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The Contribution of the Monetary Studies Programme to Caribbean Econometric Modelling

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Introduction

Many Caribbean economists are at best agnostic when it comes to econometrics. Privately they condemn it; publicly they ignore it. The many papers containing applied econometric work that have come out of the RPMS/CCMS conferences may appear to belie this assertion but this is only on the surface. By far the majority of papers presented do not have an econometric component. Furthermore, the so-called modelling session which came into existence in 1989 first appeared as an appendix to the conference, held even after the closing ceremony. Up to today it is seen as a departure from the main proceedings and many of the major participants have voiced concerns about the validity of the exercise.

The paper examines a sample of the contributions to the RPMS/CCMS conferences having an econometric content. We attempt to evaluate

- the soundness of the econometric practice at the time
- the conclusions drawn and suggested policy prescriptions
- the contribution to the understanding of the Caribbean economic reality
- the contributions to Caribbean econometric practice

We deal with these areas of interest under the following headings:

1. Money. Banking and Related Matters
2. Savings
3. Macroeconometric modelling
4. Exchange rate determination, the foreign exchange reserves and related matters.
5. The Stock Market, Capital Markets and Volatility
6. Inflation rate and Interest rate determination
7. The Balance of Payments.

Money, banking and related matters

One would expect that a conference devoted to monetary studies and funded to boot by the Central Banks of the Commonwealth Caribbean would give pride of place to this subject matter. There has been a significant amount of research arising out of the RPMS/CCMS devoted to this area. Some of the areas of concern dealt with under this heading are:

- commercial bank portfolio behaviour
- the determination of the money supply
- the estimation of the money demand function
- the role of interest rates as an instrument of monetary policy
- the monetary transmission mechanism
- the demand for commercial bank deposits and loans

In many cases the econometric study is not central and the results, even by the authors' own admission, are not be helpful. There is a general reluctance to let the econometric results prevail over *a priori* theoretical considerations.

A very good example of commercial bank portfolio behaviour is Bourne (1977). This is a fairly sophisticated paper from a mathematical point of view. Utility functions are used to derive estimable equations. This results in a five-equation model with cross-equation restrictions. A seemingly unrelated regression model is obtained and an appropriate estimation method applied. The results are generally useful and several conclusions are drawn. The most significant finding of the study is that deposit liabilities are the main single determinant of short-period changes in the portfolio of the banks. It is established that the rate of interest is not a significant variable in the determination of portfolio allocation and that the 1967 devaluation of the £ sterling resulted in a shift of resources away from foreign denominated securities. The model was fitted using quarterly data for the period 1962 to 1971.

Ramsaran (1980) is interested in establishing the determinants of the money stock and the implications for monetary policy, in particular the control of the monetary stock. In a style typical of other papers he presents at the conference, he fits a whole series of regression models using, in this case, the two general forms below:

$$H = f(CAB)$$

$$H = f(BOP)$$

H is high-powered or base money, CAB the current account balance and BOP the Balance of Payments. CAB is of course a component of BOP and BOP in turn is a component of M_2 (money supply broadly defined). So, in the first instance, there is no real difference in the explanatory variable and, in the second, his is really a crude estimation of the so-called money multiplier which can be better measured directly as M_2 /H. Ordinary Least Squares (OLS) is used to fit the models.

D. Worrell (1983) looked at growth in banking activity and tried to account for changing patterns in demand for banking deposits by the public. The paper also addressed the assets side of the Balance Sheet and looked at the demand for loans as well. The identification problem was evident as a number of the coefficients of the demand functions had positive signs, which may suggest that the function estimated was actually a supply function (or some hybrid). This paper could have benefited from an incorporation of the disequilibrium methods introduced by Fair and Jaffe (1972), which allow the economic investigator to differentiate between demand and supply series. The use of nominal rather than real income values was another shortcoming of the paper.

St. Cyr (1981) questioned whether the money supply was responsible for the inflationary process in Trinidad and Tobago. He fitted the following function:

$$p = f\left(\frac{M_d}{M_s}\right)$$

P is the price level. It is not quite clear how this is done in the paper since the author assumed the existence of money market equilibrium.

