MACROECONOMIC SYSTEMS

Krish Bhaskar and David Murray

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INTRODUCTION AND HISTORICAL PERSPECTIVE

This book has been written for the student who has completed a basic introductory macroeconomics course and is now taking a more advanced course. Its main aim is to create a basis from which the specialist topics of macroeconomics can be approached. The first section deals exclusively with a simple classical and a simple Keynesian model within a single common framework to facilitate easy comparison. These models are simplistic but they provide a sound starting point for the more advanced ideas which form the bulk of section 2. The second aim is to recognise that one of the crucial purposes of macroeconomics is to provide advice for central government policy makers. Throughout the book, therefore, we return to the policy implications of the models which are discussed.

As far as possible, the use of mathematical analysis has been kept to a minimum and the models and theories have been explained both verbally and diagrammatically. In most cases, however, we have provided a mathematical specification of the model in order to show that mathematics is merely a shorthand means of expressing ideas. In addition there are a few points where we have considered it necessary to use a mathematical analysis. The student who has only a limited understanding of mathematics should have no trouble with the vast majority of the text but it is important to stress that much of the newer theoretical and empirical work utilises mathematical and econometric techniques. An understanding of at least basic linear algebra, calculus and statistics is a very great advantage in reading the literature.

Although a study of macroeconomics has a long history it was not until the early part of this century that the ideas began to be formalised. The views of economists such as Fisher, Marshall and Pigou were based largely on Say's law and the quantity theory of money and their ideas all fell within the broad category of what we now term classical economics.[1] Included in the ranks of these classicists was Keynes: his gradual break away from the classical tradition began with his *Treatise on Money*[2] in 1930 and continued more importantly with *The General Theory of Employment, Interest and Money*[3] in 1936. In this latter work Keynes switched the emphasis of macroeconomics from the determination of the price level to the determination of output and employment. This change was stimulated by the great depression of the early 1930s and because his work showed a way of dealing with this depression it quickly gained wide acceptance.

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The General Theory, however, did not present a logical system of ideas but rather was a statement of a general view of particular elements of the macroeconomic system. Indeed Keynes did not favour mathematical models because of their alleged inflexibility. It was, therefore, open to interpretation and by the early 1950s the Keynesian income-expenditure approach had been derived from the original work and formed the mainstream of Keynesian thinking. Typical of this approach was the Hicks-Hansen ISLM analysis. For many years the income-expenditure interpretation of Keynes was almost universally accepted by academics and central governments alike.

Classical economics, however, had not been completely forgotten and in the late 1950s and early 1960s Friedman[4] produced a restatement of the quantity theory on a more rational basis. The basic conclusion of this work, which was supported by much empirical evidence, was that the stock of money is the major determinant of the level of economic activity. This was the start of the revival of interest in monetary economics and monetary policy. At the same time there was increasing disillusionment with Keynesian fiscal policies which reached a head in the middle to late 1960s. The increasing emphasis on monetary policy was rather more noticeable in the US than the UK although neither has abandoned the use of fiscal policy. The doubts which were cast on Keynesian economics have also led some economists, such as Leijonhufvud[5] to return to Keynes' original writings and consider alternative interpretations of his ideas. This reexamination seems to lead to the conclusion that in some areas Keynes own work is closer to the classical economics from which it was derived than the Keynesian economics which followed.

Before we start our discussion of particular macroeconomic systems we shall consider the model framework we intend to use. It was Keynes who first brought all the components of a macroeconomic model together and our framework is derived largely from his work and the income expenditure interpretation of it. We shall also consider at this stage the allied problems of aggregation and introduce the range of problems facing central government policy makers.

Notes and References

1. Some of the economists that we have brought into the classical net are often called neo-classicists. The distinction is not really important at this stage.
2. J. M. Keynes, *A Treatise on Money*, Macmillan, 1930.
3. J. M. Keynes, *The General Theory of Employment, Interest and Money*, Macmillan, 1936.
4. M. Friedman, *Studies in the Quantity Theory of Money*, Ed. M. Friedman, University of Chicago Press, 1956.
5. A. Leijonhufvud, *On Keynesian Economics and the Economics of Keynes*, Oxford University Press, 1968.

