

The Dynamics of Keynesian Monetary Growth:

Macro Foundations

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Contents

<i>List of figures</i>	<i>page</i>	x
<i>Foreword by Richard H. Day</i>		xv
<i>Preface</i>		xviii
<i>Acknowledgments</i>		xx
<i>Notation</i>		xxii
General introduction		1
1 Traditional monetary growth dynamics		10
1.1 Introduction		10
1.2 Macro foundations of macroeconomics		12
1.3 Basic Tobin models of monetary growth		24
1.4 Basic Keynes-Wicksell models of monetary growth		31
1.5 Basic AS-AD growth models		39
1.6 The modeling of expectations		46
1.7 A new integrated approach to Keynesian monetary growth		61
1.8 Mathematical tools		65
Appendix		67
2 Tobinian monetary growth: the (neo)Classical point of departure		69
2.1 The basic equilibrium version of Tobin's model of monetary growth: superneutrality and stability?		71
2.2 The money-market disequilibrium extension: further stability analysis		82
2.3 Labor-market disequilibrium and cyclical monetary growth		92
2.4 General equilibrium with a bond market: concepts of disposable income and Ricardian equivalence		102
		vii

2.5	A general disequilibrium version of the neoclassical model of monetary growth	112
2.6	Outlook: independent investment behavior and Wicksellian price dynamics	123
3	Keynes–Wicksell models of monetary growth: synthesizing Keynes into the Classics	127
3.1	The general prototype model	129
3.2	The intensive form of the model	136
3.3	The Goodwin growth cycle case	140
3.4	The Rose employment cycle extension	146
3.5	Monetary growth cycles: the basic case	154
3.6	Expectations and the pure monetary cycle	159
3.7	The real and the monetary cycle in interaction	168
3.8	Outlook: less than full capacity growth	171
4	Keynesian monetary growth: the missing prototype	173
4.1	A general Keynesian model of monetary growth	175
4.2	Comparative statics: the IS–LM subsector	184
4.3	Growth cycle implications	190
4.4	Employment cycle extensions	199
4.5	Keynesian monetary growth: the basic case	207
4.6	Monetary and real factors in Keynesian cyclical growth dynamics	214
4.7	Outlook: adding smooth factor substitution	220
	Appendix 1: The Benassy business cycle model	231
	Appendix 2: Technical change, wage taxation, average inflation and p-star expectations	235
5	Smooth factor substitution: a secondary and confused issue	242
5.1	The Tobin case: one further integrated law of motion	243
5.2	The Keynes–Wicksell case: increased stability through increased flexibility	253
5.3	The Keynesian case with smooth factor substitution	259
5.4	Outlook: sluggish price as well as quantity dynamics	275
6	Keynesian monetary growth: the working model	278
6.1	Introduction	278
6.2	The Kaldor–Tobin model of monetary growth	283
6.3	An integrated Keynes–Metzler model of monetary growth	293

6.4	A (5 + 1)-D modification of the six-dimensional Keynes–Metzler model	314
6.5	Outlook: macroeconometric model building	335
7	The road ahead	340
7.1	Endogenous long-run growth and employment	341
7.2	The dynamic structure of the model	348
7.3	Analysis of the employment subdynamics	350
7.4	Analysis of the growth subdynamics	354
7.5	Analysis of the complete dynamical system	356
7.6	Some numerical simulations	358
7.7	Summary and directions for future research	372
	<i>References</i>	383
	<i>Author index</i>	394
	<i>Subject index</i>	397

Figures

1.1	Phase diagram of the dynamics under adaptive expectations	<i>page</i> 51
1.2	Instability in the perfect foresight limit	51
1.3	Jump to linearization of stable manifold	53
1.4	The true and the perceived system	54
1.5	Nonlinearity in the money demand function	55
1.6	Relaxation oscillation in inflationary expectations	57
1.7	Time series presentation of the relaxation oscillation	58
2.1	Simple nonlinear money demand function	89
2.2	Bounded fluctuations for disequilibrium monetary growth	90
2.3	The case of relaxation oscillations or <i>limit limit</i> cycles	91
2.4	Disentangled real cycle in the Tobin model	122
2.5	Disentangled monetary cycle in the Tobin model	123
2.6	Combined real and monetary cycle of the Tobin model	124
2.7	Combined real and monetary cycle of the Tobin model with additional nonlinearity in the price reaction function	125
3.1	Ceilings to the validity of the Goodwin growth cycle approach	145
3.2	A nonlinear law of demand in the labor market	149
3.3	Implications of nonlinearity in the labor market	150
3.4	(a) A nonlinear investment-savings relationship; (b) a Rose limit cycle in the fixed proportions case	151
3.5	The real cycle of the Keynes–Wicksell model	154
3.6	The two Routh–Hurwitz coefficients a_1, b	158
3.7	Phase diagram of the pure monetary cycle	167
3.8	Simulation of the pure monetary limit cycle	168
3.9	Coupled real and monetary oscillators	170
4.1	The denominator in the effective demand function (4.36)	187
4.2a	Effective demand: a too weak capacity effect or $s_c < i_1$	188
4.2b	Effective demand: a strong capacity effect	189

