DETERMINANTS OF INFLATION IN SELECTED CARIBBEAN COUNTRIES

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Presented at the 29th Annual Review Seminar
Research Department
Central Bank of Barbados
July 28-31, 2008

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ABSTRACT

Inflation has been a topical issue in the literature since the early 1970's when oil prices soared to record high figures. Ever since, controlling the inflation rate has been a high priority of many countries, especially those with small open economies. In order to control a process, discovery of its determinants is of utmost importance; hence the study of the inflationary process in the Caribbean. Studies of this nature have been conducted on Caribbean economies before, however the most recent study is over ten years old. Therefore, this paper fills a time gap. It also utilizes a longer data series and a more robust testing technique, Dynamic OLS. Even though, hypothesized expectations exist for each Caribbean country, a general model is presented in order to capture new developments in the inflationary process. Jamaica, Guyana, Barbados and Trinidad and Tobago constitute the sample of Caribbean economies used in the study. Results indicate that the determinants for inflation in the Caribbean are both cost-push and demand-pull. These results are somewhat in line with previous findings and may be used to update policy decisions in Caribbean economies.

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1. Introduction

A continuous increase in prices (inflation) has a worrying impact, since it causes the cost of living to rise and the value of investments to fall. In order to manage the cost of living it is important to keep the rate of consumer price inflation at a minimum. The first step in the process of controlling inflation is to understand its determinants. This paper adds to the literature, and attempts to identify the factors that contribute to rising inflation rates in the Caribbean.

The motivation for this paper is simple. A great lag exists from the last time any research in this area was done for the Caribbean. The most recent paper on the determinants of inflation in Barbados is written by Cumberbatch (1995), while papers on inflation for the other Caribbean countries are even older. In addition, inflation in the Caribbean is currently a concern for policy makers as the recent hikes in oil prices and increases in the inflation rates seem significant to the region.

Unlike the previous studies on inflation in the Caribbean, a Dynamic Ordinary Least Squares (DOLS) methodology is used along with annual data from 1970 to 2006 in order to estimate economic relationships between inflation rates and other control variables. The DOLS estimation methodology has been proven to be robust in small samples in comparison to the VAR and VEC models. Therefore, these results are likely to be more reliable than those of earlier studies.

This paper is comprised of six sections. The first section serves as an introduction. The second provides historical information on the inflationary process over the studied period. Section three is comprised of a review of literature on the topic, both theoretical and empirical. Section four gives the specification of the economic model, discusses the data and outlines the methodology of the research paper; while section five reports results from the estimated model. Section six concludes the paper by summarising results, providing linkages with previous studies and suggesting probable policy implications of the conclusion.

2. The inflationary process in the Caribbean: the case of Barbados, Jamaica, Guyana and Trinidad and Tobago

Those countries with "true" floating exchange rates (Jamaica and Guyana), display a similar trend in their inflation rates, with rates oscillating around a certain average up until the 1990's, after which a big jump appears in the data, before leveling out once more. While the inflation rates in countries with a fixed exchange rate (Barbados) or a managed float (Trinidad and Tobago), tend to evolve in a similar pattern, which is different from those of floating exchange rate countries. In the latter group, rates were highest at the beginning of the sample period and gradually declined. (See Figure 1 in the Appendix for a Comparison of inflation rates within the study). In this section, the inflationary process is divided into decades, in order to capture significant movements over a short time span within the Caribbean.

(1970 – 1980)

Record high 'double digit' inflation rates marked the period 1970-1980 in three of the four countries mentioned above. The average inflation rate in Barbados was 13.9% with rates reaching as high as 38.9% in 1974. For Guyana, the standard rate of inflation was approximately 9.7% with a high of 17.8% in 1979. In Jamaica, prices soared at an annual average rate of 18.2% over the decade, peaking at 34.9% in 1978 and on average, the inflation rate in Trinidad and Tobago approximated 12.2% with the maximum of 22% in 1974. A widespread food shortage and a quadrupled increase in the price of oil accounted for these lofty rates. Also, during this period, the money supply in the United Kingdom and the United States of America accelerated, with a positive impact on world inflation. In addition, Taxes and interest rates in Barbados increased significantly and the Barbadian dollar was unpegged from the British pound and tied to the US dollar. This resulted in a significant revaluation of the Barbadian dollar and the inflation rate declined from 20.3% in 1975 to 5% in 1976.

(1981 – 1990)

Inflation rates in Barbados, Guyana, Jamaica and Trinidad and Tobago during the 1980's averaged 5.8%, 28.4%, 15.1% and 11.1%, respectively. The highest rates in the period for each country, in the same order were 14.6% in 1981, 109.3% in 1990, 27.8% in 1984 and 15.2% in

1983, respectively. The fuel price hike in 1979 had continued effects on the Guyanese, Jamaican and Trinidadian economies in the early 1980's. The collapse of the oil market in 1983 left Trinidad and Tobago experiencing a recession from that year until 1992. In Guyana, the jump in the inflation rate that took place in 1987, culminating in devaluation of the local currency was a consequence of supply bottlenecks and a marked increase in public expenditure.

(1991 – 2000)

The inflation rate remained low in Barbados throughout this period, averaging 2.8% with the highest rate being 7.7%. The rate in Trinidad and Tobago was also relatively low, with a mean of 5.5% and a peak of 10.8%. In Guyana and Jamaica, annual average inflation rates increased because of the continued effects of the problems that occurred at the end of the previous period. In addition, the high rates experienced in Guyana may be attributed to a continued price liberalization policy and further devaluation of the Guyanese dollar. Moreover, the increase in the inflation rate in 1994 was a result of a pick up in fuel prices, a shortage of food in the country, addition of certain tariffs and changes in the consumption tax regime. For Jamaica, between 1994 and 1997, inflation rates buoyed up to nearly 40%. This was mainly due to a financial sector crisis caused by a liquidity problem in the sector, which eventually led to the collapse of several banks and financial institutions.

(2001 – 2006)

The latter part of the sample period featured relatively low rates for all four countries. However, by 2005, with recent hikes in the price of fuel, inflation rates accelerated once more. On average, inflation rates in Barbados, Guyana, Jamaica and Trinidad and Tobago were 3.2%, 5.4%, 10.3% and 5.4%, respectively. The highest rates in these countries (in the same order) were 7.3% in 2006, 6.9% in 2005, 15.3% in 2005 and 8.3% in 2006. The additional increase in the inflation rate in Barbados in 2006 may reflect a tax levied on imports. Also, the inflation rate in Jamaica began trending upwards in 2003 after oil prices rose.

3.1. Theories of Inflation

The term inflation is used to describe a process of sustained price increase of goods and services. There are several theories of inflation; however, most of them are formulated on the basis of the aggregate demand (demand pull) and cost-push theories. Even though there is some controversy surrounding these two theories (Ball and Doyle, 1983), amongst all the arguments, they are the least controversial and lay the foundation for debates on inflation.