1 MODELS AND ANALYTICAL TECHNIQUES

Models

In any economic system there are an immense number of variables which appear on *a priori* grounds to be of interest to an economist. These variables relate to all the economic activities of firms, households, the government and other sectors of an economy. Economists are essentially concerned with two features of this complex system. Firstly, they try to understand the relationship which exists between the variables in the economy and hence find explanations for the economic decisions which are made. Secondly they endeavour to use this understanding to make predictions about some aspect or other of the economy. It is because modern capitalist economies are so complex that it becomes necessary to consider a simplified version of the real world; that is to make *ad hoc* decisions about which features of the economy are most significant and then consider the simplified relationships which result. This simplified abstract from the real world is called a model. Its advantages stem largely from the way in which it brings a complex economy within the scope of the understanding and analytical techniques of the economist. Its disadvantages result partly from the way in which the important elements of the economy are chosen on *a priori* grounds rather than as a result of empirical testing and partly because it is often difficult to establish the exact nature of the relationship between the simplified model and complex reality.

From the foregoing it is clear that the economic model builder is faced with a trade-off problem. The more simplified his model the easier it is to understand, analyse and manipulate but the further removed it is from the real world, the less relevance its predictions may have for real world problems. Thus the models which have been constructed have tended to become more complex and generally closer to reality as the analytical techniques available have become more sophisticated. The rapid development of the electronic computer has, of course, been of great importance in this context.

In general a particular model will not seek to explain how every variable in the economy is determined. Rather it will take some economic variables as given and attempt to explain how other variables are determined. In macroeconomics it is usual to assume that such variables as government expenditures and taxation are beyond the scope of the model and should be taken as given. These variables are termed exogenous variables because they are determined outside the model. The variables within the model which it seeks to explain are called the endogenous variables.

Relationships and functions

We must now consider the way in which these models are expressed. The key relationships can be expressed verbally but this is both cumbersome and and imprecise. We shall, therefore, employ a mixture of algebraic and graphical presentation. Before any more is said it is vital to emphasise that while a mathematical presentation may look forbidding to some students it is only a shorthand method of concisely and accurately expressing the key relationships of our model. The actual mathematical manipulation which is required to follow the analysis is very limited and even the non-mathematical student should be able to follow the arguments presented.

The model is constructed by first determining the key relationships in that aspect of the economy under consideration and then expressing these algebraically or graphically. For example, suppose we consider the determination of aggregate consumption. We may decide the key relationship in our model is that aggregate consumption depends systematically on aggregate real income. We can also express this as follows:

aggregate consumption, C, is a function of aggregate real income, Y,
or C is a function of Y
or $C = f(Y)$ 1.1

In this equation C is known as the dependent variable and Y is the independent variable, because the equation merely states that C depends in some way on Y. This equation, however, tells us nothing about the details of the relationship between consumption and income; it does not say whether consumption increases quickly or slowly or even falls with a change in income. It simply says that some relationship exists between these two variables and when income changes comsumption will also change. This is a generalised function.

To discover the actual effect of a change in price on consumption we need to know the specific relationship which exists. Specific relationships such as those below enable us in principle to evaluate the effect of a change in income on consumption.

$$C = a + bY \quad 1.2$$
$$C = c + dY^2 \quad 1.3$$
$$C = e + fY + gY^2 \quad 1.4$$

In equations 1.2, 1.3 and 1.4, a, b, c, d, e, f, and g are constants which are independent of income, Y. If we knew the numerical value of these constants we could then evaluate the numerical change in consumption for a given change in income.

Thus far we have assumed that there is only one independent variable but in most economic situations there will be more than one. In our example above, consumption only depends on income; however it is usually believed that there are other important factors. We could, for example, argue that consumption depends not only on income but also on the rate of interest, R, and wealth, A. We would express this mathematically as a generalised function of the type shown below.

$$C = f(Y, R, A) \qquad 1.5$$

Much the same kind of information can be expressed graphically. Equation 1.1 for example may be plotted out to show the level of consumption which corresponds to each level of income. This, however, becomes much more difficult when we have more than one dependent variable; conventional graphical techniques allow us to represent two variables only, one dependent and one independent. Thus our mathematical presentation is of more general use.