4.3a	Case 1: the “paradise” case	192
4.3b	Case 2: the “orthodox” case	192
4.3c	Case 3: the “mixed” case	193
4.4	The parameter $\beta_w(V)$ of the wage adjustment function $\beta_w(V) (V - 1)$	194
4.5	A region of global stability for case 2	195
4.6	Instability for case 2 via the Rose effect	202
4.7	Stability for case 3 via the Rose effect	203
4.8	The nonlinear Phillips-curve mechanism once again	203
4.9	Viability in the locally unstable case 2 (the real cycle, case 1)	205
4.10	A second Phillips-curve mechanism	205
4.11	Viability in the locally unstable case 3 (the real cycle, case 2)	207
4.12	The stability switch in case 1	208
4.13	Determination of the bifurcation parameter value $\beta_w^{H_1}$	213
4.14	The pure monetary cycle	219
4.15	A numerical example for the pure monetary cycle	220
4.16	The nonlinear component of the investment function	222
4.17	A nonlinear goods-market equilibrium curve	223
4.18	The phase diagram of a pure real cycle	224
4.19	A simulation of the pure real cycle	225
4.20a	A simulation of the joint monetary and the real cycle in the intrinsically nonlinear case (with no investment nonlinearity)	226
4.20b	A simulation of the joint monetary and the real cycle in the extrinsically nonlinear case	228
4.21	Benassy’s money wage Phillips–curve	233
4.22	Constructing a viability domain for the Benassy model	234
5.1	The determination of the Hopf-bifurcation parameter	249
5.2	The non-superneutrality of money	252
5.3	A restricted neoclassical production function	256
5.4	The viability domain of the Rose dynamics under smooth factor substitution	257
5.5	Potential and actual employment and output	264
6.1	Hopf bifurcation curves, stable limit cycles (projections), or stable corridors	303
6.2	Hopf bifurcation loci of the inventory cycle for $Z < 0$	310
6.3	Hopf bifurcation curves, stable limit cycles, and stability corridors for $Z < 0$	312
6.4	Six-dimensional bifurcation loci and a limit cycle for $h_2 = 0.2$ ($Q < 0$)	321

6.5	Six-dimensional Bifurcation-loci and a limit cycle for $h_2 = 0.8$ ($Q > 0$)	323
6.6	A period-doubling route to complex dynamics	324
6.7	At the edge of mathematical boundedness	325
6.8	No steady-state inflation	329
6.9	Steady-state inflation and period 1 limit cycles	330
6.10	Steady-state inflation and period 4 limit cycles	330
6.11	Steady-state inflation and period 16 limit cycles	331
6.12	Steady-state inflation and complex dynamics	331
6.13	A bifurcation diagram for the dynamics considered in figures 6.9–6.12	333
6.14	The largest Liapunov exponent of the dynamics considered in figure 6.13	333
6.15	A test for sensitivity with respect to initial conditions for the above-shown attractor	334
7.1	Phase plots and times series representations over a time horizon of 200 years (6D case)	360
7.2	Phase plots and times series representations over a time horizon of 1,000 years (6D case)	361
7.3	Bifurcation diagram of the 6D case for $\beta_v \in [0.5, 20]$	362
7.4	Downwardly rigid money wages at the inflationless steady state	363
7.5	Phase plots and times series representations of endogenous “animal spirits” over a time horizon of 220 years (7D case)	364
7.6	Phase plots and times series representations of endogenous “animal spirits” over a time horizon of 1,000 years (7D case)	365
7.7	Phase plots and times series representations of endogenous “natural growth” over a time horizon of 220 years (8D case)	366
7.8	Phase plots and times series representations of endogenous “natural growth” after a transient period of 1,000 years (8D case)	367
7.9	Bifurcation diagram for $\beta_v \in [0.5, 5]$ in the case of endogenous growth (8D case)	368
7.10	High adjustment speeds of wages and the occurrence of “complex” dynamics (8D case)	369
7.11	Phase plots and times series representations of an endogenous determination of the NAIRU-based rate \bar{V} (7D case)	370

