Determinants of Inflation in Selected Caribbean Countries

by

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and

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ABSTRACT

Inflation has been a topical issue since the early 1970s 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. However, in order to manage a process efficiently, understanding its drivers or determinants is of utmost importance; hence the study of the inflationary process in the Caribbean. Research of this nature has been conducted on Caribbean economies before, however the most recent study is more than ten years old. Therefore this paper fills a time gap. It also utilises a longer data series and a more robust testing technique, namely an unrestricted error-correction model and Pesaran et al. (2001) bounds test for cointegrating analysis. Even though hypothesised 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. The findings indicate that the determinants for inflation in the Caribbean are both cost-push and demand-pull. These results, while adding new information to the literature, also support some 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 on economic well-being, 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 inflation to a minimum. The first step in the process of controlling inflation is to understand its determinants. This paper adds to the literature by identifying the factors that contribute to inflation in four of the larger Caribbean countries.

The motivation for this paper is simple. First, a significant lag exists from the last time any research in this area was conducted for the Caribbean. The most recent paper on the determinants of inflation for Barbados is by Cumberbatch (1995), in which data up to 1993 is used, while articles on the inflation process for other Caribbean countries are more dated. Thus, there is now an additional fifteen years of data and experiences with regard to the inflation process within the region, which is sufficient reason to carry out a renewed investigation on the drivers of inflation in the various countries. Second, there have been significant advances in the econometric discipline, particularly as it relates to cointegration analysis and the disentanglement of the long-run relationship from the short-run dynamics of the system under investigation. In this regard, we utilise an unrestricted error-correction model (UECM) and Pesaran et al. (2001) bounds test for a cointegrating relationship to estimate economic relationships between the inflation rate and its potential determinants over the period 1970 to 2006. This methodology has been proven to be quite robust in small samples in comparison to the VAR and VEC models, which may be sensitive to the choice of lag length[1]. Therefore, these results are likely to be more reliable than those from earlier studies.

The remainder of this paper is divided as follows. The next section provides an historical perspective on the inflationary process over the studied period. Section three presents both a theoretical and empirical review of literature. Section four gives the specification of the economic model, discusses the data and outlines the methodology. The fifth section reports findings from the estimated model and section six concludes the paper by summarising the results, providing linkages with previous studies and suggesting probable policy implications.

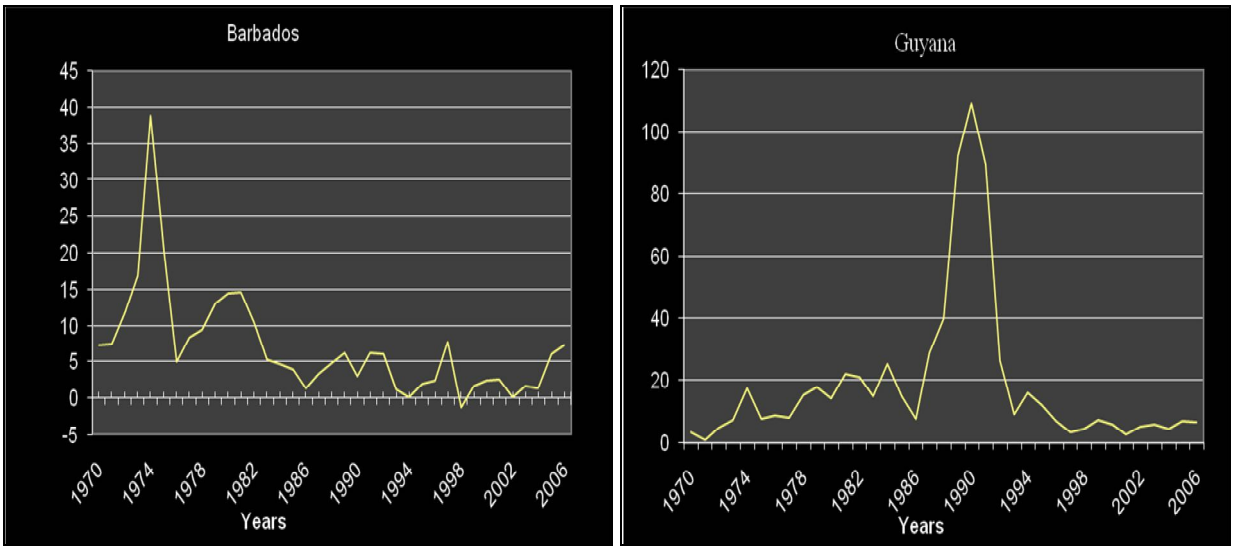
[1] See Greenidge (2006), for further discussion of the advantages of the UECM over other methodologies for estimating co-integration relationships

