1

INTRODUCTION

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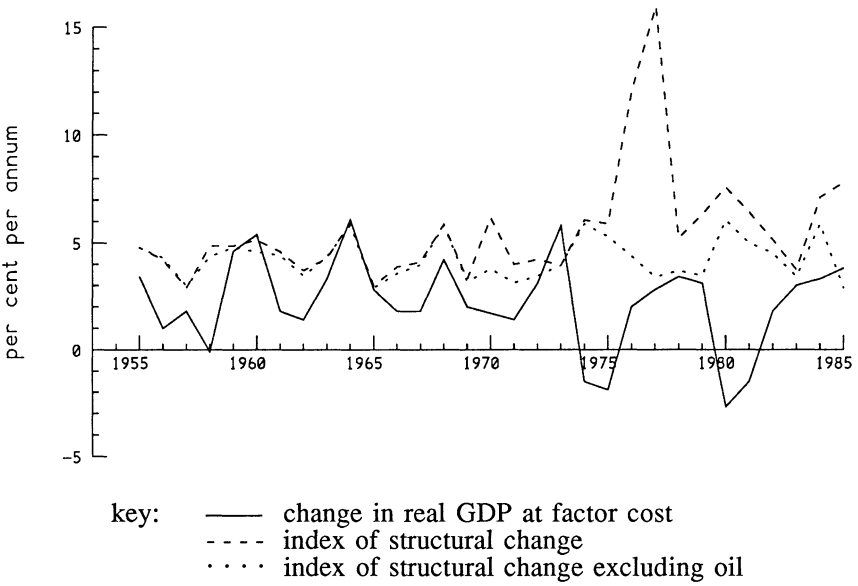
1.1 Structural Change in the British Economy

Changes in the structure of real output and changes in relative prices have clearly become much more important for the British economy as well as for the world economy since the beginning of the 1970s. Although the rate of change slowed down in the early 1980s, there remains a potential for new crises and further changes in structure on a comparable scale. The model described in this book is one which, in contrast with the other main models of the British economy, emphasises the structure of the economy and aims to model changes in structure both in, on the one hand, real output, expenditures and incomes and, on the other, relative prices and relative rates of pay.

Figure 1.1 shows the annual growth of the British economy for most of the post-war period. The growth in real gross domestic product (GDP), shown as the solid line, is noticeably cyclical with peaks at intervals of 4 or 5 years in 1960, 1964, 1968, 1973 and 1976-8. Since 1973 the rate of growth has slowed down both on average and for the peak years of the cycle.

The Figure also shows an index of structural change including and excluding the oil industry. This is calculated from the differences between average industrial growth and growth in output of each of the 40 industries distinguished in our model for each year. The index is the square root of the weighted sum of the squares of these differences, the weights being the value shares of output in total output. The index is considerably affected by abnormal year-to-year changes such as the miners' strike and the consequent period of the 'three-day week' in 1974 and the iron and steel industry strike in 1980. It is also

Figure 1.1 *Growth in the British Economy, 1955-82*



Source: UK CSO *National Income and Expenditure*, 1986 edn.

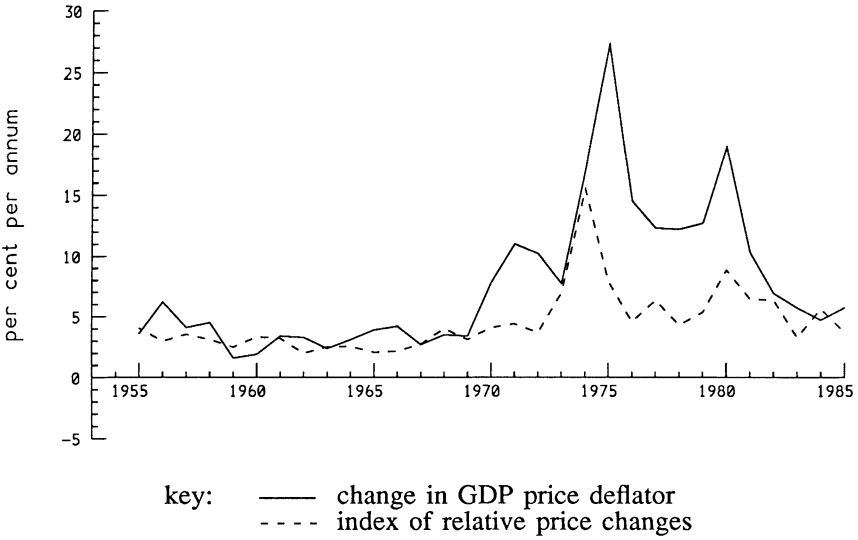
dramatically affected by the development of North Sea oil, and the index excluding the oil industry is also shown.

