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Cambridge Studies in Applied Econometrics

NUMBER 5

THE CAMBRIDGE MULTISECTORAL DYNAMIC MODEL OF THE BRITISH ECONOMY

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Cambridge Studies in Applied Econometrics

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SIR RICHARD STONE and T.S. BARKER
Department of Applied Economics, University of Cambridge

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EDITED BY

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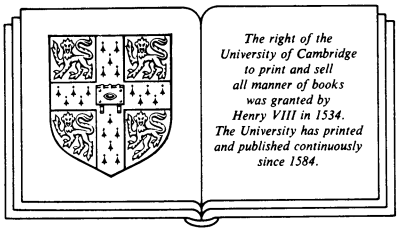

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FOREWORD

When Alan Brown and I started off the Cambridge Growth Project in 1960 I could hardly foresee that one day I should have the pleasure of writing the foreword to a volume marking the Project's twenty-fifth birthday. This volume describes the latest version, MDM6, of the multi-sectoral dynamic model of the British economy which the members of the Project have been building in the past ten years. It would perhaps be better to speak of a model-system, since the data and the relationships connecting them are set up in such a way that the consequences of alternative assumptions and theories can be calculated.

To those who have followed the Project's work from the beginning the most striking innovation has been the switch from a static to a dynamic formulation, initiated by Terry Barker. But there have been other changes as well: the extension of the areas that are treated endogenously, the sophistication of data and parameter estimation, and the development of a general computer program for solving the model in any of its variants.

After so many changes the present version has little in common with its origins. Yet there are some features of the early days that have persisted. The economy, in particular the productive system, is still disaggregated and the degree of disaggregation has not changed very much. And the data are still organised in a social accounting framework, though this is now considerably larger than it was initially and has been aligned with the revised system of National Accounts of the United Nations; also, the problem of imbalances due to residual errors and unidentified items has been faced.

After an introductory chapter, the book is divided into two parts. The first (Chapters 2 to 6) covers the main aspects of econometric model-building as they apply to the present model: theory and method, the organisation of the data, the structure of the model, econometric estimation and computer programming. The purpose and advantages of disaggregation, which is carried much further in this than in other British macro-economic models, are emphasised. The accounting framework and its construction from a variety of sources are described and reference is made to the balancing procedure used to reconcile various inconsistencies which appear in the initial data. Information is

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given on the size of the model and on its principal relationships, dynamic multipliers are calculated over the years 1986-2000 to illustrate some of its properties, and its various uses are considered. There follows a discussion of parameter estimation and hypothesis testing which departs somewhat from the conventional treatment largely on account of the model's size, non-linearity and disaggregated character. This part, which ends with a chapter on the software system needed to store the data, calculate the relationships and activate the model, brings out forcefully the variety of skills involved in econometric model-building.

The second part (Chapters 7 to 19) deals with the details of modelling in different areas of the system and describes the relationships used, the parameter estimates and the results obtained. The early chapters relate to the real side of the economy, to the determination of consumers' expenditure, fixed investment, stockbuilding and foreign trade. Since the model started as a demand-oriented representation of the economy, these topics have appeared in it from its early stages. Here, however, they are treated somewhat differently; for instance, in allocating total expenditure to its components the linear expenditure system and a mixture of this and log-linear demand functions have given way to the Rotterdam model; and the form of the aggregate consumption function proposed by Pesaran and Evans has replaced earlier formulations. The subjects modelled in the next six chapters are, in order, employment, energy, industrial prices and profits, import and export prices, earnings and income policies, and social security benefits and personal income tax.

Chapter 17, on the company sector, describes the aggregated models for industrial and commercial companies and for financial institutions developed on the lines of the earlier work by Mervyn King, and introduces a disaggregated model of the industrial and commercial subsector (excluding oil) divided into 101 components: each of the hundred largest companies and an aggregation of the remainder. This model is expensive to set up and to run but it has advantages beyond the fact that it can deal with some questions relating to individual large companies: it is helpful in removing various kinds of estimation bias and in coordinating for the large companies information on balance sheets and flows of funds in addition to the income and outlay and capital account data that appear in the aggregated model.