7.12	Phase plots and times series representations of an endogenous determination of the NAIRU-based rate of employment \bar{V} (7D case)	371
7.13	Phase plots and times series representations of an endogenous determination of “natural” rates of employment and of growth (9D case)	372
7.14	Phase plots and times series representations of small fluctuations in the level of economic activity (9D case)	373
7.15	Phase plots and times series representations of an endogenous determination of “natural” rates of employment and of growth (9D case) without extrinsic nonlinearities	374

1 Traditional monetary growth dynamics

1.1 Introduction

We reconsider in this chapter the leftover ruins of traditional monetary growth dynamics¹ which, with respect to the general dynamics they can give rise to, have so far been poorly analyzed and understood in the literature.²

We attempt to show to the reader, in section 1.2 in overview, and in detail in chapters 2–5, that these leftover ruins can be arranged and represented in a systematic way so that they form a hierarchical structured class of monetary growth models where each subsequent model type eliminates some of the weaknesses of the preceding model type. We then indicate in section 1.2 two ways in which this methodological approach to macrodynamics can be significantly extended beyond the existing scope of traditional models of monetary growth. Firstly, this way of proceeding in fact leads to the establishment of a proper (still traditional), but much neglected Keynesian model of monetary growth where both labor and capital exhibit fluctuating degrees of utilization independently of the assumptions that are made on “technology.” Secondly, our approach leads to a further improvement of this IS–LM growth type of dynamics by allowing for sluggish price, as well as quantity, adjustments (two Phillips-curve mechanisms and a Metzlerian treatment of disappointed sales expectations) and by establishing thereby what we will call the working Keynesian model of this book. Section 1.2 therefore provides a survey of what we call the macro foundations of (disequilibrium) macroeconomics, namely the indication that there is a systematic way of proceeding from less sound and

¹ See Turnovsky (1995, part I) with respect to another reconsideration of integrated macrodynamics of traditional type.

² See for example Sargent’s (1987, ch. 5) analysis of “Keynesian Dynamics” of AS–AD type and its reconsideration in Flaschel (1993, ch. 6–7) and Franke (1992a), or Stein’s (1982) investigation of dynamic models of Keynes–Wicksell type and its reconsideration in Flaschel, Franke, and Semmler (1997, ch. 10).

elaborate to more sound and elaborate presentations of integrated macrodynamic models of monetary growth. In this way we demonstrate both in this survey chapter and in more detail in chapters 2–7 a systematic procedure on the macro level by which integrated or complete macrodynamical models can be made more and more elaborate and coherent in their presentation of the fundamental feedback structures that characterize interdependence on the macro level.

Our approach proceeds independently of any justified claim for better micro foundations of macroeconomics. Indeed, improved micro foundations that emerge from research in this area should be capable of integration into appropriate modules of the macro structure that we build in this book. There is no space here, however, to go into this topic in detail. A recent approach which considers the problem of the micro foundations of macroeconomics from a critical perspective and which provides alternative and interesting micro foundations of macroeconomics (not based only on budget and technological constraints) is Hahn and Solow (1995). There it is found in particular that stickiness of wages and prices may be good for economic stability. Our treatment of Keynesian monetary growth in chapters 4–6 arrives at a similar conclusion, but from a quite different perspective.

The various steps in the building of a class of hierarchical structured models of monetary growth are made on the basis of assumptions on the structure of markets and sectors of the economy as they are used in Sargent (1987, chs. 1–5) which are indeed very convenient for the first stage of the project started in this book. We extend Sargent's (1987, part I) mainly static analysis of AS–AD macroeconomics (cum growth in his ch. 5) on the one hand into a full dynamic analysis of growing monetary economies and on the other hand into the direction of proper Keynesian models of monetary growth (where also firms are no longer on their supply schedule). In this way we lay foundations for a Keynesian approach to monetary growth which has rarely been studied in the literature so far.³ When the final stage is reached in this book, however, the need for further extensions in the structure of Keynesian monetary growth dynamics will become apparent. Possibilities for such extensions are briefly discussed at the end of chapter 7. These provide a research agenda of systematic developments along the methodological lines established in this book.⁴

In sections 3–5 of this chapter we consider for introductory purposes basic models of Tobin, Keynes–Wicksell and AS–AD type. Very general versions of these approaches are introduced and investigated in subsequent

³ See for example Orphanides and Solow (1990), where models of this type are not even mentioned.

