Does Demand Volatility Lower Growth and Raise Inflation? Evidence from the Caribbean

Magda Kandil[1]

Abstract

This Working Paper should not be reported as representing the views of the IMF.
The views expressed in this Working Paper are those of the author(s) and do not necessarily represent those of the IMF or IMF policy. Working Papers describe research in progress by the author(s) and are published to elicit comments and to further debate.

The paper investigates asymmetry in the allocation of aggregate demand shocks between real output growth and price inflation over the business cycle in a sample of fifteen Caribbean countries. In most countries, the evidence indicates the existence of a kinked supply curve, which implies that positive demand shocks feed predominantly into prices while negative demand shocks mainly affect output. This suggests that the high variability of aggregate demand in Caribbean countries, frequently exposed to shocks, tends to create an upward bias on inflation and a downward bias on real output growth, on average, over time. The analysis highlights the benefits of eliminating structural rigidities responsible for the kinked nature of the supply curve and points to the dangers of pro-cyclical macroeconomic policies.

[1] Senior Economist, Caribbean II Division, Western Hemisphere Department.

Contents

I. Introduction

In general, Caribbean countries have been largely successful in bringing annual inflation down to single digits in recent years. Nonetheless, their growth rates have been disappointing despite fiscal stimulus. Previous research (see, e.g. Sahay (2006)) suggests that absent higher growth, the fiscal position may not be sustainable over time.

Caribbean countries are small open economies that are highly dependent on tourism receipts. This unique feature exposes their economies to excessive demand variability from external shocks. The ability of these economies to absorb demand variability has implications for economic performance. Furthermore, as policy makers attempt to smooth the outcome of demand variability on economic performance, structural impediments may impose a serious challenge to their efforts.

To shed some light on structural rigidities governing the relation between demand variability and economic performance, this paper traces the nature of cyclical fluctuations on the macro-economy across a sample of fifteen Caribbean countries. Demand-side fluctuations could arise from domestic factors or policies, including monetary or fiscal policies, or external factors, such as those affecting flows of remittances and/or other determinants of the external position. Asymmetry in the response of real growth and price inflation to demand shocks over the business cycle will determine the net effect of demand variability on economic performance over time.

The analysis indicates that the majority of the Caribbean countries are characterized by a kinked supply curve; i.e., one that is flat when output is below potential and steep when it is above. This implies that during demand expansions, inflation accelerates while the real output response is moderate. On the other hand, during demand contractions, a flatter supply curve implies a bigger drop in real output growth with only a small deceleration in inflation.

These results point to two important policy implications: (i) the need to address structural rigidities that create the kink in the supply curve, and (ii) the dangers of procyclical policies that accentuate demand shocks and exacerbate the associate upward bias on inflation and downward bias on real growth.

The outline of the paper is as follows. Section II provides an overview of macroeconomic developments in the fifteen Caribbean countries, focusing on output growth and inflation. Section III provides a theoretical background for the kinked-slope of the supply curve. Section IV presents the empirical models and results. Section V analyzes the time-series results. Section VI presents the conclusion and policy implications.

II. An Overview of Macroeconomic Developments in Caribbean Countries

The analysis of the paper concerns cyclicality in real growth and price inflation across Caribbean countries. This section summarizes major indicators characterizing real growth and price inflation across countries.

Table 1 presents average real GDP growth for each of the countries under investigation over the sample period 1975–2005.[2] The lowest average real growth is in Haiti (0.64%) and the highest average real growth is in Belize (5.4%). The volatility of real growth is generally high across Caribbean countries, as measured by the standard deviation. The lowest volatility is in St. Kitts and Nevis, 2.5 percent, and the highest volatility is in Suriname, 5.9 percent. As noted by Cashin (2006), output in Caribbean countries is, on average, about 1.6 times as variable as output in the United States.[3]

In Table 1, the rate of inflation, using the GDP deflator, ranges from a low of 2.8 percent in Belize to a high of 25.9 percent in Suriname over the period 1975–2005. The highest inflation variability is in Suriname, 39 percent, and the lowest inflation variability is in The Bahamas, 2.8 percent.

Across countries, where inflation was high, real growth tended to be low, providing some evidence for supply-side constraints. On average, the correlation coefficient between real growth and price inflation is negative (-0.57) and statistically significant across countries. The paper turns to the analysis of fluctuations contributing to variation in real growth and price inflation over time.

III. Theoretical Background

Assume aggregate demand intersects with the aggregate supply curve at a level of output y^* that corresponds to full capacity utilization. Aggregate demand may be subject to random shocks that generate fluctuations

---

[2] For related literature analyzing Caribbean growth cycles, see Mamingi (1999), Borda, Manioc and Montauban (2000), and Craigwell and Maurin (2002), among others. DeMasi (1997) provides a summary of approaches taken by the International Monetary Fund in estimating growth cycles.

[3]Mendoza (1995) and Agenor et al. (2000) attribute the high volatility in developing countries to the greater incidence of exogenous shocks.

around the steady state equilibrium output over time. Assume these shocks follow a symmetric distribution, i.e., shocks have zero mean and constant variance. Demand variability determines the size of demand shifts over the business cycle. The allocation of demand shocks between real growth and price inflation is dependent on the shape of the supply curve. Along a linear supply curve with a constant slope, the effects of demand shifts, positive and negative, cancel out, implying demand variability does not determine trend real output growth or price inflation over time. However, this is not the case when the supply curve has a kink (see Figure 1).

