INTRODUCING MACROECONOMIC MODELLING

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AN ECONOMETRIC STUDY OF THE UNITED KINGDOM

P. ARESTIS and G. HADJIMATHEOU

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First published 1982 by
THE MACMILLAN PRESS LTD

London and Basingstoke
Companies and representatives
throughout the world

ISBN 978-0-333-30015-2 ISBN 978-1-349-86084-5 (eBook)
DOI 10.1007/978-1-349-86084-5

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To our children

Chloe, Katerina, Natalia

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Introduction

The analysis and forecasting of national economies on the basis of formal macroeconomic models on the scale pursued presently has been a relatively recent phenomenon. The enhanced economic role of governments, especially in the form of discretionary stabilisation and control policies, following the adoption of Keynesian policy prescriptions, has led to a marked reassessment of the need for both more accurate forecasting and a better understanding of the structure and working of the economy. The concomitant proliferation of economic research on macroeconomic and policy-related issues in conjunction with the development of appropriate statistical techniques and the subsequent availability of powerful computing machines provided the prerequisites for the pursuit of progressively more sophisticated econometric models. Despite their shortcomings present-day econometric models are, for lack of a better alternative, widely used both within and outside the government sector, first as the main instrument for more systematic and less subjective forecasting than before and, second, as the means for the study of the consequences to the economy of alternative economic policies and substantial exogenous shocks to the system.

In this context an economic model is perceived as a system of interrelated relationships, the specification of which is based on economic theory. The quantification of such relationships on the basis of historical data has become the subject-matter of econometrics. Sophisticated statistical techniques have been developed that account for the interdependence of the relationships, and which lead to unbiased and efficient estimates of the model's parameters. A choice between alternative specifications of the same relationship is possible on the basis of a host of statistical tests - including tests for parameter stability over time and the validity of parameter restrictions suggested by economic analysis. Furthermore, considering any model as a whole, historical simulation and *ex post* forecasting (see Chapter 9) can be used to assess how closely each endogenous variable tracks its corresponding historical

data series.

The estimated model can then be used for the following different but related purposes:

- (a) To make conditional forecasts of the future - the conditions being the alternative assumptions on future values of exogenous variables or policy strategies.
- (b) To simulate the consequences of alternative economic policies.
- (c) To search for an optimal way - in terms of welfare loss - of controlling certain targets through manipulation of certain instruments.
- (d) To experiment with, by evaluating the explanatory power and testing the internal consistency of alternative theoretical perceptions of how the economy or particular sectors of it work, for example by examining the problem of choosing between rational and adaptive expectations hypotheses.

The value of adopting an econometric model-building approach to economics arises, and is indeed necessitated, because of the fact that both governments and industry are involved in some kind of planning and target-setting. Furthermore, there is no serious alternative to economy-wide model-building in carrying out such functions. Even in academic research a large model is sometimes the only vehicle by which the implications and dynamic effects of a theoretical argument can be evaluated. Thus despite the persistence of doubts concerning the theoretical foundations of stochastic economic models (Hicks, 1979) and their performance (McNees, 1979), work on improving them is flourishing. In the meantime, and in the hope of real progress, the models currently available should be used critically, carefully and cautiously.

At present there are four main, non-government, academic teams engaged in economic modelling on a national basis: the London Business School (LBS), the National Institute of Economic and Social Research (NIESR), the Cambridge Growth Project (CGP) and the Cambridge Economic Policy Group (CEPG). Each of these teams is usually identified with a particular strand of economic thought. The specification of the LBS model has increasingly been influenced by monetarist views, whereas the NIESR is assumed to be closer to the traditional Keynesian approach than any of the other models. The CEPG seems to follow a more radical approach to economic modelling and policy within a post-Keynesian framework - emphasising the importance of institutional factors and traditional decision-rules and rejecting the equilibrium or optimisation approach of orthodox economics. The CGP does not seem to conform to a single school of thought, but a different type of model is produced - a markedly more disaggregated one - than the other three. Parallel to these, similar exercises are carried out in the public sector - one in the Treasury and the other in the Bank of England.

Although there is a great deal of duplication in the work accomplished by all these concerns, it can be argued that the discipline of economics is such that there are necessarily differences between economists based on valid disagreements about the theoretical

specification of a model, its estimation, its size and the set of questions it purports to answer. Given these differences it is not surprising that the teams compete with one another.