At this point we must digress briefly to draw the distinction between equations and identities. Functional equations such as 1.5 are essentially our summary of the behavioural relationships of the real world. Identities on the other hand show combinations of variables which are equated by definition. If for example we consider an individual's weekly income, Y, which he chooses to either spend on consuming goods and services, C, or to save, S, then it is clearly true that the sum of consumption and savings is identically equal to income. This identity is shown mathematically using the three bar sign as below.

$$C + S \equiv Y \qquad 1.6$$

Such an identity will be true regardless of the value of income, Y. The variables which are connected by the relationships and identities of any model may either be stock or flow variables and as will become apparent later, this distinction can be extremely important. A flow variable is always expressed as a quantity per unit time; thus an individual's flow of income is £2,000 per year. Unless the time period is specified the statement that an individual's income is £2,000 is entirely meaningless. A stock variable is one whose magnitude is measured in absolute terms at one particular point in time; thus an individual may have a stock of cash in his wallet of £20. In the models with which we shall deal the only stock variables are the stock of physical capital, the stock of money and the stock of financial assets (bonds). All other variables are flow variables.

Equlibrium

We have now seen how our behavioural relationships may be expressed mathematically. A group of such relationships and identities together will form a model of some particular sector of the economy.

In any given model the values of the exogenous variables are given and corresponding to these values there will be a set of values of the endogenous variables which will ensure that the system is consistent throughout. When the endogenous variables have all reached these values there will be no tendency for them to change unless the exogenous variables change. This is known as a state of static equilibrium. It is simply a situation where every endogenous variable is at a value to which it will tend to return if it is disturbed. Every aspect of the system is, therefore, satisfied and everyone's plans accord with the actual outcome. If now one or more of the exogenous variables are changed the equilibrium values of the endogenous variables will change accordingly but a new static equilibrium will be reached.

Statics and dynamics

The majority of macroeconomic analysis to date and certainly the majority of the analysis contained in this book is concerned with comparing the equilibria which correspond to different values of exogenous variables. This is known as comparative static analysis. As such it takes no direct account of the dynamic time path between two equilibria although it is concerned with dynamics to the extent that it is interested in whether each equilibrium is stable. In this context a stable equilibrium is one in which the system tends to return to the same equilibrium if it is disturbed. The dynamic aspect which is not taken account of is that in the real world the exogenous variables are changing continuously and are not changing at only discrete points in time. In our discussion we have mentioned the stability of an equilibrium but it is also important to notice that we have said nothing about the speed with which a system achieves its equilibrium or returns to it after disturbance. If this process is very slow then the existence of an equilibrium might be irrelevant.

Aggregation and macroeconomics

We have so far talked of general economic systems and considered some properties which are of importance. This book, however, specifically concerns macroeconomics and we must clearly consider the application of the general principles to this aspect of economics. Macroeconomics is fundamentally concerned with aggregate variables such as national income, national output, national savings, the money supply and so on. We shall, therefore, be considering the various key relationships which exist between these variables. The variables can be thought of as aggregates; for example, aggregate national output is the sum of the outputs of all the individual firms in the economy. The way in which these aggregations are made is of great importance and is an area of debate that owes much to the recent work of Leijonhufvud.[1] For macroeconomics to exist at all one has to assume that aggregation is not only possible but also theoretically justifiable.

The process of aggregation of economic variables is useful because it provides a way of summarising the many millions of individual production, consumption and other decisions which together form the economy as a whole. Aggregation may be used to simplify the real world into concise models which are easier to manipulate and understand. Aggregation as such implies that certain elements are suppressed while other more representative characteristics assume exclusive significance. Thus the process of aggregation is as important to the construction of a model as is the process of selecting relationships between these aggregates. The choice of which aggregates are of importance has been habitually based on intuitive judgements, although empirical testing may be a more satisfactory choice mechanism. The kind of problem which arises is whether durable consumption should be aggregated with current consumption or with investment since it has features which are common to both. The choice here obviously affects the functional relationships which make up the model.

The process of aggregation can be thought of as operating in two distinct areas – aggregation over individuals and aggregation over goods. An example of the problems which have to be dealt with is the question of whether, if each individual's demand for a particular commodity is a function of his resource endowments among other things, the aggregate demand for the commodity will be a function of aggregate resource endowments. Also in what ways can we talk of the 'price' of the aggregate of all consumption goods. While we shall not discuss the theoretical means for dealing with these problems in great detail, they are one of the building bricks for any macro model and the student is recommended to look at Leijonhufvud's work on the subject.

Summary

This chapter has summarised the general characteristics of economic models and indicated the technqiues that may be used in their analysis. In addition the important concept of equilibrium was discussed and the distinction between stocks and flows was emphasised. Finally the process of aggregation on which the whole of macroeconomics is based was introduced.