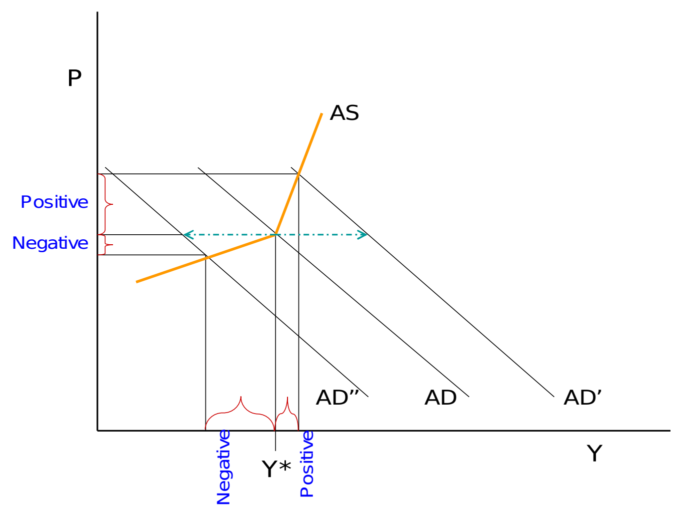

Figure 1

Theoretical explanations of a kinked-shape supply curve have emphasized the role of institutional and structural rigidities in the labor and product markets. In a framework in which nominal wage negotiations follow contractual agreements, the magnitude and speed of wage adjustments (degree of wage indexation) may be different during expansions and contractions. During boom periods, cost of living adjustments maybe specified to guarantee workers upward adjustment of wages to keep up with inflation. In contrast, employers may resist adjusting wages in the downward direction during recessions.[4]

Alternatively, the asymmetric flexibility of nominal wages maybe an endogenous response to uncertainty impinging on the economic system.

---

[4]Some (see, e.g., Kandil (2002a)), explain downward wage rigidity by employers’ desire to retain experienced workers and avoid the search and training cost of hiring new workers to accommodate a potential future rise in demand. In the context of the Caribbean region, employment is dominant in the public sector. Political consideration may necessitate higher compensation of civil servants during economic booms, while resisting a slow down in the wage bill during downturns.

Models of the variety of Gray (1978) have emphasized the dependency of the degree of indexation on the variability of stochastic disturbances. Higher demand variability may increase uncertainty and, therefore, the probability of realizing positive and negative demand shocks. Agents may form asymmetric behavior to hedge against uncertainty. Agents are more inclined to hedge against the risk of higher inflation, demanding a stipulation of cost of living adjustments to protect their real wages. In contrast, cost of living adjustments are usually not stipulated in anticipation of a slow down in demand and, therefore, price deflation. Similarly, agents in economies with a history of high trend inflation are likely to have larger incentives for upward wage flexibility, compared to downward flexibility.

An alternative explanation of supply-side asymmetry is based on the frequency and speed of adjusting product prices. This framework emphasizes the cost of adjusting prices “menu costs” in determining producers’ decisions. Menu costs comprise the cost and effort involved in changing prices (see, e.g., Ball and Mankiw (1994)). When trend inflation is high, the presence of menu cost implies an upward bias on inflation. High trend inflation increases producers’ incentives to raise prices above the current equilibrium, in anticipation of the need for continuous upward adjustment. An expansionary demand shock, coupled with high trend inflation, creates a large gap between desired and actual relative prices. During a recession, producers may resist paying the menu cost to adjust prices downward as they expect trend inflation to decrease their relative prices in par with their competitors. As a result, positive shocks are more likely to induce a larger upward price adjustment, compared to downward adjustment in the face of negative shocks.

Along a kinked supply curve (see Figure 1), demand variability induces a tradeoff between real output growth and price inflation. Assuming a steeper supply curve in the face of positive demand shocks, demand variability will have a net average positive contribution (inflation) to price and a net average negative contribution (contraction) to output over time. Accordingly, demand variability increases the trend of price inflation and decreases trend real output growth, on average, over time.

IV. Econometric Investigation

The investigation will study asymmetry in Caribbean business cycles over the period 1975–2005. Business cycles are fluctuations that develop randomly around the trend component of economic variables. The trend is the domain of real growth, which progresses over time in line with underlying fundamentals that determine production potential. The latter grows over time in line with growth in the economy’s endowed resources of labor, capital, and technological advances. Consequently, the trend component follows a non-stationary stochastic trend. In contrast, cyclical fluctuations generate transitory deviations around the stochastic trend and, therefore, are the domain of short-term stationary shocks.

It is worth noting a few factors that differentiate the analysis of this paper from similar studies analyzing business cycles in Caribbean countries. Cashin (2006) uses a statistical business-cycle filter to eliminate the trend component from the random cyclical component following the suggestions of Baxter and King (1999). Similar to Cashin, the approach of this paper relies on a filtering technique to extract the cycle (stationary component) from the trend (non-stationary component) of the dependent variables under investigation: real GDP and the GDP deflator. However, in contrast to Cashin's work, the paper develops an empirical model to model the cycle, differentiating between the effects of supply and demand shocks and modeling asymmetry in short-term adjustments to expansionary and contractionary shocks.

The empirical model identifies the size and significance of cyclical responses during booms and recessions. To identify periods of economic booms and recessions, the paper analyzes fluctuations in nominal GDP growth. The empirical model seeks to identify symmetric demand shocks along a stable supply curve. Since observed GDP reflects the intersection of supply and demand, however, it is necessary to control for the effects of factors that shift the supply curve. To isolate demand shocks, two controls are used: (i) dummy variables that correspond to the years of natural disasters (see Ramussen (2006)), and (ii) the energy price. While these two factors are arguably the major sources of supply-side shocks in the Caribbean countries, it must be acknowledged that other factors, not controlled for in the model, also play a role.

Fluctuations in nominal GDP are decomposed into a steady-state growth and a random cyclical component. The steady-state component corresponds to movements in the underlying fundamentals in full-equilibrium. Empirically, this component is derived as the *expected* GDP, using available information on a range of variables that are generally assumed to determine aggregate demand in theory.[5]The unanticipated residual in the forecast equation measures shocks to aggregate demand growth.[6] By construction, these shocks have a symmetric distribution,

[5] The list of variables in the forecast equation includes lagged variables of real output growth, price inflation, the growth of the money supply, the growth of government spending, the change in real effective exchange rate, the change in the oil price, and a dummy variable to control for structural breaks due to natural disasters.

[6] Rational forecast requires two conditions: (i) the forecast error is purely random white noise, i.e., agents are not making systematic mistakes over time, and (ii) the forecast error is uncorrelated with lagged variables that enter the information list, i.e., agents have capitalized fully on available information.

where positive shocks identify periods of economic booms and negative shocks identify periods of recessions. The difference between variables' responses to positive and negative shocks to aggregate demand will identify the degree and direction of asymmetry during booms and recessions.[7] If these responses are symmetric, cyclical fluctuations in the face of random demand shocks cancel out over time. A significant response to anticipated demand shifts implies lagged variables underlying agents' forecasts of aggregate demand have a long-lasting effect on developments in the dependent variables.

