

SOME PROBLEMS WITH MACROECONOMETRIC MODELING IN THE CARIBBEAN

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## INTRODUCTION

In spite of the numerous factors which militate against macroeconometric modeling in the Caribbean, two decades of macroeconometric modeling has met with modest success. Foremost among the factors which retard its development are insufficient and suspect data bases. For most analyses, the analyst is extremely happy with twenty observations and often he is forced to work with fewer than these. The age old question of whether the numbers he is using measures the theoretical concept is no less relevant, for in most cases the data is not collected by economists and even when it is scant attention is paid to the peculiar circumstances of the Caribbean.

Never the less, undaunted, the caribbean economists have forged ahead, in the process, generating a not insignificant volume of literature on the subject.

The aim of this paper is not to give a comprehensive review of the literature, but rather to indicate some of the areas in which insufficient attention has been paid by macroeconometric model builders. These include, the implications of disequilibrium analysis for the specification and estimation of macro-models. The integration of the money market adjustment mechanism into the behavioural equations for the other markets/subsectors, the treatment of expectations and disaggregation. For the most part, some of these problems are the result of attempts to stick too closely to conventional modes of analysis. This does not gainsay the many meaningful contributions made by unorthodox theorists

(eg. Seers, (1964) Levitt and Best (1975)).

Section I looks at the efforts to incorporate disequilibrium in macro-modeling. The integration of the money market adjustment mechanism into the other macro relationships is discussed in section II. Section III provides a discussion of the treatment of expectations in Caribbean macro models and suggests one way in which expectations can be incorporated with little difficulty. Some thoughts on the effect of data collection methods on disaggregation are also presented. The final section gives some concluding remarks.

## SECTION I

Conventional macroeconometric literature is dominated by equilibrium models. Therefore, it is not surprising that macroeconomic models for the Caribbean have been cast in this mold, despite chronic double-digit unemployment, which is suggestive of disequilibrium in the labour market. Persistent deficits on the balance of payments is also indicative of disequilibrium in both the product and money market. The emphasis on equilibrium models may be due to the comparatively greater facility in obtaining determinate and easily recognizable results from equilibrium models and the relative ease of estimating such models. However, to ignore the existence of disequilibrium and the attendant quantity changes and spill-over effects in a multimarket setting can lead to erroneous results.

Quandt (1982) has shown that the estimated coefficients will be quite different, for both small and large samples, even though the approach each other as the speed of adjustment increases. Thus the estimation of a disequilibrium system as an equilibrium system

contains the implicit assumption that the speed of adjustment to equilibrium is extremely fast. An assumption which is not justified in the Caribbean context. Identification problems also arise since, when markets are in disequilibrium, at one time you would be observing the demand curve and at another time you would be observing the supply curve or neither.

Moreover in terms of stability analysis, equilibrium macroeconomic models have the implicit assumption that labour and income are at their full employment level.

Some efforts have been made to introduce disequilibrium into the analysis of some markets by using a partial adjustment mechanism, (see Downes and Mc Clean (1982) and Soamah et al. (1984)). While the introduction of a partial adjustment mechanism introduces an aspect of disequilibrium to the model and may be adequate for the analysis of a single market, it does not address the question of spill-over effects in a multimarket setting.

Benassy (1979) suggests one solution to the modeling of multimarket disequilibrium. Let  $y_1$ ,  $y_2$  be the demand and supply of commodity 1; and  $z_1$ ,  $z_2$  be the demand and supply of commodity 2. The disequilibrium system can be written as:

$$\begin{aligned}
 y_1 &= \beta_1 X_{1t} + \alpha_1 (Z - z_2) + u_{1t} & z_1 &= \beta_3 X_{3t} + \alpha_3 (y - y_2) + u_{3t} \\
 y_2 &= \beta_2 X_{2t} + \alpha_2 (Z - z_1) + u_{2t} & z_2 &= \beta_4 X_{4t} + \alpha_4 (y - y_1) + u_{4t} \\
 y &= \text{Min}(y_1, y_2) & (1) & \quad z = \text{Min}(z_1, z_2) & (2)
 \end{aligned}$$

where  $X_{1t}$  are the exogenous variables and  $y$ ,  $z$  are the actual quantities traded. If complete separation of the samples in terms of demand and supply is possible, then twostage least squares can be used for estimation (Quandt (1982)).

Another approach is suggested by Hendry (1982). He suggests

modeling of the dynamic adjustments of the markets from the behavioural plans of the agents, since they are sufficient to introduce disequilibria and non clearing. The deviation of price and quantity from their equilibrium values, lagged one period, he suggests should be natural conditioning variables for the plans of the agents.