The demand-pull theory states that inflation results from a rise in aggregate demand. As such, the theory regards price changes as a market clearing mechanism and inflation is seen as a result of excess demand in commodity and factor markets. In view of that, factors that influence demand-pull inflation include increases in money supply, government spending and the price level in the rest of the world.

Conversely, under the cost-push theory, inflation is seen as the result of factor prices accelerating more rapidly than factor productivities. Essentially, cost-push inflation occurs as a result of decreases in aggregate supply. This may be due to an appreciation in wages or the price of raw materials. Such increases lead to higher production costs, hence the term 'cost-push' inflation. Higher production costs may bring about a reduction in the employment rate and a drop in output.

Through the avenues of demand pull and cost push theories, followers of the Keynesian and Monetarist schools of thought have formulated different approaches to understand the inflationary process. According to the Keynesians, inflation is a result of income disturbances and shocks to the economy, like oil price increases; while the Monetarists believe that inflation occurs because of excess demand and inappropriate monetary responses to economic situations.

The Keynesian Model may be represented as: $\pi = f(l, w, u, o, p^e)$

where π, l, w, u, o, p^e represent inflation rate, excess demand for labour, wage rate, unemployment, output and price expectations, respectively.

The Monetarist Model may be structured as: $\pi = f(y, m_s, i)$

where π signifies the inflation rate, y represents changes in real income, m_s means money supply and i refers to the cost of holding cash.

Classical theorists have also constructed models in an effort to better understand the causes of sustained price increases in an economy. Their approach is quite similar to that of the monetarists where inflation occurs when there is 'too much money chasing too few goods'. In this state, the increased money supply leads to a jump in the demand for goods and services, thereby, causing inflation.

In addition to the theories described above, there is the Supply side theory, which is also vaguely related to Monetarism and proposes that the supply of goods and services (instead of money supply) may be contributory to the inflationary process. That is, if there is 'too much money chasing too few goods' then two solutions are possible; either decrease money supply or increase the supply of goods and services. The variables for the determination of inflation in this model include output and money supply.

In an effort to combat criticisms from the Monetarists, the Keynesians put forward an improved theory of inflation, based upon imperfect competition. In this theory, the Keynesian theorists state that to an individual worker in wage negotiations, the price level is exogenous; however, to all the workers in the negotiation, the price level is endogenous. As a result, inflation occurs because workers want higher wages and firms want higher profits. Therefore, if workers are granted a wage increase, firms will increase prices (by a mark-up) and this leads to inflation. That is, inflation is influenced by wage increases and firms' mark-up prices.

Similar to the Keynesians, the Monetarists found an angle to combat criticism from the Keynesians by proposing a theory in which firms are unsure of the reason for a price increase. That is, they may be unsure if there are inflationary pressures at work or if consumer demand has actually risen. After finding out the reason for the price jump, firms will adjust their prices accordingly, based on rational expectations. Therefore, price expectations influence the inflation rate.

In addition, structural factors such as weather conditions, policies aimed at protecting certain industries or just trading policies, may also influence the rate of inflation. If there's a hurricane, which damages food supply and infrastructure, then, prices of goods and services will definitely shoot up. Also, in protecting certain industries, cheaper goods and services may not be allowed into the country, which results in higher prices for certain goods and services. This shows that inflation may be a consequence of weather conditions and trading or protection policies.

Another approach to understanding the inflationary process is formulated under the Structuralist model of imported inflation (Frisch, 1977). This model shows that a country's dependence on external markets may bring about inflation. A country's heavy reliance on external variables is expected to motivate upward pressure on domestic prices. Another model from the structuralist school of thought, the Scandinavian model (Frish, 1977), which seems mostly relevant to small open economies, hypothesises that inflation is influenced by world prices, wages and productivity. Frisch (1977) also mentions an augmented Scandinavian model (Branson et al., 1976), in which unemployment rate and expected inflation in the tradable sector are added to the determinants of inflation in the Scandinavian model.

Acute et al. (2001) survey more recent studies, in which the authors conclude that the newer theories on inflation focus on policy credibility, political stability and cycles and the reputation of the government. However, Acute et al. (2001) points out that these theories are based on variables that are not quantifiable and are therefore excluded from most studies. Also, Selialia (1995) (cited in Acute et al. (2001)) indicates that the political economy approach to macroeconomic policy places emphasis mostly on industrial countries. Therefore, this approach may not be appropriate for application to developing countries.

3.2. Previous Empirical findings with emphasis on the Caribbean

Numerous studies have been conducted on the inflationary process in a variety of developing countries, including countries from the Caribbean region. This section briefly reviews some of these studies, paying special attention to the ones conducted on Caribbean economies. The review should provide additional information for proper decision making in choosing

explanatory variables for the inflationary process in Barbados, Guyana, Jamaica and Trinidad and Tobago.

Bourne and Persaud (1977) focus on the inflationary processes in Trinidad and Tobago and Jamaica. Factors from both the cost-push and demand-pull theories are combined to create a hybrid model. Fifteen different formulations of the inflationary process are tested and twenty variables are included in the model. From the study, it is seen that government financing and exchange rate contributes to changes in the inflation rate in Trinidad and Tobago. Also, the wage rate and foreign prices influence inflation through increases in government spending. The authors state that even though availability and price of domestic bank credit were not very significant to the inflationary process in Trinidad and Tobago, they may be contributory factors to anti-inflationary policies. The empirical results for Jamaica differ from those of Trinidad and Tobago. Import prices and price of bank credit are also significant to the Jamaican inflationary process.

Cumberbatch (1995) formulates a two sector Scandinavian model, in an attempt to explain the Barbadian inflationary process. As noted earlier, this model is specifically designed for small open economies with a high import bias. When international prices increase, import and export prices buoy up as well, thereby affecting the trading sector directly and causing spillover effects in the non-trading sector. In the model, Cumberbatch (1995) includes import prices, past inflation rates, changes in unit labour costs, consumer credit rates, the rate at which prices change in the non-tradable sector and real national income. The empirical results indicate that import prices are the most influential factors of inflation in Barbados. Past inflation rates, consumer credit rates, unit labour costs, and real national income are also contributory to the Barbadian inflationary process as well.

In his review of the literature, Coppin (1993) states that early studies on inflation in Barbados documented the process to be mainly driven by external factors, which could not be controlled internally. However, Coppin argues from a priori information that demand side factors also cause inflation in Barbados. As such, he models inflation using real output (approximated by tourism activity), unemployment rate, interest rate, price of imported goods and the indirect tax rate. In

his findings, the author states that for the period studied (1981-1990) real output level, imported inflation and interest rates stimulated the Barbadian inflationary process.