The final two chapters treat aspects of the model which were not incorporated in earlier versions. Chapter 18 describes the progress made in modelling the financial side of the economy and Chapter 19 deals with modelling the sterling exchange rate.

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So it can be said the MDM6 represents not only a great improvement on the original model of twenty-five years ago but also a considerable advance on its first dynamic version, MDM1. The scope of the model is much enlarged and many variables that were previously treated as exogenous have been endogenised. Only two main links in the economic chain are still treated exogenously: activity abroad and government intentions about tax rates and public expenditure. As regards the former, given time and further work there is no fundamental obstacle to endogenising it within the context of a world model. As regards the latter, perhaps some day means will be found to endogenise the unforeseeable twists of the political scene, both national and international. Until this happens no model, however large and sophisticated, will be fully closed. Meanwhile the present one constitutes a big step forward towards reducing the gap to a minimum.

Let me conclude my foreword by congratulating Terry Barker, William Peterson and the other members of the team on a splendid piece of work and wishing the Project continued success in the future.

Cambridge
January 1986

Richard Stone

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PREFACE

This book consolidates the research of the Cambridge Growth Project in developing a multisectoral dynamic model of the British economy over the past ten years. The last book reporting the project's work as a whole (Barker, 1976) described in detail the final version of the static model. Work on the dynamic model began in earnest in 1974 and the reasons for the development were set out by Barker (1978), although from early on in the history of the Project we had been aware of the need for a model 'designed to carry the economy through the transitional period preceding the steady state' (Stone and Brown, 1962). A converged solution of the dynamic model was achieved in 1975 and the first projections of the operational model were presented at a conference in 1976 and subsequently published by Barker (1978). The previous account of the model (version 4) was published as Barker et al. (1980). The account in this book supersedes and consolidates these earlier publications.

There has been a major development on the computing side of the work. The dynamic model has been solved since December 1982 with a general-purpose software package, described by Peterson and van der Ploeg (1983), rather than with a specially written FORTRAN program. This has made the model more flexible in that alternative versions, for example one without wage rates as endogenous, can be readily constructed. This book is mainly an account of one particular version, that which was operational in 1986; but we now have a modelling and data system capable of generating a large number of versions of the model and of sets of alternative projections. Some of these involve alternative parameter estimates based on different economic theories and can completely change behaviour in the model. Others may involve more minor changes in specification. The existence of such alternatives is occasionally mentioned, or the alternatives are described, in the chapters below: the operational version represents the considered views of different researchers working together but there is considerable room for differences of opinion.

From this account so far, it should be clear that the book is not a collection of papers on different themes, but an account of a closely-integrated research project. The relationships in the different economic

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areas should fit together to give a coherent and consistent picture of the economy as a complete interdependent system. The data should fit into a consistent accounting framework and the members of the team should follow closely comparable estimation procedures. Although the book comprehends all the relationships in the model, it is not necessary to go into each one in the same detail. Where relevant material has been published, we rely on reference to it.

We have also omitted or summarised the estimates of the equations in the model because of shortage of space. Standard errors of parameter estimates are not given here except in the case of the aggregate equations, although we have indicated them by the use of asterisks where estimates are significantly different from zero. Full listings of data on exogenous variables, input-output coefficients and classification converters and the parameter estimates are available as annexes to the MDM Users' Manuals produced for different versions of the model.

We have made sure that the model described in the book does correspond to an actual operational version used for forecasting the economy. However, model-building is a continuous process. There are always developments such as extra observations, new techniques and new theories which will lead us to re-estimate or respecify the model. The version in this book was operational in 1986. It will inevitably become obsolete, but with the inclusion of a model of financial behaviour we expect the present structure of the model to remain more or less unchanged for some years to come.

There have been two important changes in the relationship of the Project and its research with users of the model and with other macroeconomic modelling groups.