Despite the effect of strikes and lockouts, the general pattern is fairly clear. Average structural change was steady at about 3-5% a year until 1975 when it rose to 10% a year as a result of the development of North Sea oil and then to 8% in 1980 as a result of the very sharp declines in many manufacturing industries compounded by the strike in the iron and steel industry. By 1982 the average structural change was back to about 4%, the same rate as in the period before the oil development.

There appears to have been a significant change in the relationship of structural change to general growth from the end of the 1960s. Previously structural change moved pro-cyclically with the peaks corresponding to those in average annual growth in 1960, 1964 and 1968. However, since 1972 this has no longer been the case and structural change excluding the development of North Sea oil has taken place most sharply in years of decline in GDP: in 1974 and 1975, following the first OPEC oil-price crisis, and in 1980 and 1981,

following the second oil-price increases. The British economy appears to have changed from one in which accelerated structural change accompanied general growth to one in which it has accompanied general decline.

Figure 1.2 *Price Inflation in the British Economy, 1955-82*



Source: UK CSO *National Income and Expenditure*, 1986 edn.

Figure 1.2 shows annual price inflation for the economy. The main feature here is the dramatic increases in inflation after 1969 in a series of steps, the first in the early 1970s leading to a peak rate of inflation in the GDP deflator, the solid line in the figure, of 11% in 1971, the second immediately following OPEC I with a rate of 27% in 1975 and the third following OPEC II with a rate of 18% in 1980.

The rate of relative price changes, calculated in the same way as the index of structural change in real output, is also shown in the figure as the dashed line. It shows one main peak in 1974 when relative oil prices rose sharply and a subsidiary peak in 1980 for the same reason. Otherwise relative price inflation has increased from about 2-3% a year to about 5% a year, an increase which is much less than that in the general rate of inflation.

1.2 A Model of Economic Structure and Change

The Cambridge Multisectoral Dynamic Model of the British economy, MDM, is designed to analyse and forecast changes in economic structure. It is an operational model in the sense that it is solved on a computer, and is used regularly for forecasting and so includes up-to-date estimates of future trends in world production and inflation and the latest position with regard to tax rates and public expenditure.

There are five features of the model which make it an appropriate technique for analysing economic structure:

1) industries are behavioural and technical agents in the model;
2) the model is comprehensive of the economy;
3) it emphasises economic policy;
4) it is a dynamic model; and
5) it projects over the medium term.

1. The industrial dimension

The industrial disaggregation into 40 industries is chosen on the basis of three factors: first, the particular institutional and technical characteristics of production - e.g. the electricity industry is individually distinguished, as well as each of the other main fuel industries; second, the economic significance of the activity - e.g. the main service industries are distinguished from each other because of their importance in employment and wage generation; and third, the official statistics available. Industries include six service industries as well as four primary industries, so that the industrial breakdown covers the whole of gross domestic product, except for government services and certain items of consumers' expenditure which are treated separately in the model.

Individual industries are the basis for many of the economic relationships in the model. This is what distinguishes a multisectoral model from a macroeconomic model, the latter often treating the whole economy as a productive unit. Industries are the behavioural agents in the model for industrial investment, employment, prices, wages and intermediate demand.

Those working in and planning for particular industries may well know their own industries and the way they work much more than is represented in the model. Discussions with industrial economists and planners help to improve the industrial projections. The strength of the model lies in its simulating the interactions between different industries, and between them and the rest of the economy. The model can handle

explicitly technical change, e.g. changes in the input-output tables.

Figures 1.3 and 1.4 illustrate these points. Figure 1.3 shows some relationships for one industry in a time sequence. Output from earlier years affects investment and employment in the current year; current investment affects the industry's productivity and hence its demand for employees; but the investment is also partly affected by current output. The demands for the industry's products for investment, consumption, and exports are summed and divided between domestic output and imports.