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

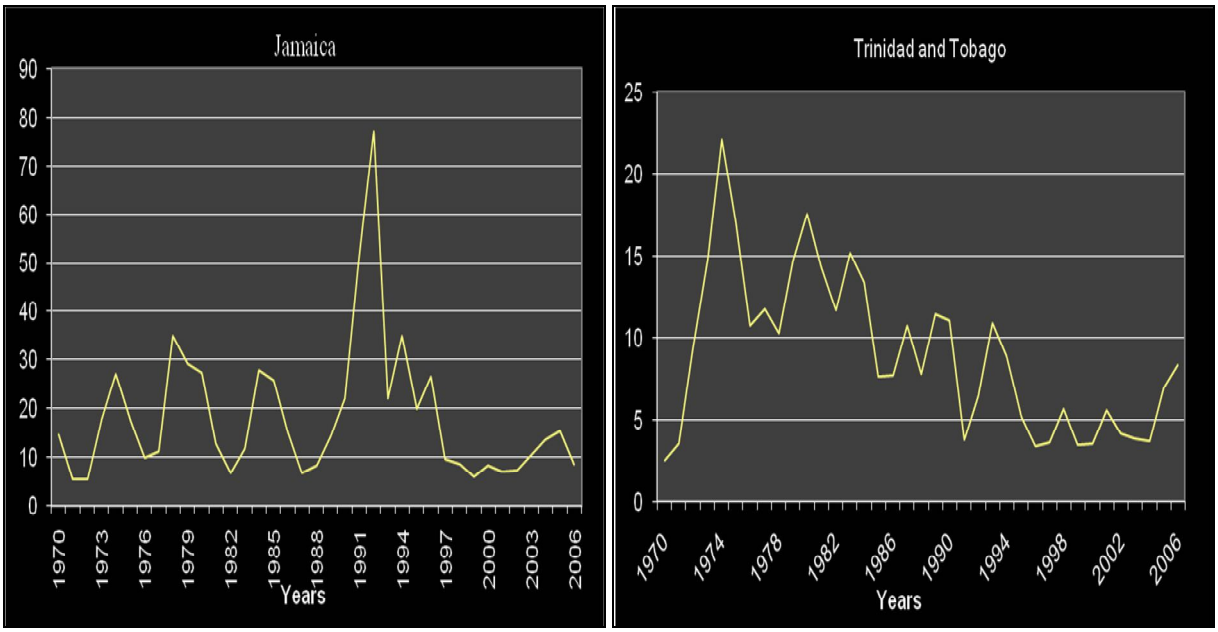
Figure 1 provides a comparison of inflation rates for the countries used in this study. Those countries with "true" floating exchange rates (Jamaica and Guyana), display a similar trend in their inflation rates, with rates oscillating around a certain average up until the 1990's, after which there is a spike in the data. 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 to each other, but one that is different from that of floating exchange rate countries. In the latter group, rates were highest at the beginning of the sample period and gradually declined. In this section, the inflationary process is divided into decades, in order to capture significant movements over a short time span within the Caribbean.

Figure 1: Inflation rates in the Caribbean

(a) (b)



(c) (d)



(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, while the average inflation rate in Trinidad and Tobago approximated 12.2% with a 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 UK and the U.S.A accelerated, with a positive impact on world inflation. Domestic factors also contributed to inflation rates in the period. For example, in the Barbadian economy, taxes and interest rates 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 seems to have had continued effects on the Guyanese and Jamaican economies in the early 1980's. In addition, inappropriate domestic policies served to accentuate the inflation problem in these two countries. For example, in the case of Jamaica such inconsistent domestic policies saw money supply increasing by roughly 40% per year over this period; government spending ballooning, with large wage increases to public sector employees every two years; and a significant expansion in the stock of domestic debt (Thomas, 1988). 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. The collapse of the oil market in 1983 left Trinidad and Tobago experiencing a recession from that year until 1992.

(1991 – 2000)

With the exception of Jamaica and Guyana, inflation rates during the 1990's remained relatively low, with the highest rates in Barbados and Trinidad and Tobago being 7.7% and 10.8%, respectively. 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 and the impact of strong capital account liberalisation policies in both countries. In addition, the Guyanese dollar experienced severe devaluation during this period. In 1994 a pick up in fuel prices, a shortage of food in the country and the addition of certain tariffs and changes in the consumption tax regime resulted in even higher inflation rates in Guyana. In the case of Jamaica, between 1991 and 1996 the rate of inflation averaged 38.6%, with a high of 77.9% in 1992. Again, poor domestic policies contributed to the rise in inflation over this period. Specifically, there was the substitutability of short-term debt with money which showed up in an increase in the money supply during 1991 and 1995, large wage settlements due to trade union pressures in 1993 and the latter part of 1995, and government intervention in 1995 and 1996 in support of troubled financial institutions which resulted in increased public expenditures. However, though the above mentioned policies would have certainly contributed to Jamaica's inflationary problems, Schuler (1998) argues that the most

inflationary policy in the 1990s was the government's practice of constantly borrowing money directly from the Bank of Jamaica to finance its deficit.

(2001 – 2006)

In the latter part of the sample period, all four countries experienced relatively low rates of inflation. 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, with the highest rates (in the same order) being 7.3% in 2006, 6.9% in 2005, 15.3% in 2005 and 8.3% in 2006. Even though, the increased inflation may be attributed to oil price increases in 2005 and 2006, other factors may have influenced the rate, as well. For example, there was an additional tax levy on imports in 2006 in Barbados and an oil price spike in 2003, which may have significantly affected the Jamaican inflation rate.