Model Specification

The stationarity of the variables under investigation is tested following the suggestions of Nelson and Plosser (1982). Based on the results of the KPSS test for non-stationarity (see, Kwiatowski, Phillips, Schmidt, and Shin (1992)), the variables under investigation are non-stationary in level and stationary in first difference. Given these results, the empirical models are specified in first-difference form as follows:

$$Dy_t = a_0 + a_1 E_{t-1} Dn_t + a_2 E_{t-1} Do_t + a_{3p} posn_t + a_{3n} negn_t + a_{4p} poso_t + a_{4n} nego_t + \eta_t \quad (1)$$

In equation (1), *D(.)* is the first-difference operator. The logarithm of real output is denoted by y_t. The logarithm of nominal GDP, n_t, approximates domestic demand for goods and services. The logarithm of the energy price is denoted by o_t. Anticipated changes at time *t-1* are denoted by E_{t-1}.

To detect asymmetry, shocks to the energy price and aggregate demand are decomposed into positive and negative components, denoted by pos_t and neg_t. The parameters a_{3p} and a_{3n} measure the responses of the dependent variable to the demand shock during booms and recessions. The direction and degree of asymmetry is measured by the statistical significance of the difference in the response of the dependent variable to

[7] A number of studies have analyzed asymmetric cyclical fluctuations. Using quarterly data for the United States, the evidence of Cover (1992) suggests that positive money supply shocks do not have an effect on output while negative money supply shocks do. Kandil (1995) provides evidence and explanation of the asymmetric effects of monetary shocks across a sample of major industrial countries. Kandil ((1996), (2002a)) analyze the evidence of the asymmetric effects of aggregate demand shocks using aggregate data of real output, price, and wage for the United States. Kandil (1998), and (1999) contrast the evidence of supply-side asymmetry using aggregate demand shocks across a sample of developing and industrial countries. Kandil (2001) and (2002b) investigate asymmetry in the effects of monetary and government spending shocks using aggregate data for the United States. Other evidence on the asymmetry of business cycles includes DeLong and Summers (1988), Romer and Romer (1989) and Swanson and Van Dijk (2002).

the positive and negative components of aggregate demand shocks. Finally, the term η_t is a stochastic error with mean zero and constant variance.

Producers are expected to reflect the cost of anticipated demand fully into their pricing strategy, eliminating the need for additional adjustment in output. Nonetheless, institutional rigidity may prevent full adjustment to demand shifts, necessitating a positive response of real growth. Faced with aggregate demand shocks, producers are expected to vary the output supplied positively with a magnitude that is dependent on resource and structural constraints in the short-run.

In addition, the energy price is expected to determine the cost of production. Higher price of oil increases the cost of the output supplied and decreases real growth.

Asymmetry in the output response to positive and negative demand shocks will verify the possibility of a kinked-shape supply curve.[8] A supply curve that is flatter during cyclical downturns and steeper during booms would be supported by a larger a_{3n} relative to a_{3p}.

The empirical model for price inflation replicates that for output growth:

$$Dp_t = b_0 + b_1 E_{t-1} Dn_t + b_2 E_{t-1} Do_t + b_{3p} posn_t + b_{3n} negn_t + b_{4p} poso_t + b_{4n} nego_t + \mu_t \quad (2)$$

Aggregate price inflation is denoted by Dp_t. As demand shocks are absorbed in real growth and price inflation, $b_{3p} = 1 - a_{3p}$, $b_{3n} = 1 - a_{3n}$. If prices are more flexible upward, $b_{3p} > b_{3n}$ and the aggregate supply curve is steeper during booms, relative to recessions.

To understand the propagation mechanism from aggregate demand to the real economy, the analysis considers possible asymmetry in specific demand variables during booms and recessions. To that end, empirical models are estimated using specific demand variables as dependent variables: private consumption growth, Dc_t, private investment growth, Dv_t, export growth, Dx_t, import growth, Dim_t, and the change in trade balance, $Dtbal_t$.

[8] The asymmetric impact of demand shocks on real output growth is not addressed in the context of mainstream business-cycle theories, which include the equilibrium explanation pioneered by Lucas (1973) and neo-Keynesian models emphasizing nominal wage rigidity (e.g., Fischer (1977), Gray (1978)) or price rigidity (e.g., Ball, Mankiw, and Romer (1988)).

Empirical Methodology

To estimate the empirical model in (1), proxies for forecasted growth in domestic demand and the energy price are needed. The growth of aggregate demand, Dn_t, is endogenous according to Engle's (1982) test. To form a proxy of agents' forecasts, the growth of aggregate demand is regressed on the lags of selected variables (see footnote 8) based on the results of a formal causality test. Lags of statistically significant variables are included in the forecast equation. In addition, the forecast equation accounts for significant structural break dummies that mark years of natural disasters (see Ramusen (2006)). Dummy variables are introduced following the results of a formal test suggested by Dufour (1982).

The predicted values are a proxy of agents' forecasts of aggregate demand. The residual of the forecast equation is a proxy for unanticipated random shock to demand growth. To satisfy rationality (see footnote 9), the residual in the forecast equation is a pure white noise with a zero mean and a constant variance. Hence, shocks are distributed symmetrically around the steady state forecasted trend.

Following the suggestions of Cover (1992), positive and negative shocks to demand growth are defined for the joint estimation as follows:

$$neg_t = -\frac{1}{2}\{abs(shock_t) - shock_t\}$$

$$pos_t = \frac{1}{2}\{abs(shock_t) + shock_t\}$$

Where a*bs(.)* is the absolute value operator and *shock* is the surprise component to the specific variable, as described above.

The energy price is exogenous. Accordingly, agents' forecast of the energy price is modeled as a second-order autoregressive, or AR (2). The proxy for energy price surprises is then formed by subtracting these forecasts from the actual change in the log value of the energy price. Energy price shocks have zero mean and a constant variance.

Pagan (1984 and 1986) showed that the use of regression proxies requires an adjustment of the covariance matrix of estimators of the parameters of the model containing constructed variables. As suggested by Mishkin (1982), a simple alternative is to estimate the expectation equations jointly with the equations explaining the dependent variables using 3SLS. To account for the endogeneity of aggregate demand, instrumental variables are introduced. The instrument list includes two lags of the log first difference of real growth, price inflation, the energy price, the real effective exchange rate, government spending, and the money supply.

