A Model of Price Formation for Small Economies; Three Caribbean Examples

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Abstract

The point at issue in analyses of price formation in small open economies is the importance of domestic inflationary pressures. Foreign prices will clearly have a powerful effect, but can they be overshadowed by fiscal and monetary expansion or interest rate and exchange rate policy? This paper presents a small model for treating this question. Domestic effects arise via the price of non-tradable goods, which are determined by domestic demand and supply. Demand is influenced by expenditure and hence by monetary and fiscal policies and the balance of payments, while supply curves shift with changes in local and imported costs. The model is tested for three Caribbean countries.

A Model of Price Formation in the Caribbean

The economies of Caribbean island states are small and open, depending on foreign exchange earned in a few large sectors, together with long-term capital inflows, to finance imports of consumer goods, raw materials and machinery. Although home-produced goods satisfy the larger portion of final demand, most material inputs and all machinery is imported. Domestic prices are necessarily influenced by foreign prices to a considerable degree. However, controversy surrounds the relative impact of domestic factors. To what extent has inflation in the Caribbean resulted from exchange rate changes, wage policies and monetary expansion? This study presents a model to test for these influences. We describe the model in the remainder of this section; section two presents the empirical results.

We begin by dividing the economy into tradable and non-tradable sectors, a familiar dichotomy which can be made to yield a variety of results, depending on the links specified between the sectors.[1] Our system of equations allows for effects from the price and output of tradable goods to the price of non-tradables. Rising prices of tradables may provoke wage increases which push up the costs

of producing non-tradables, and they may erode real incomes sufficiently to reduce the demand for nontradables. Increased production of tradables generates income and spending, some of which will be directed to the non-tradable sector. If the increment of tradable output is exported, foreign exchange reserves may rise, increasing the supply of money, lowering the cost of credit and stimulating expenditure. Again, part of that expenditure goes for non-tradables.

The economies we will be analysing - those of Barbados, Jamaica and Trinidad and Tobago - divide cleanly into tradable and non-tradable segments. Tradable goods, comprising exports, imports and import-competing goods, include mineral production, agriculture, manufacturing and tourism. All the rest are non-tradable: construction, internal transport, public utilities, business and professional services, distribution and government.[2] In the tradable sector prices are a product of 'world' prices and the exchange rate.[3]

Bauxite/alumina and petroleum are the two significant mineral exports of the countries in this study; they are produced and marketed by multinational corporations under specific intra-firm arrangements (some part of the industry is now locally owned, but marketing continues to

depend wholly on foreign multinationals). Sugar, the principal agricultural export, is sold under special arrangements with the EEC (formerly with the UK) and the US and Canada, for the most part.[4] Prices of food items for domestic consumption fluctuate widely in the short-run, but long-run trends are governed by the ready availability of imported substitutes.

The supply of tourist accommodation in any Caribbean country is very small, compared to the markets from which visitors are drawn - the US, Canada, Europe and Northern South America - so the demand curve should be almost infinitely price elastic. The scanty evidence so far available is ambiguous. Clarke [1978] turns up elasticities close to zero for Barbados, but Ffrench [1972] records high elasticities for Jamaica. A plausible view is that each country is able to project its personality to allow for very low demand elasticities in the neighbourhood of the existing world price. Outside this range elasticities are probably infinite. The issue is clouded by variation among tourists in the season of travel and type of facility required. An assumption of exogenous prices seems least problematic, in the absence of detailed analysis of the tourism sector. Prices may influence the growth of hotel accommodation in the medium-term, but for the annual model we intend to estimate, capacity may be taken as given.

Export manufacturing is small in relation to its potential market in North America and other countries in the Caribbean, and there is little scope for domestic price variation if the sector is to remain competitive.

Prices of import-competing goods are determined (at the upper limit) by world prices, subject to tariff changes and quantitative restrictions. Quantitative restrictions have featured importantly in the incentives for manufacturing, and our failure to incorporate them into the analysis introduces a qualification to the results. However, import competing manufactures account for no more than five percent of real output and the proportion for which quantitative restrictions were significant may be only one to three percent, depending on the country. Tariffs have changed little over the period of our analysis. The countries under study unified their tariffs under the provisions of the Caribbean Community (Caricom) agreements in 1973. Changes were made in individual items, but the overall levels of protection remained about the same; there has been no subsequent modification.