3.0 Theories of inflation

3.1 Theoretical view on the determinants of inflation

There are several theories to explain what causes 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 (see Ball and Doyle, 1969, for a detailed discussion), 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. Accordingly, 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 rate, output and price expectations, respectively.

The Monetarist Model may be structured as $\pi = f(y, m_s, i)$, where y represents changes in real income, m_s means money supply and i refers to the cost of holding cash (interest rate).

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 is a product of '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 the money supply or increase the supply of goods and services. The variables for the determination of inflation in this model include the output gap (representing the deviation of actual output from desired output) and excess money (which is the difference between actual and desired money).

In an effort to combat criticisms from the Monetarists, the Keynesians put forward a modified 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, since 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 (Cumberbatch, 1995) hypothesises that inflation is influenced by world prices, wages and productivity. Frisch (1977) also mentions an augmented Scandinavian model (developed by Branson and Myhrman, 1976), in which unemployment rate and expected inflation in the tradable sector are added to the determinants of inflation in the Scandinavian model.

Dlamini et al. (2001) surveyed 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, the authors point out that these theories are based on variables that are not quantifiable and are therefore excluded from most empirical studies. Also, Selialia (1995) (cited in Dlamini 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 developing countries

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.

One of the earlier studies in the region is that of Bourne and Persaud (1977), which focuses on the inflationary processes in Trinidad and Tobago and Jamaica over the period 1960 - 1975. 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 contribute 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 are not very significant to the inflationary process in Trinidad and Tobago, they may be contributory factors to anti-inflationary policies. For Jamaica, the authors report that import prices and the price of bank credit are significant to the inflationary process.

Almost a decade later, Holder and Worrell (1985) investigated the drivers of inflation in the region utilising a simultaneous price formation model for Barbados, Jamaica and Trinidad and Tobago over the period 1963 to 1980. 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, while changes in wage rate show significance in Jamaica only and domestic interest rate increases influence 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. In a later study, Downes et al. (1991) administer a more thorough econometric investigation into the inflationary process in Barbados using data from 1965 to 1987 and conclude that wages, productivity, unemployment and the price of tradables are contributing factors to inflation. Downes et al. (1992) revisit the issued but also included Jamaica and Trinidad and Tobago in the analysis. 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 so 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 and productivity growth rates are contributing factors to the inflationary process only in Barbados.

Following on from Downes et al. (1992), Cumberbatch (1995) also addresses the issue of what drives inflation in Barbados but opts to do so within the context of a two-sector Scandinavian model. 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-tradable 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 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 as 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 hypothesises that for the period studied (1981-1990) real output level, imported inflation and interest rates stimulated the Barbadian inflationary process.

A number of studies have been conducted on the inflationary process in non-Caribbean developing countries. Domac and Elbirt (1998) study 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 (2008) 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 (2006) 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.

A small sample of inflation studies is also taken from the more developed world. Claus (2000) studies the usefulness of the output gap in determining inflation rates in New Zealand. The author finds that with a positive output gap, there is a 2/3 probability that inflation will increase in the next quarter and a 3/5 probability that inflation will rise the next year. This, Claus (2000) points out, is an indication that the output gap is a good predictor of inflationary pressures. Turner (1995) also finds that a positive output gap is usually four times more inflationary than a negative one in Canada, Japan and the USA. Watanabe (1997) also supports this finding for Japan.

In addition, Belke and Polleit (2006) investigate the relationship between inflation and excess liquidity in the Swedish economy. With the use of single equation and structural VECM estimation techniques, a significant relationship is uncovered and excess money is said to play a key role in future price movements.

Careful examination of the literature reveals that in developing countries, the following variables are mostly responsible for the inflationary process: import prices; wage rates; interest rates; exchange rates; excess money supply; unemployment rate; productivity. Even though all these variables are important, import prices seem most significant in this group. Studies from the more developed countries emphasize output gap and excess liquidity measures, which indicate that demand pressures significantly influence inflation rates.

4.0 Model specification, methodology and data

4.1 Model specification

The above literature review on the inflationary process points to the employment of several different models to capture the determinants of inflation in the Caribbean. In addition, a number of similar variables from each model are found to be significant in the empirical work, which makes it difficult to choose a particular theoretical model to examine the causes of inflation in the Caribbean. Therefore, an 'encompassing' model, pulling on several schools of thought is specified and a general-to-specific approach (GETS) employed. The advantage of the GETS approach lies in its

ability to deliver results based on underlying economic theories of inflation, which are also consistent with the properties of the data. The general model is specified as follows:

$$\pi = f\left(\overset{+}{Oil}\pi, \overset{+}{Pw}\pi, \overset{+/-}{Ygap}, \overset{-}{r}, \overset{+}{U}, \overset{+}{EM}, \overset{-}{E} \right) \quad (1)$$

where the represented variables, in order of appearance, are: inflation rate, oil price inflation, world price inflation, real output gap, interest rate, rate of unemployment, excess money and exchange rate.