## SECTION II

Sticking too closely to orthodoxy, in ignoring spill-over effects in a multimarket setting, has prevented the satisfactory integration of the money market into the over all macroeconomic models. The money market probably exhibits the highest speed of adjustment among the markets which are usually modeled. However, disequilibrium arises frequently because of the policy actions of the monetary authority. It has been shown with annual data that the assumption of long run equilibrium in the money market cannot be rejected. However, the evidence is the other way around with quarterly data. This can be interpreted as evidence supporting an adjustment mechanism which takes approximately one year to work, or a statistical artifact created by aggregation. In either case, temporary disequilibrium in the money market can create significant spill-over effects into the other markets because of the nature of the adjustment process.

In the Classical system the price level is the variable which equilibrates the money market. The rate of interest performs this role in Keynesian analysis. In the Caribbean neither of these variables perform the equilibrating role effectively because of the

nature of price and interest rate determination. There is thus a quantity response. Disequilibrium in the money market is reflected in changes in expenditure, both domestic and foreign. The composition mix in these countries is such that much of the expenditure will fall on imported goods.

Equilibrium in the money market is restored when the net foreign assets of the Central Bank has been changed sufficiently and probably marginal changes in the price level has occurred. This suggests that expenditure functions have to be modeled as functions of disequilibrium in the money market. To state the case more clearly, the specification of the import demand as a function of relative prices and income only is no more than unwarranted embrace of orthodoxy, given the nature of the money market adjustment. The same holds for the other expenditure functions.

St. Cyr (1977) recognizes the problem, but tackles it in a conventional manner. He specifies aggregate expenditure as a function of the level of the money supply and the demand for imports as a function of aggregate expenditure. The exact adjustment mechanism is, however not clearly specified.

One attempt to integrate the adjustment of the money market into the expenditure functions has been made by Mc Clean (1982). He models private consumption and imports as functions of the discrepancy between the actual and desired level of high powered money. This is indicative of the extent of disequilibrium in the money market, since the money market in these economies is demand centered. The desired level of high powered money is unobservable. This will create a problem in estimating such expenditure functions. One suggestion for estimating expenditure functions in this form is

to model the desired level of high powered money as an appropriately lagged moving average, which is consistent with adaptive expectations. Or the desired level of high powered money can be replaced with its rational expectations prediction.

One implication of ignoring money market considerations in estimating import demand functions is that the estimates will be biased. This is the classical omitted variables problem (Madala (1979)). The estimated elasticities will pick up the influence of the money market.

The role of government in the creation of disequilibrium is not always recognized, because for the most part, neoclassical economics deals with a timeless, institutionless world. The political business cycle theorists have attempted to introduce government as an institution explicitly into macroeconomic modeling. Nordhaus (1975) suggested that, "the government... chooses economic policies during its incumbency which maximizes its plurality at the next election." (p. 174). There is no evidence to suggest that such considerations do not influence economic policy in the Caribbean. However, the models which are usually constructed in the conventional tradition hardly reflect the political-economic determinants of vote garnering, mainly because they are not readily identifiable or measurable.

The literature on Political Business Cycles can give some insights into the modeling of the impact of politically motivated, government policy action on macroeconomic variables. Some of the concerns which emerge from the literature on political business cycles are pertinent to macro-modeling in the Caribbean. These are:

- (1) Policy makers, by focusing on specific interest groups may

not realize the macroeconomic consequences of their actions.

(2) Macroeconomic ills are inevitable by-products of democratic government in its pursuit of political power.

(3) The effects on real economic variables, due to monetary and fiscal policy actions, although they employ aggregate economic tools may not be for macroeconomic reasons.

(4) Conventional Macroeconomics poses questions erroneously, analyses the problems incorrectly and generates false conclusions.

### SECTION III

The treatment of expectations is also an area of concern in Caribbean macroeconomic modeling. This state of affairs is even more objectionable than the absence of disequilibrium analysis, for economists purport to explain and predict how economic agents make ex ante decisions. Thus, for the most part, agents are dealing with the future value of variables. This sets out a clear role for expectations in macroeconomic analysis. The analysis of the labour market, money market, investment behaviour and consumption are incomplete without an analysis of expectations. In spite of the advances in modeling expectations, Caribbean macro-models have, for the most part, maintained a distinctly deterministic character. This can be construed as, either that expectations are unimportant, a position which very few economists will hold; or that the current ex post variables are accurate representations of peoples expectations. This is an empirical matter which has to be resolved by evidence.