Given the prevailing world prices in these tradable activities, the output level may be derived from the supply schedule. In the one-year time interval used for testing our model capacity is given and, by assumption, is not fully

extended. The prevalence of excess capacity in the Caribbean may be demonstrated by referring to otel occupancy rates in tourism, potential- and actual bauxite/alumina production, oil refinery capacity and output, and annual and peak sugar production (See Table 2). The level of output (Q_t) is varied in accordance with prevailing prices and the costs of variable inputs, which consist of imported materials, labour and finance. Because of the level of aggregation at which this model operates the prices of output and materials are the same, P_t. Wages (W) are modified by an index of changes in output per worker (y/N) to give a variable for adjusted labour costs, S. Working capital needs of most firms in the Caribbean are satisfied by commercial banks (Miller [1971], McClean [1975], Bourne [1977], Ramkissoon [1982], Worrell and Prescod [1983]), so the bank loan rate (r) is an appropriate measure of finance costs.

$$(1) \quad Q_t = f_1 (P_t, S, r)$$

The non-tradable sector is the core of this model; it is here that domestic influences interact with external factors to determine domestic prices. Demand and supply conditions determine prices and output, but the market is not perfectly competitive. Most non-traded activities are dominated by a few large firms which exercise market

leadership, with a larger number of comparatively tiny companies trailing in their wake. This is a widely recognised characteristic of commerce, services and construction activity in the Caribbean, although it is not well documented (However, see McClean [1975] on the commercial sector and Fry [1982] on banking). The market may best be seen through the eyes of decision-makers in the dominant firms. They perceive an expected demand for their product which is based on real national income (y), the relative prices of the two goods (P_n/P_t) and the cost of consumer credit (r).

$$(2) \quad Q_n^* = f^1(y, P_n/P_t, r)$$

The demand function is conventional except for the inclusion of the interest rate; purchases of durables are invariably financed with bank credit, so the cost of credit should influence demand.

Producers plan a level of output which raises the previous year's production by a proportion of the discrepancy between Q_n^* and last year's output.

$$(3) \quad Q_n = Q_n(-1) + v[Q_n^* - Q_n(-1)]$$

Using the relationship for Q_n^* in equation (2) gives us

$$(4) \quad Q_n = f_2[y, P_n/P_t, r, Q_n(-1)]$$

Producers will set the price (P_n) for this output which will prevail in the current period, by virtue of their market leadership. It is set by calculating the cost of producing an amount equal to Q_n.

Factor prices are the same for producers in both sectors. There is no difficulty with finance costs: prime bank customers are to be found in every activity, and the spread of rates by activity is fairly uniform. Wage rates are more variable among sectors, but they tend to move together and the differential narrows considerably when allowance is made for variations in output per worker (Worrell [1982], pp. 17 & 36). The price of non-tradables is fixed by producers according to

$$(5) \quad P_n = f_3(Q_n, S, r, P_t)$$

Non-tradable producers also use imported materials at the unit cost P_t.

The remaining equations model the impact of disturbances to the banking system on interest costs and thence on prices; there is also a wage-determination function. The domestic interest rate is guided by trends in the London Eurodollar market (r_f), with which all banks in the Caribbean maintain close links. However, there is a corridor around the current Eurodollar rate within which domestic rates may fluctuate. The width of that band depends on the degree of perceived exchange risk and the costs of foreign currency transactions. Within that band, banks may maintain local interest rates which diverge somewhat from trends abroad, depending on the state of domestic bank liquidity. With small oligopolistic financial systems it is not always profitable for banks to eliminate their excess liquidity immediately. There may be greater returns to widening the margins between the foreign cost of funds and the returns on amounts employed at home, when foreign rates are lower than domestic rates. Alternatively, banks may be prepared to see foreign rates go some way beyond local rates if there is excess liquidity. In either case, significant excess liquidity is associated with widening differentials between rates at home and abroad.

$$(6) \quad r = f_4(r_f, \Delta Cr/\Delta Tml)$$

The second argument of the function, a measure of changing bank liquidity, is the ratio of changes in credit advanced

by the banking system (ΔCr) to changes in the system's total monetary liabilities (ΔTml).

The liabilities of banks are a function of income and the differential between interest rates at home and abroad, provided the spread between them is sufficiently large. The interest rate variable reflects the openness of the financial system of Barbados, Jamaica and Trinidad; the existence of exchange controls of varying degrees of severity has not impeded switching from local deposits to financial assets held abroad, when the incentive was strong. Small interest rate differentials provoke little reaction, no doubt because of transfer and nuisance costs; the equation includes only differences large enough to cover these costs.

The equation contains a variable MX which captures the effect of discretionary injections to the money supply. The sources of such disturbances are changes in foreign exchange reserves and central bank financing for Government. This is not a variable one would expect to find in conventional monetary models; they assume that a monetary disturbance leads to (a multiplied) expansion in money, resulting in an excess money supply. This provokes a revision of expenditures sufficient to eliminate the excess money. It is precisely the absence of such a reaction which

will result in a significant coefficient for MX in the monetary liabilities equation. Monetary injections may cause monetary liabilities to vary independently of changes in income and interest rates because of the low substitutability between real and financial assets. If there is any response to the injections it will come via substitution of foreign for local financial assets. This may happen if the increase in monetary liabilities relative to credit depresses local interest rates relative to foreign rates (see equation (6)) and the effect will be measured by the coefficient of the second argument of the following equation:

$$(7) \quad \Delta Tml = f_5(Y, D(r - r_f), MX)$$

The change in monetary liabilities is proportionate to each year's income stream; so long as there is any element of financial saving in the accumulation of monetary liabilities, they should grow even if income remains the same from year to year. The variable D is a dummy which is used to filter out deviations between local and foreign rates which are too small to have an effect. Real interest rates are not included in the final version of the equation; preliminary tests showed them to be insignificant, confirming results obtained previously (Zephirin [1981] p. 37, Worrell [1982] p. 27 and Bourne [1974] pp. 433, 434, 438, 439).