The Treasury and the Bank of England teams are subject to constraints to which academics do not have to conform. They rarely publish forecasts and/or recommendations which may be in contrast to a particular government's policy or its economic philosophy. They are also disinclined to allow themselves to appear to be closely or explicitly identified with a particular school of economic thought and its underlying political undertones. Their work is mainly for internal purposes, i.e. servicing the government, and so it is not usually produced to compete in the arena of economic persuasion.

In addition to the above establishments, there are certain private units which provide a substantially narrower and more specific service. They are not, usually, engaged in economic modelling as such, but they use existing models, mainly the Treasury one, to arrive at forecasts which they subsequently make available to their clients. The most notable ones are the Henley Centre for Forecasting, Phillips & Drew, SCI CON and the St James Club (*The Economist* newspaper group). Two of the academic teams, the LBS and the CGP, have also developed a commercial side to their activities.

Building and continuously updating an economy-wide model is a costly and demanding pursuit that draws heavily on economic theory and econometric techniques. Developing the model is therefore a multi-faceted educational process, because:

- (a) It uses a large amount of historical data, covering many aspects of economic activity which is examined and used to highlight and, it is hoped, to explain the working of an economic system.
- (b) The initial specification and subsequent improvements in the structure of an economic model require continuous study of economic theory and reflect an increasing experience from the past performance of the model.
- (c) An increasing efficiency in estimation of the model depends on the extent to which developments in econometric methods are adopted.
- (d) In modelling practice, measurement problems, lag responses, dynamic steady-state paths and stability are recurrent issues which have to be faced and to be fully specified.

Despite the fact that in the recent past considerable progress has been made, there is still a great deal of scepticism as to whether big models in their present form can be relied upon to guide policy-makers. Objections arise on the basis of persisting problems. The mere size of the models frequently leads to the use of *ad hoc* relationships and the adoption of specifications which are not firmly based on economic analysis; the data sets available for estimation and stability testing are still relatively small, especially so when asymptotic tests are involved, which very often results in short-term relationships which lack historical background;

the universal forecasting failure of models in the mid-1970s has raised important questions concerning their parameter stability; and parameter instability, in turn, may be the result of all sorts of mis-specification of the underlying structure. A potentially more damaging criticism is the view that the structural relationships employed are not invariant to policy, and are therefore unlikely to be sufficiently reliable for both forecasting and policy evaluation (Lucas, 1976) - the introduction of the concept of *rational expectations* can be considered as an attempt to allow for this kind of structural change.

The acceptance of these problems and their consequences have led to a more realistic assessment of the models' contribution to economics and policy-making and to a recognition of the need for more research. However, modelling activity and econometric forecasting are going to stay with us.

In 1973 Ash and Smyth argued that the UK macroeconomic models had not been a waste of time. Their argument, however, had been developed before the oil crisis of the 1970s, before the failure to predict the stagflation and stagnation of the decade, and before the concurrence of high and rising inflation and high and rising unemployment. All these events imposed some severe problems to model-builders and model-handlers. Nevertheless, they seem to have managed rather well: 'Recent studies based on the 1970s experience and more current versions of macroeconomic models indicate that structural models out-perform time-series models for most (though not all) variables and that the margin of superiority increases over longer horizons' (McNees, 1979, p.259). Furthermore, with improvements in their performance, models will be more widely used and studied both within and outside the economics profession.

The existing models are too big and too complicated to constitute the object of study in the context of a textbook in economic modelling. The present study is an attempt to carry out a small-size modelling exercise, based on an annual aggregate model of the UK economy, mainly for teaching purposes. Chapter 1 explains the main issues encountered in econometric modelling practice and provides the necessary technical background for the understanding of the specification and estimation of the model. It presupposes a level of econometric knowledge usually attained in a standard introductory course in econometric methods. We feel that econometric textbooks are usually more boring than necessary, in that they are too rich on technical details concerning estimation methods, but rather poor on specification (Rao and Miller, 1971, is an exception), something which is now increasingly recognised by econometric practitioners. In discussing econometric practice, therefore, we have decided to concentrate mainly on specification problems, on testing procedures and on the correct interpretation of the reported statistics. As Hendry (1980, p.399) observes: 'The rapid development of computer speeds and storage capacity should by now have relegated most of estimation theory to footnotes about numerical approximations and refocussed attention on all of the issues surrounding methodology, inference, model formulation

and equations selection.