The results of Engle's (1982) test for the presence of serial correlation in a simultaneous-equation model indicate that the error terms of the empirical models follow an autoregressive process of order one for some countries. For these countries, the estimated empirical models are multiplied through by the filter $(1-\rho L)$ where ρ is the serial correlation parameter and L is the lag operator. The serial correlation parameter is estimated jointly with the rest of the model's parameters.

V. Analysis of the Time-Series Results

All data under investigation are annual and taken from the IMF’s International Financial Statistics and World Economic Outlook databases.

The empirical model in (1) is estimated using data for various dependent variables under investigation. The empirical investigation includes data for the following countries: Antigua and Barbuda, The Bahamas, Barbados, Belize, Dominica, Dominican Republic, Grenada, Guyana, Haiti, Jamaica, St. Kitts and Nevis, St. Lucia, St. Vincent, Suriname, and Trinidad and Tobago. The sample period extends from 1975–2005, except in a few cases where data availability constrained the sample period.

The results are organized in two tables. The tables summarize the parameters that measure the responses of each of the dependent variables to anticipated domestic demand shifts, and the positive and negative shocks to domestic demand.[9] Table 2 presents the evidence for real output growth, private consumption, and private investment. Table 3 presents the evidence for export growth, import growth, and the change in the trade balance.

Real Output Growth

The results of estimating the empirical model of real output growth are presented in Table 2 across the sample of Caribbean countries under investigation. The discussion below will focus on asymmetry in the effects of aggregate demand shocks on real output growth during cyclical upturns and downturns. Evidence of this asymmetry will determine the net effect of demand variability on trend real output growth.

During economic booms, an expansionary shock to aggregate demand stimulates real output growth significantly in The Bahamas, Jamaica, St. Kitts and Nevis and St. Vincent. This is evident by the positive and statistically significant effects of expansionary shocks to aggregate demand on real output growth. The positive response of real growth indicates flexibility to expand the supply during boom periods. In all other

[9] Details of estimated parameters are available upon request.

countries, there is no evidence of significant real output growth in the face of expansionary demand shocks, implying inelastic supply curve that necessitates fast adjustment of price inflation to demand expansion.

The contractionary effects of aggregate demand shocks are more pervasive across Caribbean countries. In all but four countries (Dominican Republic, Guyana, Haiti, and Jamaica) real output growth shrinks significantly during economic downturns.

The difference in the response of real output growth to positive and negative aggregate demand shocks measures the direction and significance of asymmetry. A negative and significant difference indicates that output contraction exceeds expansion with respect to symmetric fluctuations in aggregate demand shocks. Accordingly, higher variability of aggregate demand, a higher probability of realizing positive and negative shocks, is likely to have a net negative effect, shrinking real output growth, on average, over time. Statistical significance supports this scenario in Antigua and Barbuda, Barbados, Belize, Dominica, Grenada, St. Lucia, Suriname, and Trinidad and Tobago.

There is no country in the group in which the growth expansion from a positive demand shock exceeds the contraction as a result of a negative shock. Output fluctuations appear to be symmetric, indicating a neutral effect of fluctuations in aggregate demand on real output growth, on average over time, in The Bahamas, Dominican Republic, Guyana, Haiti, Jamaica, St. Kitts and Nevis, and St. Vincent. In these countries, institutional and structural constraints are similar during booms and recessions, resulting in similar effects of demand shocks on output expansion and contraction. Hence, the effect of demand variability is neutral on real growth in these countries.

In sum, there appears to be evidence for a kinked supply curve in many Caribbean countries. Specifically, contractionary shocks to aggregate demand move along a flatter supply curve, implying an output contraction that exceeds the expansion resulting from a symmetrical distribution of demand shocks.

Price Inflation

The asymmetric impact on inflation is a mirror image of the real output response, as both variables combine to nominal GDP (the corresponding coefficients add up to one). Thus, the shape of the supply curve, supported by the output response, implies an inflationary bias in the face of demand variability.

In Table 2, the difference in the response of price inflation to positive and negative aggregate demand shocks measures the direction and significance of asymmetry. A positive and significant difference indicates that price inflation exceeds deflation with respect to symmetric fluctuations in aggregate demand shocks. Accordingly, higher variability of aggregate demand is likely to have a net positive effect, increasing price inflation, on average, over time.[10] Statistical significance supports this scenario in Antigua and Barbuda, Barbados, Belize, Dominica, Grenada, St. Lucia, Suriname and Trinidad and Tobago.

Determinants of Asymmetry

Among theoretical explanations of a kinked supply curve, the sticky-price explanation suggests higher incentives to adjust prices upward, relative to downward adjustment, in countries that have experienced a history of higher trend inflation. In a high inflationary environment, agents are more inclined to pay the menu cost and adjust prices upward to prevent a relative deterioration in their product prices. In contrast, high trend inflation reduces incentives to pay the menu cost and adjust prices downward, contemplating a fast reversal of the cycle.

A sticky-wage explanation also suggests higher incentives to adjust wages upward in countries with high trend inflation. Cost of living clauses are likely to be specified to ensure workers adequate compensation in the face of higher inflation. By contrast, wages are likely to be sticky-downward in countries with high trend inflation. Workers are likely to factor in the impact of higher inflation on real wages and resist a slowdown in nominal terms during cyclical downturns.

The implications is higher trend inflation may provide an explanation for the observed asymmetry. Countries with higher trend inflation are likely to exhibit a stronger evidence of asymmetry, implying a steeper supply curve during upturns and a flatter supply curve during downturns.

To verify the validity of this theoretical hypothesis, the parameters measuring asymmetry in output and price in the face of demand shocks are regressed on trend price inflation across the sample of Caribbean countries. The evidence does not support the theory’s implications.[11] Across countries, higher trend inflation significantly increases output expansion relative to contraction, while accelerating price deflation

[10] In support of this evidence, in a cross-country regression, trend inflation increases significantly the higher the variability of aggregate demand.

[11] This evidence supports the analysis in Kandil (1995) using data across industrial countries.

relative to inflation. This evidence suggests that countries with higher trend inflation have taken more serious steps to fight inflation.