The importance of the real interest variable ir the money equations of less developed countries is an unresolved issue, ranging sceptics (Coats and Khatkhate [1980] pp. 22-25) against theorists who pin great faith in efficacy of interest rate policy in development (McKinnon [1973]). Our own view, developed elsewhere by one of the authors (Prescod & Worrell [1983]), is that interest rate policy may well have significant effects on financial accumulation in countries with rampant inflation, but it will be much less influential where inflation rates have been as low as they have been in the Caribbean.

The variable MX, sometimes referred to as 'the source of the monetary base', is the sum of Central Bank advances to Government (Ag) and changes in foreign exchange reserves (ΔR). The former is a policy variable, while the latter may be derived from the balance of payments identity:

$$(8) \quad \Delta R = X - mP_t + K$$

where X represents exports, m real imports and K all other items, which we euphemistically refer to as 'capital'.

Imports are determined by a conventional demand function:

$$(9) \quad m = f_6(y, P_t/P_n)$$

Exports are given by predetermined external prices and production factors, which are mainly internal. They may be derived directly from the value of tradables. All exportables in the countries under consideration are exported. Only the relatively small import-competing production must be deducted from the output of tradables to arrive at exports. If the import-competing sector were much larger, import-competing manufacture might absorb some of the expenditure meant for non-tradables. This would dampen inflationary pressures, since import-competing prices cannot rise in the absence of a foreign price increase. However, this effect will be small in the countries under study; import competing production accounts for about 8% of tradable output in Barbados, 12% in Jamaica and 5% in Trinidad and Tobago.

Capital movements are exogenous to this model. Some short-term capital flows are a response to interest differentials, interest rate and exchange rate uncertainty and social and political factors. The purely economic variables do not satisfactorily explain the variation in short-term capital flows, so we must supply them to the model as an exogenous factor.[5]

Wages are formed by a simple scheme of adaptive expectations. The model uses a two-period lag on prices, which tests with a variety of options suggested as the most suitable.

$$(10) \quad W = f_7(P_{-1}, P_{-2})$$

The model is completed by identities breaking down the prices of tradables into foreign price and exchange rate components, and by identities for the banking system and the balance of payments. The equations are summarised for convenience in Exhibit A.

The workings of the model may be clarified by discussing the implications of major policy initiatives. A devaluation will push up domestic prices directly via the price of tradables and indirectly through the cost of raw materials used in the non-tradable sector. It also raises import prices; if imports are sufficiently elastic foreign expenditure will fall, foreign reserves will rise and the level of monetary liabilities will increase. This may provoke an interest rate decline and expansion in output and expenditure. In the first instance, prices may ease somewhat because of the impact on the cost of finance for firms in the non-tradable sector. However, as producers revise their expectations about levels of demand prices tend

to rise once more. If import demand is inelastic, foreign spending will rise, depressing re erves and creating exactly the opposite effects on prices. We may expect these secondary effects to be dwarfed by the initial direct price and cost effects.

Devaluation will have no effect on the demand for tradables, which the small country may take as infinite at the given world market price. However, changes in the relative prices of tradables and non-tradables may provoke a switch of factors of production between the sectors and associated shifts in supply.[6]

If we find that the wage reaction to inflation does not fully compensate for price increases, a large devaluation will reduce real wages. That reduces inflationary pressures on non-tradables somewhat, and it will stimulate increases in the output of both sectors by shifting supply schedules down. Real income rises, bringing a further demand for non-tradables that could add a little to inflation.

We may pose a second issue to illustrate the model's properties. Where real wages outstrip productivity gains and push up prices, can the monetary authority provide an antidote? Increased reserve requirements and higher

interest rates will be counterproductive, driving costs and prices still higher. Credit restrictions will be helpful only if they are selectively applied to consumer lending, where they could drive up loan rates and reduce demand pressure on the non-tradable sector. Global credit restrictions may be inflationary because of their impact on the cost of producers' credit. If the wage push is really strong firms may be forced into bankruptcy, contracting output, income and spending.

The consequences of fiscal policies can be analysed, even though we omitted an explicit fiscal sub-sector to keep the model as small as was practicable. Fiscal policies may be described by their impact on real income and credit. An expansionary fiscal policy - one that increases the contribution of government to real activity and is financed by additional credit - is inflationary. The increment to income stimulates more expenditure on non-tradables (and tradables too, but their prices are fixed) while the extra credit demand drives up loan interest rates and costs. If imports are elastic the increase in domestic prices relative to import prices will provoke additional importation as well, and the loss of reserves should serve to tighten the supply of credit somewhat. If the Government expansion can be financed without additional credit the inflationary pressures are reduced, but a balance

of payments crisis is s ll possible and prices may rise somewhat. Finally, if the Central Bank finances the entire amount of the fiscal expansion, loan interest rates will not rise and may actually fall because of the increase in commercial bank liquidity. This stimulates output and expenditure, but cannot be sustained unless foreign exchange reserves are large enough to finance the induced rise in imports.