⁴ See Chiarella and Flaschel (1998f) and Chiarella et al. (1998, 1999).

chapters. Since Sargent's treatment of the AS–AD growth model focuses on the role various expectations schemes play in the dynamics generated by this model type, we in addition provide an alternative view on the modeling of expectations in section 1.6 which will be used in subsequent chapters on various levels of generality. Section 7 provides a few characterizations concerning the proper Keynesian models of monetary growth that we shall introduce and analyze in chapters 4–7.

1.2 Macro foundations of macroeconomics

The purpose of this section is to indicate to the reader that there is a hierarchical structured body of disequilibrium models of monetary growth where each subsequent stage in the development of such models improves the descriptive relevance of the preceding stage in a systematic and significant way. Independently of the need for sound micro foundations of the assumed (fairly conventional) behavioral relationships, the evolution of disequilibrium macrodynamics (which is not easily micro founded) does thereby indeed exhibit systematic progress to more and more convincing formulations of the fundamental modules of the dynamics of monetary growth in disequilibrium, and thus to the description and analysis of real growth dynamics. To show this in detail and to indicate how the framework of disequilibrium macrodynamics that we develop can be extended beyond its current scope are two of the main purposes of this book.

Subsection 1.2.1 provides a brief summary of the evolution and achievements of dynamic disequilibrium models of monetary growth in the past. Subsection 1.2.2 reviews the contributions that this book will make to the current state of the theory of monetary growth with under- or overemployed factors of production. A brief outlook on what needs to be and can be done on the basis of the results achieved in this book will conclude the subsection.

1.2.1 A brief genesis of disequilibrium models of monetary growth

We discuss in this subsection forerunners to the Keynesian model of monetary growth to be introduced in chapter 4 and developed further in subsequent chapters toward our working model of disequilibrium monetary growth dynamics.

The starting point

- Neoclassical models of monetary growth of Tobin type
- Extension of the Solow model of real growth:
 - towards an inclusion of financial assets

- where money market (dis-)equilibrium drives inflation
- in interaction with inflationary expectations

Neoclassical models of monetary growth were introduced into the macroeconomic literature through the work of Tobin (1955, 1965) which extended the Solow model of real growth by introducing monetary factors. Generalized versions of this model type were developed subsequently by Johnson (1966), Sidrauski (1967a), Hadjimichalakis (1971a,b), Nagatani (1970), Hadjimichalakis and Okuguchi (1979), and Hayakawa (1979). Burmeister and Dobell (1970), Sijben (1977), Sargent (1987), and Orphanides and Solow (1990) give further presentations and a survey of this literature. These extensions were generally characterized by the consideration of money as an asset in addition to real capital and the use of money market disequilibrium as the foundation of the theory of inflation and inflationary expectations, coupled with Say's Law on the markets for goods (thereby excluding any goods-market problems).⁵ Tobin type models have led to an enormous amount of literature on equilibrium growth models with optimizing behavior of economic agents, which, due to its general equilibrium nature, is not a suitable topic for a book such as this, the focus of which is on disequilibrium monetary growth theory.

Typical issues addressed by the above-cited authors were the analysis of the steady state effects of the growth rate of the money supply (and of so-called Tobin effects) and the local stability analysis of the steady state where in particular the destabilizing role of inflationary expectations was investigated when the adjustment of adaptively formed inflationary expectations became sufficiently fast. A detailed presentation of such stability issues is provided in Hayakawa (1984), while Benhabib and Miyao (1981) investigate the possibility of the cycles generated by Hopf bifurcations for intermediate adjustment speeds of inflationary expectations. It is shown thereby that the Cagan (1967) inflationary dynamics and the disequilibrium approaches that were built on it by Goldman (1972) and others not only give rise locally to saddlepath situations (that are now the basis of the jump-variable technique of rational expectations models), but that there will emerge limit cycles for particular ranges in the adjustment speed of expectations from the nonlinear structure of these neoclassical models of monetary growth.