In light of these results, the empirical evidence rejects possible endogeneity of asymmetric price flexibility with respect to trend price inflation across countries. Determinants of asymmetric price flexibility are likely to be of the result of structural rigidities in labor and product markets that constrain downward adjustments in inflation, even when the trend rate is low.

Asymmetry in Specific Demand

To shed some light on the propagation of aggregate demand shocks to the real economy, the box highlights major features of asymmetric adjustments in the specific components of aggregate demand over the business cycle.

Box 1. Asymmetry in the Behavior of Specific Demand Components

Private Consumption:

- *During a boom*, private consumption growth increases significantly and correlates with higher price inflation in Dominica, Dominican Republic, Guyana, Haiti, Jamaica, St. Lucia, Suriname, and Trinidad and Tobago.
- *During a recession*, private consumption growth decreases significantly and correlates with output contraction in Barbados, Belize, St. Kitts and Nevis, St. Lucia, and Suriname.
- *During a recession*, private consumption growth decreases significantly and correlates with price deflation in Dominican Republic, Haiti, Jamaica, St. Kitts and Nevis, St. Lucia, and Suriname.
- In Barbados, the reduction in consumption growth during a recession exceeds the increase during a boom.
- In Guyana, the increase in private consumption growth during a boom dominates the reduction during a recession.

Private Investment

- *During a boom*, private investment growth increases significantly and correlates with higher price inflation in Dominica.
- *During a recession*, private investment growth decreases significantly and correlates with larger output contraction in Barbados, Belize, and Suriname.

Exports

- *During a boom*, export growth increases significantly and correlates with higher price inflation in Barbados.
- *During a recession*, export growth decreases significantly and correlates with larger output contraction in Belize, Dominica, Guyana, St. Lucia, and Trinidad and Tobago.

Imports

- *During a boom,* import growth increases significantly and correlates with higher price inflation in Antigua and Barbuda, Grenada, St. Kitts and Nevis, and Suriname.
- *During a recession,* import growth decreases significantly and correlates with larger output contraction in Guyana and St. Lucia.

Trade Balance

- *During a boom***,** the increase in imports dominates the increase in exports, resulting in significant reduction in the trade balance in Antigua and Barbuda

To summarize, asymmetric cyclical fluctuations are also evident in the behavior of demand components over the business cycle. Private consumption increases significantly during economic booms, further accelerating price inflation in some countries. In other countries, significant reduction in private consumption during recessions exacerbates real output contraction. Asymmetric cyclical fluctuations of private investment appear even more pronounced compared to private consumption, further exacerbating the inflationary effect and output contraction over the business cycle. In general, cyclicality in exports and imports cancel out during booms and recessions, moderating cyclical fluctuations in the trade balance.

VI. Summary and Conclusion

In an empirical model that differentiates responses to positive and negative demand shocks, the paper investigates asymmetry in the allocation between real output growth and price inflation. The results indicate that the majority of Caribbean countries are characterized by a kinked aggregate supply curve. Asymmetry, in most cases, reveals a steeper supply curve with respect to expansionary demand shocks, compared to contractionary shocks. Consequently, relative to the underlying trend, output contraction exceeds expansion and price inflation exceeds deflation over the business cycle; variability creates a negative growth and a positive inflation bias.

Two major policy implications emerge from this analysis. First, the evidence warrants a careful analysis of institutional and structural rigidities that underlie the kinked-shape supply curve in many of the countries under investigation. A review of constraints to factor mobility and institutions for price adjustments would be helpful in identifying the precise factors responsible for the kinked supply curve. Priorities should then be established to reduce such structural rigidities in the factor and product markets responsible for downward biases on growth and upward biases on inflation implied by the kinked supply curve.

A parallel policy track should aim at smoothing demand variability. Demand variability can be exacerbated by procyclical macroeconomic policies that amplify the impact of external shocks. In particular, additional fiscal spending during economic booms further accelerates price inflation while a slowdown in government spending during a recession exacerbates the contactionary effects. As a result, procyclical policies only serve to worsen the growth-reducing and inflationary bias associated with a kinked supply curve.

Table 1. Caribbean Real Growth and Price Inflation

	Real GDP Growth		Inflation of GDP Deflator	
Country	Average (In percent)	Std Dev (In percent)	Average (In percent)	Standard Deviation
Antigua and Barbuda	4.2	3.5	7.2	9.9
The Bahamas	2.4	4.8	3.9	2.8
Barbados	1.9	3.5	4.6	4.5
Belize	5.4	5.3	2.8	6
Dominica	2.7	5.3	5.2	4.5
Dominican Republic	4.1	3.5	14.2	1.3
Grenada	3.6	3.9	5.5	5.8
Guyana	0.67	4.8	18.6	2.6
Haiti	0.64	3.8	11.2	8
Jamaica	1.2	2.8	16.6	11
St. Kitts and Nevis	4.5	2.5	5.7	6.7
St. Lucia	4.8	4.6	4.6	5.2
St. Vincent and the Grenadines	4.5	3.2	4.7	4
Suriname	1.8	5.9	25.9	39
Trinidad and Tobago	2.5	5.6	7.3	8

Table 2. Fluctuations in Real Output Growth, Price Inflation, and Private Spending