Ramsaran and Maraj (1985) attempted to fit a series of demand for money functions for the period 1970-1974. Once again the estimated coefficients suggested that identification was a problem (was it money demand or supply?). There was some confusion that elasticities could only be derived from a double logarithmic model. There are also significant data problems identified, such as whether permanent, real or nominal income should be used in the estimation. Ramsaran and Maraj considered all these possibilities and concluded that the interest rate is not a

determinant of the demand for money in Caribbean economies. Bourne (1977) had already come to this conclusion. The authors also suggest that the $\check{R}^2$ statistic tends to be lower for real rather than for nominal values. This statement is not entirely a valid one as in some of the cases the dependent variable differed (comparisons based on $\check{R}^2$ are then not valid). Ramsaran (1991) followed up this exercise on the demand for money with a paper that estimated an income velocity of money function. In the end, the author selected an equation that described the velocity of circulation of money as a function of income and the rate of inflation. He described in depth the perceived significance of the level of income to the income velocity of circulation in Barbados, Guyana, Jamaica and Trinidad and Tobago. The precise nature of the influence of the rate of interest variable on the velocity of circulation was however inconclusive. The authors however have attempted to grapple with a useful problem.

In the "Ramsaran" papers, the authors fit a myriad of functions in an attempt to derive the significant explanatory variables in this equation. This practice runs counter to the LSE methodology of "general to specific" modelling and is reminiscent of data mining. See Lovell (1985).

Watson (1996) moved away from the traditional methods in this attempt to model the money transmission mechanism in the Trinidad and Tobago economy. The paper applied the Vector Autoregression (VAR) methodology to quarterly data to derive a link between the monetary and real sectors. The empirical evidence was used to conclude that both money and credit matter in the transmission process but that money plays a more important role.

Savings and Investment

Banks and banking instruments are the first choice of Caribbean savers. The importance of savings to the Caribbean society cannot be overemphasized. Savings is the driver of economic activity. To some extent, the issues addressed in this category were already raised in the previous section. Some of the topics discussed in this section include national savings, household budgetary savings and national investment studies.

Ekanyake and St. Cyr (1991) attempt to establish a savings function for Trinidad and Tobago. They fist looked at household budgetary savings and national income accounts for the period 1955 to 1987. They fitted the following function:

$$S = f(Y, r)$$

where S is the national savings level, Y is national income, and r the rate of interest. The key issue to the discussion surrounded whether or not the interest rate variable was significant in this economy. That is to say, the authors addressed whether the McKinnon/Shaw hypothesis was superior to the Keynesian hypothesis as they pertain to the role of interest rates in the determination of savings. The authors are not confident in the results of the estimation exercise. They estimated a marginal propensity to save of 36% that was later estimated at 22% in 1988. It is hardly likely that these results would differ so significantly over this time period and, at any rate, both appear unduly high for Trinidad & Tobago.

Ekanyake and St. Cyr also looked at national income data for the period 1955-1987, 1955-1973 and 1985-1987. A causality test was introduced to determine whether interest rate caused savings or vice versa. The results of the causality test show that interest rates cause savings, yet the interest rate variable is not significant to the regression exercise. Estimates of the marginal propensity to save once again differ significantly over the duration of the study. They also fitted a simultaneous model based on the model introduced by Leff and Sato (1975).

Ramsaran (1981) also attempts to develop a savings function with a similar objective as St. Cyr and Ekanyake. This paper attempted to fit the following savings function for the Trinidad and Tobago economy:

$$S = f(Y)$$

The author excluded found that the (nominal) interest rate was insignificant and excluded it from the regression. He concluded that policy prescriptions to increase the level of savings should not

include any attempt to alter the interest rate, as this variable is not significant to savings in the Trinidad and Tobago economy. The use of nominal interest rates in this exercise however could have masked the trend in the interest rates.

Watson and Ramlogan (1990) looked at a savings function for Trinidad and Tobago and attempted to discern the direction of causality between interest rates and the level of savings. They verified that real interest rates are significant more so in the short run than in the long run and they also cause the national savings level. The authors adopted an Error Correction Mechanism (ECM) as introduced by Engle and Granger (1987). They employed the Engle and Granger two step procedure to estimate the ECMs. The Engle-Granger cointegration test is also incorporated in the analysis. The results indicate that interest rates are an important determinant of savings, especially over the long run. This sharply contradicts the results found in the other studies discussed above. Foreign savings were also found to be important.

Watson (1993) employed the panel data techniques to look at savings functions in the OECS region. He was concerned with the econometric validity of using these methods in general and showed them to be valid only if some important underlying assumptions were pre tested. The author observed that savings functions throughout the OECS were disparate and concluded those savings functions should be fitted separately for each country and not pooled. Watson also concluded that foreign savings were dominant in some cases and not in others. Also, the McKinnon Shaw hypothesis is rejected in some but not all cases

Ramlogan and St. Cyr (1991) attempt to derive the determinants of private investment. They fit the following function:

$$Ip = f(GDP, Ig, Wr, Cp, Sf)$$

where Ip represents private investment, Ig, public investment, Wr, the real wage rate, Cp, domestic consumption, and Sf, foreign savings. There were two immediate problems with the results of this regression. First, the authors used nominal values in their calculations instead of constant prices. There was no attempt to deflate the variables used. Second, they derived private investment as a residual obtained from deducting government expenditure from total investment levels.

