1 Competing approaches to Keynesian macrodynamics

1.1 Introduction

1.1.1 General methodological remarks

This book proposes a view of dynamic macroeconomic modelling that stresses the non-market-clearing approach. Here the focus is very much on dynamic adjustment processes amongst the principal markets and agents of the macroeconomy and the dynamic linkages between these. Our starting point is the *Keynes–Metzler–Goodwin* (KMG) model developed in earlier work of the authors together with other collaborators. The label is meant to highlight the key macroeconomic mechanisms introduced by the great economists referred to. The 'Keynes' refers to the causal nexus from financial to real markets, 'Metzler' to inventory dynamics and 'Goodwin' to the dynamics of distributive shares. It is our view that these are the core mechanisms which need to be at the heart of descriptive models of the macroeconomy.

An important aim of our analysis is to understand the dynamic interplay between these core driving mechanisms of the macroeconomy, in particular which are stabilizing and which destabilizing, and which parameters have the most influence in moving the economy back and forth between the regions of stability and instability. In the shock-driven models of modern macrodynamics a stabilizing effect is one that reduces the variance of some important state variables; however, here we are almost exclusively concerned with deterministic systems, and so the terms 'stability' and 'instability' are used in the sense that they refer to the local properties of the steady state.

For the KMG model that we work with, it can be mathematically proved that parameter variations that bring about instability are associated with a Hopf bifurcation. We will not be so concerned with regard to the details of this phenomenon but, rather, take it mainly as an indication that over a wider range of parameter values the dynamics are basically of a cyclical nature. Here, we are specifically interested in oscillations that

occur at business cycle frequencies. For these investigations, however, we will need to resort to a numerical analysis.

Of course, oscillations in linear deterministic models will die out if the equilibrium is stable. This equally holds true if, as in the most elementary specifications of our building blocks, the model is (not linear but) 'quasi-linear'. On the other hand, the intrinsic nonlinearities (such as a multiplication of two variables) are also not sufficient to bound the explosive motion if the steady state is locally unstable. Hence, in order to generate persistent and bounded cyclical behaviour, we employ parameter combinations that imply instability and then introduce an extrinsic nonlinearity that takes effect in the outer regions of the state space, so that locally the system is spiralling outward and further away from the steady state it is spiralling inward. Since the KMG model, despite the various feedbacks from wage-price and inventory dynamics, is essentially still an investment-driven model, we will in this book focus concretely on a suitable nonlinearity in the investment function.

The present book adds two features to earlier work of the authors on the KMG model. First, it undertakes a very careful calibration of the model to the stylized business cycle facts of US data. The dynamic properties of the resulting calibrated model are studied in detail, especially stability regions in the space of key parameters. Second, in the final two chapters we take the LM block of versions of the model hitherto developed and replace it with a Taylor-type interest rate rule. This type of rule has, of course, become a – if not the – major policy tool of central banks worldwide, so in the interests of realism any model of the modern business cycle needs to incorporate it. To the resulting model we give the label *Keynes–Metzler–Goodwin–Taylor* (KMGT). The model could be taken by economists and policymakers inclined to the non-market-clearing approach and used as the basis of policy experiments and further empirical studies.

With its stress on the underlying macroeconomic forces of the economy and their interaction, the authors have characterized their approach in previous works as *macrofounded*. The authors still contend that this is the major advantage of the approach to business cycle modelling that they are advocating in this and other work. The approach thus stands in contrast to other currently more fashionable approaches, in particular real business cycle theory and the New-Keynesian approach. The common element of these two frameworks is the insistence on deriving all dynamic equations from microfoundations. In a pure form, this involves a representative agent solving an intertemporal expected utility-maximizing problem. The corresponding Euler equation, the market-clearing assumptions and the hypothesis of rational expectations yield

the dynamic structure of these models. Models of this kind still amount to a Robinson Crusoe economy, progress perhaps being that Friday has joined as his companion.[1] In a less pure form, these models are enriched by modifying the Euler equation or combining it with elements that intuitively or plausibly are meant to capture additional features such as, for example, other sectors in the economy or so-called backward-looking, boundedly rational agents. These models are microfounded in spirit, but no longer in all explicit details.[2]