Similar to Bourne and Persaud (1977), Downes et al. (1992) conduct a study on Jamaica, Trinidad and Tobago and Barbados. However, this later study uses a combination of variables from the structuralist and monetarist models, namely, the exchange rate, US price level, money supply, interest rate (as a proxy for the cost of holding money), changes in wage rate, levels of productivity and factors that cause domestic inflation to deviate from purchasing power parity. The authors find that import prices are very influential to the inflationary process in the Jamaican economy, however, not in the other two countries examined. Exchange rate and import inflation are also significant in all three countries, but to varying degrees. The authors also state that the wage rate and productivity growth rate are contributing factors to the inflationary process only in Barbados.

Another paper on these three countries, done by Holder and Worrell (1985), shows a simultaneous price formation model, which is used to explain inflation. The authors report that foreign prices greatly impact local prices in all three countries. However, cost of imported raw materials encourages inflation in two of the three countries. Exchange rates and trade protection also drive the inflationary process in all three countries (consistent with findings of Downes et al., 1992), while changes in wage rate show significance in Jamaica only and domestic interest rate increases influence inflation in Barbados. During the period under investigation (1963-1980), Downes et al. (1985) find that imported inflation leads to domestic inflation in Trinidad and Tobago. In addition, Downes et al. (1987) administer a study on the inflationary process in Barbados, in which they reveal that wages, productivity, unemployment and the price of tradables are contributing factors to inflation in Barbados.

In an earlier article, Downes (1985) hypothesises that since the Barbadian dollar is pegged to the US dollar, then inflation should be caused mostly by external factors. Accordingly, Downes models the inflationary process in Barbados based on the theory of cost-push inflation. The results from this study indicate that import prices and the prime lending interest rate are the most instrumental variables to the inflationary process.

A number of studies have been conducted on the inflationary process in developing non-Caribbean countries. Domac (1999) studies the inflationary process of Albania from 1994 to 1997 and finds that money supply, credit to government and several exchange rates are driving the inflation rate. Diouf (2007) examines the process in Mali for the period 1979 to 2006 and concludes that, in the short run, real income, domestic interest rates, foreign inflation and nominal exchange rate are contributory to the inflation rate. However, in the long run, monetary and external factors are the most significant contributors. In an article by Moser (1995) on Nigeria, factors from the demand-pull and cost-push theories are combined to form a hybrid model of inflation. Moser then concludes that money supply and agroclimatic conditions are the main determinants of inflation in Nigeria. Another study conducted by Ubide (1997) on Mozambique yields similar results to those of Moser (1995). Leheyda (2005) investigates the inflationary process in Ukraine between 1998 and 2003 and reports that, in the short run, money supply, wage rates, exchange rate, real output and exogenous shocks influence the inflation rate in Ukraine. However, in the long run, money demand, purchasing power parity and mark-up relationships influence the inflationary process.

Careful examination of above reveals that in developing countries, the following variables are mostly responsible for the inflationary process: import prices; wag rates; interest rates; exchange rates; money supply; unemployment rate; productivity. Even though all these variables are important, import prices seem most significant.

The approach of this study will be similar to that of Cumberbatch (1995) since the Scandinavian model is directly applicable to small open economies like the ones studied in the rest of this paper.

4.1. Model specification

Literature on the inflationary process in the Caribbean point to the employment of several different models to capture the determinants of inflation. However, a number of similar variables are found to be significant in these papers, which makes it difficult to choose one theoretical

model to determine the causes of inflation in the Caribbean. Therefore, an 'encompassing' model, pulling on several schools of thought is specified as follows:

$$\pi = f(\overset{+}{O}, \overset{+}{PW}, \overset{+/-}{Y}, \overset{-}{R}, \overset{+}{U}, \overset{+}{MS}, \overset{-}{S})$$

where the represented variables, in order of appearance, are: inflation rate, oil prices, world prices, real national income, interest rates, rate of unemployment, money supply and exchange rates. It is expected that oil and world prices, money supply, unemployment rate and possibly real national income exert a positive influence on inflation rates in the Caribbean and that interest rates and exchange rates negatively relate to the inflationary process.

The world price index contains oil prices, amongst other things and in earlier years oil and world prices displayed similar patterns. However, of late, the two variables have become somewhat independent, with oil prices playing a smaller role in charting the direction of world prices and recent increases in non-commodity prices playing a bigger part in world price determination. Therefore, both variables are included in the model, with the expectation of little or no multicollinearity between the two (see Table 5 for a correlation matrix). Given that these Caribbean islands have small open economies, increases in world prices is expected to apply pressure to local prices and due to the inability of these countries to produce enough oil to sustain themselves (with the exception of Trinidad and Tobago), increases in oil prices are also expected to exert upward pressure on local prices.

With respect to national income (output), the relationship is specified as ambiguous because the sign may change depending on whether it is being argued from the demand or the supply side. On the demand side, if effective demand increases, then production will buoy up and so will prices. However, if supply of goods and services increases first, without an equal or greater increase in demand, then prices will drop.

An increase in interest rate (if it is higher than the inflation rate) leads to greater savings and reduced or constant spending on goods and services. This pick-up in savings creates a situation of contracting money demand. In equilibrium, money demand equals money supply, therefore if money demand decreases, then money supply will also decrease. As a result, prices will adjust

downwards allowing the market to achieve equilibrium. If interest rate is below inflation, then there will be no effect on savings and the price level.

The inclusion of the unemployment rate in the model allows the data to determine the superiority between output and unemployment, since these variables are alternatives in the short run Phillips curve model. Also, its inclusion is a test to see if the short run Phillips curve theory applies to the long run or the Friedman (1968) and Phelps (1967) theory of a positive relationship between unemployment and inflation in the long run is more appropriate.

It is expected that changes in money supply have positive effects on the inflation rate. An increase in money supply without an equal rise in the production of goods and services leads to a situation of "too much money chasing too few goods". This is the definition of demand pull inflation. However, if there is a greater boost in the production of goods and services, in comparison to the increase in money supply, then the inflation rate and money supply will display a negative relationship.

An appreciation in a country's exchange rate means that the local currency is worth more and as a consequence, prices are relatively lower. However, if the exchange rate depreciates, prices of goods and services are relatively higher. Hence, the negative a priori expectation on exchange rate and inflation.

4.2. Methodology

The determinants of inflation are investigated by using a Dynamic Ordinary Least Squares (DOLS) procedure, proposed by Stock and Watson (1993). This technique improves upon Ordinary Least Squares and Maximum Likelihood Estimation methods since it is better at handling small sample and dynamic sources of bias. It also performs well, in comparison to the Johansen (1988) procedure, in that, the Johansen method (being a full information technique) allows for the possible misspecification of one equation to affect others. With DOLS, possible endogeneity problems are accounted for through the inclusion of leads and lags of first differences of the I(1) regressors and the use of the General Least Squares procedure to account

for serial correlation in a robust single equation approach (cited from Al-Azzam and Hawdon, 1999).