The study concluded that the crowding out effect was evident for the Trinidad and Tobago economy. Further they rejected the McKinnon/Shaw hypothesis and observed that the

level of foreign savings was significant for private investment in Trinidad and Tobago. This crowding out of private investment was verified even more forcefully for Jamaica but rejected for Barbados. Nominal time series data are used.

Watson (1992) estimated a private investment function for Guyana using constant prices. He used the retail price index as a deflator. This is a very unreliable indicator of the level of investment prices. Watson rejected the crowding out theory for Guyana and concluded that public investment is a major determinant of private investment in Guyana. The McKinnon/Shaw hypothesis is verified, as the real interest rate is significant. The author incorporates the Engle/Granger two step procedure approach to establish the cointegrability among the variables over the period 1970 to 1990. The ECMs are successfully established.

Macroeconometric models

It was perhaps inevitable given the thrust of econometric modelling all over the world, that this aspect of applied econometric work would receive considerable attention in the Caribbean. Some of the macroeconometric models presented at the CCMS/RPMS conferences are under the guise of monetary models and done within a monetary framework, like that of Keith Worrell (1979). This is an example where the author specifies, estimates and tests a macroeconometric model based on the work of Linder (1967).

The author estimated a small eleven equation model, (five of which are identities) of the Jamaican economy. He utilized the two-stage least squares (2SLS) estimation method and compares them to others referred to as OLS. There is a serious attempt to validate the model using standard statistical criteria and on other tests such as the Bassman overidentification test and the Theil forecast errors test. This work represents a reasonably careful application of existing econometric methodology at the time the author was writing. The ESP programme was used to calculate coefficient estimates. The money supply equations are fundamental to the system. They are however estimated in the differenced form, which could be indicative of some misspecification. It is small wonder then that these results were "most disappointing." The author attributed the failure of his model to the presence of multicollinearity, which is not always clearly discernible. Worrell is not satisfied with the model but is not prepared to discredit *a priori* expectations.

Worrell and Holder (1979) presented another example of an econometric model which was also a monetary model in the sense that it focused on the instruments of monetary policy. It was clearly a first stage in the development of an overall model that linked the real to the monetary sector. The model was highly aggregated and was estimated over the period 1946-1978 using the two-stage least squares (2SLS) estimation method. It contained a total of 10 equations, 5 of which were behavioral. There was some attempt at evaluation, such as the use of the R^2 statistic, the student t-statistics and the Durbin-Watson (DW) statistic in the presence of 2SLS estimation. This practice was criticized by Watson (1987). Further, in one specification, high R^2 values coexist with low DW statistics, which may be suggestive of spurious correlation.

Interestingly enough, it was established that the demand for loans was positively related to the interest rate. This is a perverse result and could imply that a supply function was

estimated instead of a demand function by the authors. At the time of this paper, the literature on disequilibrium models was new, but the classical identification problem was already established. The simulated values are used to evaluate this model, but these results are poor. Once again, this did not deter the authors' from recommending the use of the model based on its apriori construct.

Joefield-Napier (1979) constructed a quarterly model of the Trinidad and Tobago economy with somewhat similar objectives to the Worrell/Holder model. He attempted to answer the question, "does money matter?" (Worrell (1979) and Watson (1994) also raised this issue). The author fitted his model with data spanning the period 1970 to 1978. OLS was the estimation method. In addition, the author estimated an aggregate export function. Trinidad & Tobago exports are dominated by the export of oil and therefore, in our view, should be exogenous. Both the money demand and money supply variables were incorporated into the analysis. It was not clear why the author did this, since he had previously established that these two variables were in equilibrium and the published values identical.

Other papers of note include that by Williams (1985). This author looked at a portfolio balance model. The demand for money was incorporated through a partial adjustment process and the supply of money is assumed exogenous. The three stage least squares (3SLS) estimation procedure is used to correct for the presence of serial correlation in the model. The model uses quarterly data for the period 1966-1983. The poor results are blamed on "data problems." Around this time, Samuel (1986) presents a critique of these models and calls for the incorporation of disequilibrium systems and rational expectations functions using Lucas' critique at the estimation stage.