Earlier studies, as seen in the literature review, include variables as they are, in levels, to investigate inflation rate. However, this study investigates the effect of other rates of change on inflation. Hence, the use of oil inflation, world price inflation, output gap, excess money among the other traditional rates of unemployment, interest and exchange.

The simultaneous inclusion of the world price and the oil price variables in the model requires an explanation. The world price index contains oil prices, amongst other things and in earlier years oil and world prices displayed similar evolving 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 (since the correlation coefficient between the two variables is 0.13). Given that the 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.

Money supply and output, among other variables are repeatedly seen as important to the inflation process from the literature. However, excess money and output gap are used to pick up on demand pressures in the economy, since studies show that they tend to perform better at times than simple money supply and output. A positive output gap indicates that demand pressures are present and inflation is increasing; while the excess money variable shows that 'too much money is chasing too few goods' and therefore, demand pull inflation is expected. The unemployment rate is included in accordance with the theory of the Phillips curve, which hypothesises a relationship between inflation and unemployment. In this regard, it should be noted that the Phillips curve as originally

formulated presumes a negative relation between inflation and unemployment (Phillips, 1998). However, recently there has been an explosion of studies arguing that there is no evidence of such a trade-off between inflation and unemployment (see for example, Moghaddam and Jenson, 2008; Niskanen, 2002; Reichel, 2004). In fact, the general conclusion from this recent research is that there is at best a positive relation between inflation and unemployment with a lag of roughly two years, which is consistent with earlier theoretical reformulations of the Phillips curve by Phelps (1967) and Friedman (1968). Thus, in this vein we hypothesise a positive relation between the two variables. Finally, the *a priori* expectation of the relationship between the inflation rate and interest rates are specified in the model as being negative. However, at the theoretical level, the relationship can also be positive from a cost-push perspective. That is, treating the interest rate as a cost of borrowing, an increase in the rate of interest, may result in firms passing on the increased cost to the consumers in the form of higher prices.

The determinants of inflation are investigated using the Unrestricted Error Correction Model (UECM) approach proposed by Pesaran et al. (2001), where short- and long-run effects are estimated jointly from a general autoregressive distributed-lag (ARDL) model. Pesaran et al. (2001) refers to this as the ARDL approach to cointegration modelling. This approach has two main advantages over the other common procedures to cointegration analysis, mainly the Engle and Granger two-step approach and the Johansen maximum likelihood framework. The first advantage stems from the fact that the other methods focused on the estimation of long-run relationships among I(1) variables, which inevitably involves a certain degree of pre-testing and thus introduces a further degree of uncertainty into the analysis of relationships between levels (Cavanagh et al., 1995; Pesaran et al., 1996; Pesaran et al., 2001). Moreover, their widespread use has led to the common misconception that long-run relationships exist only in the context of cointegration among integrated variables (Greenidge, 2006; Loayza and Ranciere, 2006). With the UECM, cointegration analysis can be conducted irrespective of whether the explanatory variables are I(0), I(1) or a mixture of both. The second advantage is that this technique improves upon the other methods since it is better at handling small sample and dynamic sources of bias. Pesaran and Shin (1998), Pesaran et al. (2001) and Haug (2002) show that the OLS estimators of the short-run parameters in the UECM are $\sqrt{T}$ -consistent and the long-run coefficients are super consistent in small sizes.

The UECM of equation 1 is:

$$\Delta\pi_t = \phi_0 + \sum_{i=1}^{p-1}\gamma_i \Delta\pi_{t-i} + \sum_{i=0}^{q-1}\delta_i \Delta X_{t-i} + \alpha\pi_{t-1} + \beta_i X_{t-1} + \varepsilon_t \qquad (2)$$

where X represents the set of inflation determinants identified in equation 1, ϕ and γ are the short-run coefficients related to inflation and its determinants, α and β are the level effects and thus the long-run coefficients are computed as $-(\beta_i/\alpha)$, α also represents the speed of adjustment to the long-run relationship, ε_t is a disturbance term with the classical assumptions. The inclusion of lagged inflation allows a richer structure and can be taken as a measure of inflation inertia. The inertia is usually interpreted as measuring indexation or inflation expectations. If there is no inflation inertia, then γ would not be significantly different from zero.

A long-run relationship is said to exist between inflation and its determinants if the coefficients on the lagged level variables are jointly significant. This is a standard F-statistic test, however its asymptotic distributions is non-standard. As such, Pesaran et al. (2001) provide two sets of asymptotic critical values; one set assuming that all the regressors are I(1); and another set assuming that they are all I(0). These two sets of critical values refer to two polar cases but actually provide a band covering all possible classifications of the regressors into I(0), I(1) or even fractionally integrated. If the calculated F-statistic lies above the upper level of the band, the null is rejected, indicating cointegration. If it falls below the lower level of the band, the null cannot be rejected, indicating the lack of cointegration. If the calculated F-statistic falls within the band, a conclusive inference cannot be made.