In Chapters 2-7 the following pattern is followed: after a brief discussion of the main developments in a particular sector of the economy - consumers' expenditure, fixed and inventory investment, public expenditure and revenue, demand for and supply of money, unemployment and inflation, exports and imports - behavioural equations are formulated and estimated. In the process of specifying these relationships and, subsequently, while discussing the estimation results, extensive references are made to the relevant theoretical and empirical literature in the particular area. Key studies recommended for further reading are indicated by asterisks in the Bibliography at the end of the book (pp.226-41). The methods of ordinary least squares and instrumental variables are used for estimation. The instrumental-variables estimates form the basis of the discussion of both the individual relationships in the various chapters and the model as a whole as summarised in Chapter 8. The ordinary least squares estimates are given in an appendix at the end of the book (pp.211-17). A comparison of the two sets of estimates gives some idea of the consequences on ordinary least squares estimators of the presence of endogenous variables among the regressors. The use of annual rather than quarterly data was dictated by a number of considerations, including our intention to discuss developments in the UK economy over a relatively long period of time, which inevitably generates problems of reliable data when quarterly data are required. Given the purpose of the book we also wish to avoid making relationships too complicated, especially in the search for appropriate distributed lags and the correct resolution of the seasonality problem. Within the limits set by these considerations, and given that our sample period, allowing for lags, consists of only twenty-two observations (1955-78), the selection of the estimated forms finally included in our model was based on a series of diagnostic tests which have only recently been made available in modelling practice.

Following the sectoral analysis, the estimated behavioural relationships are brought and linked together with the help of well-known identities - including the government's budget constraint - so as to provide an integrated model. The outcome is a standard expenditure-based aggregate model. Its special features include an explicit endogenous treatment of government expenditure and revenue, culminating in the full incorporation of the budget constraint. A summary of the model, together with a discussion of its main features and a flow chart, appear in Chapter 8.

Finally, in Chapter 9, after an explanation and illustration of the simulation process using a simple three-equation model, the performance of the main model is assessed on the basis of simulated results. Subsequently the model is used for policy evaluation. The latter is carried out, first, by changes in policy instruments and repeated simulations, and, second, by introducing a simple welfare-loss function and the application of optimal control techniques.

Throughout this study we have tried to be explicit about the shortcomings of our model in particular and the whole exercise in general.

Some of these shortcomings are confined to this study and some are the result of the state of econometrics and economics as well as the nature of the object of study, i.e. economic behaviour. In all existing models a large part of the latter is left unexplained, so only a limited number of questions can be answered on the basis of present-day modelling. Furthermore, these answers are dependent upon the specific structure of the model and the underlying economic 'philosophy' adopted. Given that complete validation of a model is far from feasible and that parameter stability is probably a very rare occurrence in estimated relationships, any 'illumination' offered must be viewed with considerable caution. Unless (a) assumptions used in the course of a study are made explicit, (b) appropriate statistical tests, whether carried out or omitted, are reported or referred to, and (c) measurement problems and relevant institutional changes are discussed, econometric results are likely to be misleading and thus regressive in the effort to understand the working of the economy. They can of course continue to be used for short-term forecasting.

We hope that we offer a fair picture of economic modelling - a step-by-step explanation of the procedure and work involved in developing and using an economy-wide model of the United Kingdom. We believe that the book will be useful to advanced undergraduates and postgraduates in macroeconomic courses - especially for empirical economics, applied econometrics and economic dynamics and control. It will also be useful for economists interested in economic modelling.

August 1981

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Acknowledgements

It would seem true to say that no author is without debts. In the course of this work we have incurred debts which are not easily repayable. We have benefited a great deal from suggestions and comments, both specific and general, from friends and colleagues. We wish to thank Robin Becker and Elias Karakitsos, whose help on the computing as well as theoretical aspects of optimal control has been substantial, Edward Clark, Sanjay Dabysing, Sami Daniel, Vince Daly, Cieran Driver, Gregor Koolman, Ron McQuaid and Berc Rustem. In the same context special thanks are due to Gerard Dummett, Keith Povey and John Winckler of the Macmillan Press for encouragement and constructive suggestions at various stages of this project. We also wish to thank Pat Vass, Pat Knight, Norma Phayer, Shirley Angel and the ladies of the secretariat at Penrhyn Road, Kingston Polytechnic, for typing earlier drafts and the final manuscript. To our wives who have for long endured our tendency to drift into interminable discussions about model-building, even at clearly inappropriate occasions, the end of this work should be a great relief.

P. A. and G. H.