The model sets no restrictions on the use of foreign exchange reserves; in fact, when reserves are exhausted, domestic currency must be devalued in one form or another. Although we have not done it, exchange rate changes could be made a function of reserve losses or gains, for countries where a systematic foreign exchange policy can be discerned.

Results

Foreign prices play a large direct role in domestic price formation, with the foreign price index contributing about one-third to domestic price formation in each of the three countries tested. In addition, the cost of imported raw materials plays an important role in determining production costs in two countries. In one instance relative prices change in a way that affects the aggregate spending

on home goods. Domestic policies which affect the local price of traded goods - exchange rate changes and trade protection - have an impact similar to that of foreign prices. Domestic interest rate increases are inflationary only in Barbados and wages are an important price determinant only in Jamaica. Exogenous increases in real income are not inflationary in any of these countries.

These results are derived from least squares regressions run on a log-linear specification of the model. The countries tested are Barbados, Jamaica and Trinidad and Tobago, using annual data for 1963 to 1980. The equations for prices and output, which comprise a simultaneous system, were run together, using the two-stage least squares technique. The remaining equations are recursive and are estimated using ordinary least squares. Where the Durbin-Watson test did not indicate an absence of serial correlation we applied the Cochrane-Orcutt procedure. The results are presented in Table 3; the use of the Cochrane-Orcutt technique is indicated by the serial correlation coefficient (rho).

Barbados

We report acceptable results in tests on Barbados data for the output of tradable and non-tradable goods, the

price of non-tradable goods, monetary liabilities, wages and imports. These equations all produce high coefficients of determination (70% or better), no significant multicollinearity and no coefficients which violate our maintained hypotheses. However, the Durbin-Watson test is inconclusive for three of these equations (Q_t, Q_n, and P_n). The interest rate result is significant, with a reasonable coefficient of determination (78%) and no serial correlation, but neither of the arguments exerts a measurable influence.

The price of non-traded goods, which bears the burden of domestic price influences, is highly sensitive to the prices of imported inputs (an elasticity ranging between 1.16 and 1.94, allowing the equivalent of two standard deviations on either side of the point estimate), and less sensitive to interest costs (an elasticity ranging between 0.23 and 0.95). Wages and the growth of aggregate demand exert no noticeable pressure. The interest rate therefore becomes the only channel of influence from domestic sources, but it is not responsive to changes in bank liquidity ($\Delta Cr/\Delta Tml$); as a result, monetary and balance of payments disturbances will not affect prices.

The output of non-tradables is highly elastic with respect to income, much less so with respect to relative

prices and not at all sensitive to the cost of credit. The supply of tradable goods increases with their price, suggesting that the stimulus to revenues is greater than the additional import costs for raw materials for this sector. Domestic costs have no effect on the supply of tradables.

Monetary liabilities react strongly to income changes and weakly to exogenous factors which increase financial liabilities (MX). Import demand responds sharply to changes in income and relative prices, augmenting or depleting the supply of financial resources by its effect on foreign exchange reserves. The last equation is for wages, which react sluggishly to prices of the previous period.

Interest rate and exchange rate policies will affect the rate of price increase but other domestic policies will have no measurable effect on prices. Financial adjustment does not influence prices because the demand for credit, relative to the supply of financial resources from local (monetary liabilities) and foreign (foreign exchange reserves) sources has no detectable effect on the cost of credit. Moreover, changing finance costs do not alter supply schedules for tradables. Wages, the other prominent source of domestic inflationary pressure, have no impact on prices of non-tradables or the supply of tradables.

These results are not implausible provided we avoid the implication that they hold whatever the magnitude of variation in wages, credit, monetary liabilities and reserves. Modest variance such as these variables exhibited for Barbados may not produce significant inflation. Banks may act as shock absorbers when credit demand changes relative to liabilities, altering their holdings of excess reserves (See Coats and Khatkhate [1978], Worrell [1983]). Firms may be able to tolerate some upward drift in wages, provided there are no massive discontinuities. Furthermore, the economy apparently allows little scope for demand pressure to build up in the non-tradable sector. Any tendency for a demand-induced rise in the price of non-tradables causes substitution of tradables in expenditure plans.

Jamaica

For Jamaica the equations for the price and quantity of non-tradables, the output of tradables, and wages all meet the criteria of acceptance - R^2 over 80%, coefficients that can be justified by economic theory and no serial correlation (except for wages, where the Durbin-Watson test is inconclusive). The coefficient of determination for the monetary liabilities equation is rather low (62%), but the equation is otherwise acceptable.