Whilst it is, of course, good to obtain microfoundations for the postulated behavioural relationships, this approach carries with it certain disadvantages, in our view. Most importantly, the nature of the solution procedures for stochastic intertemporal optimization models makes it very difficult, if not impossible, to understand clearly the dynamic linkages and feedbacks between the various sectors and agents of the economy. It may in this respect be worth referring to the points made by Romer (2000) about the relevance of the IS-LM-AS model for analyzing short-run fluctuations, a model that in our terms could be viewed as a macrofounded model (though we emphasize that Romer himself does not employ that term). Romer sees two important advantages. First, prices do not adjust instantaneously to disturbances, and this seems to be a necessary feature of any model purporting to describe economic reality. Second, the microfounded approach does not at the end of the day lead to models that are more realistic than those based on intuitive or so-called 'ad hoc' arguments. As Romer (2000, pp. 7f.) summarizes it,'The tradeoff [when moving from the ad hoc assumption in IS-LM-AS to a relatively simple formulation based on intertemporal optimization] is similar for grounding the analysis of investment demand, money demand, price rigidity, and soon more strongly in microeconomic foundations: even the easiest models are dramatically harder than their IS-LM-AS counterparts, and not obviously more realistic.'

One might also go one step further and scratch at the halo of the expression 'microfoundations' as it has been used in the last three

[1] For example, Friday may be a rule-of-thumb consumer, as in the New-Keynesian models by Amato and Laubach (2003) or Gal et al. (2004).

[2] As a consequence, the conventional jump-variable techniques of this literature are less obvious in these models than in a purely optimizing framework. We recall that, in the early stages of the development of the jump-variable techniques for solving rational expectations models, some concerns were expressed about the lack of any theory to explain the jump in economic variables as well as about the arbitrariness in the selection of jump variables in larger-scale models. Some of these issues were articulated by Burmeister (1980). A nice quotation is also the following side remark by Blanchard (1981, p. 135) in his application of the jump-variable technique to the value of the stock market: 'Following a standard if not entirely convincing practice, I shall assume that q always adjusts so as to leave the economy on the stable path to equilibrium.'

decades against 'ad hoc' model building. We feel, in fact, sympathetic to Solow in his summary of the contemporarily predominant methodological approach: 'One could even question whether a representative agent model qualifies as microfoundation at all' (Solow, 2004, p. 660).[3]

A more specific point where we certainly depart from current fashions is in the handling of expectations. For almost three decades the rational expectations assumption has been accepted almost as an article of faith in some quarters. Interestingly, its hold on the economics profession has loosened over the last decade, with many papers on boundedly rational and heterogeneous agents appearing in a range of journals and books. Nevertheless, the grip of the rational expectations assumption is still almost vice-like in the reigning business cycle paradigms. However, we remain to be convinced that it is useful to build models of the economy where agents have the information and computational ability to form rational expectations or behave 'as if' they had such abilities. We believe that such an assumption is so far from reality that it does not serve even as some sort of baseline around which the economy moves. Rather, the formation of expectations under conditions of incomplete information, bounded rationality and limited computational ability is part of economic reality.

Apart from this negative judgement, four points should be mentioned with regard to the treatment of expectations in this book. First, we join the common – in fact, almost exclusive – practice in macrodynamic modelling of concentrating on the rate of inflation as the one and only variable about which expectations are formed.[4] Second, we will avoid the expression 'expected rate of inflation'. We, rather, introduce a variable π that in an uncertain environment the agents conceive as some average over a longer time in the future; it is not just the rate expected for the next period. Therefore, we prefer to use the term 'inflation climate' for π.

From this point of view it becomes, third, reasonable to consider the changes in π as revisions of a currently held opinion, which are made in a gradual manner in light of the most recent information about inflation.

[3] It would by no means inappropriate if we filled the next pages by quoting all the methodological remarks from this paper, which is an obituary of James Tobin where Solow reminds us of his seminal paper 'A general equilibrium approach to monetary theory' from thirty-five years ago. On this occasion we may say that we see ourselves in the tradition of Tobin's approach, about which Solow, to provoke contradiction we suppose, fears 'that it may soon be extinct, like some obscure Melanesian language whose native speakers are dying off (Solow, 2004, p. 659)

[4] Though it is hardly ever mentioned as a problem, we consider this a most serious shortcoming. Keynes' famous 'animal spirits' that are guiding entrepreneurs certainly refer to other, or at least additional, economic variables. Thus, in future work, we intend to take up the notion of a 'state of confidence' or a general 'business climate' as the expectational variable that should be centre stage in macrodynamic modelling. A first attempt in this direction was Franke and Asada (1994).