Henry et al (1989) and Watson and Teelucksingh (1997) represent attempts to estimate fairly large macroeconometric models in the Caribbean. In the paper by Henry et al, the objective is clearly stated "to map out the courses of the Trinidad and Tobago economy in the next five years." It attempted to predict the movements of the major macroeconomic variables in particular GDP, the government budget balance, the balance of payments and the unemployment rate." The model was estimated over the time period 1966-1986. The 2SLS method was used on a model that the authors claim to be block recursive. If this is true, then the authors could have utilized ordinary least squares (OLS), as the results obtained form using OLS are equivalent to that of the 2SLS method in a block recursive system.

The model employed 34 equations with 18 exogenous variables. It was evaluated using ex-post forecasting for the period 1987 to 1988 and ex-ante forecasting over the period 1989 to 1993. On both grounds the results were not convincing, simulations were not good and forecasts were way off. Watson (1994) has discussed some of the shortcomings of this CBMOD1 model developed by the Central Bank of Trinidad and Tobago. CBMOD1 however represented a comprehensive attempt to deal with macroeconometric policy formatting for the forecasted period spanning 1989 to 1993. It characterized a classic approach to modelling and to that time it was the largest macroeconometric model of a Caribbean economy.

The Watson and Teelucksingh paper is a cointegration approach to estimating a multiple equation system in which a variant of the LSE "general to specific" modelling methodology is employed. This paper presented a relatively large model with a prolific use of identities as compared to the paper by Henry et al. The paper drew policy conclusions about the relative strengths and weaknesses of fiscal and monetary policy.

The Exchange rate, foreign exchange reserves and related matters

The foreign exchange rate is one of the most significant variables in a small open economy. The exchange rate has both economic and social implications and can greatly affect the well being of Caribbean nationals. The collapse of the Bretton Woods system in 1973 resulted in a reversion to a flexible system of exchange rate determination for the metropolitan countries. The Caribbean's experience with a floating regime can be traced to the liberalisation of markets in Guyana, Jamaica and Trinidad and Tobago. Jamaica has the greatest experience with the use of alternative management techniques in fixed and floating systems. The exchange rate has appeared as an explanatory variable in several of the econometric models derived in previous studies. Its experience as a dependent variable became more pronounced in the period after the liberalisation of Caribbean rates of exchange in the 1990s. This section focuses on the following areas of interest:

- the determination of the exchange rate;
- the validity of the notion of purchasing power parity to the Caribbean economy;
- the impact of a devaluation on the balance of payments;
- the existence and nature of exchange rate volatility and its implications to the real sector.

Ramcharran (1983) developed a small model to analyze the impact of devaluation on the demand for imports and exports in Jamaica. An aggregate import function is fitted, followed by separate fits for imports of consumer durables, consumer non-durables, raw material and capital goods. The explanatory variables in the demand for imports function were real income, the price index of the export commodity and the exchange rate. Log linear demand functions are employed.

Exports are treated in a similar fashion: an aggregate function, then separate functions for bauxite, sugar and alumina. The explanatory variables selected for the demand for exports function were real income, the exchange rate, the price index of the import commodity, and gross foreign reserves.

The data spanned the period 1969 to1978, which the author acknowledges as "too short for time series analysis," yet he proceeds with the estimation and results. The results denoted low R^2 statistics, insignificant coefficient values and a DW statistic and indicated the presence of

serial correlation. The author concludes that a devaluation would significantly affect the levels of imports and exports in the Jamaican economy.

Gajadhar (1990) estimated an exchange rate function that selected domestic inflation, international inflation. the balance of payments and a time trend as the determinants of this variable. He attributed the time trend variable as probably arising due to the progressive deterioration of the public debt position, external debt position and debt service payments. OLS estimation for the period 1962-1988 revealed a high R^2 and reasonable DW statistics and T-statistics. The author also attempted to introduce the Hildreth-Lu procedure to correct for serial correlation at a time when this practice is severely criticised by the general-to-specific school. The results indicated that all variables except the balance of payments were significant in the determination of the exchange rate. This represented an attempt to introduce the principle of parsimony into the estimation exercise. The author fits different sets of variables and incorporates a number of explanatory variables in the levels as well as lagged values.

Ghartey (1994) used the framework of the monetary approach to fit a model of the exchange rate and attempts to test the purchasing power parity theory for Trinidad and Tobago. Jamaica and Barbados. His purchasing power parity equation fitted the rate of change of the exchange rate as a function of the difference in the change of domestic and foreign price levels. The monetary approach to the exchange rate equation saw the exchange rate as determined by the difference in the domestic and foreign money supply variables. The author tested for seasonal integration and cointegration and used seasonally differenced quarterly data for the period 1960:01 to 1992:04.