4.3. Data

This paper uses annual data related to the period 1970 – 2006 for Barbados, Guyana, Jamaica and Trinidad and Tobago. Data are obtained from the International Financial statistics database, Economic and Financial Statistics publications (Barbados) and Annual Statistical Digest publications from several central banks in the Caribbean. There are several problems with the data; unemployment rates for Guyana are non-existent, there are missing unemployment data points for Barbados and there are missing values for lending rates in Guyana. Therefore, the unemployment variable is excluded from the Guyana model. Estimation for Barbados is done only for the period 1975 – 2006 and the estimation period for Guyana is 1974-2006.

Inflation rates in Barbados and Trinidad and Tobago are measured as the percentage change in the annual Retail Price Index (RPI), but for Jamaica and Guyana, changes in Consumer Price Index (CPI) are used as a measure of inflation rate, instead. Money supply for all the countries is the sum of currency outside banks demand deposits other than those of the central government and time savings and foreign currency deposits of resident sectors other than the central government. Oil prices refer to average crude oil prices. Real GDP signifies nominal GDP adjusted for inflation. Unemployment rates refer to the number of persons unemployed in relation to the labour force. The prime lending rate defined for Jamaica, is a weighted average rate charged by commercial banks on all loans, excluding staff loans. In Barbados and Guyana, the prime lending rate refers to the interest rate charged by commercial banks to preferred customers and in Trinidad and Tobago, it is the median of basic prime rates charged by commercial banks on loans. Exchange rate is defined as national currency per US dollar and it is measured at the end of the period. World prices are represented by the commodity price index for the world, which is calculated by weighting commodity price indices with the average export earnings of the commodities selected during the years 1995 to 1997 in 175 countries.

5. Estimation and Results[1]

The ADF, PP and KPSS unit root tests are utilsed to check the stationary properties of the individual series, which reveal that all the series are either integrated of order zero I(0) or one I(1). A Dynamic OLS model is then estimated, which includes leads and lags of the first differences of the I(1) variables up to j= ±2, and in a general to specific approach used to arrive at a parsimonious model. Several diagnostic tests are conducted at each stage of the model reduction process for Normality, serial correlation, model misspecification and heteroskedasticity. All the final models presented in this paper have passed these tests.

Barbados

The I(1) variables for Barbados are money supply, oil prices, world prices, national income and unemployment rate and the I(0) variables are interest, exchange and inflation rates. The estimated results for the long run (See equation 1a in the Appendix) indicate that a negative relationship exists between money supply and inflation with a 10 percent decline in the money supply leading to a 17.2 percentage point rise in inflation. A possible explanation for this is that the production of goods and services, on average, increases more than money supply. Therefore, prices are decreasing even though money supply has increased. As expected the sign on oil prices is positive, with a 10 percent climb in oil prices resulting in an advance f 11.7 percentage point in the inflation rate. A ten percent rise in world prices results in a 1.02 decrease in inflation, revealing a negative relationship between inflation rates and world prices. On the surface this may seem strange; however, looking at the trends over the last couple of decades shows China emerging as a great source of mass production at very competitive prices. This has effectively contributed to the depression of world prices starting from the 1990's. The increase in production in China has led to a slowdown in the rise of inflation (caused by oil prices). Therefore, the indirect impact of world prices on inflation rates is indeed negative, given the present situation. A ten percent change in the unemployment rate serves as a catalyst for inflation to change by 1.91 percentage points, in the same direction, indicating a positive relationship between the two

[1] In the equations that follow, $\overline{R}^2$ signifies the fraction of the variance of the dependent variable explained by the model, F is the F-statistic for the joint significance of the explanatory variables, DW is the Durbin Watson statistic, Norm(JB) is the Jarque- Bera normality statistic, White's Het test is the White's heteroschedasticity test, RESET-F is the Ramsey test for functional form misspecification and BG-F is the Breusch Godfrey test for serial correlation.

variables. This shows that the long run relationship specified by Friedman (1968) and Phelps (1967) holds in Barbados. The sign on national income (output) is positive, pointing to the relevance of the demand side argument for Barbados. That is, if demand for goods and services rise, so will their prices. Two dummy variables are introduced in 1984 and 2001 to account for shocks to the Barbadian economy caused possibly by the world debt crisis in the 1980's and effects from the 9/11 world trade centre destruction in 2001.

The error correction model indicates that changes in the lagged values of inflation rate, oil prices, world prices, interest rates, unemployment rate, output (national income) and money supply contribute to the inflation rate in Barbados in the short run. The coefficient (-0.667) of the error correction term shows that 66.7% of the deviations from the long run equilibrium are corrected each period. (See equation 1b in the appendix)

Guyana

The results for Guyana (see equation 2a in the appendix) indicate that, in the long run, money supply has the greatest impact on the inflation rate, since a hundred percent increase in the money supply leads to a 1.4 percentage point advance in the inflation rate. Exchange rate between Guyana and the US has the smallest impact on inflation in the long run, with a hundred percent appreciation of the exchange rate resulting in a 0.0134 decline in the inflation rate. Inflation buoys up by 0.7038 percentage points when real interest rates rise by 100 percent. Also, a 100 percent increase in world prices effects a 0.31 percentage point climb in the inflation rate. These results show that the estimated relationships coincide with expectations.

In the short run, changes and lags of national income (output), inflation rate, oil price, world price, interest rate, money supply, and exchange rate contribute to the inflation rate. A dummy variable was also included to account for shocks to the Guyanese economy in 1985, possibly caused by the world debt crisis in the 1980's. An error correction term of –0.729 indicates that, on average, 72.9% of the short run deviations from the long run relationship are corrected in each period. (See equation 2b in the appendix)

Jamaica

Of all the variables tested for Jamaica, national income (output) exhibits the most influence on the inflation rate, with a 10 percent increase in national income leading to a 5.43 percentage point rise in the Jamaican inflation rate. In addition to national income (output), oil prices, world prices, interest rate, unemployment and exchange rate also contribute to the inflationary process. A ten percent hike in oil prices leads to a 1.04 percentage point rise in the inflation rate, and an increase in world price by ten percent results in a drop in the inflation rate by 1.28 percentage points. A ten percent change in interest rate leads to a 3.12 percentage point change in the inflation rate in the same direction. If inflation is rising at a greater pace than interest rates, then lenders of fixed rate loans stand to lose on previous investments, therefore, the rates charged on future loans will be higher in order to compensate for this loss; hence, the positive relationship between inflation and interest rate. A climb in the unemployment rate by ten percent effects a 3.8 percentage points decrease in the inflation rate. This shows that the Phillips curve theory holds in the long run for Jamaica. (See equation 3a in the appendix for actual estimation results)

In the short run, lagged and contemporaneous changes in the money supply, interest rate, unemployment rate and world prices affect the inflation rate in Jamaica. Two dummy variables are introduced to account for the oil price shocks in the Jamaican economy in 1978 and 2006. An error correction term of –0.73 suggests that approximately 73% of the short-term deviations from the long run relationship are corrected each period. (See equation 3b in the appendix)

Trinidad and Tobago

The results for Trinidad and Tobago (see equation 4a in the appendix) indicate that national income, money supply, unemployment rate and world prices influence inflation rates. A ten percent increase in national income leads to a 2.249 percentage point rise in the inflation rate and a ten percent climb in the money supply results in a 0.59 percentage point decline in the inflation rate (a possible explanation is given above for the same relationship in Barbados or it may be that money supply seems to be growing but it is simply a matter of increased money transference among different groups of individual). A ten percent increase in world prices effects a 0.66 percentage point hike in inflation and inflation declines by 0.284 percentage points when unemployment rises by ten percent, emphasizing the Phillips curve relationship. Dummy

variables are introduced for the years 1981 and 1998, which may explain the after effects of the oil price shock in 1978 and the financial sector crisis in 1997, respectively.