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Notes and References

1. A. Leijonhufvud, *On Keynesian Economics and the Economics of Keynes*, Oxford University Press, 1968.

Selected Readings

E. F. Beach, *Economic Models*, John Wiley and Sons, 1957, New York.

2 THE FRAMEWORK OF A MACRO MODEL

Introduction

The purpose of this chapter is to suggest a common framework within which we can consider the traditional classical and Keynesian theories. The framework is based on the Keynesian income-expenditure approach and as such is open to much criticism.[1] It does, however, provide a convenient way of looking at conventional theory as well as providing a base from which to approach the more complex theoretical concepts of section 2.

Macroeconomic models

The general principles of constructing macroeconomic models

Most macroeconomic models explicitly or implicitly recognise five basic aggregates which are important. These are consumption goods, investment goods, labour services, money and other financial assets. Each of the main themes of macroeconomic thought has reduced these five to a smaller number by combining two of them and it is this process which provides one way of distinguishing between alternative systems. Indeed Leijonhufvud[2] argues that on this basis Keynes' ideas as expressed in *General Theory*[3] are closer to classical theory than to the Keynesian income-expenditure analysis.

In general, therefore, we can think of the macroeconomy aggregating into five markets each with its own supply and demand functions and equilibrium price. In addition we postulate the existence of an aggregate production function* relating the flows of output of consumer and investment goods to the flows of labour and capital services. The flow of capital services is determined by the aggregate stock of capital in existence which is built up by the flow of new investment goods, although in the short run the flow of new capital is likely to be negligible compared to the existing stock.

The conventional Keynesian income-expenditure model, which provides the framework for our discussion of both the classical and Keynesian systems, deals with four markets only by bringing together con-

* The 'General Theory' does not include an aggregate production function.

sumption goods and investment goods. It is assumed that there is a single physical output which can be used for both investment and consumption and we can, therefore, consider a single goods market. The production function shows how labour and capital inputs are transferred into a single output of goods, which can be used for both investment and consumption purposes.[4]

The crucial point is that we have reduced the complexity of the model by removing the relative price of consumer goods compared with investment goods and need only consider four markets – the goods market, the labour market, the money market and the financial assets or bonds market – together with the single output production function.

A framework for macroeconomic models

The framework within which both the classical and Keynesian systems are presented in Chapters 4-7 comprises an aggregate production function and the four markets for goods, money, labour and bonds. One further simplification is that the discussion in section 1 assumes throughout that there is no foreign trade. This is clearly a very large assumption if we are concerned with a country like the UK and it is therefore relaxed later in section 2. The nature of the main components of this framework is discussed below.

a) Production function The production function specifies the way in which the flow of labour and capital services are combined to produce an output of goods for both consumption and investment purposes and as with all microeconomic production functions it assumes the most efficient method of production. One feature of the production process is that value is added to the two inputs so that the value of the output will be greater than the sum of the values of the inputs.

In this context capital is defined as machinery, plant and buildings. It is assumed that, although the flow of investment adds to the capital stock, and depreciation reduces the capital stock, in the short run changes are negligible compared with the total existing stock of capital. The capital stock may therefore be assumed constant in the short run with labour the only variable output. Although there are no raw material inputs in the production function this does not mean that we are making something for nothing; we are simply saying that raw materials are freely available. In the manufacture of steel, for example, the iron ore and coal are removed from the ground at no cost other than the use of labour and capital and as long as these raw materials exist to be mined they do not constrain production in the way that labour and capital do. It is important to remember too that because we are talking only of the short run we can justifiably assume that no new raw materials such as natural gas are found and that no technical progress takes place.

Mathematically our production function is expressed as in equation 2.1.

$$Y = y(N, \bar{K}) \qquad 2.1$$

where Y is the output of goods (identically equal to real income)
N is the quantity of labour
and $\bar{K}$ is capital (the bar indicates that capital is fixed).

This is a typical two input, one output short run production function and with capital fixed the marginal physical product of labour declines after a certain point. This is an important factor in determining the nature of the demand for labour as we shall see later in Chapter 4.

b) Goods market The reasoning behind the amalgamation of consumption and investment goods has already been presented and, although the problem of consumer durables has not been mentioned explicitly, it should be clear from the earlier analysis that it may be handled in the same way. It should be remembered that investment is defined as the creation of new productive capacity so that the purchase of financial assets does not constitute investment according to our definition although it is often referred to as investment in the everyday usage of the term. (The only financial assets in our model are bonds.)

