam. On this basis it was assumed that there was a single cointegrating vector in each economy and the over-identifying restrictions were imposed. Although these were not rejected at the 5% level only in Bar and SKN, and at the 1% level only in AB, Dom, and Jam and TT; the asymptotic critical values are likely to cause over-rejection in small samples and the restrictions were maintained despite being rejected by the tests. In the output equation, nothing was significant except the lagged change in output. The ECM term in the money equation was significant and positive, as it should be, in half the cases and was insignificantly positive in the rest.

Table 6 gives the estimates of α_i and $a = \alpha_1 + \alpha_2 - \alpha_3$ and r the number of cointegrating vectors; cointegration requires significant feedbacks; significant (t>2)

adjustment coefficients are shown in bold. There may be cointegration and no significant adjustment if the restricted cointegrating vector that we are using is not the right one. There is at least one significant adjustment coefficient, everywhere except SLu, Bah (where there is no cointegration), Guy (where the coefficients in the price and money terms are just below 2) and TT. Jam where there is no cointegration the error correction term, v_{t-1}, has a large and significant feedback on money. All the feedbacks to output have the right sign except in TT, where there is no significant adjustment and all the feedbacks to money have the right sign. Half the feedbacks to prices have the wrong sign (the correct sign is negative), and is significantly wrong in two cases, SKN and Bel. In all cases the condition for stable adjustment in the system is met.

Table 6

Adjustment Coefficients[a]

Countries	P	y	m	a	r
ECCB					
AB	-0.010	**-0.047**	0.077	-0.134	1
DOM	**-0.096**	-0.025	**0.301**	-0.422	1
GRE	**-0.041**	-0.003	**0.099**	-0.143	1
SKN	**0.049**	-0.021	**0.160**	-0.132	1
SLU	0.006	-0.016	0.075	-0.085	1
SVG	0.041	-0.034	**0.209**	-0.202	1
Non-ECCB					
BAH	0.009	-0.033	0.026	-0.050	0
BAR	**-0.271**	**-0.075**	**0.341**	-0.687	2
GUY	-0.075	-0.001	0.042	-0.118	1
BEL	**0.053**	**-0.054**	0.039	-0.040	2
JAM	-0.038	-0.007	**0.133**	-0.178	0
TT	0.009	0.023	0.074	-0.042	2

[a] Significant feedbacks; significant (t>2) adjustment coefficients are shown in bold.

We now examine the response of the cointegrating VAR to shocks, again examining both the orthogonalised impulse response to a pure money shock and the generalised impulse response to a price shock. By construction, shocks are permanent in this system, unlike the unrestricted VAR examined earlier. The size of the shocks will also

be different, because the standard errors in the restricted cointegrating system can be larger than those in the unrestricted VAR. The estimates are given in Tables 7 and 8.

Table 7

Cointegrating VAR

Orthogonalised Impulse Response Functions, 1SE shock to money, percent						
	On impact			After 50 quarters		
ECCB	P	y	m	p	y	m
AB	0.0	0.0	2.7	1.1	1.7	2.8
DOM	0.0	0.0	3.7	1.0	0.5	1.6
GRE	0.0	0.0	3.5	1.6	0.1	1.7
SKN	0.0	0.0	4.3	-1.2	1.7	0.5
SLU	0.0	0.0	2.8	-0.2	1.3	1.2
SVG	0.0	0.0	3.3	-0.6	0.9	0.3
Non-ECCB						
GUY	0.0	0.0	4.9	3.6	0.5	4.1
BEL	0.0	0.0	3.0	-2.1	4.6	2.5
JAM	0.0	0.0	3.7	2.7	0.5	3.2
BAH	0.0	0.0	2.0	-0.5	1.6	1.1
BAR	0.0	0.0	2.3	1.0	0.4	1.4
TT	0.0	0.0	3.4	0.2	-3.6	-3.2