The short run dynamics of the estimated model reveal that changes and lags in the inflation rate, world prices, unemployment rate, money supply and national income influence inflation. Also, the error correction term indicates that 74.2% of the short run deviations from the long run are corrected each period. (See equation 4b in the appendix)

6. Conclusion and Policy implications

This study seeks to examine the determinants of inflation using data on four selected Caribbean countries. The results from the Dynamic OLS regressions suggest that the models are sufficient for explaining changes in the rate of inflation between 1970 and 2006. According to the estimates, all of the variables included in the regressions are not significant to the inflation process in each of the countries examined.

In particular, the results indicate that long run inflation in Barbados is influenced by real national income (output), money supply, oil prices, world prices and the unemployment rate. Oil prices are also significant for explaining inflation movements in Jamaica as well as the exchange rate, unemployment rate, interest rates, world prices and national income. The unemployment rate is not a significant factor to the inflation process in Guyana. In Guyana, the variables influencing an increase in the aggregate price level are interest rates, world prices, exchange rates and money supply.

The determinants of inflation in Trinidad and Tobago differ slightly from those in Barbados. The main distinguishing factor is the oil price impact. As expected, oil prices are not significant in explaining inflation trends in Trinidad and Tobago. This is not surprising, mainly because Trinidad is one of the major producers of oil in the Caribbean region.

In summary, the results seem to contradict some traditional thoughts about the determinants of inflation in developing countries. However, they are partially in line with the majority of studies on inflation in the region. (See Bourne and Persaud (1977), Cumberbatch (1995), Coppin (1993), Downes et al. (1987, 1992), Downes (1985) and Holder and Worrell (1985))

Given the significance of world prices in all four countries, when world prices begin to change, policy makers should design policies in order to ease the probable effects on inflation. The same holds true for oil prices in Barbados and Jamaica. Results indicate that national income moves in tandem with rising inflation, therefore policy makers should ensure that income growth occurs in sectors that are not overheating. Also, a negative relationship exists between exchange rates and inflation, which indicates that policies should be designed to keep exchange rates constant or encourage appreciation of the dollar.

References

Al-Azzam and Hawdon, 1999, "Estimating the demand for energy in Jordan: A stock-Watson Dynamic OLS (DOLS) approach", Surrey Energy Economics Centre, *Department of Economics Discussion Papers*.

Bourne and Persaud, 1977, "Financial variables in the inflationary process: Two Caribbean cases", in Inflation in the Caribbean, ed. By C. Bourne *(Kingston: Institute of Social and Economic Research),* pp. 54-71.

Branson, W, H., 1975, "Monetarist and Keynesian Models of the Transmission of Inflation", *The American Economic Review*, Vol.65, No. 2, pp. 115-119.

Coppin, A., 1993, "Recent Evidence on the determinants of inflation in a tourism-oriented economy: Barbados", *Social and Economic Studies*, Vol 42: 2 &3.

Cumberbatch, C., 1995, "A Model of Inflation in Barbados", Macroeconomics and Finance in the Caribbean: Quantitative Analyses, Technical Papers Series Vol.2, Edited by DesLisle Worrell and Roland Craigwell, Caribbean Centre for Monetary Studies.

Dlamini, A., A. Dlamini and T. Nxumalo, 2001, "A co-integration analysis of the determinants of inflation in Swaziland".

Diouf, M., 2007, "Modelling Inflation for Mali", The International Monetary Fund, *African Department Working Paper*.

Domac, I. And Elbirt, C., 1999, "The Main Determinants of Inflaiton in Albania", The World Bank, *Policy Research Working Paper Series*.

Downes, 1985, "Inflation in Barbados: An Econometric Investigation," *Economic Development and Change*, 33:3, 521-532.

Downes, Holder and Leon, 1987, "Inflation in Barbados: A Co-integration Approach," *Central Bank of Barbados Working Papers*, pp.173-177.

Downes, Maynard and Worrell, 1992, "Macroeconomic adjustment and the inflation experience of selected Caribbean countries" prepared for the XXIX Meeting of Technicians of Central Banks of the American Continent.

Friedman, M. 1968. "The Role of Monetary Policy." American Economic Review 58, pp. 1-17.

Frisch, H., 1977, "Inflation Theory 1963-1975: A 'second Generation' survey", *Journal of Economic Literature*, Vol. 15, No. 4, pp. 1289-1317.

Greenidge and Milner, 2007, " Financial liberalisation and Economic Growth in Selected Caribbean countries", *in Aspects of financial liberalisation and capital market development in the Caribbean,* ed. By Craigwell, Greenidge and Williams, pp. 55-109.

Heakal, R., 2008 "Cost-Push inflation versus demand-pull inflation" retrieved June 2008, from the website: http://www.investopedia.com/contributors/default.aspx?id=80.

Holder and Worrell, 1985, "A model of price formation for small economies: Three Caribbean examples", *Journal of Development Economics*, Vol. 18, pp.411-428. North-Holland.

Leheyda, N., 2005, "Determinants of Inflation in Ukraine: a co-integration approach", Centre for Doctoral Studies in Economics and Management, University of Manheim, Mimeo.

Machlup, F., 1960, "Cost push and demand pull" *in Inflation,* ed. By Ball and Doyle, 1983.

Manhertz, H., 1977, "The price determination process in a small open economy- The Jamaican experience", *in Inflation in the Caribbean,* ed. By C. Bourne (Kingston: Institute of Social and Economic Research), pp. 1-27.

Melberg, Hans, 1992, “Inflation: An overview of theories and Solutions”, Retrieved June 23, 2008, from *http://www.geocities.com/hmelberg/papers/921201.htm*.

Moser, G. G., 1995, “The Main determinants of inflation in Nigeria”, *International Monetary Fund Staff Papers*, 42(2), pp. 270-289.

Phelps, E.S. 1967. "Phillips Curves, Expectations of Inflation, and Optimal Unemployment over Time." *Economica* 34, pp. 254-281.

