USING ECONOMIC MODELS IN POLICY MAKING

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The varieties of economic modelling technique and practice mirror the lack of strong orthodoxy in the economics profession of the 1980s. There are several opinions as to the most useful way to model an economy for policy making purposes. Venerable multi-equation models, much refined, are still widely used. They have been criticised because their theoretical underpinnings are not always transparent, and their critics have argued for smaller models which hued more closely to their theoretical roots. Some argue for intuituve rather than econometric modelling, because all statistical modelling falls short of the strict requirements of statistical theory. It may be argued that all economic modelling is based on outmoded mechanistic theories of human behaviour and motivation, rendering them incomplete and inconsistent, and that they should all be replaced.

Each of these approaches has its partisans, some of whom are prepared to maintain the primacy of their stand over all other views of the matter. In the process of claim and counter-claim, many of us are no longer certain that superior merit may be demonstrated, for any modelling strategy. That leads some to despair of the useful content of economic models. We find that position overly pessimistic; creative use of a variety of the techniques at his disposal can enrich the policy-maker's insight, provided he remains acutely aware of the limitations of each and does not suspend his own critical judgement. This paper intends to suggest an eclectic approach to the modelling of small open developing economies, taking account of the possibilities and limitations of available techniques.

The paper's first two sections suggest why we believe that econometric models alone will not suffice: the best remain technically deficient (section 1 explains why) and they all require unsatisfactory compromises between what technical efficiency requires and what is practical (the burden of section 2). Section 3 outlins the eclectic approach and section 4 describes progress to date towards an eclectic model for Caribbean economies.

1. The Technical Efficiency of Models

Definition and measurement present the econometric model builder with the first of his challenges. He must define each variable unambiguously so that the behaviour of individuals with respect to that variable always accords with theoretical notions. For example, suppose we believe that real retained imports are a function of real income and of the prices of imports relative to all other prices. (We leave aside quarrels about whether that is how people really behave, or whether we might have used expected income or expenditure or absolute prices or some other variable.) We must resolve a number of issues with respect to the measurement of each variable. What prices are to be used to measure a constant purchasing power of imports and of

income? How are we to resolve the index number problem? Is the behaviour of all individuals the same for all items included in the definition of imports or are luxuries treated differently than necessities? And how are they to be distinguished? Does income from work generate the same hunger for imports as does income from property, and are propensities the same for the old and the young, the rich and the poor, men and women, those with large families and those with small? Should services be included with imports, and how should we measure the price of services? Should the price index of imports include only the prices of actual imports, or should they also take account of the fact that there are competing sources of supply? (This is an issue of especial importance in the current era of flutuating exchange rates, which make for rapidly changing competitive relationships.) Should the price of 'other' goods exclude all import-competing products? It is possible to deal exhaustively with each of these issues, but few research programmes can accomodate such an approach, for each relationship represented in the model.

The modeller faces a problem of aggregation. All the units subsumed in aggregate described by a particular variable name must exhibit the behaviour attibuted to that variable. That must invariably be taken on trust because there is no way of knowing whether all units do conform other than by carrying out the test which called for the aggregate in the first place. For example suppose that our imports above really comprised necessities, which depended on income alone, along with luxuries, which also responded to relative prices. In order to specify behaviour correctly we would wish to divide our tests into two, separating the categories of import and including the appropriate explanatory variables in each case. But how would we know the difference between a necessity and a luxury other than by observing how poeple's consumption was affected by changes in relative prices? And if we were able to do that in the first place there would be no need for an 'experiment' to measure propensities to import. It is precisely to address our ignorance of the relationship between imports, income and prices that we try to measure a variable called 'imports' in the first place.

Econometric models embody extremely parsimonious descriptions of behaviour. In addition to income and relative prices, imports are affected by lifestyles, economic ties to one's neighbours, size, systems of belief (the pervasiveness of materialism, envy, competitiveness), restrictions on travel and communication, geography and many other factors. For econometric purposes we assume these all to be of trivial importance, compared to the effects of income and prices. How are we then to judge the results of our tests? If they appear good, does that mean that our parsimonious description is powerful, or have we failed to detect really really important behaviour because our test procedures were too crude? If our results appear

unacceptable, is our representation of behaviour mistaken, or have we include too many 'oddballs' along with those whose behaviour the equation faithfully represents? Put another way, the descriptions embodied in economic models are extremey brief, and not sufficiently discriminating.