Country	Output Growth			Price Inflation			Growth of Private Consumption			Growth of Private Investment		
	Posn	Negn	Asyem	Posn	Negn	Asyem	Posn	Negn	Asyem	Posn	Negn	Asyem
Antigua and Barbuda	0.01	0.90*	-0.89*	0.99*	0.099*	0.89*	...	...	...	...	...	...
	(0.02)	(3.60)	(-3.36)	(4.11)	(0.40)	(3.80)	...	...	...	...	...	...
The Bahamas	0.54*	0.78*	-0.24	0.46*	0.22	0.24	1.54	-0.039	1.58	-6.96	3.36	-10.32
	(2.75)	(3.50)	(-1.22)	(2.38)	(1.01)	(1.40)	(0.75)	(-0.07)	(0.76)	(-1.07)	(1.61)	(-1.58)
Barbados	-0.032	0.89*	-0.92*	1.03*	0.11	0.92*	0.05	1.57*	-1.52*	0.14	5.46*	-5.32*
	(-0.19)	(4.93)	(-5.47)	(6.04)	(0.63)	(5.40)	(0.10)	(2.92)	(-2.98)	(0.06)	(2.47)	(-2.28)
Belize	0.041	1.17*	-1.13*	0.96*	-0.17	1.13*	0.63	1.14*	-0.51	0.63	7.16*	-6.53*
	(0.18)	(3.48)	(-4.96)	(4.20)	(-0.50)	(4.94)]	(1.62)	(1.98)	(-1.31)	(0.47)	(3.62)	(-4.87)
Dominica	0.13	1.28*	-1.15*	0.87*	-0.28*	1.15*	1.73*	1.28	0.45	9.85*	-3.02	12.87*
	(0.33)	(3.69)	(2.92)	(2.18)	(-0.80)	(2.88)	(1.97)	(1.68)	(0.51)	(2.24)	(-0.79)	(2.93)
Dominican Republic	-0.17	-0.10	-0.27	1.17*	1.10*	0.07	0.85*	0.93*	-0.08	0.77	0.42	0.35
	(-1.02)	(0.57)	(-1.62)	(6.93)	(6.06)	0.41	(3.68)	(3.77)	(-0.34)	(1.30)	(0.66)	(0.59)
Grenada	-0.20	1.01*	-1.21*	1.20*	-0.009	1.21*	...	...	...	...	...	...
	(-0.90)	(4.80)	(-5.44)	(5.39)	(-0.04)	(5.13)	...	...	...	...	...	...
Guyana	-0.12	0.11	-0.23	1.12*	0.89*	0.23	1.52*	0.62	0.90*	5.16*	2.43	2.73**
	(-0.87)	(0.85)	(-1.67)	(8.20)	(6.54)	(1.68)	(4.32)	(1.36)	(2.56)	(3.31)	(1.20)	(1.75)
Haiti	-0.16	-0.19	0.03	1.16*	1.19*	-0.03	1.03*	0.88**	0.15	-0.008	-0.65	0.67
	(-0.69)	(-0.56)	(0.13)	(4.99)	(3.54)	(-0.13)	(2.96)	(1.75)	(0.43)	(-0.01)	(-0.33)	(0.80)
Jamaica	0.20**	0.083	0.12	0.80*	0.92*	-0.12	0.92*	0.90**	0.02	1.48	2.69	-1.21
	(1.77)	(0.44)	(1.04)	(7.29)	(4.84)	(-1.09)	(3.41)	(1.94)	(0.07)	(1.50)	(1.59)	(-1.22)
St. Kitts and Nevis	0.31*	0.21*	0.10	0.69*	0.79*	-0.10	0.41	1.15**	-0.74	2.20	-4.72*	6.92*
	(2.81)	(2.72)	(0.91)	(6.15)	(10.13)	(-0.89)	(0.48)	(1.92)	(-0.87)	(1.11)	(-3.41)	(3.49)
St. Lucia	0.09	0.70*	-0.61*	0.91*	0.30**	0.61*	1.59*	0.99*	0.60	-0.79	2.37	-3.16
	(0.54)	(3.89)	(-3.52)	(5.33)	(1.69)	(3.57)	(4.29)	(2.54)	(1.62)	(-0.10)	(0.78)	(-0.40)
St. Vincent and the Grenadines	0.59*	0.85*	-0.26	0.41*	0.15	0.26	0.43	-0.20	0.63	1.20	2.11	-0.91
	(2.80)	(3.21)	(-1.23)	(1.99)	(0.56)	(1.26)	(1.08)	(-0.39)	(1.58)	(0.65)	(0.89)	(-0.49)
Suriname	-0.03	0.17**	-0.20*	1.03*	0.83*	0.20*	1.02*	1.05*	-0.03	1.27*	1.26**	0.01
	(0.49)	(1.89)	(-3.27)	(16.61)	(9.10)	(3.22)	(8.78)	(5.94)	(-0.28)	(2.73)	(1.78)	(0.02)
Trinidad and Tobago	-0.27	0.78*	-1.05*	1.27*	0.22	1.05*	1.04**	0.42	0.62	1.28	1.86	-0.58
	(-0.93)	(2.21)	(-3.62)	(4.33)	(0.63)	(3.58)	(1.74)	(0.59)	(1.04)	(0.76)	(0.92)	(-0.34)

Notes:
Edn: Anticipated aggregate demand growth.
Posn: Expansionary shocks to aggregate demand during a boom.
Negn: Contractionary shocks to aggregate demand during a recession.
Asyem: difference in the response to expansionary and contractionary shocks.
Coefficients measure the response of each variable to demand shifts. Bracketed magnitudes are t-statistics, where * and ** denote statistical significance at the 5 and 10 percent levels.