The results indicated that there were no seasonal unit roots for the countries in the study. The Augmented Dickey-Fuller (ADF) and Dickey-Fuller (DF) tests showed all the series to be I(1). The causality tests indicated that the change in money supply variable Granger-caused the change in the exchange rate in Jamaica only. The study consisted primarily on report of the findings of the estimation exercise. There was little discussion on the policy conclusions of these results.

The rate of inflation and the interest rate

The price level and the rate of interest are the equilibrating variables in the goods and money markets respectively. Inflation is defined as an appreciable and sustained increase in the level of prices. During the 1980s chronic balance of payments deficits and frequent realignment of the exchange rate were significant factors influencing the increase in the rate of inflation for the Caribbean countries. In the previous sections, RPMS/CCMS authors have all but excluded the nominal interest rate as a significant variable in the determination of the demand for money and the level of national savings. In this section, the authors are primarily interested in the determinants of the level of inflation and the real interest rate.

Thomas (1990) derived an inflation function for Jamaica that was solely dependent on the impact of the exchange rate using a single equation system. That is to say, he attempted to model the inflationary response to the magnitude and duration of exchange rate shocks. The openness and smallness of the Jamaican economy implied price-taking behaviour, so that the exchange rate is a significant explanatory variable. The author acknowledged that a more complete analysis will involve an assessment of the role of external shocks and domestic monetary shifts in stimulating inflation, through the adaptation of a simultaneous equation model. This paper is very much policy oriented. Thomas chose Jamaica because of its repeated attempts to use the exchange rate as an instrument during this period. A monthly distributed-lags system was used to capture the dynamic features of the process of the inflationary response to exchange rate changes. The classic Koyck transformation method was employed to fit a monthly model of the response of the consumer price index to changes in the exchange rate.

The incorporation of the distributed lags system implies a monotonic decreasing effect as one moved into the past in relation to an exchange rate shock. The lagged endogenous variable incorporates some serial correlation, which is eliminated by the transformation. OLS results are biased but consistent. This model was fitted for two time periods, January 1978 to December 1980 and January 1984 to December 1989 since the exchange rate was fixed for the period between those outlined. The results may be indicative of spurious correlation. Although the R^2 statistic is low, the t statistic indicates that the variables were significant for both time periods. The paper concluded by saying that the effects of the exchange rate on inflation are temporary, with the implication that policy can affect nominal and not real exchange rate values.

Joefield-Napier (1975) was concerned with the real causes of the inflationary spiral in the Jamaican economy. He investigated several theories that relate the inflationary process to changes to domestic money supply, the cost of production and structural imbalances. The author claimed that inflation in Jamaica goes beyond the classical cost-push, demand-pull scheme and that this must be expanded to incorporate the role of the rate of interest and government monetary and fiscal policies.

This paper began by providing a lengthy theoretical discourse on the possible causes of inflation in the Jamaican economy. Annual data for the periods 1959 to 1972 were used. The author derived estimates of the expected rate of inflation form the rural and urban consumer price indices. He fits a model in which the demand for real money balances is a function of the expected rate of change of prices per month. Thus it appears that the author was concerned with the issue of causality between the real demand for money and the expected rate of inflation. There is a minimal use of econometric methods in this paper. The results of the estimation of the foregoing exercise were very poor with low R^2 and T statistics that imply a non-rejection of the null hypothesis. Joefield-Napier pointed to the presence of serial correlation but made no attempt to deal with it. The author then fitted alternative models of the demand for real money balances using different definitions of the money stock and concludes that there is a high income elasticity of demand for real money balances. There is no discussion of the identification problem and the equivalence of money demand and money supply is implicit in the analysis. The author justified his *a priori* expectation largely through the analysis of the trends of macroeconomic variables rather than through the incorporation of econometric methodology.

In another paper, Joefield-Napier (1977) attempted to discern the linkages between foreign interest rates in the North Atlantic and domestic interest rates in the Caribbean economies. He incorporated the works of Thomas (1965) and McClean (1975) who viewed the linkage as arising out of the policy of Head Offices in the metropolitan countries, and structural and institutional factors respectively. The equation fitted showed the three month treasury bill rate for the UK as a function of the three month treasury bill rate of the US, Canada, and the Caribbean (Guyana, Jamaica and Trinidad and Tobago), a rate differential and a dummy variable representing the oil shock.