It is very difficult to find a sufficiently illuminating macromodel which satisfies even fairly loose criteria for reliable statistical inference. For one thing, random selection is never possible, and none of the attempts to compensate is fully acceptable. The most recent - cointegration - addresses only one of the possible sources of non-randomness, i.e. autoregression. There a many other sources, most of which may be described under the rubric of 'excluded variables'. But there are infinitely more possibilities for 'excluded varibles' than any practical modeller may seriously contemplate. (Cointegration is based on the notion that the change in an entity, which appears to vary randomly, is different from the thing itself, which appears to be related to its earlier incarnation. It also presumes that a series which appears in probability to be random is in fact random. While both are acceptable common sense notions neither has an impeccable logical foundation.)

Changes in the circumstances subsumed in 'cateris paribus' are taking place all the time, violating the fundamental assumption that these factors can be ignored because they remain constant. These changes include the introduction of new products and novel ways of producing them. Perhaps the most revolutionary in recent times have been in the fields of communications and transport. There are also institutional and political developments which affect economic relationships, developments such as the rise of international banks as the principal conduit for international financial flows and the sudden economic prominence of oil-producing nations. Changes in the economic decision making process are another influential factor; they derive from the introduction of new information techniques, and improved decision systems. Other changes which have affected patterns of economic behaviour in recent years include changes in lifestyles (significantly, the increased propensity for froeign travel), marketing innovations and the introduction of new financial instruments such as credit cards, personal pension plans and mutual funding arrangements. Standard mechanical representations of 'structural change' employed by economic model builders do not begin to address the complex implications of changes such as these.

It is perfectly reasonable to maintain that there is no logical basis for any empirical procedure. All statistical inference is based on the notion of persistent occurrences in repeated sampling, but it is quite illogical to beleive that something will happen at the next sampling simply because it has been observed on every previous occasion. History is replete with examples of events which were

unprecedented in the history of the world. The most obvious are the extinction of races or species, but Hiroshima, Auschwitz and AIDS provide other examples close at hand.

Suppose we follow accepted practice and turn a blind eye to this unpalatable truth. Empirical procedures may be illogical but for most purposes we may get by if we accept evidence of regularities. Our research design must still meet impossible standards of falsifiability if we are to reach irrefutable conclusions. Tests must be designed, not merely to determine whether or how well data sits with the hypothesis offered, but to show that this hypothesis offers a more powerful explanation than any other. Since the number of alternative hypotheses is legion, it is always necessary to settle for a less than fully exhaustive research programmme. The most that can ever be said about any test is that it is the best explanation we can offer, so far as our current understanding goes and so far as the information available will allow. What appears perfectly reasonable today may seem quite misguided tomorrow. It is true that the economist's credibility depends on not having to reverse himself every day, but we ought to be prepared to admit ot changes in direction when new insight clearly warrants.

There is a grevious mismatch between human behaviour and the mechanical models used for statistical tests. Hutchison (1981), McCloskey (1983) and others have reminded us that the economist's description of behaviour is based on a philosophically discredited paradigm, one which no longer has the allegiance of modern scientists. We may illustrate the implications by considering the notion of causality. In what sense does a change in his income 'cause' an individual to change his level of consumption? Possibly, with his material circumstances now significantly altered, he does an implicit or explicit reevaluation - in the course of which he may make mistakes or be misinformed - re-assessing his prospects and determining on a revision in his consumption habits and on their timing. It is possible to imagine other ways in which the individual's consumption reaction may be determined. Someone who is living below the level of subsistence will presumably spend the entire increment without pause for reflection. In the case of a firm consumption reactions may vary with the type of organisation, the nature of the decision making process, the firm's ownership and its prospects. The testable analogue to these highly diverse real life 'causes' is a consumption machine which outputs as consumption a given proportion of any income that is put in.