4.3 Data

This paper uses annual data over the period 1970 to 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.

Due to data availability, 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. In this regard, official 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, while estimation for Barbados is done only for the period 1975 – 2006 and for Guyana for the period 1974-2006. 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

The UECM is estimated with up to three lags of the first differences of the variables and a general-to-specific approach is utilised to reduce the model to a parsimonious representation of the data generation process. We consider this to be a sufficiently long lag length to begin with since we are working with annual data. Several diagnostic tests are conducted on the final model including tests for normality, serial correlation, model misspecification and heteroskedasticity.

Barbados

The final estimated UECM for Barbados is reported in Table 1. The model passes all the relevant diagnostic tests and thus can be taken as an adequate representation of the inflation process in Barbados; explaining approximately 88 percent of the variability in the inflation rate over the

period. The findings indicate that both external and domestic factors play a significant role in inflation determination in Barbados.

There appears to be a fair amount of negative inertia in the inflation process. The coefficient on the lagged change in the inflation rate of roughly -0.37 implies that a one percentage point increase in the rate of inflation in a given year would translate into a 0.37 percentage point decline in the rate of inflation in the following year. In a low inflation environment such as Barbados, the negative coefficient may be reflecting inflation expectations where, following a shock to the inflation rate, persons expected the rate to decline towards normal levels. Such reasoning is supported by two common theories of inflation expectations, namely adaptive and rational expectations.

According to the former, economic agents form their expectations of inflation based on recently observed inflation, which in the case of Barbados is generally low inflation rates, and this may affect the general price level. Thus, prices fall because people expect them to fall and they expect them to fall because they have seen previous expansions in the rate falling very quickly. On the other hand, the rational expectations theory of inflation purports that people use all the available information, including that about current policies, to forecast the future. Therefore, if policymakers are credible, rational people will understand their commitment to a low inflation environment and, in the face of an inflation shock, quickly lower their expectation of inflation. Barbados' expressed commitment to it fixed exchange rate guarantees such credibility.

Table 1: Determinants of Inflation in Barbados

$$\Delta\pi_t = \underset{}{-0.0144} \underset{(-2.88**)}{-0.372\Delta\pi_{t-1}} \underset{(-2.425**)}{-0.256\Delta\pi_{t-2}} \underset{(-2.297**)}{+0.092\Delta \ln EM_t} \underset{(2.247**)}{+0.142\Delta \ln EM_{t-1}} \underset{(3.698***)}{+0.032\Delta Oil\pi_t} \underset{(2.489**)}{}$$

$$\underset{(-3.241***)}{-0.057\Delta Oil\pi_{t-1}} \underset{(2.909***)}{+1.319\Delta \ln r_{t-1}} \underset{(1.967*)}{+0.062\Delta \ln U_{t-2}} \underset{(-3.335***)}{-0.348 \ln \pi_{t-1}} \underset{(4.740***)}{+0.126 \ln Oil\pi_{t-1}}$$

$$\underset{(-2.927***)}{-0.861 \ln r_{t-1}} \underset{(3.210***)}{+0.034 \ln U_{t-1}}$$

Diagnostics

$\bar{R}^2 = 0.88$ $F = 8.127$ [0.000] $DW = 2.06$ $Norn = 1.164$ [0.559] $AR = 0.332$ [0.724]

$ARCH = 0.122$ [0.732] $RR = 0.254$ [0.614] $HET = 0.125$ [0.911] $Chow(92) = 0.902$ [0.623] $Chow(04) = 0.103$ [0.903]

Long-run multipliers (Long-run response of the inflation rate with respect to a one percentage point increase in):

Oil Inflation	0.363
Interest Rate	-2.473
Unemployment rate	0.097

Notes: T-statistics are shown in parentheses. R^2 is the fraction of the variance of the dependent variable explained by the model, *F* is the F-statistics for the joint significance of the explanatory variables, *DW* is the Durbin Watson statistic, *AR* is the Lagrange multiplier test for p-th order residual autocorrelation correlation, *RR* = Ramsey test for functional form mis-specification (square terms only); *Norm* is the test for normality of the residuals based on the Jarque-Bera test statistic ($\chi 2$ (2)). *ARCH* is the autoregressive conditional heteroscedasticity for up to p-th order (see Engle, 1982). *HET* is the unconditional heteroscedasticity test based on the regression of squared residuals on squared fitted value.

Finally, *Chow(n)* is Chow's (1960) test for parameter constancy based on breakpoints in the sample (two breakpoints are tested - the sample mid-point, 50th , and the sample 90th percentile, 90th).

The positive coefficient on changes in excess money supply implies that short-run increases in money supply, in excess of its underlying trend value, generate inflation. This is consistent with the monetarist view of inflation, where too much money chasing to few goods results in price increases. However, there is no evidence that excess money is an inflation determinant in the long-run. This

finding is in line with previous work by Greenidge et al. (2001) where the authors show that money supply in Barbados is endogenous and is driven by the demand for money. Thus, the effects of short-run increases in the money supply will quick dissipate as the stock of money gravitates towards that demanded. The estimates also suggest that oil price inflation has positive initial impact on domestic inflation but this effect begins to die off by the second year (evident by the negative coefficient on the lagged oil price inflation variable). Nonetheless, it does not completely die off and the long-run effect of such an oil price shock is positive, where, for every percentage point increase in oil price inflation, domestic inflation will be approximately 0.36 percentage points higher over time.