We have not been able to eliminate positive serial correlation from the import equation and we cannot explain the direction of influence from liquidity to interest rates, so that equation is suspect.

The results on the price of non-tradables indicate serious wage push, but no effects from imported input prices or interest rates. We seem to have a downward sloping supply curve for non-tradable goods: the coefficient of Q_n in the price equation is negative (-0.68). This result may indicate gross under-utilisation of installed capacity. Wages react to the previous year's prices with an elasticity of 0.67, but workers seem unconcerned about longer-term trends.

The quantity of non-tradables is very elastic with respect to income; it is also affected, very slightly, by interest rate changes. Relative price effects are insignificant. We seem to have another downward sloping supply curve in the results for tradable goods. This equation produces the strange result that wage increases are associated with higher levels of output. Interest costs do not matter.

Foreign interest rates have no discernible effect on rates in Jamaica, while rising credit, relative to

available funds, tends to depress local rates. However, this is a very weak tendency. Monetary liabilities respond very sharply to changes in income but exogenous monetary impulses have no effect and neither do differentials between interest rates at home and abroad. Imports record significant elasticity with respect to income, but no response to changes in relative prices.

Wage increases in Jamaica are inflationary and the economy suffers from a dynamic wage-price spiral. However, the spiral is not explosive; wages do not increase by the full amount of the previous year's price increase, and the overall effect on current year prices will be less than the amount of the wage increase, since only non-tradable prices are affected. The importance of wage-push probably reflects the greater variance of wages in Jamaica, when compared with Barbados. Secondary effects of increased wages reduce their inflationary impact somewhat. The wage increase has a perverse effect on tradable goods output, which increases, adding to national income and the demand for non-tradables. Because of the downward sloping supply curve for non-tradables this may reduce their prices somewhat. In fact, any expansion in aggregate demand appears to be deflationary because of this circumstance. Additional financial resources, either by domestic monetary expansion or by foreign reserve accumulation do not affect the cost of credit and cannot therefore be inflationary.

Trinidad and Tobago

The Trinidad-Tobago results are satisfactory for tradables, the price of non-tradables, monetary liabilities and imports. The tests for wages and interest rates yield well-behaved coefficients, but R^2 is unacceptably low in both cases. The results for non-tradable output are unsatisfactory: only one variable (interest rates) is significant and its coefficient does not carry the expected sign.

Imported inflation on the supply side and aggregate demand pressure have severe effects on the price of non-tradables in Trinidad-Tobago. Wage increases provoke only a tiny price response, and they appear to be deflationary. Interest costs do not seem to matter. The equation to determine non-tradable output behaves very strangely: output bears no relation to national income or relative prices, and it increases with rising interest rates. Their prices have a moderate positive effect on the output of tradables; wage increases do not curtail output while rising interest rates tend to raise output level, perhaps by inducing greater economy in the use of bank finance.

Wages are strongly influenced by lagged prices, but the more distant prices seem to have a perverse impact.

Interest rates are heavily influenced by foreign rates. Monetary liabilities respond to income and diferentials between local and foreign rates, but not to exogenous monetary influence. Imports are income elastic, but relative prices have a small perverse impact.

The Trinidad results suggest that an interest rate rise can be inflationary, but only indirectly. The increase induces additional demand for non-tradables, strangely enough, and it is this, rather than the cost of supply, which drives up the price of non-tradables. Interest rate increases also depress the supply of tradables, but that will not ease pressure on domestic prices because the consequent fall in income has no measurable effect on the demand for non-tradables. Wage increases, on the whole, appear to be deflationary, depressing the price of non-tradables and leaving output of tradables unchanged.

Comparisons

Foreign prices, exchange rate changes and trade controls have the largest effect on domestic prices, through their direct effects on the prices of traded goods. In addition, Barbados and Trinidad and Tobago show evidence of indirect effects via production costs for non-tradables. In Barbados, there is a further effect via the change in the

relative price of tradables and non-tradables, which increases the demand pressure on the non-tradable sector.

Interest rate increases are inflationary in Barbados, where they push up the cost of producing non-tradables. In Jamaica, they are deflationary, reducing the demand for non-tradables somewhat without affecting their costs of production; however, the deflationary effect is not very powerful. Interest rate effects are not very clear in Trinidad-Tobago: they have the perverse effect of raising the demand for non-tradables, but they also cut the supply of tradables, depressing national income and the demand for non-tradables.

In Jamaica wage increases inflate supply costs for non-tradables but they lower supply schedules for tradables. There is a damped wage-price spiral, with a one-year lag on wages. In Trinidad-Tobago wage increases lower supply schedules for non-tradables, but have no other effects. Wage effects are not significant in Barbados.

Exogenous increases in real income (perhaps via windfalls in the tradable sector) are not inflationary. They raise the demand for non-tradables in Barbados and Jamaica, though not in Trinidad-Tobago. In Barbados, demand pressure leaves non-tradable prices unchanged while it has a deflationary impact in Jamaica.