Relative prices, relative wages, capacity effects, time trends, and other influences all enter the relationships, but these are not shown in the figure.

Figure 1.3 *Some Economic Relationships in MDM for One Industry*

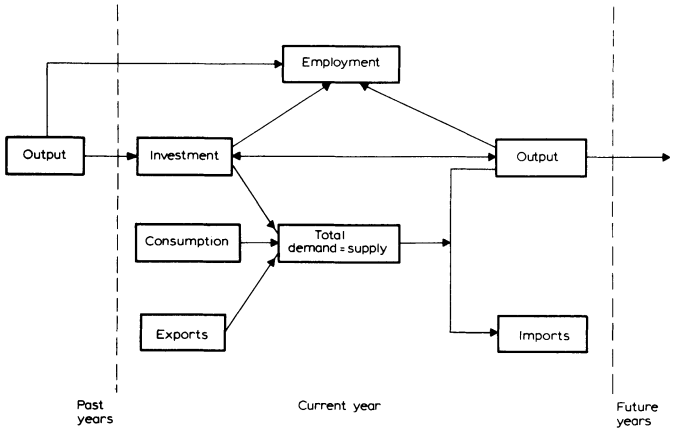
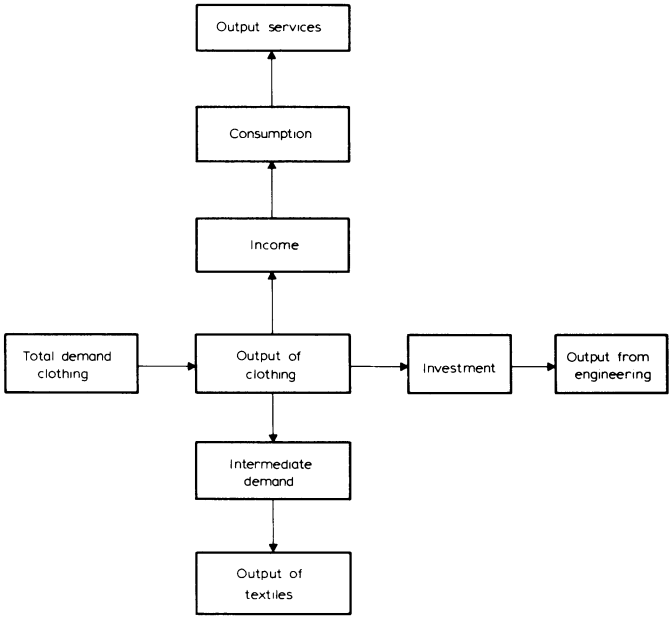


Figure 1.4 shows some inter-relationships between industries. When extra demands are made for an industry's products (in this example, clothing), these generate a series of further demands for the products of other industries. Three of these further demands are shown. First, the clothing industry pays out some incomes in the form of wages and profits; these are spent on consumer goods and lead to more output of the service industries. Second, the extra output of clothing gives rise to more investment requirements, and these are supplied partly by the

engineering industry which produces investment goods. Third, extra output of clothing requires current industrial inputs of materials, services and fuels and thus for example increases the output of textiles which produces intermediate inputs.

Figure 1.4 *Some Interrelationships between Industries in MDM*



2. Comprehensive coverage of the economy

Although the strength of MDM lies in its detailed treatment of industries and their products, it includes a comprehensive treatment of the economy. The model is based on an accounting framework - the UN System of National Accounts (SNA) - which systematically organises the disaggregated accounts for production, consumption and accumulation. These flows are measured in both current and constant prices, with prices (strictly unit-values) calculated implicitly.

The current-price flows extend to transactions for the main institutional sectors in the economy, so that the model provides

projections of net acquisitions of financial assets for the personal sector, companies, government and the rest of the world. Stocks of financial assets and liabilities in 32 categories are calculated for these institutional sectors.

Industrial employment is also modelled, being explained in terms of output and relative wages for each industry. The aggregate labour demand, taken with the likely labour supply given by analysis of demographic trends, gives a measure of future levels of unemployment.

The detail in which the industrial sector is modelled extends to consumers' and government's expenditure and to foreign trade. Consumers' expenditure is divided into 42 categories as shown in the UK *National Income and Expenditure* (1982 edition) and the expenditures are explained by means of econometric relations in terms of incomes, relative prices and credit variables. Government expenditures are in two groups, current and capital expenditures, and these in turn are divided into 5 and 9 functional categories respectively. These expenditures are exogenous, normally being projected from the government's public expenditure plans. Exports and imports are explained for the 40 commodity groups.