Ranson, D., “Inflation” The concise encyclopaedia of Economics retrieved from the website: http://www.econlib.org/library/Enc/Inflation.html on June 23, 2008-06-2.

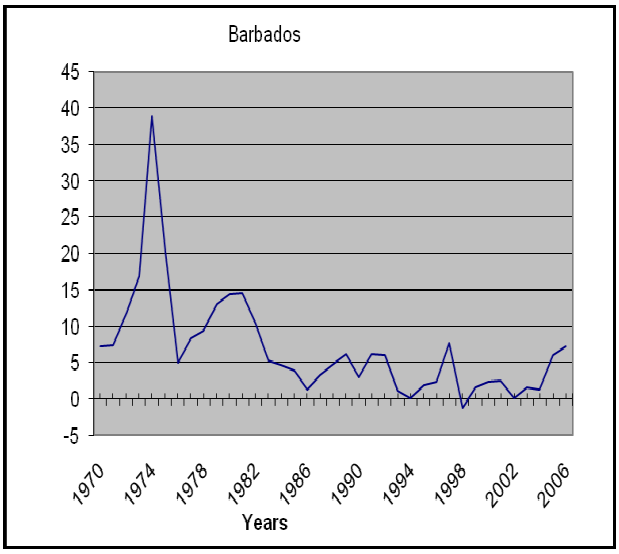
Stock and Watson, 1993, “ A simple estimator of cointegrating vectors in higher order integrated systems”, *Econometrica*, Vol. 61, No.4, pp. 783-820.

Ubide, A., 1997, “Determinants of Inflation in Mozambique”, International Monetary Fund, *IMF Working Papers*.

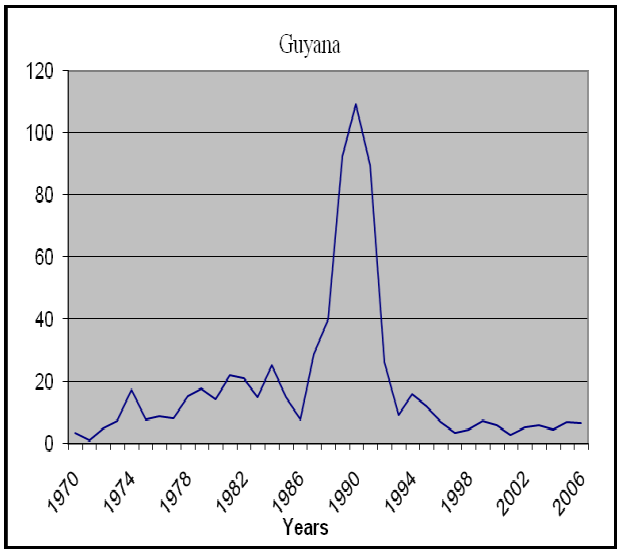
Appendix

Figure 1: Inflation rates in the Caribbean

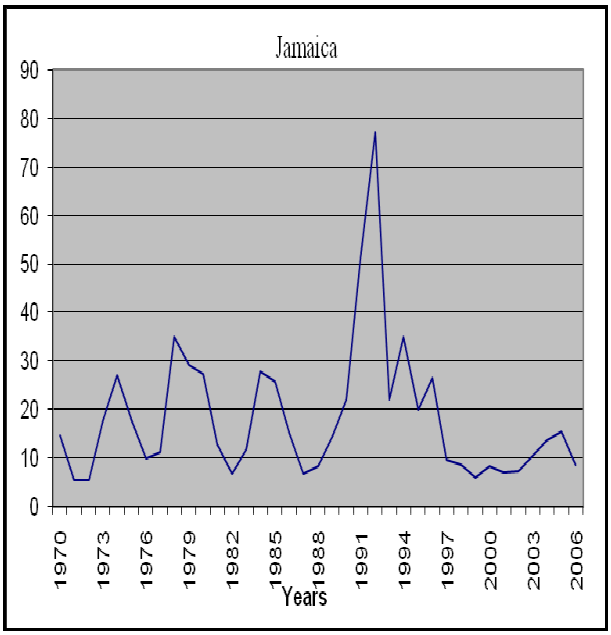
(a)



(b)



(c)



(d)

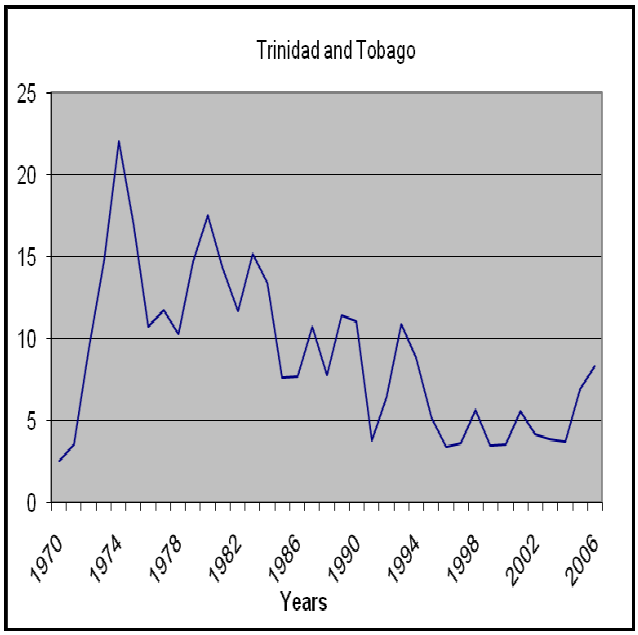
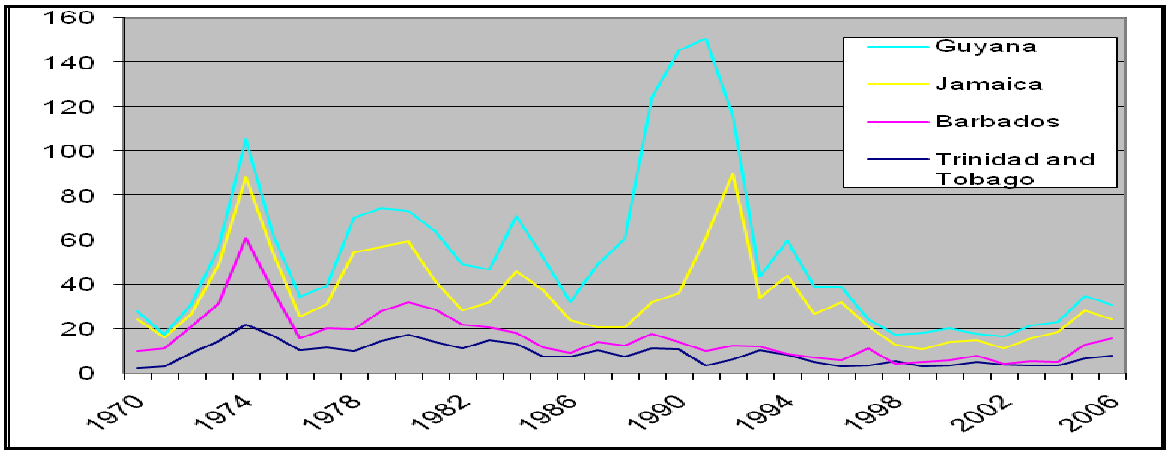


Figure 2 shows a comparison of inflation rates in selected Caribbean countries



Unit root tests

The following tables display information on the unit root tests of relevant series. For the ADF and PP tests, *, ** and *** represent Mackinnon critical values for the rejection of the null hypothesis of a unit root at the10%, 5% and 1% level of significance, respectively. For the KPSS test, $^{+}$, $^{++}$ and $^{+++}$ signify rejection of the null hypothesis of stationarity at the 10%, 5% and 1% level of significance, respectively (premised on the asymptotic results presented in KPSS, 1992, Table 1,pp. 166). The symbol "(Δ)" represents the first difference of the original series.