Conclusion

The results indicate a need for specific policies tailored to the observed circumstances of each country. There are two requisites: a model which captures all the important channels of macro-economic influence and empirical tests which measure the relative importance of economic interaction. The channels of influence provided by the model used in this study are the same for all countries because they are alike in their contrast between tradable and non-tradable markets, the importance of imports in production and expenditure, the use of bank finance for working capital and the non-competitive nature of banking. However, some channels of influence which are important in one country are of trivial significance in another, while others produce opposite results in different countries. The impact of foreign prices, exchange rates and trade protection is common to all countries and they are all subject to domestic inflationary pressures, but they vary greatly as to the source of such pressures. Policy-makers cannot afford to generalise about the efficacy of interest rate, wage, fiscal or credit policies; their effects differ because of the peculiarities of economic behaviour in each country, as measured by the coefficients estimated for the equations of the model.

Footnotes

1. Alternative models for comparison may be found in Corden and Neary, [1982], Claasen and Salin [1979] and Lindbeck [1979], among recent studies. The inflation models presented in these studies are generally less explicit with respect to the monetary mechanisms and depend more on intersectoral factor movements.

2. A few activities in this sector such as off-shore banking and consultancy services are tradable, but they account for only a tiny percentage of the value added.

3. The exchange rate used is a trade-weighted average of the rates with respect to each country's main trading partners. Price indices for tradables, raw materials and imports are computed in domestic currency and the exchange rate index is then applied to derive implicit foreign prices.

4. Caribbean sugar was marketed mainly under the Commonwealth Sugar Agreement (CSA) until 1974; amounts in excess of the CSA quota were small, and were marketed in the US and Canada, under preferential arrangements. The Lome agreement provided for smaller quotas to replace the CSA quotas, on Britain's accession to the common market. Excess amounts have been marketed more widely since then, but the US and Canada remain the principal markets for surpluses over the quota.

5. Experiments with the determinants of short-term capital flows are reported in Worrell [1983]. The hypothesised economic arguments have so far failed to explain the variation. Experiments are continuing.

6. See Worrell [1982] on price elasticities in sugar production in Barbados and Williams [1972] p. 97 on coffee in Jamaica. No substitution is possible in mineral production because the raw material is specific and the labour content trifling. Some substitution may have occurred in Jamaica between the tourist sector and the food producing sector; workers laid off by hotels in the 1970's may have returned to farming. The effect could not have been sufficiently important to show up in macroeconomic tests, and would not have been possible elsewhere because of declining labour absorption in agriculture.

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Exhibit A

The Price Model

$$Q_t = f_1(P_t, S, r) \qquad f_1'(P_t)>0,\ f_1'(S)<0,\ f_1'(r)<0$$

$$Q_n = f_2[y, P_n/P_t, r, Q_{n(-1)}] \qquad f_2'(y)>0,\ f_2'(P_n/P_t)<0,\ f_2'(r)<0$$

$$P_n = f_3(Q_n, P_t, S, r) \qquad f_3'(Q_n)>0,\ f_3'(P_t)>0,\ f_3'(S)>0,\ f_3'(r)>0$$

$$r = f_4(r_f, \Delta Cr/\Delta Tml) \qquad f_4'(r_f)>0,\ f_4'(\Delta Cr/\Delta Tml)>0$$

$$\Delta Tml = f_5[Y, D(r - r_f), MX] \qquad f_5'(Y)>0,\ f_5'[D(r-r_f)]>0,\ f_5'(MX)>0$$

$$m = f_6(y, P_t/P_n) \qquad f_6'(y)>0,\ f_6'(P_t/P_n)<0$$

$$W = f_7(P_{-1}, P_{-2}) \qquad f_7'(P_{-1}, P_{-2})>0$$

$$P \equiv \alpha P_t + (1 - \alpha) P_n$$

$$P_t \equiv P_{ft}.ER$$

$$Cr \equiv Tml - \Delta R$$

$$Y \equiv P_y$$

$$S \equiv WN/y$$

$$y \equiv Q_n + Q_t$$

$$MX \equiv Ag + R$$

$$\Delta R \equiv X - mP_t - K$$

Variable names

Ag - Central bank lending to Government
Cr - Total domestic credit
D - Dummy variable D=1 for $|r-r_f| \geq 3$; D=0 otherwise
ER - The exchange rate
K - 'Net capital flows'
m - Real imports
MX - Monetary disturbance variable
N - Employment
P - GDP deflator
P_{ft} - Index of foreign currency prices of tradables
P_n - Price index for non-tradables
P_t - Price index for tradables
Q_n - Real output of no-tradables
Q_t - Real output of tradables

R - Level of foreign exchange reserves
r - Domestic interest rate
r_f - Rate on Eurodollars in London
S - Wage index, adjusted for productivity changes
Tml - Total monetary liabilities
W - Wage index
X - Exports
y - Real income
Y - Nominal income

Note on symbols

f () means the partial derivative of the function with respect to the variable in brackets.