In chapter 2 we will start from the most basic (general equilibrium) version of the Tobin monetary growth model and shall subsequently

⁵ Labor market phenomena were generally treated as in Solow (1956) by assuming full employment and the macroeconomic marginal productivity theory of income distribution. But labor market disequilibrium is easily introduced into this framework as in Goodwin (1967), here combined with neoclassical smooth factor substitution as discussed in detail in chapter 5.

establish step by step a general disequilibrium version of this model type (with money and bonds as financial assets and, of course, Say's Law remaining the [trivial] representation of goods market equilibrium). As in the evolution of the literature on models of monetary growth, we thus begin this book with the stability problems of monetary models of neoclassical growth where we, however, attempt to stress the cyclical properties of the dynamics of these models which, when necessary, may be bounded and thus imply viable cyclical oscillations through appropriate nonlinearities in the assumed behavioral relationships of neoclassical monetary growth. The main ingredients of our development of a Tobin general disequilibrium monetary growth model are listed at the head of this subsection.

The Keynes–Wicksell alternative

- Independent investment behavior based on Tobin's q
- Removal of Say's Law due to savings \neq investment
- Augmented Wicksellian demand-pressure price-inflation
- Money wage Phillips curve
- Full capacity growth

The next model type that we develop is based on the Keynes–Wicksell approach to monetary growth. The most important work in this area of monetary growth theory has been provided in the late sixties and early seventies by Stein (1966, 1968, 1969, 1970, 1971) and by Rose (1966, 1967, 1969). Further contributions are Fischer (1972), Fujino (1974), Sijben (1977), Nagatani (1978), Brems (1980), Iwai (1981), and Asada (1991). In particular Stein (1982) has related this type of approach to the discussion between Keynesians, monetarists, and New Classics, while Skott (1989a,b) provides a general theory of conflict about income distribution and of effective demand with similarities to the Keynes–Wicksell theory of monetary growth. Rose (1990) pursues the same aim from a somewhat different perspective and relates his general approach to many partial models of macroeconomic dynamics. The work of these latter two authors shows that there are still emerging important developments of this Keynes-oriented area of monetary growth theory, which in particular attempts to provide a Marshallian perspective of Keynes' theory of effective demand.

The importance of the Keynes–Wicksell approach toward an explanation of the working of a (growing) monetary economy stems from two observations. Firstly, in the recognition that savings and investment decisions are to be differentiated from each other in an essential way (thereby denying the validity of Say's Law both in its trivial and in a more elaborate form), and that the theory of price inflation must be related to the goods market and its disequilibrium and not, as in the generalized Tobin models,

to money market disequilibrium. Goods market imbalance was measured in these approaches through the deviation of investment decisions from savings decisions. The theory of inflation was based on this imbalance and augmented by expected inflation in Fischer (1972) in a monetarist fashion in order to allow for steady state equilibrium. The money market, by contrast, was now described through the usual Keynesian LM-equilibrium condition as the theory of the nominal rate of interest (the deviation of which from the nominal gross rate of profit was then used to determine the level of investment).

Secondly, that this alternative to the neoclassical view on monetary growth dynamics stressed the cyclical implications of labor market disequilibrium, the conflict over income distribution and capital accumulation. The work of Rose (1967) in particular established the Goodwinian (1967) growth cycle mechanism in an independent way and from a different perspective by relating it to a locally unstable Wicksellian theory of price inflation that gave rise to persistent fluctuations by way of appropriate assumptions on wage flexibility in a setup with smooth factor substitution. Rose (1990) provides important extensions of this type of monetary growth theory, extensions which have significantly influenced the formulation of the wage–price dynamics of our general Keynes–Wicksell model in chapter 3.

Our view on the Keynes–Wicksell contribution to the analysis of monetary growth is that it represents a decisive step forward in the macroeconomic description of such growth processes. Neoclassical and Keynes–Wicksell models of monetary growth are not situated in the hierarchy of monetary growth models on the same level of abstraction, but follow each other in this order, since the latter model type takes account of the independence of investment decisions from savings conditions and tries to incorporate this fact from a Wicksellian perspective in the simplest way possible. This extension in the approach to monetary growth also leads to an inclusion of a new financial asset besides money and bonds (equities) that is explicitly introduced, and related to Tobin's q , in our general reformulation of the Keynes–Wicksell approach in chapter 3. The main ingredients in our development of the Keynes–Wicksell alternative are listed on p. 14.