The findings also suggest that, in the short-run, changes in interest rates have a positive impact on inflation in Barbados, with a one percentage point rise in the interest rate resulting in a 1.3 percentage point advance in inflation. This most likely reflects the tardiness of persons to immediately adjust consumption patterns in the face of shocks to interest rates, which they deem to be temporary. However, the results also indicate that over time the impact of real interest rates on inflation is negative, thus consistent with the notion that as the cost of borrowing rises persons will eventually adjust their spending patterns accordingly. The estimates also revealed that inflation rate is significantly influenced by unemployment rate, both in the short- and long-run.

The presence of a long-run equilibrium relationship between inflation and its determinants in the case of Barbados is confirmed based on the result of the 'bounds' test. The computed F-statistic on the exclusion test of the three level variables is 10.227, which exceeds the asymptotic critical upper 'bounds' value of -3.99 in Pesaran et al. (2001, Table CII(iii)) for the existence of a cointegrating relationship, thus rejecting the null of no cointegration relationship at 5% level. This implies that the inflation rate in Barbados and its determinants are cointegrated or co-moving. Moreover, the coefficient on the lagged inflation term, representing the implicit speed of adjustment towards equilibrium, is negative and highly significant and indicates that approximately 35 percent of any deviation from the long-run equilibrium inflation level is corrected each year. Thus, it takes roughly three years for equilibrium to be restored following a shock to inflation.

Guyana

The estimated results for Guyana are presented in Table 2. The model passes all the various diagnostic tests and the computed F-statistics of 38.26 for the cointegration test exceeds the bounds

upper critical value of 3.99 for a 5% significance level. Thus, the null hypothesis of no cointegrating relation is rejected, which indicates that inflation and its determinants are cointegrated, these determinants being the past inflation rate, oil prices inflation, real interest rate, output gap, and exchange rate changes. Cointegration is also confirmed by the presence of the significant lagged inflation term, whose coefficient points to an adjustment speed of roughly 40 percent, which means that it takes roughly 2.5 years for inflation to return to its long-run level following a shock to inflation.

Based on the significance of changes in lagged inflation variable, inertia is a significant factor in the inflation process in Guyana, where a one percentage point increase in inflation in a given year would translate into a 0.47 percentage point rise in inflation in the next year. This is not surprising given Guyana's history of high inflation. In such an environment and faced with higher than expected inflation in the current year, economic agents are likely to revise their inflation expectations upwards, which would tend to lead to increases in wages and the prices of other goods and thus bringing about further inflation. The results also show that changes in oil price impact on inflation in Guyana, both in the short- and long-run. A one percentage point expansion in oil price inflation would, within one year, lead to approximately a 0.2 percentage point rise in domestic inflation and over time raise its equilibrium level by 0.35 percentage points. As theory predicts, in a small open economy changes in the exchange rate are significant in determining inflation. The results for Guyana show that a one percent depreciation of the exchange rate leads to a 0.27 percent increase in long-run inflation. The huge depreciation of the Guyanese dollar relative to the US dollar over the period under review implies that the price of imported commodities has increased when expressed in local currency. In the case of the short-run impact, the changes in the exchange rate are also significant and positive, where the effect of a one percent depreciation on inflation is estimated at around 0.62 percent (including both the lagged and contemporaneous coefficients).

Table 2: Determinants of Inflation in Guyana

$$\Delta\pi_t = \underset{}{-0.0034} + \underset{(4.029***)}{0.465}\Delta\pi_{t-2} + \underset{(3.924***)}{0.197}\Delta Oil\pi_{t-1} + \underset{(4.713***)}{0.107}\Delta Oil\pi_{t-2} - \underset{(-4.667***)}{2.988}\Delta\ln r_{t-1} - \underset{(-4.723***)}{2.702}\Delta\ln r_{t-2}$$

$$- \underset{(-2.633**)}{0.734}\Delta\ln Ygap_{t-2} + \underset{(8.184***)}{0.421}\Delta\ln E_t + \underset{(3.170***)}{0.199}\Delta\ln E_{t-1} - \underset{(-3.901***)}{0.397}\ln\pi_{t-1} + \underset{(4.654***)}{0.349}\ln Oil\pi_{t-1}$$

$$+ \underset{(3.412***)}{0.11}\ln E_{t-1}$$

Diagnostics

$\bar{R}^2 = 0.90$ $F = 25.68$ [0.000] $DW = 1.85$ $Norn = 0.042$ [0.979] $AR = 0.831$ [0.453]

$ARCH = 1.344$ [0.262] $RR = 1.556$ [0.258] $HET = 24.51$ [0.321] $Chow(92) = 1.867$ [0.226] $Chow(04) = 0.268$ [0.768]

Long-run multipliers (Long-run response of the inflation rate with respect to a one percentage point increase in):

Oil Inflation	0.348
Nominal Exchange Rate	0.273

Notes: Same as Table 1.