The results of this exercise indicate the presence of serial correlation, which ought to invalidate further discussion about the meaning and significance of other statistics. The author however reports the R^2 statistic as high and the explanatory variables as significant. He then discussed the significance of his findings in spite of the weaknesses in his specification. The author estimated the above equation in the first differences, which he suggested would lead to the partial elimination of the problem of serial correlation. He also attempts to estimate the rate of harmonization between the Caribbean interest rates and those of the North Atlantic. A simple correlation matrix is constructed in this regard, but the results are not definitive. This paper failed to draw concrete conclusions about the association between Caribbean and international interest rates, but it did provide some useful suggestions for the investigation of a more disaggregated model of financial flows between the two regions.

Bourne and Persaud (1975) attempted to discern the effects of selected financial variables on the inflationary process in Trinidad and Tobago during the period 1967-1974. A hybrid of the demand-pull and the cost-push theories of inflation was chosen as the selected methodology. The authors developed a recursive structural model based on a system of thirteen equations. The endogenous variables are the rate of change of prices, the total supply of goods and services, the final demand accounting relation, the balance equation for final goods and services, the consumption function, the investment function, government expenditure, money demand, the wage rate and import prices. The money supply process is assumed exogenous. This simultaneous system of equations is solved for the reduced form. Quarterly data for the period 1967:01 to 1974:04 were used in the estimation process. The assumption of static prices implied that there were no lagged endogenous variables in the equation. The authors determined the lag length of the explanatory variables by incorporating a rudimentary stepwise regression to the log-linearized price equation. They excluded those variables that added less than 0.6 to the value of the adjusted coefficient of determination. The DW statistic was not reported in this part of the exercise so one could not ascertain the presence or absence of serial correlation. The authors then fitted a range of reduced form equations that incorporated various combinations of the selected explanatory variables. This estimation method appears to run counter to the general to specific methodology. Finally the authors report on the significance of the selected coefficients. They conclude that government financing and the exchange rate were the most significant determinants of the inflationary process, while domestic credit had minimal influence.

Syfox (1991) provided a quantitative analysis of inflation in post-independence Guyana. The selected inflation rate equation was a function of the rate of growth of the money stock, the rate of growth of nominal interest rates and the rate of growth of real incomes. The author relied on the theoretical underpinnings of the Monetarist, Keynesian, and structural view of the inflation process to determine which Guyana best conforms to.

Syfox ran a multitude of tests to justify the validity of the model. First, he tested for the presence of heteroskedasticity and rejected this hypothesis. Second, he tested the data for the presence of ARCH processes as outlined by Engle (1982), and concluded that this type of heteroskedasticity did not affect the model. The models were tested for first, second and third order autocorrelation and the author concluded that there is no serial dependence in the error terms. The author then justified the absence of multicollinerity by demonstrating that there was little change in the parameter estimates based on minute changes in the sample size. He further employed the Ramsey Reset test for misspecification and the Chow test for structural breaks. Syfox concludes that foreign inflation, the exchange rate and import price elasticities seemed to be the most significant cause of domestic inflation in Guyana.

Robinson (1996) applied the Vector Autoregressive (VAR) ECM model to the forecasting of the inflation rate in Jamaica with the objective of outlining the mechanism of the transmission process. He fitted a monthly model of the inflation process for the period 1980:01 to 1995:12. The long run static model provided very good results with a high R^2 statistic and significant explanatory variables. The short run ECMs also resulted in a fairly good fit. The author was however cautious in suggesting the causality of the relationships based on the apparently high correlations. The paper provided an in-depth discussion of the origin, advantages and disadvantages of adopting a VAR specification methodology over conventional models. Robinson concluded that expansionary monetary policy has an expansionary effect on prices, while contractionary policy has a lag effect of at least two months. Exchange rate stabilization may also be the most effective way of reducing price instability.

Samuel and Leon (1994) attempted to investigate the extent to which price convergence has been achieved in the CARICOM region. They employed cointegration methodology to assess the perceived stability of the long run relationships among similar variables in the region. A quarterly VAR is used for over the period 1957:01 to 1993:04, to test whether the inflation rates in Barbados, Dominica, Jamaica and Trinidad and Tobago had in fact converged to the

'core' US inflation rate. The data set consisted of the consumer price index (CPI) for the CARICOM countries and the producer price index (PPI) for the United Sates. The order of integration of the variables was determined at the seasonal frequencies, after which the authors tested for the presence of a cointegrating vector among the variables at the appropriate frequency. With the exception of Dominica, seasonal dummy variables were not significantly different from zero. The Johanssen test revealed some convergence among the US, Barbados and Dominica rates but not among the US, Jamaica and Trinidad and Tobago rates. The authors attributed this divergence from their *a priori* expectations to the presence of exchange rate volatility in these two countries. Further, they believed that a monetary union could be achieved within a floating exchange rate regime as long as these rates are stable. Hence, despite the empirical results, the authors are generally unwilling to alter their apriori expectations. Instead they cite the characteristics of the data set as the prime reason for the disparity.