Table 3. Fluctuations in Export Growth, Import Growth, and the Trade Balance

Country	Export Growth			Import Growth			Change in Trade Balance		
	Posn	Negn	Asyem	Posn	Negn	Asyem	Posn	Negn	Asyem
Antigua and Barbuda	0.54	0.018	0.52	3.04*	-1.09	4.13*	-1.83	1.60*	-3.43*
	(0.32)	(0.01)	(0.31)	(2.52)	(-0.87)	(3.42)	(-3.16)	(2.68)	(-5.90)
The Bahamas	3.08	1.19	(1.11)	-3.15	1.59**	-4.74	13.06	-1.04	14.10
	(0.87)	(1.05)	(-0.31)	(-1.11)	(1.74)	(-1.67)	(1.13)	(-0.28)	(1.22)
Barbados	1.80*	-0.031	1.83*	1.033**	1.14*	-0.11	1.28	-2.16	3.44*
	(2.73)	(-0.04)	(2.78)	(1.85)	(1.95)	-0.19	(1.05)	(-1.68)	(2.01)
Belize	0.72**	3.41*	-2.69*	0.49	0.99	-0.50	0.21	-0.16	0.37
	(1.91)	(6.18)	(-1.74)	(1.01)	(1.16)	(-1.03)	(0.65)	(-0.33)	(1.14)
Dominica	-0.29	2.68*	-2.97*	1.77**	1.22	0.55	-0.036	-0.38	0.34
	(-0.19)	(2.01)	(-1.95)	(1.70)	(1.35)	(0.53)	(-0.12)	(-1.45)	(1.15)
Dominican Republic	1.47	1.55	-0.08	0.75	1.33**	-0.58	12.18	21.79	-9.61
	(1.58)	(1.55)	(-0.09)	(1.04)	(1.72)	(-0.80)	(0.31)	(0.52)	(-0.24)
Grenada	0.87	0.94	-0.07	2.17*	0.37	1.80*	-0.97*	0.11	-1.08*
	(1.11)	(1.27)	(-0.089)	(3.01)	(0.54)	(2.50)	(-2.32)	(0.29)	(-2.58)
Guyana	0.48**	1.70*	-1.22*	0.39	1.41*	-1.02	6.7	-9.03	15.73
	(1.91)	(6.82)	(-4.85)	(1.15)	(4.20)	(-3.01)	(0.46)	(-0.63)	(1.07)
Haiti	0.95	1.76	-0.81	0.80	1.04	-0.21	-15.99	-11.11	-4.88
	(0.91)	(1.17)	(-0.78)	(1.03)	(0.93)	(-0.31)	(-0.92)	(-0.44)	(-0.28)
Jamaica	2.41	0.50	1.91	0.055	1.50	-1.47	51.89	-23.60	75.49*
	(1.38)	(0.49)	(1.09)	(0.06)	(0.92)	(-1.60)	(1.44)	(-0.44)	(2.09)
St. Kitts and Nevis	1.14*	0.71*	0.43	0.88	-0.22	1.10*	-0.05	0.16	-0.21
	(2.21)	(1.98)	0.83	(1.54)	(-0.56)	(1.93)	(-0.22)	(0.92)	(-0.92)
St. Lucia	-0.15	1.55*	-1.70*	0.46	1.28*	-0.82*	-0.22	-0.067	-0.15
	(-0.27)	(2.71)	(-3.06)	(1.10)	(2.89)	(-1.96)	(-0.67)	(-0.20)	(-0.47)
St. Vincent and the Grenadines	2.67*	2.81*	-0.14	1.18	-0.33	-0.52	-0.051	0.85	-0.91
	(2.59)	(2.15)	(-0.14)	(1.18)	(-0.26)	(-0.41)	(-0.08)	(1.02)	(-1.41)
Suriname	1.17*	1.12*	0.05	1.14*	0.82*	0.32	82.99	117.04	200.03
	(7.65)	(4.96)	(0.33)	(4.48)	(2.21)	(1.26)	(0.65)	(-0.63)	(1.57)
Trinidad and Tobago	-0.48	1.54*	-2.02*	0.04	0.68	-0.64	-30.85	32.85	-63.7*
	(-0.63)	(1.70)	(-2.65)	(0.05)	(0.65)	(-0.80)	(-1.48)	(1.32)	(-2.06)

Notes:
Edn: Anticipated aggregate demand growth.
Posn: Expansionary shocks to aggregate demand during a boom.
Negn: Contractionary shocks to aggregate demand during a recession.
Asyem: difference in the response to expansionary and contractionary shocks.
Coefficients measure the response of each variable to demand shifts. Bracketed magnitudes are t-statistics, where * and ** denote statistical significance at the 5 and 10 percent levels.

Annex I. Data Definition and Sources

1. GDP: Gross domestic product, current prices, WEO, NGDP.
2. Real GDP: Gross domestic product, constant prices, WEO, NGDP_R.
3. Consumer Price Index: WEO, PCPI.
4. Money: Broad Money, WEO, FMB.

5. Private Consumption: Private consumption expenditure, current prices, WEO, NCP.
6. Private Investment: Gross private capital formation, current prices, WEO, NIP.
7. Private Fixed Investment: Gross private fixed capital formation, current prices, WEO, NFIP.
8. Total Investment: Gross fixed capital formation, current prices, WEONFI.
9. Exports: Exports of goods and services, current prices, WEO, NX.
10. Imports: Imports of goods and services, current prices, WEO, NM.
11. Trade Balance: Exports minus imports of goods and services.
12. Current Account Balance: WEOBCA.
13. Government Spending: General government total expenditure and net lending, WEO, GGENL.
14. Exchange Rate: National currency per US dollar, WEO, ENDA.
15. Caribbean GDP: Sum of gross domestic product, current prices, U.S. dollars, WNGDPD.
16. US GDP: Gross domestic product, current prices, US dollar, W111NGDPD.
17. Interest Rate: various representatives of interest rates as follows:
    - Discount Rate: IFS, 60..ZF
    - Money Market Rate: IFS, 60..BZF
    - Treasury Bill Rate: IFS, 60..CZF
    - Savings Rate: IFS, 60K..ZF
    - Deposit Rate: IFS, 60L..ZF
    - Lending Rate: IFS, 60P..ZF

Data are available from *World Economic Outlook*, WEO, or *International Financial Statistics,* IFS, available from the IMF.

References

Agenor, P. R., McDermott, C. J. and Prasad, E., 2000, "Macroeconomic Fluctuations in Developing Countries: Some Stylized Facts," *World Bank Economic Review*, No. 14, pp. 251–285.

Backus, D. and Kehoe, P., 1992, "International Evidences on the Historical Properties of Business Cycles," *American Economic Review,* No. 82, pp. 864–888.

Ball, Laurence and Mankiw, N. Gregory, 1994, "Asymmetric Price Adjustment and Economic Fluctuations", *Economic Journal*.

Ball, Laurence, Mankiw, N. Gregory and Romer, David, 1988, "The New Keynesian Economics and the Output-Inflation Tradeoff", *Brookings Papers on Economic Activity*, 1: 1–65.

Baxter, M. and King R., 1999, "Measuring Business Cycles: Approximate Band-Pass Filters for Economic Time-Series", *Review of Economics and Statistics,* No. 81,
pp. 575–593.

Blanchard, Olivier, J. and Summers, Lawrance, H., 1988, "Beyond the Natural Rate Hypothesis", *The American Economic Review,* 78, 187.

Borda, P. Manioc, O. and Montauban, J., 2000, "The Contribution of US Monetary Policy to Caribbean Business Cycles," *Social and Economic Studies*, No. 49, pp. 225–250.

Burns, A. and Mitchell, W., 1946, *Measuring Business Cycles,* National Bureau of Economic Research, New York.

Cashin, Paul, 2006, "Caribbean Business Cycles," in *The Caribbean from Vulnerability to Sustained Growth,* edited by Ratna Sahay, David O. Robinson and Paul Cashin, pp. 17–57, International Monetary Fund.