3. Economic policy in the model

A distinguishing feature of MDM is its very detailed treatment of the indirect tax structure, public expenditure and the income tax system. Of the 507 exogenous variables, 406 are policy instruments of one sort or another.

This large number arises from the disaggregation of the model. For example, with 42 categories of consumers' expenditure and 13 types of indirect tax or subsidy (such as VAT, purchase tax, specific duties and subsidies) there are 546 potential instruments, although of course most of these are redundant or seldom changed.

MDM has been developed as a model for analysing the effects of economic policy over the medium-term future. Although most of the policy applications consist of analysing the consequences of changes in instruments, research has been done into the achievement of economic objectives over the projection period. These more advanced applications require more computing, but do allow the calculation of solutions in which the model provides values for the instruments of policy necessary to achieve the objectives.

4. The dynamics of MDM

MDM is a dynamic model, that is it solves year by year into the future using its own solutions for earlier years. Input-output models have as one of their main purposes the projection of different structures of the economy, for example a projection of the UK economy with a much higher level of industrial investment than over the early 1980s. In earlier models developed by the Project the emphasis on structure meant that the dynamics of a projection were sacrificed in order to concentrate on the long-term trends. The development of a dynamic, year-by-year solution has allowed us to combine the changes in structure with a consideration of the dynamic adjustment required. In the example of the projection of higher investment, we can simulate the year-by-year effects on the economy of an investment plan phased over a number of years, as well as describe the eventual structural consequences of the plan.

These dynamics have obvious advantages in the use of MDM for industrial planning. The user can include detailed assumptions about the development of an industry's markets, prices or costs, or indeed about the development of the exogenous variables such as the growth in world production and trade. Different assumptions, provided they are annual and are put in the correct form, can replace those currently in the model and new projections calculated. Furthermore, compared to a static input-output model, MDM becomes more similar to the aggregate models of the economy such as those of the Treasury, the London Business School and the National Institute of Economic and Social Research. The year-by-year forecasts of the main economic aggregates given by the models are comparable, with the additional advantage that with MDM the industrial and other sectoral composition of the aggregates can be examined. In consequence MDM is now one of the five models whose properties and forecasts are regularly compared with each other by the UK Economic and Social Research Council's Macroeconomic Bureau at the University of Warwick.

5. Projections over the medium term

MDM is a model of growth and fluctuations over the medium term and the long term. This makes it all the more necessary to model the supply side of the economy. Whereas short-term models can take the supplies of labour, capital and foreign exchange reserves as given, a medium-term model must acknowledge that these are partly determined by the development of the economy.

In particular short-term models take no account of the effect of investment on labour productivity, which is usually extrapolated on the

basis of past trends. Thus in short-term aggregate models the underlying growth rate is fixed and the actual growth rate can only be increased by reducing unemployment, i.e. running the economy closer to full capacity. But in a medium-term disaggregated model like MDM, the underlying growth rate can also be increased by extra investment or a reallocation of supply towards more productive sectors. The actual growth rate projected by MDM will depend on the growth in effective demand which is affected by capacity utilisation and limited by the growth in supply of labour and foreign exchange.

1.3 The Plan of the Book

The rest of this book is divided into two Parts: Part I considers the model as a system and Part II describes the treatment in the different economic sectors of the model.

Part I starts with Chapter 2 which is a discussion of the theory underlying the research and the methods we adopt. The emphasis is on the disaggregation which is a distinguishing feature of our approach. We compare our model with similar models constructed for other economies and with other operational models of the UK economy. Chapter 3 describes the accounting system and the data base, Chapter 4 gives an overview of the properties of the model including summaries of the main relationships, dynamic multipliers and tests of dynamic stability, Chapter 5 deals with estimation techniques and Chapter 6 with the computer software we have developed for large-scale multisectoral models.

Part II describes individual economic sectors. Each chapter aims to describe or summarise the relevant theory and the experience for the UK economy over the sample period, usually 1954-81. The specification of single equations on sets of equations is developed and then the main estimated parameters and econometric tests of the equations are presented. Each chapter usually finishes with a discussion of the properties of the equations specified.