Some of the more "frontier type" econometric methods are to be found in these studies. The modelling of stock market behaviour in the Caribbean is closely related to the examination of volatility in stock returns. There is some overlap within this topic area into the examination of volatility in exchange rate returns.

Bourne (1985) presented a highly descriptive paper on the economic aspects of the Trinidad and Tobago stock market. He examined the coefficients of variation, weekly percentage changes and standard deviations of stock prices as an indicator of volatility. Cross-sectional analyses of the firms were facilitated through estimation of separate regression equations on the bid prices for pooled data derived from seven manufacturing firms and three banks over the period 1971 to 1982. The results indicated that the yield and price earnings ratio are significant to the determination of bid prices of manufacturing firms, while the dividends divided by paid up share capital and the post tax profits dividend by paid up share capital determine the bid price in commercial banks. Bourne further addressed the issue of stock market efficiency through the evaluation of a log-linear random walk model of stock prices. The results verified that there was serial dependence in six of the sixteen stocks examined. The market was therefore inefficient, as there was no independence in successive changes in stock market prices. Finally, the author attempted to determine the extent of influence of inflation on stock prices and returns through the application of a simple linear regression model. All the hypotheses put forward by this author were examined using the traditional approach of the application of OLS to a linear model and the verification of the significance of explanatory variables from observation of the standard T and F tests. At this time, there was already some available literature that addressed the issue of volatility in a non-linear environment. This paper could have therefore benefited from an incorporation of an ARCH type process to examine the issue of non-linearity or volatility persistence in the error term.

Leon (1991) presented some of the first discussions that addressed the issue of volatility in the Caribbean stock markets within a Generalised Autoregressive Conditional Heteroskedastic (GARCH) framework. This paper demonstrated that the observed autocorrelation of stock price returns in Jamaica could be modeled as a GARCH process. The data for this exercise extended from the period 1969:07 to 1988:12. Leon first establishes the existence of unit roots in the data

through the application of the Dickey-Fuller tests and observation of the autocorrelation and partial autocorrelation functions. He then fitted the data to a GARCH-in-mean process. The results indicated that 54% of the shocks persist after one year. This, he believes could lead to expenditure switching by risk-averse economic agents as stock returns are negatively related to volatility. The author suggests that a stable macroeconomic climate was required to stimulate the growth of equity markets in developing countries.

Kim and Langrin (1996) examine volatility spillovers of stock returns in the United States to stock returns in Jamaica and Trinidad and Tobago using a GARCH specification. The authors believed that newly liberalized economies were subject to increased volatility due to the direct purchases of domestic securities by foreign investors. That is to say, the liberalization of the foreign exchange markets and the relaxation of capital controls allow the easy repatriation of profits and the conversion of domestic currency to the US dollar. The data used in the analysis consisted of a weighted index of daily stock market returns for the period November 1987 to December 1995. The results suggested that a GARCH (2,2) process provided the best fit for the Jamaican data, while a GARCH (1,1) provided the best fit for Trinidad and Tobago and the United States data. Volatility spillovers are not immediately observable and as such an indicator vector or instrument must be generated to act as a proxy. The authors employed a technique by Hamao et al. (1990) and Kim and Rogers (1995). Here, the conditional variances of the domestic stock returns incorporate an additional variable which is the squared residuals from the estimation of a univariate GARCH (1,1) model to the United States data.

The results indicated that although volatility spillovers were important to explaining volatility in stock returns in both markets, volatility spillovers from the US during the pre liberalization time period was more significant for Jamaica than Trinidad and Tobago. They suggested that market inefficiency, and barriers to entry may be the major reasons why spillover was less prevalent in Trinidad and Tobago.

Hamilton (1996) explored the issue of increase stock market volatility in Jamaica in the post liberalization time frame. She employed the GARCH methodology to determine the extent and causes of stock market volatility in Jamaica for the period October 1988 to October 1994. As with the previous authors, Hamilton used the maximum likelihood estimation technique offered by the RATS programme to obtain solutions to a GARCH type specification.