The findings also indicate that changes in interest rates and the output gap are significant determinants of inflation in the short-run but have no long-run effects. For the former, one percentage point increase in the cost of borrowing reduces inflation in Guyana by approximately three percentages points in the following year and by almost 2.7 percentages points by year two. With respect to the latter, the coefficient on changes in the output gap is significant and negative, and suggests that a one percent rise in the output gap would decrease annual inflation by 0.73 percent. However, both effects are only transitory and the equilibrium inflation level remains unchanged.

Jamaica

The results for Jamaica are presented in Table 3. The model passes various diagnostic tests, including that for serial correlation of the residuals, functional form misspecification, non-normal residuals and heteroscedastic disturbances. Additionally, as in the previous two cases, the selected

variables form a cointegrating relationship as the computed F-statistic of 119.59 significantly exceeds the upper bound critical value from Pesaran et al (2001). Moreover, the coefficient on the lagged inflation term is negative and highly significant, and indicates that following a shock to inflation this equilibrium relationship is re-established within one and a half years.

Table 3: Determinants of Inflation in Jamaica

$$\Delta\pi_t = \underset{(4.274**)}{0.082\Delta Oil\pi_{t-1}} + \underset{(2.964***)}{1.221\Delta\ln r_t} \underset{(-2.532**)}{-1.019\Delta\ln r_{t-1}} - \underset{(-4.713***)}{0.772\Delta\ln r_{t-2}} + \underset{(2.174**)}{0.518\Delta\ln Ygap_t} + \underset{(3.072***)}{0.137\Delta\ln EM_t}$$

$$+ \underset{(4.487***)}{0.235\Delta\ln E_t} + \underset{(3.133***)}{0.194\Delta\ln E_{t-1}} \underset{(-9.354***)}{-0.671\ln\pi_{t-1}} + \underset{(4.612***)}{0.142\ln Oil\pi_{t-1}} \underset{(-3.604***)}{-0.198\ln r_{t-1}}$$

Diagnostics

$\bar{R}^2 = 0.90$ $F = 31.54$ [0.000] $DW = 2.03$ $Norn = 1.983$ [0.371] $AR = 0.487$ [0.622]

$ARCH = 0.028$ [0.870] $RR = 0.583$ [0.454] $HET = 16.07$ [0.779] $Chow(90) = 0.559$ [0.835] $Chow(03) = 1.579$ [0.227]

Long-run multipliers (Long-run response of the inflation rate with respect to a one percentage point increase in):

Oil Inflation	0.212
Interest Rate	0.295

Notes: Same as Table 1.

As in the previous cases of Barbados and Guyana, the findings for Jamaica show oil price inflation as having a significant impact on domestic inflation in both the short- and long-run. A 10 percentage point rise in the price of oil in any given year will lead to a 0.8 percentage point expansion in the local inflation rate by the following year. This effect grows over time, with the local rate eventually settling at a level which is roughly 1.4 percentage points higher. The interest rate also has a short- and long-run impact on inflation, where a the immediate effect on a one percentage point increase in interest rates is a 1.2 percentage point rise in inflation but thereafter the inflation rate declines and the end result is a 0.2 percentage point reduction in the rate. The other variables that affect inflation in Jamaica, the output gap, excess money and changes in the exchange rate, only have a short-run or transitory impact. The coefficient on the output gap is positive and equal to

roughly 0.52, implying that a one percentage point rise in the output gap would increase inflation by about half of a percentage point. As expected, the impact of an increase in excess money on inflation is positive and is estimated at around 0.14 percentage points. The impact of a depreciation of the nominal exchange rate on inflation is also positive and estimated at around 0.23 and 0.19 percentage points for the current period and lagged period changes respectively but this effect soon dies out.

Trinidad and Tobago

Table 4 contains the results for Trinidad and Tobago. Here too, the model passes all the diagnostic tests. Specifically, there is no evidence of autocorrelation in the disturbance of the error term, the errors are heteroscedastic and independent of the regressors, the normality test suggests that the errors are normally distributed, and the RESET test indicates that the model is correctly specified. The computed F-statistic of 135.2 significantly exceeds the upper critical bound value and thus indicates that there is a long-run equilibrium relationship between inflation and its determinants. The coefficient on the lagged inflation variables is negative and highly significant, and suggests that approximately 50 percent of the short-run deviations from this equilibrium relation is corrected each year.