Formally (but only formally, we stress), this mechanism can be described as adaptive expectations. Though this adjustment principle has a bad reputation in some quarters, there is indeed widespread evidence from economics and the behavioural sciences that it is by no means that foolish and that it is indeed widely used by real economic agents (Flaschel et al., 1997, pp. 149–62 or, more extensively, Franke, 1999, give a compilation of such arguments). For the purposes of the present discussion, the following short citation from Mankiw (2001, p. C59) is illuminating enough. After noting how odd it is to assert that expectations about inflation are formed without incorporating all the news events that are so readily available in the modern world, he adds, 'Yet the assumption of adaptive expectations is, in essence, what the data are crying out for.'[5]

The fourth point is that we combine the 'adaptive expectations' with another relevant mechanism. While the former could also be characterized as chasing a trend, we additionally draw on a general idea from the asset markets, a fundamentalist view, so to speak, according to which the variable is expected to return to its normal level after some time. The adjustment mechanism that we will propose for our inflation climate π will thus be a weighted average of 'adaptive expectations' and these, as we call them, regressive expectations.

Returning to our interest in business cycle dynamics, we may also point out that the microfounded models are limited in the type of cyclical behaviour they can generate. The solution procedures usually involve a (log-)linearization of the Euler equations, otherwise it may be difficult to apply the solution methodology required to operationalize the rational expectations assumption.

Since linear dynamic models can make economic sense only in their regions of stability, exogenous stochastic processes are needed to generate persistent cycles. Attempts to calibrate these types of models often come down to tuning various types of exogenous stochastic processes. This problem is similar in kind to that of introducing suitable nonlinear mechanisms into our deterministic models to bound the explosive

[5] In our view, agents in the real world are not 'forward-looking', which is just another expression for rational expectations. They are 'backward-looking', to take up this currently fashionable term, in that they have only data from the past on the basis of which they can form expectations about the future. On the other hand, agents are sufficiently sophisticated to make use of econometric methods. While, being univariate, the adaptive expectations method is a particularly simple one, it would be more appropriate to assume that the agents adopt vector autoregressions to forecast future inflation. Then, in order to reduce at least the computational effort, one might try to short-circuit this general device by some simplified adjustment formulae where, however, reference is made not only to current inflation but also to some measure of the output gap, and perhaps the interest rate too.

motion. If this device may be viewed as the ad hoc feature of the macrofounded approach, then it may equally be argued that the open choice of exogenous stochastic processes may be seen as the ad hoc feature of the microfounded approach.

A final argument that we may give for developing further the macrofounded approach that we are advocating is that it still seems to be at the heart of the explicit or implicit modelling framework used by many policymakers. This is, no doubt, due to the fact that the microfounded approaches leave obscure the linkages between the different sectors and agents of the economy. But it is precisely these linkages that are of importance to policymakers.

1.1.2 A historical perspective

After elaborating on the many aspects of his new and, as he emphasized (Keynes, 1936, p. 3), *general* theory about the most fundamental macroeconomic relationships, Keynes (p. 313) purports in chapter 22 of *The General Theory* that this work should also be useful for a better understanding of the fluctuations that are summarized as business cycles, or, in his words, the trade cycle. The definite article 'the' already indicates that it is viewed as a systematic phenomenon (pp. 313f.):

> By a *cyclical* movement we mean that as the system progresses in, e.g. the upward direction, the forces propelling it upwards at first gather force and have a cumulative effect on one another but gradually lose their strength until at a certain point they tend to be replaced by forces operating in the opposite direction; which in turn gather force for a time and accentuate one another, until they too, having reached their maximum development, wane and give place to their opposite. We do not, however, merely mean by a *cyclical* movement that upward and downward tendencies, once started, do not persist for ever in the same direction but are ultimately reversed. We mean also that there is some recognisable degree of regularity in the time-sequence and duration of the upward and downward movements.

Hence, there must be deeper causes for this kind of cyclical behaviour. The most important cause Keynes identifies is investment and its key determinant, the marginal efficiency of capital (p. 313). The other two pillars of his theory are the marginal propensity to consume and the state of liquidity preference. Once these 'three main gaps in our existing knowledge' are filled, the complementary 'theory of prices [and wages] falls into its proper place as a matter which is subsidiary to our general theory' (pp. 31f.).