Table 1

Export Structure

(Percentages)

	Barbados	Jamaica	Trinidad & Tobago
	1982	1981	1980
Tourism	44.8	20.0	4.3
Bauxite/alumina	-	50.6	-
Petroleum	-	-	75.6
Sugar	6.0	3.1	0.9
Other Export Agriculture	-	0.9	-
Manufacturing	26.7	10.2	n.a.
Transport, misc. services	22.7	6.2	8.5
Other	-	9.2	10.7
Total, goods and services	100	100	100

Sources: Central Bank of Barbados, Balance of Payments 1982 and Annual Statistical Digest 1982, IMF, International Financial Statistics and Balance of Payments Yearbook 1982.

Note: n.a. - not available

Table 2

Selected Indices of Capacity Utilisation

Tourism: Hotel Room Occupancy Rates

	Average	Highest	Lowest	Source
Barbados 1970-76, 1980-82	52.3	68.6	42.9	(1), table H12
Jamaica 1970-80	43.7	57.5	28.9	(2), table I9

Bauxite/alumina: Jamaica

Capacity Utilisation Rate (%)

	Bauxite	Alumina
1976	79.2	
1977	88.0	
1978	90.3	73.0
1979	88.5	73.5
1980	93.0	85.0

Source: (2), table 7.7

Oil Refining: Trinidad 1978-81
(000 metric tonnes per year)

Capacity	Average Output	Output/Capacity %
23,050	11,570	50.2

Source: (3), tables 21 & 22

Sugar: Ratio of actual to peak production in 1970-82 period

	Barbados	Jamaica	Trinidad & Tobago		Barbados	Jamaica	Trinidad & Tobago
1970	100	98	94	1976	66	94	87
1971	87	100	92	1977	76	77	75
1972	72	98	100	1978	65	74	63
1973	75	86	78	1979	74	74	61
1974	70	97	79	1980	87	60	48
1975	61	94	69	1981	61	52	39
				1982	57	63	35

Source: (1), table J1

Cont'd. on next page

Table 2 Cont'd.

Identification of Sources:

(1) Central Bank of Barbados, Annual Statistical Digest, 1982

(2) World Bank Report No. 3781-JM 'Jamaica: Development Issues and Economic Prospects'.

Table 3

Estimation Results

Barbados

1. $LQ_t = \underset{(1.93)}{0.834} + \underset{(5.96)}{0.401}P_t - \underset{(-1.60)}{0.24}\ LS - \underset{(-0.33)}{0.0351}\ Lr$

   $R^2 = 0.85$ D-W = 1.12 SEE = 0.10 F(3,17) = 31.1

2. $LQ_n = \underset{(-5.46)}{-5.30} + \underset{(5.73)}{0.842}LY - \underset{(-2.20)}{0.119}\ L(P_n/P_t) - \underset{(-0.90)}{0.052}\ Lr - \underset{(-0.76)}{0.139}\ LQ_n(-1)$

   $R^2 = 0.82$ D-W = 1.01 SEE = 0.03 F(4,16) = 18.23

3. $LP_n = \underset{(-0.98)}{-0.72} - \underset{(-0.54)}{0.61}\ LQ_n + \underset{(8.05)}{1.55}\ LP_t - \underset{(-0.11)}{0.03}\ LS + \underset{(3.26)}{0.59}\ Lr$

   $R^2 = 0.96$ D-W = 1.07 SEE = 0.16 F(4,16) = 92.03

4. $Lr = \underset{(4.36)}{1.46} + \underset{(0.94)}{0.14}\ Lrf + \underset{(0.87)}{0.04}\ L(\Delta CR/\Delta Tml)$

   $R^2 = 0.78$ D-W = 1.56 SEE = 0.16 F(2,19) = 33

   Rho = 0.72

5. $L\Delta TML = \underset{(-2.17)}{-36.61} + \underset{(2.31)}{6.07}\ LY - \underset{(-0.46)}{0.05}\ D(rd-rf) + \underset{(2.37)}{0.26}\ LMX(-1)$

   $R^2 = 0.56$ D-W = 1.29 SEE = 0.96 F(3,17) = 7.33

6. $L_m = \underset{(-2.99)}{-10.74} + \underset{(4.65)}{2.57}\ LY - \underset{(-6.84)}{1.67}\ L(P_t/P_n)$

   $R^2 = 0.97$ D-W = 1.56 SEE = 0.16 n F(2,19) = 293.0

   Rho = 0.18

7. $Lw = \underset{(85.92)}{4.72} + \underset{(2.16)}{0.15}\ LP_{-1} - \underset{(-0.20)}{0.01}\ LP_{-2}$

   $R^2 = 0.71$ D-W = 1.98 SEE = 0.08

   Rho = 0.56

Jamaica

1. $LQ_t = \underset{(19.14)}{4.13} - \underset{(-3.33)}{0.94}\ LP_t + \underset{(6.89)}{0.87}\ L + \underset{(1.03)}{0.39}\ Lr$