Table 1 showing unit root tests for the series in Barbados

Series		ADF	PP	KPSS
Π (log)	Level	-3.535*	-3.318*	0.1079
O (log)	Level	-2.489	-2.527	0.134+
	(Δ)	-5.399***	-5.401***	0.231
Pw (log)	Level	-1.953	-1.860	0.1996++
	(Δ)	-6.067***	-6.264***	0.336
Y (logs)	Level	-2.671	-1.525	0.138+
	(Δ)	-3.407**	-4.159***	0.074
r (Prime lending rate in logs)	Level	-3.453**	-2.67*	0.169
U (logs)	Level	-0.893	-1.710	0.145+
	(Δ)	-5.217***	-5.198***	0.102
Ms	Level	-2.105	1.749	0.127+
	(Δ)	-7.864***	-7.583***	0.183
S (exchange rate bds:us)-logs	Level	-5.905***	-7.59***	0.439+
	(Δ)			0.209

Table 2 showing unit root test results for the series in Guyana

Series		ADF	PP	KPSS
π (logs)	Level	-2.889*	-2.188	0.143
	(Δ)		-3.967***	
O (logs)	Level	-2.489	-1.86	0.134+
	(Δ)	-5.399***	-5.401***	0.231
Pw (logs)	Level	-1.953	-2.146	0.199++
	(Δ)	-6.067***	-6.264***	0.336
Y (logs)	Level	-0.866	-0.526	0.159++
	(Δ)	-3.216**	-3.216**	0.107
r (Prime lending rates in logs)	Level	-2.64*	-2.032	0.182++
	(Δ)		-3.005**	0.277
Ms (logs)	Level	-2.769	-0.653	0.0.098
	(Δ)	-3.657**	-3.805***	
S (exchange rate guy:us) in logs	Level	-2.534	-0.572	0.106
	(Δ)	-5.384***	-5.617***	

Table 3 showing the unit root results for series in Jamaica

Series		ADF	PP	KPSS
Π (logs)	Level	-3.167**	-3.031**	0.117
	(Δ)			
O (logs)	Level	-2.489	-2.527	0.134+
	(Δ)	-5.399***	-5.401***	0.231
Pw (logs)	Level	-1.953	-1.860	0.199++
	(Δ)	-6.067***	-6.264***	0.336
Y (logs)	Level	-1.963	-0.542	0.148++
	(Δ)	-4.042***	-4.022***	0.134
r (real Prime lending rates in logs)	Level	-2.601	-1.784	0.171++
	(Δ)	-5.732***	-5.734***	0.101
U (logs)	Level	-2.797	-2.731	0.141+
	(Δ)	-4.397***	-4.373***	0.119+
Ms (logs)	Level	-1.128	-1.133	0.127+
	(Δ)	-6.245***	-6.238***	0.206
S (exchange rate jam:us) in logs	Level	-2.01	-2.13	0.107
	(Δ)	-5.521***	-5.559***	

Table 4 showing the unit root results for series in Trinidad and Tobago

Series		ADF	PP	KPSS
π (logs)	Level	-4.669***	-5.763***	0.189++
	(Δ)			0.195
O (logs)	Level	-2.489	-2.527	0.134+
	(Δ)	-5.399***	-5.401***	0.231
Pw (logs)	Level	-1.953	-1.86	0.199++
	(Δ)	-6.067***	-6.264***	0.336
Y (logs)	Level	0.125	0.519	0.119+
	(Δ)	-2.19	-0.564	0.154++
R (Prime lending rates in logs)	Level	-2.391	-2.392	0.166++
	(Δ)	-5.446***	-5.456***	0.0.067
U (logs)	Level	-1.675	-1.675	0.063
	(Δ)	-5.437***	-5.408***	
Ms	Level	-1.726	-1.579	0.132+
	(Δ)	-4.049***	-4.059***	0.229
S (exchange rate tt:us)	Level	-1.912	-2.008	0.108
	(Δ)	-6.654***	-6.656***	

Long run estimates

Equation 1a: Barbados

$$\pi = \underset{(0.915)}{-3.303} \underset{(0.026)}{-0.172LMS_t} + \underset{(0.016)}{0.117LO_t} - \underset{(0.019)}{0.102LPW_t} + \underset{(0.041)}{0.191LU_t} + \underset{(0.119)}{0.454LY_t} + \underset{(0.0122)}{0.034\Delta LPW_t}$$
$$\underset{(0.035)}{-0.151\Delta Lu_t} - \underset{(0.140)}{0.927\Delta LY_t} + \underset{(0.022)}{0.135\Delta LMS_{t-1}} - \underset{(0.017)}{0.046\Delta Lu_{t-1}} - \underset{(0.024)}{0.158\Delta LMS_{t+1}} \underset{(0.012)}{0.048\Delta LO_{t+1}}$$ [2]
$$\underset{(0.012)}{-0.035dum01} \underset{(0.011)}{-0.025dum84}$$

$$\bar{R}^2 = 0.9434; F = 33.15996(0.000); DW = 2.011; Norm(JB) = 0.237(0.888);$$
$$White's\ Het\ F = 1.31(0.323); BG - F = 0.108(0.748); RESET - F = 2.603(0.133)$$

Equation 2a: Guyana

$$\pi = \underset{(0.0003)}{0.0031PW_t} - \underset{(0.0002)}{0.007r_t} + \underset{(0.0009)}{0.014LMS_t} - \underset{(4.73)}{0.000134LS_t} - \underset{(0.0005)}{0.0009\Delta PW_t}$$
$$+ \underset{(0.00021)}{0.0011\Delta r_t} + \underset{(0.000138)}{0.00029\Delta r_{t-1}} - \underset{(0.022)}{0.075\Delta LMS_{t-2}} + \underset{(0.0089)}{0.062\Delta LS_t} + \underset{(0.013)}{0.042\Delta LS_{t-1}}$$

$$\bar{R}^2 = 0.996; DW = 1.782;\ Norm(JB) = 4.1963(0.1227);$$
$$White's\ Het\ F = 1.258(0.3651); RESET - F = 3.047(0.096); BG - F = 0.0024(0.961)$$