Further, there are a variety of ways in which A may be said to cause B, all of which are reduced to a single-function A-B machine in econometric tests. An increase of income may cause the purchase of a car by providing the means to acquire that previously desired but unaffordable object. An increase in one's credit rating may 'cause' the purchase, in an econometric sense, because it

occurs in the present rather than in a future time period. A move to the suburbs causes the purchase of a car by creating motivation where none existed before. An increase in the national income causes an increase in tax revenues of government in a purely mechanical sense, since payments are obligatory. The increase in income may cause a change in government expenditure as well, but here the causal relationship is reflected in the judgement of politicians as to whether the more affluent community needs more or fewer government services. The complex nature of the behaviour which economists rather cavalierly describe as 'causes' makes for vagueness in model specification and creates imprecision in the interpretation of empirical results.

Economists labour under the necessity to divide continuous time into arbitrary periods of equal length over which to record their observations. Some transactions such as the receipt of income do take place at regular intervals (though the intervals seldom coincide for all the agents whose income is included in any single aggregate), but others - consumption, for example - are quite sporadic. The devices for linking the two types of transaction are all in the nature of stop-gaps. The time frame over which relationships work themselves out often remains confused, as in the real life measurement of multiplier effects. The nature of the reaction itself may vary. In some markets excess demand causes a change in price, in others a change in the amounts offered. The conceptual stories which address these issues -fixprice and flexprice models - are difficult to model and they require arbitrary assumptions.

Some economic relationships involve a wide sweep of time. An example which is of current concern to policy makers in many small open economies is the relationship between the balance of payments, external debt and economic growth. The attempts to model long term relationships in economics are exceptionally crude in their assumptions about the nature of social relations. 'Lifetime' income variables and 'intergenerational' models treat society as an infinitely lived two period machine as their point of departure. Despite their sophisticated use of technique, their assumptions about society have been advanced very little beyond this, and they are of little use to the policy maker.

The margins of error in econometric models are always too large to form an independent base for the choice of policy. They result from the combination of errors in variables and errors of estimation. The extent of probable error is neglected in most empirical work, and most of our analysis is based on central tendencies. Policy makers must take a more conservative stance, which accounts for the importance of intuition and judgement in the formation of policy, even where econometric models are use to inform the decision.

The errors in variables are in any case incalculable, since so much is at the discretion of the investigator.

There is increasing scepticism among economists of the notion of the disinterested observer. Every investigator, no matter how scrupulous, must make choices among the multitude of variables that may claim his attention. His choices cannot but be influenced by what he hopes to find, by what he already knows, and by how he interprets the initial circumstances that confront him when he starts out on his quest. No investigation can be truly free from its author's bias, and none may therefore satisfy the objective criteria which form the basis for calculating probable margins of error.

2. The Compromise Between Technical and Operational Efficiency

Logically, the specification which provides the best fit should also forecast most reliably, provided the researcher has used a model which adequately represents the reality. His tests would have uncovered the sources of economic behaviour which guide outcomes as a rule and over time. This information should provide us with reliable projections. In practice it is seldom the case that the best fitting model is the best predictor.

Some economists have tried to sidestep the problem by using prediction criteria to the neglect of goodness of fit - the familiar argument attributed to Milton Friedman. It is an unhappy compromise which does not explore the sources of the discrepancy between the implications of the goodness of fit criterion and that of the prediction. It leaves open the possibility of surprises. The explanation may very well be a bad one which happens to fit the most recent data. If anything the goodness of fit criteria should be preferred because they are invaraibly based on more numerous observations. To apply the prediction criteria we must hold back a few recent observations, too few to allow for confident inference.

Nonetheless, policy makers are constrained to use the results which provide the best prediction, or to adjust the results of the best fit in order to improve its power of prediction. The essential reason why apolicy maker builds amodel is to forecast and simulate. For the policy maker the best predictor is operationally more efficient.

Judgemental inputs often violate the criteria of efficient econometric technique, but they are essential for good policy modelling. The policy maker will usually have non-quantifiable but concrete information bearing directly in the expected outcome. For example he may know that investment has taken place in the production of new products, or that there will be a signal change in productivity because new technogolies are embodied in activities which are soon to come on stream. He may be aware that upcoming products are of significantly different quality than the old. There may have been unusual or unprecedented events whose effects will show up in the

projections - general strikes, natural disasters, oil shocks. There may have been known changes in 'cateris paribus' conditions - demographic changes, changes in social and pschycological factors. In the end, policy making is an art, and so the policy maker must also admit his own gut feelings.