   $R^2 = 0.86$ D-W = 1.35 SEE = 0.09 F(3,17) = 337

2. $LQ_n = \underset{(-4.71)}{-2.07} + \underset{(6.34)}{0.93}\ LY + \underset{(0.53)}{0.08}\ L(P_n/P_t) - \underset{(-2.36)}{0.06}\ lr - \underset{(-0.52)}{0.08}\ LQ_{n-1}$

   $R^2 = 0.98$ D-W = 2.07 SEE = 0.03 F(4,16) = 212.4

3. $LP_n = \underset{(2.62)}{3.2} - \underset{(-2.42)}{0.68}\ LQ_n + \underset{(1.27)}{0.29}\ LP_t + \underset{(3.23)}{0.66}\ LS + \underset{(0.28)}{0.06}\ Lr$

   $R^2 = 0.99$ D-W = 1.25 SEE = 0.06 F(4,16) = 651.6

4. $Lr = \underset{(3.32)}{0.48} - \underset{(0.07)}{0.008}Lrf - \underset{(-2.04)}{0.06}L\ (\Delta Cr/\Delta Tml)$

   $R^2 = 0.84$ D-W = 1.97 SEE = 0.13 F(2,19) = 49.97)

   Rho = 0.96

5. $L\Delta Tml = \underset{(-2.60)}{-25.9} + \underset{(2.91)}{3.92}\ LY - \underset{(-0.36)}{0.04}\ D(rd-rf) + \underset{(1.33)}{0.15}\ LMX-1$

   $R^2 = 0.62$ D-W = 1.91 SEE = 0.91 F(3,17) = 9.38

6. $Lm = \underset{(-0.34)}{-1.55} + \underset{(0.96)}{0.63}\ LY + \underset{(0.44)}{0.17}\ L(P_t/P_n)$

   $R^2 = 0.97$ D-W = 1.69 SEE = 0.15 F(2,19) = 321.9

   Rho = 1.04

7. $Lw = \underset{(2.03)}{1.37} + \underset{(3.21)}{0.67}\ LP_{-1} + \underset{(0.59)}{0.13}\ LP_{-2}$

   $R^2 = 0.99$ D-W = 1.43 SEE = 0.057 F(2,17) = 1.62

   Rho = 0.92

Trinidad

1. $LQ_t = \underset{(11.86)}{2.84} + \underset{(4.85)}{0.29}\ LP_t - \underset{(-2.55)}{0.08}\ LS + \underset{(3.85)}{0.22}\ Lr$

   $R^2 = 0.87$ D-W = 1.07 SEE = 0.17 F(3,17) = 38.1

2. $LQ_n = \underset{(-0.64)}{-6.39} + \underset{(0.66)}{0.81}\ LY + \underset{(1.06)}{0.38}\ L(P_n/P_t) + \underset{(2.57)}{1.49}\ Lr + \underset{(1.26)}{0.18}\ LQ_{n-1}$

   R2 = 0.99 D-W = 2.01 SEE = 0.9 F(4,16) = 391.5

3. $LP_n = \underset{(-14.83)}{-1.03} + \underset{(13.51)}{1.02}\ LQ_n + \underset{(20.41)}{0.31}\ LP_t + \underset{(-2.81)}{0.03}\ LS - \underset{(-1.19)}{0.20}\ Lr$

$R^2 = 0.9995$ D-W = 2.03 SEE = 0.05 F(4,15) = 8,241.8

Rho = 0.63

4. $Lr = \underset{(0.94)}{0.99} + \underset{(1.42)}{0.51}\ Lrf - \underset{(-1.80)}{0.11}\ L\ \Delta Cr/\Delta Tml$

$R^2 = 0.86$ D-W = 2.2 SEE = 0.4 F(2,19) = 60.8

Rho = 0.87

5. $L\Delta Tml = \underset{(-5.99)}{-41.03} + \underset{(6.71)}{5.39}\ LY + \underset{(7.29)}{0.79}\ D\ (r-r_f) - \underset{(-0.19)}{0.02}\ LMX\text{-}1$

$R^2 = 0.93$ D-W = 2.02 SEE = 0.58 F(3,16) = 67.9

Rho = 0.27

6. $Lm = \underset{(-8.8)}{-18.7} + \underset{(12.45)}{3.16}\ LY + \underset{(3.12)}{0.38}\ L\ (P_t/P_n)$

$R^2 = 0.96$ D-W = 2.1 SEE = 0.19 F(2,19) = 217.2

Rho = 0.34

7. $Lw = \underset{(-0.15)}{-0.22} + \underset{(3.15)}{6.49}\ LP_{-1} - \underset{(-2.73)}{6.17}\ LP_{-2}$

$R^2 = 0.44$ D-W = 2.2 SEE = 1.04 F(2,11) = 6.6

Rho = -0.36