The total real output of goods, Y, is effectively the supply function of the goods market. The total demand function is derived by adding together consumption demand, C, and investment demand, I. In equilibrium, therefore, real output is equal to the sum of real consumption and real investment.

$$Y = C + I \qquad 2.2$$

Since we are considering a closed economy total real output must also be total real income and real income must be either consumed or saved. Thus we have the identity that income is identically equal to consumption plus savings.

$$Y \equiv C + S \qquad 2.3$$

Combining equations 2.2 and 2.3 we can rewrite the equilibrium in the goods market as savings are equal to investment as shown in equation 2.4.

$$S = I \qquad 2.4$$

It is important to realise here that equations 2.2 and 2.4 are merely expressing the same equilibrium condition in alternative forms.

c) Labour market Since labour is employed in the production process the demand for labour services is derived from the aggregate demand for consumption and investment goods. The supply of labour services, on the other hand, is determined by the willingness of the stock of labour to supply labour services.

From a given short run stock of labour, the flow of labour services can vary as the existing labour force works longer hours or new entrants (such as students and housewives) are attracted into the labour force. This topic is considered further in Chapter 13. In equilibrium the demand for labour services, N^d, and the supply of labour services, N^s, are equated.

$$N^d = N^s \tag{2.5}$$

Perhaps the most important concept relating to the labour market is that of full employment of the labour force. In practice this is very difficult to define accurately. From the economists' point of view, however, things are easier – full employment is that situation where all those people willing to work at the going wage rate are able to find employment. This is simply the point of intersection of the labour supply and demand schedules. In practice full employment to a journalist or politician means that the male population of working age, apart from some who are unemployable, are in full-time employment. This means a recorded 2 per cent to 2½ per cent rate of unemployment in the UK (higher in the US) but takes no account, for example, of women who may wish to work but cannot find employment.

d) *Bonds market* We shall assume that there is only one type of interest bearing financial asset which we shall call a bond.

The particular characteristics of bonds are that they have an infinite life and receive interest in the form of a fixed sum of money per bond payable in each time period. Thus the rate of interest on the bonds inversely varies with the price of the bond.

All physical investment is financed by the issue of bonds so that the supply of bonds, B^s, is equivalent to intended investment. Also we assume that any saving which takes place does not take the form of cash hoarding, but rather involves the purchase of bonds so the demand for bonds, B^d, is equivalent to intended saving. In equilibrium, of course, demand and supply must be equated.

$$B^d = B^s \tag{2.6}$$

e) *Money market* All the transactions which are aggregated into the goods, labour and bonds markets could take place in a barter economy. However, the models that we intend to discuss all admit the existence and importance of money. For the present we shall define money as coins and notes and avoid the complications which arise with the existence of commercial banks. People demand to hold cash balances for many reasons, for example, they need cash to finance purchases and to avoid the risk involved in holding bonds. Throughout section 1 we shall assume that the supply of money is determined not by economic forces but by the government or central bank. Accordingly the money supply is assumed to be fixed exogenously. In equilibrium the demand for money, M^d, must equal the fixed supply, $\bar{M}$.

$$M^d = \bar{M} \tag{2.7}$$

Walras' law

Walras' law states that, if in a system of n markets, n – 1 are in equilibrium the nth market must also be in equilibrium. The implication of this is that if we are dealing only with equilibrium situations then one market need not be considered. Conventionally the bonds market is excluded and we proceed to consider the goods, labour and money markets only. When these markets are in equilibrium the bonds market will also be in equilibrium. This obviously makes the analysis more straightforward and is, therefore, of great importance. It must, however, be pointed out that in recent years many economists have cast some doubt on the validity of Walras' law. This is discussed more fully in Chapter 8.

Summary

By considering the general problems of aggregation and their application to macroeconomic models we have specified a particular framework within which to consider the classical and Keynesian systems. This framework is composed of an aggregate production function and the goods, labour, bonds and money markets. We have also argued that if we are interested only in comparing one equilibrium position of the model with another – comparative static analysis – then we need only consider the production function and the goods, labour and money markets. In the discussion thus far we have said nothing at all about behavioural relationships between the chosen aggregates. Indeed it is the differences in these relationships that differentiate the classical and Keynesian systems which we are going to discuss.

Many assumptions have been made in arriving at a framework which is relatively easy to manipulate and understand. One of the more significant problems is that we cannot be sure whether the predictions and policy implications of any model of this type are of any relevance to the real world. Nevertheless we should remember that however unsatisfactory this method is, there are no real alternatives.

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