This approach to a theory of the trade cycle has not received full attention in the discussions that developed after the appearance of *The*

General Theory, which in the main is probably due to the strong psychological factors that are penetrating the dynamic feedback mechanisms. So the concepts just mentioned provided only a loose theoretical frame for the more formal versions of Keynesian theory. In its striving for a rigorous design, modern macrodynamic modelling started out from more precise, and more limited, behavioural assumptions. This holds point in the 1950s and 1960s, as well as for the progress that the contemporary New-Keynesians claim to have made. In the remainder of this chapter we give a brief overview of these approaches from our point of view, and then locate our own approach with respect to these traditions. Since, in particular, price and wage formation are here not just a 'subsidiary' component, we emphasize the different assumptions and specifications concerning perfectly flexible or more sluggish prices and wages. It should also be remarked that this discussion – not only because of its brevity – loses sight of the systematic cyclical movements that Keynes had in mind. We will, however, return to this topic in the analysis of our own models later in the book.

We start, therefore, in the next section with a reconsideration of the old Neoclassical Synthesis, which we date as Stage I. Based initially on Patinkin's micro-oriented approach to macrodynamics and then further refined, this blend of Keynes and the Classics considered the original debate from the perspective of a larger modelling framework where all building blocks of the Keynesian approach are present, together with Classical and later Friedmanian supply-side arguments (marginal cost determination of the price level and an expectations-augmented money wage Phillips curve). A rigorous and almost canonical formulation was given to it by Sargent's advanced textbook (1979, chaps. 1–5). At the one end of the synthesis, the Classical version of the working of the macroeconomy was obtained by assuming enough flexibility in the real markets, in the first instance fully flexible wages and prices, while at the other end the Keynesian version emerged when real markets became less perfect and at least money wages were assumed to adjust in a delayed manner.

In section 1.3 we subsequently consider the basic components of the New-Keynesian approach, which we perceive as the Neoclassical Synthesis, State II. In section 1.4, still in a highly stylized fashion, the main ingredients of our own modelling framework are discussed. Here, the preceding sections 1.2 and 1.3 prove to be useful in two respects. First, the best perspective from which to understand and evaluate our work is to view it as introducing disequilibrium elements into the AS-AD setting of the Neoclassical Synthesis, Stage I, in order to remove certain central theoretical weaknesses. We will thus present our approach as a

matured Keynesian macroeconomic model of disequilibrium dynamics. If it were not so risky in the overall competition for catchy and marketable labels, we might even be tempted to call it defiantly an Old-Keynesian approach.[6]

Second, the discussion of the Neoclassical Synthesis, Stage II, is useful since, interestingly, the reduced and sketchy way in which we try to characterize it allows us to recognize a close correspondence between our and the New-Keynesian modelling of, in particular, the wage-price and output dynamics. When stripped down to the bones, at first sight only the period-dating of these variables in the postulated relationships seems to be different. It will, however, also be worked out that this leads to radically different conclusions regarding the working of the economy.

1.2 Neoclassical Synthesis, Stage I: traditional AS-AD dynamics

We reconsider in this section what constituted the core of Keynesian macroeconomic theory until the beginning of the 1970s. This was, of course, the Neoclassical Synthesis, and we have already announced that, thirty years later and with a view to our discussion further below, we will also occasionally refer to it more precisely as the Neoclassical Synthesis, Stage I (NCS I). This body of theory organizes the description of a closed economy into three major building blocks: the IS and LM relationships for the goods and money market, which in combination yield the so-called AD curve; an AS curve derived from the marginal productivity principle for labour; and demand facing supply on the labour market. In its basic equilibrium formulation, prices (p) as well as nominal wages (w) are perfectly flexible, so that the economy is on its steady-state growth path.[7] For easier reference, let us denote this approach as NCS I(p, w). More recently it has found expression in the New-Classical economics and the equilibrium business cycle theory.

The agents' out-of-equilibrium behaviour has always been discussed verbally and also often formalized in small models, which, however, have mostly concentrated on selected issues. A first and most influential attempt to introduce disequilibrium adjustments into a complete macroeconomic model of NCS I was undertaken by Sargent (1979, chap. 5). We therefore find it appropriate to begin our review of Keynesian macrodynamics at this point.