Canova, F., 1998, "Detrending and Business Cycle Facts", *Journal of Monetary Economics,* No. 41, pp. 475–512.

Ghosh, A. R., A. Gulde, J. D. Ostry and H. Wolf, 2002, *Exchange Rate Regimes: Choices and Consequences,* Cambridge, Massachusetts: MIT Press, Cambridge, Mass.

Corbae, P. D. and Ouliaris, S., 2003, "Extracting Cycles from Non-Stationary Data", *Econometric Theory and Practice: Frontiers of Analysis and Applied Research*, Essays in Honor of Peter C. B. Phillips, edited by P. D. Corbae, B. Hansen, and S. Durlauf.

Cover, James P., 1992, "Asymmetric Effects of Positive and Negative Money Supply Shocks," *Quarterly Journal of Economics, 107, pp. 1261-1282.*

Craigwell, R. and Maurin, A., 2002, "Production and Unemployment Cycles in the Caribbean: The Case of Barbados and Trinidad and Tobago", *mimeo*, Research Department, Central Bank of Barbados.

DeLong, Bradford and Summers, Lawrence H., 1988, "How Does Macroeconomic Policy Affect Output?" *Brookings Papers on Economic Activity*, pp. 433–480.

DeMasi, P., 1997, "IMF Estimates of Potential Output: Theory and Practice," *Staff Studies for the World Economic Outlook*, International Monetary Fund: Washington DC, pp. 40–46.

Engle, R. R., 1982, "A General Approach to Lagrange Multiplier Model Diagnostics", *Journal of Econometrics,* 20, 83–104.

Dufour, J. M., 1982, "Generalized Chow Tests for Structural Change: A Coordinate Free Approach", *International Economic Review*, 23: 565–575.

Gray, Jo Anna, 1978, "On Indexation and Contract Length", *Journal of Political Economy*, 86, 1–18.

Fischer, Stanley, 1977, "Long-Term Contracts, Rational Expectations and the Optimal Money Supply Rule", *Journal of Political Economy,* 85, 191–205.

Hodrick, R. J. and Prescott, E. C., 1980, "Post-War US Business Cycles: An Empirical Investigation", *Discussion Paper No. 451*, Carnegie-Mellon University, Pennsylvania.

Kandil, Magda, 1995, "Asymmetric Nominal Flexibility and Economic Fluctuations," *Southern Economic Journal*, January, Vol. 61, No. 3, pp. 674–695.

Kandil, Magda, 1996, "Sticky-Wage or Sticky-Price? Analysis of the Cyclical Behavior of the Real Wage, *Southern Economic Journal.*

Kandil, Magda, 1998, "Supply-Side Asymmetry and the Non-Neutrality of Demand Fluctuations", *Journal of Macroeconomics*, Vol. 20, No. 4, pp. 785–810.

Kandil, Magda, 1999, “The Asymmetric Stabilizing Effects of Price Flexibility: Historical Evidence and Implications”, *Applied Economics*, 31, pp. 825–839.

Kandil, Magda, 2001, “Asymmetry in the Effects of US Government Spending Shocks: Evidence and Implications”, *The Quarterly Review of Economics and Finance*,
Vol. 41, pp. 137–165.

Kandil, Magda, 2002a, “Asymmetry in Economic Fluctuations in the U.S. Economy: The Pre-War and the 1946–1991 Periods Compared,” *International Economic Journal*, Vol. 16, No. 1, Spring, pp. 21–42.

Kandil, Magda, 2002, “Asymmetry in the Effects of Monetary and Government Spending Shocks: Contrasting Evidence and Implications”, *Economic Inquiry*, Vol. 40, No. 2, pp. 288–313.

Knight, W. E., 1996, “A Computer Method for Calculating Kendall’s Taw with Ungrouped Data,” *Journal of American Statistical Association*, 61, 436–439.

Kwiatowski, Denis, Phillips, Peter C. B., Schmidt, Peter and Shin Yeng Cheol, 1992, “Testing the Null Hypothesis of Stationarity Against the Alternative of a Unit Root, How Sure Are We That Economic Time Series Have a Unit Root?” *Journal of Econometrics,* 54, pp. 159–78.

Lindbeck, Assar and Snower, Dennis, 1986, “Wage Setting, Unemployment, and Insider Outsider Relations”, *The American Economic Review,* 76, 235–239.

Lucas, Robert, 1973, “Some International Evidence on Output-Inflation Tradeoffs”, *American Economic Review*, pp. 326–34.

Mamingi, N., 1999, “Testing for Convergence and Common Features in International Output: The Case of the Eastern Caribbean Countries,” *Journal of Eastern Caribbean Studies*, No. 24, pp. 15–40.

Menodoza, E., 1995, “The Terms of Trade, the Real Exchange Rate, and Economic Fluctuations,” *International Economic Review,* No. 36, pp. 101–137.

Mishkin, F. S., 1982, “Does Anticipated Monetary Policy Matter? An Econometric Investigation”, *Journal of Political Economy,* Vol. 90, pp. 22–51.

Nelson, Charles and Plosser, Charles, 1982, "Trends and Random Walks in Macroeconomic Time Series," *Journal of Monetary Economics*, 10, 139–62.

Pagan, A., 1984, "Econometric Issues in the Analysis of Regressions with Generalized Regressors", *International Economic Review*, 25, pp. 221–47.

Pagan, A., 1986, "Two-Stage and Related Estimators and Their Applications", *Review of Economic Studies,* 53, 517–38.

Ramussen, Tobias, 2006, "Natural Disasters and Their Macroeconomic Implications," in *The Caribbean from Vulnerability to Sustained Growth,* edited by Ratna Sahay, David O. Robinson and Paul Cashin, pp. 181–205, International Monetary Fund.

Romer, C. and Romer, D., 1989, "Does Monetary Policy Matter?" in Blanchard, Olivier, and Fischer, Stanley, *NBER Macroeconomics Annual.*

Sahay, Ratna, 2006, "Stabilization, Debt, and Fiscal Policy in the Caribbean", in *The Caribbean from Vulnerability to Sustained Growth,* edited by Ratna Sahay, David O. Robinson and Paul Cashin, pp. 17–57, International Monetary Fund.