Where expectations have been introduced, a decided



preference for adaptive type mechanisms has been displayed. This type of expectations formation mechanism, apart from being ad hoc and assume that economic agents use information inefficiently, are plagued by numerous shortcomings which are discussed exhaustively in Begg (1983).

The rational expectations hypothesis, which, although it suffers from a few weaknesses of its own, is based on sound optimizing principles and the intuitively appealing assumption that agents will not consistently make the same mistakes if there is a penalty associated with making these mistakes.

The macroeconomic modelers in the caribbean, who enthusiastically embrace deterministic equilibrium macro-models would not be caught even planning to think about incorporating rational expectations into their models. But rational expectations is the logical extension of equilibrium models in a non-deterministic setting. This type of behaviour can only retard the advance of macroeconometric modeling in the region. If an equilibrium mode of analysis is chosen, then you may just as well get as much mileage as possible from that mode.

One important problem with conventional macroeconometric modeling highlighted by the rational expectations hypothesis is the so called Lucas (1976) Critique. Lucas observed that unless the equations in a macro model are truly behavioural or structural, simulations of alternative government policies in such a model can be erroneous if agents form expectations rationally.

This point can be illustrated by a simple multiplier-accelerator relationship. (see Holden et al (1985).

$$Y_t = C_t + I_t + G_t \quad (7)$$

$$C_t = cY_t + E_t \quad (8)$$

$$I_t = d(Y_{t-1} - Y_{t-2}) \quad (9)$$

$$G_t = G_0 \quad (10)$$

The rational expectations solution for investment is:

$$I_t = [-d/(1-e)]Y_{t-1} + dG_0/(1-c)(1-e).$$

Now assume that government expenditure is no longer given by (10), but by:

$$G_t = G_0 + \delta_0(Y_{t-1} - Y_f) + \delta_1(Y_{t-2} - Y_f) \quad (10a)$$

The new reduced form equation for investment is:

$$I_t = \frac{-d(1-(c+\delta_1))Y_{t-1}}{1-c-d} + \frac{d\delta_1}{1-c-d}Y_{t-2} + d \left( \frac{G_0 - \delta_0 Y_f - \delta_1 Y_f}{1-c-d} \right)$$

The new reduced form equation is quite different from the original one. It is quite clear that the parameters are not invariant to the policy rules. Thus simulations in this setting will lead to misleading results. The solution to Lucas' problem is quite simple in principle. Model builders should ensure that the equations in the system are genuinely structural and expectations are formally modeled. However, this problem is quite difficult to solve in practice, since it is not always clear what constitutes behavioural as opposed to reduced form parameters. It would seem that for the correct solution of the problem it is necessary to estimate the parameters of technology and taste, the only parameters which might be regarded as stable across policy regimes. However, formidable problems are encountered in attempting to do this (Hansen and Sargent

(1980)).

An alternative approach is followed by the Liverpool Model builders. Expectations are modeled rationally, treating the parameters of the model as constant. This may be reasonably accurate, for small changes in policy regime, since changes in parameters may be of secondary importance to explicit modeling of expectations.

The counter-intuitive findings of the early rational expectations theorists, is one of the reasons put forward for the wide berth given the rational expectations hypothesis. However, it has been demonstrated quite conclusively that these results have precious little to do with the rational expectations hypothesis per se, but rather with the nature of the underlying models, in which the natural rate hypothesis is the centrepiece.

The estimation of macroeconomic models with rational expectations can be done quite easily with the more popular estimation packages.

Consider a standard econometric model in linear form:

$$\beta Y_t + \sum_{i=1}^m (\Gamma_i Y_{t-i}) + \sum_{i=1}^p (\theta_i X_{t-i}) + \sum_{i=1}^n (\phi_{t-i} Y_{t+i}) + U_t \quad (3)$$

where  $Y_t$ ,  $Y_{t-1}$  are observations of the current and lagged endogenous variables.  $X_{t-1}$  are the exogenous variables and  ${}_t Y_{t+i}$  are the expectations of the endogenous variables for period  $t+i$  made in period  $t$ .  $\beta$ ,  $\Gamma$ ,  $\theta$  and  $\phi$  are appropriately dimensioned arrays of parameters.  $U_t$  is a vector of the usual error terms.