The first change has come through the incorporation of Cambridge Econometrics in 1978. This company was set up to provide a commercial forecasting and analysis service using the dynamic model and has been producing regular forecast reports based on successive model versions since its formation. The company has made a substantial contribution to the funding of the Project through this commercial service.

The existence of Cambridge Econometrics has meant that the work of the Project has moved away from the provision of standard or 'base' forecasts, and we have not included in this book any applications of the model. The main application is to be found in Cambridge Econometrics forecast reports, while applications which involve the analysis of alternative scenarios and problems of economic policy are written up as occasional articles and conference papers (Barker, 1981c; Peterson,

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1984). This book has been restricted to an account of the model and its methodology.

The second change has come through the UK Economic and Social Research Council's foundation of the ESRC Macroeconomic Modelling Bureau at the University of Warwick. Versions of the Project's model have been deposited with the Bureau each year since 1983, together with the current Cambridge Econometrics forecasts. The Bureau has compared model properties and forecast performance with four other models developed with ESRC support and with the Treasury model (Wallis (ed.), 1984, 1985 and 1986). The existence of the Bureau, and its role as a forum within which model-builders in the UK can meet and discuss their results, has made it easier for us to relate our work to that of the other macroeconomic modelling groups. However, the emphasis on economic structure, and on its analysis through a consistent disaggregation of the economy, has remained a guiding principle of our work.

The book is a result of team effort and the authorship of chapters roughly represents the contribution of different members of the team to the overall model. We are grateful to Christine Hudson who typed the various drafts, to Ann Newton who sub-edited the final draft, to Diana Day who prepared the figures, to Bobbie Coe and, above all, Shirley Seal who prepared the text and tables for the laser printer.

Our work has received generous support and encouragement from several public bodies in the United Kingdom. The Treasury and the Department of Trade and Industry provided financial support at the early stages of research into the dynamic model jointly with the Economic and Social Research Council, who have continued through the ESRC Macroeconomic Consortium to provide most of the funding since then. The Central Statistical Office have been very helpful in providing data and helping with their interpretation. We should like to express our thanks for this continued support.

We should also like to thank Hashem Pesaran of the Faculty of Economics and Politics, University of Cambridge and John Whitley of the ESRC Macroeconomic Modelling Bureau, University of Warwick who have given us helpful and constructive comments on the draft text.

The greatest debt of the team is to Richard Stone, the founder of the Project, to whom this book is dedicated, for his guidance, inspiration and scholarship through the years.

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Cambridge *Terry Barker and William Peterson*

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CONVENTIONS

Except for sections of algebraic expostion which are self-explanatory, names of variables and parameter sets in this book closely follow the conventions for FORTRAN names, i.e. groups of capital letters and numbers beginning with a letter. A list of variable names is given at the back of the book together with the conventions used in deriving them.

+ - * and /	denote addition, subtraction, multiplication and division of scalars and of individual elements of vectors and matrices
( )	are grouping brackets
[ ]	enclose comments
(.)	as a postscript on a name indicates that it is a vector with a dot denoting all the elements
(.,.)	as a postscript on a name indicates that it is a matrix
(^.)	denotes that the vector is converted to a diagonal matrix
(...)'	denotes that the matrix is transposed
(-1), (-2), etc.	as applied to a variable or a group of variables as a postscript denote a one, two etc. period lag (this may also be done by adding L1, L2 etc. to the FORTRAN name)
LN(V)	natural logarithms of variable V
MATP(.,.), M2(.,.)	matrix multiplication of variable matrices M1 and M2

Individual elements of vectors, rows, columns or elements of matrices are denoted by replacing the dot by the appropriate number in the classification; e.g. Y(4) is gross output of the oil and gas industry which is the fourth industry in our classification.

£m	£ million
£(1975)m	£ million, 1975 prices (all quantities are in £(1975)m unless otherwise indicated and all prices are unit-values, 1975=1.000, unless otherwise indicated)
n.e.s.	not elsewhere specified
..	not available or not appropriate
-	insignificant or negligible

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