[6] Inspired by the title of Tobin's (1992) article on the sense and meaning of less than perfect price flexibility.
[7] For a detailed presentation, see, e.g., Sargent (1979, chap. 2).

For a better comparison with the New-Keynesian models later on and their emphasis on monetary policy, it should be mentioned at this stage that all versions of NCS I that we are going to consider assume a neutral policy of Friedmanian type – that is, money supply is exogenous and grows at a constant rate.

1.2.1 Keynesian AS-AD dynamics with rational expectations

Sargent's (1979, chap. 5) economy comprises three sectors: households, firms and the government. The behavioural assumptions he employs are a good compromise between richness, where in some parts partial microfoundations are also provided, and parsimony, where stylized assumptions serve to keep the model analytically tractable. In particular, Sargent takes account of the budget equations for savings and asset accumulation; flows and stocks are thus explicitly related in a consistent manner.

The model departs from NCS I in only one respect: the assumption of perfectly flexible money wages w is abandoned and replaced with gradual adjustments. They are represented by an ordinary expectations-augmented wage Phillips curve, which is formulated in continuous time. Denoting inflationary expectations by π^e, measuring the demand pressure on the labour market by the deviations of the actual rate of employment $e = L/L^s$ from its exogenously given NAIRU level e^o (L is labour demand and L^s the labour supply), and specifying the speed of adjustment by a positive coefficient β_{we}, the wage Phillips curve reads

$$\hat{w} = \pi^e + \beta_{we}(e - e^o) \tag{1.1}$$

($\hat{w} = \dot{w}/w$ is the growth rate of w). Regarding expectations, π^e in (1.1) is viewed as capturing the price changes in the near future, even over the next short period, so to speak. If sluggish wages are to be the only departure from the equilibrium formulation of NCS, myopic perfect foresight has to be assumed in this respect. In the continuous-time setting we therefore have, for p the price level and $\hat{p}$ the current rate of inflation,

$$\pi^e = \hat{p} \tag{1.2}$$

To be precise, $\hat{p}$ has to be thought of as the right-hand time derivative; cf. Sargent (1987, p. 120).[8] Prices themselves, the perfect flexibility of

[8] In a further departure from NCS I(p, w), Sargent (1987, chap. 5.1) assumes gradual adjustments for expected inflation π^e, too. As will be worked out in chapter 2, section 4, this model has still some peculiar features, which can be seen as a weak reflection of the peculiar features that will arise in the presence of (1.2).

which is maintained, are supposed to be determined within a standard AS schedule based on marginal wage costs. Accordingly,

$$p = w/F_L(K, L) \tag{1.3}$$

where K is the capital stock, $F = F(K, L)$, the neoclassical production function (without technical progress), and $F_L = \partial F/\partial L$, the marginal product of labour.

The most important feature of the IS part of the model, which goes slightly beyond a principles textbook, is that (net) investment is no longer a function of the interest rate alone. Sargent instead conceives it as an increasing function of a return differential q, which is the difference between the real rate of return, r, of firms on their capital stock and the real rate of interest $i - \pi^e$ (i being the nominal interest rate).[9] With the neoclassical production function, r is given by the marginal product of capital $F_K = \partial F/\partial K$ minus the rate of depreciation of the capital stock. For the other other components of aggregate demand it is convenient to assume suitable fixed proportions to the capital stock as trend term (as they are detailed in chapter 2, section 2, of this book, for example). This leads to a simple multiplier relationship for output Y of the kind $Y = (1/s)(I + K)$, where I is investment and s the constant propensity to save of private households. Together, the model's IS block in intensive form is described by

$$y = (1/s)(I/K + \text{const.}) \tag{1.4}$$

$$I/K = f_I(q), \quad f_I' > 0 \tag{1.5}$$

$$q = r - (i - \pi^e) \tag{1.6}$$

$$r = F_K(K, L) - \delta \tag{1.7}$$

On the other hand, the LM equilibrium condition for the exogenous money supply M in a growing economy can be posed as

$$M = pY\ f_m(i), \quad f_m' < 0 \tag{1.8}$$

As far as the evolution of money, capital and the labour supply is concerned, it considerably eases the exposition if we here neglect the capacity effects of investment and assume that the capital stock K grows at the

[9] Sargent (1987, pp. 11–14) demonstrates that this expression is indeed close to Tobin's (average) q.