If a finite planning horizon is assumed, taking rational expectations on (3), conditional on the information at time  $t$ , yields:

$$\beta_t Y^e_{t+j} + \sum_{i=1}^m (\Gamma_{1i} Y^e_{t+j-i}) + \sum_{i=0}^p (\theta_{1i} X^e_{t+j-i}) + \sum_{i=1}^n (\Phi_{1i} Y^e_{t+j+i}) = 0 \quad (4)$$

(Chavas and Johnson (1982)).

Equation (4) provides a structure for estimating expectations. Given the assumed planning period,  $m$ , all expectations of variables for time periods greater than  $t+m$  are deleted from the model. If the variables are expressed as deviations from their unconditional means. After manipulations, the model can be written compactly in the following form:

$$CY^e + DY^L + FX^e + GX^L = 0 \quad (5)$$

Where  $X^L$  and  $Y^L$  are the lagged values of  $Y$  and  $X$ .

Assuming the square matrix  $C$  is non-singular the reduced form equation is:

$$Y^e = \pi_1 Y^L + \pi_2 X^e + \pi_3 X^L \quad (6)$$

where  $\pi_1 = C^{-1}D$ ,  $\pi_2 = C^{-1}F$ , and  $\pi_3 = C^{-1}G$ .

Equation (6) provides a structure for generating expectations. This can be substituted back into (1) to estimate the structural parameters. The only expectations variables which will be left are the expectations of the future predetermined variables. These cannot be generated endogenously. Time series techniques are suggested to obtain these.

The various limitations of data in the caribbean are alluded to by most econometricians and the econometric implications of these are well documented in Watson (1984). However there is one aspect of data collection which restricts the range of models which

can be built, and is often over-looked. Although, the data collected does not always measure the theoretical variables we wish to deal with, there is still some theory underlying the data collection process. The theory which informs this process is the conventional theory. Therefore, although we may want to model certain relationships in an unorthodox manner, we may be restricted by the nature of the available data.

The most important restriction is in terms of disaggregation. The most popular disaggregations are in terms of tradables and non-tradables and in terms of the sectors identified in the national accounts. While these forms of disaggregation may make sense for certain purposes, given the dynamics of caribbean economies, such disaggregation may not be very useful for policy evaluation.

Take for example the disaggregation in terms of tradables and non-tradables. We lump these together because we believe that these sectors respond in roughly the same way to stimuli. However, that need not be the case. The elasticity of demand for our traditional exports, which are sold in the developed countries is operationally infinite. Thus, the output of the products will be supply side determined and, hence, not amenable to demand side stimuli and price competition. On the other hand the demand for exports to the Caricom market is not infinitely elastic and demand side factors may be important. Therefore, lumping the two together does not make much sense. It would make more sense to lump Caricom exports and non-traded goods together.

A similar line of reasoning holds for disaggregation in terms of the national accounting sectors. Take for example

manufacture. The dynamics of production depends crucially on the market in which the product is sold. Therefore, what is required is disaggregation along these lines. However, data is not usually collected in this way. Thus although the theorist may recognize this limitation of the model he is building, data limitations permit only minor departures from orthodox models.

This analysis suggests that maybe we ought to re-examine the theoretical base on which our data collection process lies. It also indicates that there has to be greater communication between the theorists and the data collectors.

An issue relating to the marketing arrangements is the estimation of elasticities for balance of payments purposes. If we accept the assumption that the elasticity of demand for our traditional exports is infinite, when we try to estimate elasticities for these exports, we are really estimating supply elasticities rather than demand elasticities. For infinite demand elasticity imply a horizontal demand curve and the changes in quantities are purely supply responses.

#### CONCLUSION

Macroeconomic modeling in the Caribbean does not have a very long tradition, but the volume of literature in the field is increasing. The models which have been constructed have not always accurately reflected the peculiar conditions of this type of economies. Although the peculiarities have been recognized and some attempts have been made to incorporate these into recent macro models, implications are not always rigorously pursued and they have

not been welded into a general theory. The various constraints facing the model builders have forced many a determined model builder to use models which they would be the first to admit are far from what they would like to see.

In this paper we have argued that some of the structural features of the Caribbean have been given insufficient attention. This has led to the formulation of equilibrium type models, which ignore the spill-over effects of multimarket disequilibria. Inadequate integration of the money market adjustment mechanism into the macro models and the neglect of expectations formation. The theoretical base of data collection also restricts the type of models which can be estimated.

It is said that model building is an art. The practitioners of this art for in the Caribbean have not been very creative This is due to the constraints imposed by strict adherence to the conventional mold of macroeconomic modeling.

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