The policy maker needs also to compromise on the size of his model. More information can be put into larger models, including specific judgemental information, to give more reliable predictions than are attainable with smaller models. However, as the model becomes larger it is more and more difficult to visualize the interactions it embodies and to be sure that they correspond to the economic behaviour that the modeller wishes to represent. This problem shows up most starkly when simulations throw up implausible results from what previously appeared to be a well-behaved system. To diagnose the problem the modeller must be able to trace reactions though the system from the policy with which he initiated the simulation through to the final outcome. The longer and more complex the reaction chain, and the more numerous the simultaneous interactions, the more elusive is the source of the surprise. The modeller is left with the two choices, both uncomfortable: a model of many equations, with many opportunities to input specific information, but at the cost of much vagueness about its internal workings; or a spare model which is more easily understood, but which will not admit enough specific information.

3. An Eclectic Choice of Technique

The foregoing is the basis for an argument in favour of an eclectic choice of technique. Econometric methods cannot claim primacy over pure theorising, statistical measures of central tendency, graphical analysis or well informed argument. This is true no matter how careful the econometrician is. The recent emphasis on more exacting standards of econometric practice is welcome and necessary, but the fundamental weaknesses of empirical method cannot be overcome, no matter how careful the researcher is, nor how exhaustive his tests.

No existing national econometric model addresses all the concerns of section 1. Even if it were possible to finesse all the technical issues the fundamental problem of the mechanistic nature of econometric logic would remain a barrier to credibility. The econometric approach can by no means be neclected, however. Every alternative basis for the formulation of policy is equally flawed, some very much more so. The only feasible basis for sensible, practical policy discourse is to admit all carefully reasoned methodologies, and subject them all to critical scrutiny.

The approach suggested here for policy formulation is a combination of the following:

- a verbal theoretical description of the workings of the economy, supported by diagrams, algebra and visuals;

- graphical presentation of major economic statistics suggested by theoretical considerations;
- simple statistical measures of the variables suggested by theory (means, ratios, variances, trends);
- 'thinking' econometric models designed to clarify the economic relationships suggested by theory, but at too high a level of aggregation for applied policy making;
- 'applied' econometric models in sufficient detail to reduce margins of error within limits acceptable for policy inference. It may be necessary to devise models in small modular units, fitting them together by non-econometric means;
- full discussion and interchange of the results.

4. An Illustration for the Caribbean

Aspects of this eclectic approach have been practiced at the Central Bank of Barbados over the past several years, in research which addresses a number of issues in Caribbean economies. Results of these efforts have appeared in a number of publications and working papers, which will be alluded to in what follows. The approach has evolved rather haphazardly over time, and there has been a distinct bias towards the econometric. Reviewing the experience we are now suggesting the need for a better balance with other procedures, and a more conscious effort to blend the insights from all lines of enquiry.

Economic growth in the small island economies of the Caribbean is circumscribed by the structure and performance of the external sectors. The structure of exports and imports, the way they have evolved over time, and the policies which affect their performance will set the parameters for the long term growth path of the economies. Because the economies are small they will exert no influence on the prices of exportables and import competing goods (There are specific exceptions). The output of tradables therefore depends entirely on domestic supply conditions. This makes for an important distinction with the nontradable sector, where the interplay of demand and supply serves to determine output and prices. For the analysis of the short run we conceive of the economy as divided into the familiar Swan-Solow tradable and nontradable sectors. We also try to explain the outturn for the balance of payments, government finances, money and credit, and wages and employment.

The structure of the economy as we represent it is illustrated in diagram 1. It contains an output and price determining segment where the production of tradables is determined solely by the costs of production at world market prices, while the output of nontradables depends on the strength of domestic demand for them as well as on their prices. This segment of the model determines output as the sum of the sectoral performance, and prices, which depend on given foreign prices, the strength of domestic demand conditions affecting nontradable prices, and on domestic

costs, including interest rates. There may be shocks affecting demand arising from external capital inflows and from domestic money creation, apart from the external price shocks to which open economies are subject. Output and prices may also be affected by exchange rate changes, which arise principally because of excess demand for foreign exchange. (In a world of floating exchange rates every country's exchange rate is constantly changing against some index, but these third country variations have proved to have negligible effects on output and prices in the Caribbean; see Worrell,1982.)