Table 8

Cointegrating VAR

Generalised Impulse Response Functions, 1SE shock to inflation, percent						
	On impact			After 50 quarters		
ECCB	P	y	m	p	y	M
AB	0.5	-0.2	0.0	1.9	-0.7	1.2
DOM	1.3	-0.1	0.3	1.1	-0.3	0.8
GRE	0.9	0.0	0.0	1.2	-0.3	0.9
SKN	1.0	0.0	0.1	1.2	-0.6	0.7
SLU	1.6	-0.3	0.6	2.2	-0.5	1.7
SVG	1.4	-0.2	-0.2	1.9	-0.8	1.1
Non-ECCB						
BAH	0.7	-0.1	-0.2	1.4	-1.3	0.0
BAR	1.4	-0.1	0.5	2.0	-1.7	0.4
GUY	8.5	0.3	1.0	3.2	1.4	4.6
BEL	1.2	-0.3	-0.4	2.3	-2.3	0.0
JAM	2.4	0.0	0.6	8.2	-0.3	7.9
TT	1.4	-0.2	-0.1	2.1	0.3	2.4

Table 7 shows that a one standard error shock in AB raises money by 2.7%, and after 50 quarters prices are 1.1% higher, output 1.7% higher and money 2.8% higher. Table 8 shows that a one standard error shock to prices in AB is 0.5%, this would be associated on average with a 0.2% reduction in output and a no increase in money in the same quarter. After 50 quarters as those shocks worked through the system, prices would be 1.9% higher, output 0.7% lower and money supply 1.2% higher.

Notice that the effects on P plus Y minus M sum to zero, because the cointegrating relationship constrains them. Across countries, the long-run effect on prices is greater than the short-run effect in all but two countries. This is the reverse of the pattern for the unrestricted VAR where long-run impacts were smaller. The exceptions are Guy and SLU. In the case of Guy, the price level rises immediately by 8.5%, carries on rising for a short time (not shown in the table) then falls to its long-run level. This is almost certainly the constraining effect of the cointegrating vector. By period 50 all of the countries have returned to their cointegrating relation given by satisfying the stability condition. The CV diverging in response to a shock shows differing speed of adjustments from the fastest estimate for Bar of -0.687 (corresponding to a half life of about 9 months) to the slowest for Bel of -0.040 (corresponding to a half life of approximately 10 years). The short run effects of a shock to prices tend to be negative for output and positive for money (in 8 out of 12 countries in both cases). The long run effects on output are negative in all countries except Guyana and TT and to money are positive in all countries.

7. Conclusions

Examination of historical statistics suggests dividing these twelve countries into two groups, the high inflation countries, Jamaica, Trinidad and Guyana, and the other nine. We then estimated three standard models that are used to analyse the monetary transmission mechanism, an autoregression, an unrestricted VAR, and a cointegrating VECM, to see whether the estimates allow us to discern differences in policy, behaviour or performance between the countries. The results were interesting but did not provide a clear-cut answer.

We are able with the autoregression to discern differences between the countries inflation performance that may be attributed to policy responses conditioned by institutional structure. The estimates are able to show that the inflation experience of the ECCB countries, Bel, Bar and Bah with low mean inflation, low persistence and low variation stand in contrast to that of Guy and Jam with AB and TT falling somewhere between. There is some evidence from Granger non-causality tests that income is broadly causal with respect to money and prices and not the other way around. Estimates of the cointegration VECM provide evidence that inflation shocks are associated with falling income in the long run in ten of the twelve economies. This is supported by unrestricted VAR estimates that indicate inverse short-run output responses to inflation shocks. The system did not show monetary shocks being positively linked to prices and negatively to output but the long run inverse relationship between price shocks and a decline in income was clear. This, it could be argued, may be linked to the argument of making inflation the primary macroeconomic target and a secondary role for intermediate targets such as the money supply (Loayza & Soto 2002, Mishkin 2000).

The estimates are not clear cut, but this may be because we have used closed economy models and the balance of payments constraint is very likely to be a motive for monetary policy responses that seem to underlie differences in economic performances. An area for further research is to see whether one could construct a model based on the external constraint in order to see the extent to which the specification can inform on policy responses and performance. This is difficult, since for nine of the countries there is no variation in exchange rates and little variation in interest rates.

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