Some Thoughts on Model Building for Developing Countries

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Introduction

Over the past twenty years, a great deal of research time and effort have gone into the development of macroeconometric models for industrialized economies. The reasons behind building such models have centred traditionally on the notion that they can provide a better understanding of the mechanisms through which individual theoretical relations interact within the overall structure of the economy. Macroeconometric models also provide policy makers with powerful analytical techniques by which alternative government policies may be evaluated. They also help to provide direction for the collection of new data and for the improvement of existing ones. There is evidence of a growing interest in the development of macro-models for developing countries. In this paper it is our intention to discuss some specific issues relating to model building for developing countries within a general framework of the basic principles of model building.

What is a model? In general terms a model is a tool for solving problems. For our purposes, we define a model as a mathematical system of simultaneous equations that embodies the researcher's perceptions about how some of the important

relationships that constitute our economic environment function. Like all models, an economic model is an abstract of reality. Our economic environment is too complex to be described in all details. A model simplifies it in a way that facilitates our understanding of how it works.

Whether for a developed or developing country, a model may pass through four stages, namely: specification, estimation testing and evaluation.

Specification: We may broadly define specification as the mathematical formulation of the relationships among economic variables in terms of equations that lend themselves for empirical testing. The first stage is to define the problem that one wishes to investigate. Generally it is the nature of the problem that conditions the structure of the model and the role of its variables. Suppose a researcher wants to find out what factors determines real output in Barbados. He formulates the relevant theory on real output determination and then translates that theory into a set of equations.

There is no doubt that specification of a model should be informed by economic theory. But that is not enough. Not only should specification be informed by economic theory but the theory should also be informed by the modeller's perceptions of how that particular economy works. How far to go in simplifying reality also depends on the model builder. Indeed that determines the size (small or large) of the model.

There are strong and weak arguments for either choice but with hindsight I would say that one needs to start with a small model which brings out the essential features of the theory one wants to explain.

One important benefit of a small model is that it makes the researcher understand better what the salient features are and to explain to policy makers the assumptions of the model. However, a small model does not necessarily mean an aggregate model of a few stochastic equations. A simple model should combine easy to manipulate mathematical relationships with a judicious disaggregation of the sectors concerned. A two-sector model of traded and non-traded components could be a convenient starting point for a developing country.

At this stage, one needs to investigate the facgors that may determine the actual functional forms. While economic theory may indicate the variables on which the particular endogenous variable depends, it rarely provides strong justification for a particular functional form. Typically, the chosen function will be simple but compatible with a priori restrictions implied by the theory or by previous empirical work.

After formulating the model, before one investigates how the model fits the data, one must first look at the data. That is one way to check for possible changes in the underlying economic structure. The available data might also

suggest changes in some of the specified equations. Alternatively, good proxies could be used for some of the variables for which data may not be available. The onus is on the model builder to find approximations of variables which cannot be measured directly or for which no data exist.

Estimation: We define the estimation stage to include:

(i) the assembly of relevant data pertaining to the model, and

(ii) fitting the model to the data to obtain numerical estimates for the parameters using appropriate statistical techniques.

It is important that the appropriate statistical tests are undertaken and the results properly reported. Variables with the wrong signs, abnormally high or low regression coefficients or elasticities should not be accepted without further analysis. In some cases what really needs to be done is a further investigation of the error processes involved. In many instances, however, poor results may suggest that important variables may have been omitted or some of the critical assumptions of basic econometric theory may have been violated.

While there exists a spectrum of statistical tests (R^2, F-test, t-test, etc.) that could be used in the process of statistical inference, these may not be sufficient guide as to the acceptability of the results. In general the

decision would depend on the primary purpose of the model. The researcher may be forced to make compromises, accepting equations which though less desirable from a statistical point of view, nevertheless help to improve the forecasting performance of the model.