Table 4: Determinants of Inflation in Trinidad and Tobago

$$\Delta\pi_t = \underset{(5.873***)}{0.221} + \underset{(3.864***)}{0.408}\Delta\pi_{t-1} + \underset{(2.131**)}{0.027}\Delta Oil\pi_t - \underset{(-1.724*)}{0.153}\Delta \ln Ygap_t - \underset{(-3.082***)}{0.175}\Delta \ln Ygap_{t-1}$$

$$+ \underset{(4.331***)}{0.123}\Delta \ln E_{t-1} + \underset{(2.691***)}{0.072}\Delta \ln E_{t-2} - \underset{(-7.194***)}{0.504}\ln \pi_{t-1} + \underset{(3660***)}{0.047}\ln Oil\pi_{t-1} + \underset{(5.522***)}{0.093}\ln E_{t-1}$$

Diagnostics

$\bar{R}^2 = 0.78$ $F = 8.744$ [0.000] $DW = 1.92$ $Norn = 1.399$ [0.497] $AR = 1.706$ [0.206]

$ARCH = 0.002$ [0.963] $RR = 0.480$ [0.496] $HET = 0.202$ [0.993] $Chow(90) = 0.559$ [0.226] $Chow(03) = 1.579$ [0.227]

Long-run multipliers (Long-run response of the inflation rate with respect to a one percentage point increase in):

Oil Inflation	0.093
Nominal Exchange Rate	0.185

Notes: Same as Table 1.

The findings point to some inertia in the inflation process in Trinidad and Tobago where a one percentage point increase in the inflation rate in a given year would, *ceterius paribus*, lead to a 0.41 percentage point increase in the rate in the following year. As noted earlier, this is most likely capturing economic agents' revisions to their inflation expectation. Oil price inflation is also a significant determinant of domestic inflation in Jamaica, with both a short- and long-run impact. A 10 percentage point rise in the rate of change of oil prices would have an immediate 0.3 percentage point expansion in the inflation rate and over time a 0.9 percentage point rise. Changes in the nominal exchange rate also have short- and long-run effects, where a 10 percent depreciation in any given year would lead to a cumulative 1.9 percentage point increase in the inflation rate over the next two years and raise the long-run level of inflation by approximately 1.9 percentage points. The other significant determinant in the inflation process is the output gap and here it appears that a positive output gap leads to a contraction in the inflation rate. This would suggest that, historically, when output is growing above its trend value that it is generally supply and not demand driven.

6. Conclusion and Policy implications

This study seeks to examine the determinants of inflation using data on four selected Caribbean countries over the period 1970 and 2006 using a more robust estimation method, namely an unrestricted error-correction model and Pesaran et al.'s (2001) bounds test for a cointegrating relationship. Due to the small sample size of the current study, the use of traditional cointegration techniques such as the Engle and Granger (1987), Johansen (1988) and Johansen and Juselius (1990) methods to capture the long-run inflation process may yield unreliable estimates. The results from this analysis suggest that the selected models are sufficient for explaining the evolution of inflation in the respective countries. In addition, though all of the variables included in the regressions are not significant to the inflation process in each of the countries examined, there is however a fair degree of commonality in the determinants. This commonality is particularly so for the influence of oil prices and exchanges rate changes.

In each of the countries, changes in oil prices have both a short- and long-run impact on inflation, and though the magnitudes vary, the long-run effect is generally higher than the short-run impact. The design of policy to mitigate the effects of rising oil prices on domestic inflation would have to take this time dimension into consideration. The findings also point to changes in the nominal exchange rate as being important in the determination of the inflation process in those countries with a floating exchange rate regime. In the three floating rate countries, changes in the

exchange rate have led to increased inflation in the short-run and in two of the countries – Guyana and Trinidad and Tobago - the effects were permanent and served to raise the equilibrium inflation rate. From a policy perspective this would imply that the exchange rate is an important transmission channel of monetary policy to inflation. Thus, the authorities can use monetary policy tools, particularly the exchange rate, to target inflation.

Another noteworthy result is that of the interest rate's influence on inflation. We find the long-run effect to be negative, as theory would suggest. However, there appears to be some "over shooting" in the short-run, where an increase in the interest rate actually leads to a rise in inflation after which inflation abates towards a lower long-run level. This, we hypothesise, may be due to the tardiness or inability of individuals to immediately adjust consumption patterns in the face of interest rate shocks and is consistent with standard theories of consumption. Nonetheless, over time the higher interest rate takes effect and persons adjust accordingly.

The policy implication of this finding is that the authorities may first see a rise in inflation rates following an increase in interest rate. Without fully understanding the overall time path of the inflation rate towards its new equilibrium, policy makers may not see, in the short-run, a reduction in the inflation rate following a policy action of increasing interest rates and may be tempted to push up interest rates even further, with unwelcoming effects.

We also find the price inertia phenomenon taking place in three of the four countries studied, where expectations of past inflation experiences impact on the current inflation rate. This may also be reflecting the stickiness of wages or other backward-looking indexation arrangements. In fact, as noted earlier, inertial forces usually show up in countries where formal and informal contracts typically index nominal wages to inflation. Since most Caribbean countries do have organised labour markets, it is not surprising that such forces play a significant role in inflation in these countries. It should be stressed however, that though the expectational component of inflation inertia may result from the lack of credibility of policies, the degree and potential determinants of inertia as a whole should be investigated in more detail for the respective countries. Nevertheless, a policy implication of our findings is that reducing the level of inertia through the promotion and conduct of credible policies can be effective in combating high levels of inflation.

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