Nicholls et al, (1996) investigated the issue of volatility in selected Caribbean exchange rates in the post liberalized period. The paper began by addressing the issue of non-linearity in the data generating process. The BDS statistic was employed to verify this hypothesis. This paper represented a first attempt by Caribbean authors to diverge from the assumption of linearity in exchange rates and to test for the existence of non-linearity though the investigation of alternative correlation dimensions. The authors attributed the non-linearity to the existence of volatility persistence in the error terms. The data was then fitted to a GARCH (1,1) process. The results indicated that for Jamaica and Guyana, exchange rate volatility was evident in the post-liberalized era. The Trinidad and Tobago data however, though demonstrating some measure of volatility, was far less pronounced.

The Balance of Payments

Cox and Zephirin (1979) developed a model that linked prices and credit to the balance of payments for Barbados. They investigated the relationships under the broad headings of the elasticities, absorption and monetary approaches and the fiscal approach to the balance of payments. In the analysis of the elasticities approach, the authors were interested in the effect of a devaluation on the balance of trade. In analyzing the absorption approach, they were interested in whether balance of payments disequilibria were due to disequilibria between domestic absorption relative to domestic output. In the examination of the monetary approach, they defined the monetary base identity as the sum of commercial bank deposits and currency in circulation, which was in turn equivalent to the sum of net foreign assets, net credit to the government, commercial bank credit and other assets and liabilities. In the fiscal approach, the authors were concerned with the extent on the influence of fiscal deficits on current account imbalances.

Annual data for the period 1966 to 1977 were used in the regression analysis. The authors cite the small sample size as a primary cause of unfavorable regression results. The reported DW statistics indicate the presence of autocorrelation in the error term, yet the authors report on the significance of the T statistics and the favourable R^2 statistics. The authors are reluctant to rely solely on the result of their estimation exercise due to this shortcoming and incorporate the use of 'chart analysis' in the discussions. Cox and Zephirin make no definitive conclusions about the balance of payments and the factors that influence its components. They instead point to the fact that several theories of the balance of payments appear relevant to Barbados. Policy makers must therefore be cognizant of this characteristic in determining techniques this variable.

Syfox (1992) presented a model of the balance of payments of Guyana in an attempt to assess its performance after the implementation of structural adjustment mechanisms such as the Economic Recovery Programme. He fitted the balance of payments for Guyana as a function of the foreign inflation rate, depreciation, real income, the interest rate and domestic credit using annual data over the period 1963 to 1988. The results of the exercise were mixed. The signs of the coefficients of domestic credit and real income were counter to *a priori* expectations. World inflation and depreciation were significant. Overall, the author presented a useful discussion of

the relevance of the diagnostic checks to his analysis. There was some confusion however about the meaning of the constant term. The author incorrectly suggested that if all other variables remained constant, then the dependent variable would increase to the extent of the constant term. This is true in a strictly mathematical sense, but not applicable to this discussion, as zero terms in the independent variables are not within the experience of the model.

St. Cyr (1978) attempted to describe an econometric relationship between wages, prices and the balance of payments for Trinidad and Tobago for the period 1956-1976. He began by outlining the various interrelationships that exist among macroeconomic variables such as the balance of payments, the money supply, aggregate demand, imports, domestic and international prices. He presented a simultaneous model consisting of six equations, two of which were identities. The author cited unavailability of disaggregated data as a major shortcoming to his analysis. The results of the initial estimation were relatively favourable. Further, St. Cyr derived the reduced form of the structural equations and determined the short run coefficient estimates. The author concluded that significant levels of domestic inflation would generate balance of payments disequilibrium for the Trinidad and Tobago economy.

Modeste (1992) tested for the influence of a distributed lag exchange rate model on the balance of payments of Guyana. The author relied on the monetary approach to the balance of payments as his theoretical framework. Modeste derived a single reduced form equation for international reserves flow as the solution of a simultaneous model that consisted of four equations, the percentage change in the demand for money, the rate of change of prices, the percentage change in the money stock and money market equilibrium. The model was fitted by OLS using annual data for the period 1964-1990. The author concluded that both the foreign price level and the exchange rate were significant variables for the balance of payments in the Guyanese economy.

Conclusion

The Monetary Studies progarmme has been a very useful outlet for econometric work in the Caribbean. A lot of the work presented there eventually appeared in journals like Social and Economic Studies and as book chapters. But there is a still a long road to over. Conclusions have been often tentative, almost apologetic, and in many instances policy recommendations have ignored the results obtained. Data problems have been frequently advanced for the lack of confidence in the models.

There is no doubt that great care should be employed in using the results obtained. Yet we cannot help but believe that authors should be a bit bolder in their interpretations and policy prescriptions. If not, it would always appear that econometric methods are employed to give some perceived respectability to the work, as if it were some necessary evil that should otherwise be avoided.

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