Equation 3a: Jamaica

$$\pi = \underset{(1.597)}{-6.202} + \underset{(0.014)}{0.1038LO_t} - \underset{(0.018)}{0.128LPW_t} + \underset{(0.031)}{0.312LR_t} - \underset{(0.017)}{0.198LS_t} - \underset{(0.053)}{0.383LU_t} + \underset{(0.118)}{0.543LY}$$
$$+ \underset{(0.017)}{0.121\Delta LMS_t} - \underset{(0.014)}{0.034\Delta LO_t} + \underset{(0.017)}{0.221\Delta LS_t} + \underset{(0.017)}{0.09\Delta LMS_{t-1}} + \underset{(0.0133)}{0.033\Delta LO_{t-1}} + \underset{(0.0177)}{0.088\Delta LPW_t}$$
$$\underset{(0.036)}{-0.225\Delta LR_{t-1}} + \underset{(0.015)}{0.389\Delta LS_{t-1}} + \underset{(0.057)}{0.1975\Delta LU_{t-1}} - \underset{(0.0183)}{0.064\Delta LMS_{t-2}} + \underset{(0.027)}{0.148\Delta LR_{t-2}} + \underset{(0.0194)}{0.139\Delta LS_{t-2}}$$
$$+ \underset{(0.0684)}{0.49\Delta LU_{t-2}}$$

$$\bar{R}^2 = 0.981; F = 92.251(0.000); DW = 2.011; Norm(JB) = 1.715(0.4243);$$
$$White's\ HetTest - F = (); BG - F = 0.0425(0.84); RESET - F = 0.41(0.536)$$

[2] All variables specified with an L in front as a representation of a log. The presence of a d before the variable's name signifies the first difference of the variable.

Equation 4a: Trinidad and Tobago

$$\pi = \underset{}{-1.899} + \underset{(0.229)}{0.225}LY_t - \underset{(0.024)}{0.059}LMS_t + \underset{(0.0047)}{0.066}LPW_t - \underset{(0.0071)}{0.0284}LU_t - \underset{(0.0069)}{0.118}\Delta LMS_{t-1} + \underset{(0.0234)}{0.073}\Delta LMS_t$$
$$- \underset{(0.019)}{0.077}\Delta LS_t - \underset{(0.026)}{0.386}\Delta LY_t + \underset{(0.073)}{0.256}\Delta LY_{t+1} + \underset{(0.065)}{0.045}dum98 - \underset{(0.0137)}{0.043}dum81 \quad (0.0148)$$

$$\overline{R}^2 = 0.918; F = 34.716(0.0000); DW = 1.925; Norm(JB) = 0.151(0.9274);$$
$$White's\ Het\ test - F = 1.84(0.129); RESET - F = 1.054(0.316); BG - F = 0.0314(0.861)$$

ECM estimates

Equation 1b: Barbados

$$\Delta\pi = \underset{(0.015)}{0.215} + \underset{(0.0391)}{0.359}\Delta\pi_{t-2} + \underset{(0.0054)}{0.08}\Delta LO_t - \underset{(0.0055)}{0.077}\Delta LPW_t + \underset{(0.016)}{0.136}\Delta LR_t + \underset{(0.016)}{0.079}\Delta LU_t$$
$$- \underset{(0.0645)}{0.402}\Delta LY_t + \underset{(0.011)}{0.152}\Delta LMS_{t-1} + \underset{(0.0055)}{0.044}\Delta LO_{t-1} - \underset{(0.0159)}{0.072}\Delta LR_{t-1} + \underset{(0.0137)}{0.113}\Delta LU_{t-1} -$$
$$+ \underset{(0.01089)}{0.049}\Delta LU_{t-2} + \underset{(0.0626)}{0.156}\Delta LY_{t-2} - \underset{(0.0434)}{0.667}ECT_{t-1}$$

$$\overline{R^2} = 0.968; DW = 2.145; F - statisic = 56.577(0.0000); S.E\ of\ regression = 0.005314$$

Equation 2b: Guyana

$$\Delta\pi = \underset{(0.022)}{-0.075}\Delta LY_{t-1} - \underset{(0.0314)}{0.18}\Delta LY_{t-2} - \underset{(0.0823)}{0.195}\Delta\pi_{t-2} + \underset{(0.0043)}{0.011}\Delta LO_{t-2} + \underset{(0.00023)}{0.0018}\Delta PW_t - \underset{(0.00027)}{0.0009}\Delta PW_{t-1}$$
$$- \underset{(0.00011)}{0.0067}\Delta LR_t - \underset{(0.00058)}{0.0013}\Delta LR_{t-2} + \underset{(0.01155)}{0.037}\Delta LMS_t - \underset{(0.01294)}{0.042}\Delta LMS_{t-2} + \underset{(0.000008)}{0.00055}\Delta LS_t + \underset{(0.000163)}{-0.00063}\Delta LS_{t-1}$$
$$- \underset{(0.0049)}{0.023}dum1985 - \underset{(0.071)}{0.73}ect_{t-1}$$

$$\overline{R}^2 = 0.997; DW = 1.385; S.E.of\ regression = 0.0007$$

Equation 3b: Jamaica

$$\Delta\pi = \underset{(0.027)}{0.112}\Delta LMS_t + \underset{(0.055)}{0.123}\Delta LR_t - \underset{(0.098)}{0.225}\Delta LU_t + \underset{(0.028)}{0.109}\Delta LMS_{t-1} + \underset{(0.0241)}{0.147}\Delta LPW_{t-1} - \underset{(0.0599)}{0.187}\Delta LR_{t-1}$$
$$+ \underset{(0.0361)}{0.372}\Delta LS_{t-1} + \underset{(0.0945)}{0.310}\Delta LU_{t-1} - \underset{(0.0349)}{0.139}dum06 + \underset{(0.0363)}{0.122}dum78 - \underset{(0.062)}{0.729}ect_{t-1}$$

$$\bar{R}^2 = 0.902; DW = 1.988; S.E.of\ regression = 0.034$$

Equation 4b: Trinidad and Tobago

$$\Delta\pi = - \underset{(0.0965)}{0.182}\Delta\pi_{t-2} + \underset{(0.0104)}{0.064}\Delta LPW_t - \underset{(0.0113)}{0.034}\Delta LU_t - \underset{(0.022)}{0.107}\Delta LMS_{t-1}$$
$$+ \underset{(0.0112)}{0.039}\Delta LU_{t-2} + \underset{(0.063)}{0.202}\Delta LY_{t-2} - \underset{(0.1447)}{0.742}ect_{t-1}$$

$$\bar{R}^2 = 0.71; DW = 1.944; S.E.of\ regression = 0.0169$$