The second segment of the structure enables us to determine the balance of payments outcome. Exports consist of the already determined output of tradables, less such consumption of these items as residents wish to buy at the ruling price. Imports depend on the same demand factors as nontradables: income, 'shocks' and their prices (relative to the prices of domestic goods). Capital flows are partly a result of government decision, partly in response to investment prospects, and they are influenced in the short run by interest rate differentials at home and abroad and by expectations about the exchange rate. The net result is the change in reserves or of the exchange rate.

The third segment is concerned with government finance. Revenues are determined by the level of incomes and other bases of taxation, given the rates of taxation which government may alter at will. Expenditures are entirely at the discretion of the government. The resulting deficit is financed by external borrowing, to an extent determined by the government, by borrowing from the banking system, in an amount which depends on the interest rates set on the money and credit markets, and by money creation, which depends on the shortfall in financing from other sources. Government's principal impacts are in terms of direct contribution to output from public services and the expenditure injection which results from money creation. (Government's contribution to output should probably not be considered at the discretion of officials, but as part of the nontradable output demanded at any given price. Government expenditures should nevertheless be considered autonomous, since officials may set transfers at any level they choose.)

In the financial segment of the model output and prices determine the supply of monetary liabilities and the demand for credit, along with the interest rate. The interest rate varies with the responses of liabilities and credit, with foreign interest rates (because of the possibility of currency substitution) and with the central bank's discount and reserve requirement policies. The interest rate as determined in this market influences the supply curves in the output segment and may therefore affect income and prices. In addition, the prospects for growth and the expected profitability of investment may alter the supply of credit. A deterioration in investment prospects may impair

the security offered by firms seeking loans, and they may obtain less credit than their levels of operation may require, resulting in a reduction of output as working capital finance shrinks.

The next segment helps us to determine wages and employment. We envisage the outcome as the result of a bargain in which empolyers have a demand which varies with expected output and labour productivity and workers' supply is keyed to a wage which protects them against erosion of purchasing power. Observation of the pattern of past wage movements may suggest the relative bargaining strength of the contending parties and indicate how the market responds to a need to increase output. These inferences, about the growth of productivity and the wage-price adjustment process, should enable us to deduce the level of employment.

Finally, we have an investment segment, which forms the link between the economy's short term adjustment and the long term prospects for growth. Investment will be influenced by the domestic wage rate and the level of comparative wages abroad, and by the rate of taxation as it affects the returns to investment relative to those for consumption and hoarding. In addition, there are a large number of factors which influence the investment climate, including social and political factors. The rate of investment which results, and in particular the rate of investment in the tradable sector, sets the limit to the economy's long term growth. Any attempt to push the growth rate above this results in excess demand for foreign exchange and an exchange rate change which will ultimately depress the rate of growth, if the expansionary impulse persists.

The model is described most fully at an earlier stage of its evolution in Worrell and Holder,1984, where it is presented in its historical context and with the aid of charts showing the adjustment process and a listing of equations. Statistical analysis using this implicit framework is to be found in Worrell,1982 and in Worrell,1987, for Barbados in the first instance and for the English speaking Caribbean in the second. Both publications make extensive use of charts to illustrate performance trends. Several econometric models have been tested on various aspects of the working of the economy, all mining much the same vein in their description of the economic structure. They include work on wages and employment (Boamah,1985), on price formation (Holder and Worrell,1985), on the financial sector (Worrell,1985 and Worrell and Haynes,1987). These models should all be considered 'thinking' models in our earlier classification. They all operate at a fairly high level of aggregation, which yields valuable insight, but makes direct application to policy formulation unrealistic.

The modelling process needs to be systematised and advanced by means of a better combination of the available methodologies. A way must be found of putting the system together in a less aggregated form so that simulations may be linked directly to specific policies that the authorities may contemplate. However, even at the present stage the modelling exercise has yielded some insights.

We believe there emerges a hierarchy of policies, with fiscal policy having a direct impact on imports and the balance of payments, as well as on the demand and prices of nontradables. Devaluation of the exchange rate proves inflationary, and it thereby depresses demand; switching effects are possible, but are more difficult to detect. The exchange rate is yet to throw up significant long lasting supply effects. Monetary policies seem to have very slight impact. We stress that these deductions are not derived from empirical tests alone; they are the joint result of theory, observation, tests and experience with the management of Caribbean economies.

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DIAGRAM 1. ECONOMIC STRUCTURE