It should be noted, however, that usually the performance of a model in simulation exercises can be affected by the type of estimating techniques employed. What technique to adopt would generally depend on the structure of the model. The use of single equation estimating techniques such as the Ordinary Least Squares (OLS) to estimate an interdependent model from its constituent parts leads to inconsistent and biased estimates. Moreover, while the standard goodness-of-fit criteria for single equations tell us something about how well the equations fits the data, they do not tell us how well the separate parts of a model fit together. Complete systems may fit poorly even though each part fits well in isolation. Therefore it is important that muti-equation estimating techniques are employed to estimate an interdependent model.

Testing and Evaluation

After the model has been put together, sample data collected and the parameters estimated, the investigator might want to conduct experiments to predict the unobserved

or future values of the endogenous variables. Before this is done, however, he should try to demonstrate the reliability of his model and instil some confidence in its use by establishing some initial credibility. The model should be put through a number of validation tests. These include analyses of the ex-post simulation and the ex-post forecasting errors, sensitivity tests and multiplier analyses. A satisfactory simulation will be decided not only on the standard quantiative measures (such as the Root Mean Square Error, RMSE, etc.) but also on application objectives experience and comparison with other investigator's work.

Once the model's credibility is established, it can then be used for ex-ante forecasting and/or policy evaluation. Usually, for policy evaluation the model is simulated under current policies to produce a forecast of what would happen if current policies are maintained unchanged. Then a hypothetical alternative policy is specified to produce another set of forecast values. The differential behaviour of the alternative paths of the economy under the two experiments is taken as a measure of the consequences of changing government policy.

Model Building for Developing Countries

It has generally been acknowleged that model building principles such as outlined above could be used to study the economies of developing countries, as they have been for

industrial economies. However, a model for a developing country should not and cannot be a prototype of that for a developed country because of differences in structure and other factors.

A typical developing country is characterised by supply constraints, not only of physical capital but also for skills of different types. Therefore supply is slow to adapt to changing demand conditions. A model for such a country must, therefore, necessarily emphasise supply conditions more than demand factors. But, since there is no aceptable theory about how national economies of developing countries operate, model building for these countries entails a great deal of problems. The model builder is at a loss as to what theoretical framework to mould the model. He is faced with the task of trying to modify existing theoretical orthodoxy to suit what he sees as the special characteristics of the economy he wants to study. This naturally exposes him to all sorts of criticism. Questions may be raised about whether his perceived theory captures the essential economic features of the economy for which the model is being built. The specification stage presents a challenging problem for the model builder.

A successful model should fit the data and meet statistically acceptable tests. At this stage too one may encounter problems because all the relevant data may not be available. Where data exists, they may not be of the right quality and may also not span long enough period to ensure that

consistent and stable estimates are obtained. The model builder may be forced to spend some time to estimate some of the key data. Not only is this time consuming but it is also a second best solution. The use of estimated data introduces further uncertainty in the modelling process. One is never sure what degree of confidence to place in a model which is fitted with estimated data.

Sometimes the modeller may have to use inappropriate estimating techniques simply because the appropriate computer hardware and software may be not available This limits the models ability to generate unbiased and consistent estimates and consequently dependable forecasts. The problem extends to policy evaluation. At this stage, it is important that the model is solved simulateously so that any forecast would have taken into account all relevant cross correlations. Therefore, a multi-equation computer simulation package (such as one that employs the Gauss-Siedel iteration process) becomes indispensable in the modelling process. Not many developing countries do have access to such a forecasting tool.

These problems outlined above invite some caution in our claims of what national econometric models can do for developing countries. They also point to what need to be done in terms of priorities for research. The first need is to expand and improve the statistical base of the economy. Secondly, there is a need for more detailed empirical research on the key sectors of the economy. A better understanding of the key sectors can provide

new insights for improving the structure of national macroeconometric models. National models can provide useful preliminary guides to policy. However, they should not necessarily replace judgemental estimates. Wherever possible the policy maker should use the results provided by both methods to inform his judgement before coming to a final decision.