The Keynes–Wicksell type of analysis exhibits a number of problems. Firstly, the labor market is treated basically from a (neo)classical perspective in the same fashion as in the Goodwin model of the classical growth cycle, except with neoclassical factor substitution. Secondly, goods market imbalances drive prices and not quantities as in the Keynesian dynamic multiplier approach. Thirdly, capital is always operated at its full capacity as described by the usual profit-maximizing marginal productivity condition for real wages. Therefore, the (neo)classical view on capital accumula-

tion is still, at least partially, present in this type of analysis. A logically compelling next step in the Keynesian analysis of monetary growth, therefore, should be to establish a proper type of Keynesian goods market and money market analysis in the tradition of the IS–LM approach to the description of the functioning of these two markets. This is indeed the step that was taken in the literature on Keynesian dynamics in the context of monetary growth in the late seventies.

The Keynesian AS–AD growth model

- Keynesian IS–equilibrium (in addition to LM–equilibrium)
- Infinitely flexible prices based on marginal wage costs
- Expectations – augmented money wage Phillips curve
- Profit-maximizing output decisions of firms

The textbook treatment of Keynesian monetary growth dynamics (see Turnovsky 1977a and Sargent 1987 for typical examples) dispensed with the Wicksellian approach to the determination of the price level, or rather its rate of change, by simply adding wage dynamics and inflationary expectations dynamics in a monetarist fashion and Solovian capital stock growth to the usual AS–AD approach of the Keynesian short-run macroeconomic equilibrium.⁶ To date this AS–AD growth model has been considered as the representation of traditional Keynesian growth dynamics (see for example Turnovsky 1995, part I). Yet the fact remains that the full dynamics of such integrated AS–AD growth models have rarely been analyzed to a satisfactory degree, which means that the dynamic behavior of these seemingly conventional models is poorly understood.⁷ This represents an important gap in the theory of monetary growth, since we therefore do not have a generally accepted pool of knowledge at our disposal against which the achievements of more recent theories of monetary growth can be usefully compared. The main elements of the Keynesian AS–AD growth model are summarized above.

There are, however, inconsistencies present in the AS–AD theory of effective demand, inflationary dynamics, and real capital accumulation. Basing the theory of the price level on its determination through marginal wage costs, as Keynes (1936) did, amounts to assuming that producers are, on the one hand, constrained by the effective demand for goods, but are, on the other hand, capable of passing on this constraint to the labor supply of households, by allowing in one way or another for profit-maximizing prices so that they can stay on their supply schedule. In our view this

⁶ IS–LM equilibrium coupled with the assumption that prices are always equal to marginal wage costs, the money wage level being given at each point in time.

⁷ See in particular Flaschel, Franke, and Semmler (1997) for some investigations of the dynamics of these AS–AD growth models.

basically means that firms are price takers and quantity takers at one and the same time, which would give rise to a contradiction if prices are not assumed to adjust in such a way that the level of effective demand becomes consistent with the profit maximizing level of the output of firms. Our conclusion is that the Keynesian theory of goods-market constrained firms needs a theory of the price level other than that of the neoclassical approach to the theory of the firm. Such an alternative theory might be that of monopolistic competition or even more advanced theories representing more advanced stages in the evolution of capitalistic market economies. Furthermore, a Keynesian theory of the AS–AD type (even if it were consistent) would still be a theory of full-capacity growth and would thus represent only a partial description of what we observe in reality.

Barro (1994b, p. 4) has recently come to the same conclusion from a different but related perspective, stating in particular:

We have available, at this time, two types of internally consistent models that allow for cyclical interactions between monetary and real variables. The conventional IS–LM model achieves this interaction by assuming that the price level and the nominal wage rate are typically too high and adjust only gradually toward their market-clearing values. The market-clearing models with incomplete information get this interaction by assuming that people have imperfect knowledge about the general price level.

This quotation lends further weight to our viewpoint that models of IS–LM growth with gradually adjusting wages *and* prices are the correct alternative to the general equilibrium approach to monetary growth. This perspective is in fact not a new one, but has indeed been essential for the so-called neo-Keynesian or non-Walrasian disequilibrium analysis of the short-, the medium-, and sometimes also the long-run evolution of temporary fixed price equilibria. This approach can therefore be used to improve considerably the presentation of macrodynamic disequilibrium growth of AS–AD type, though most of the efforts in this area have gone into the modeling of fixed price temporary equilibria from a microeconomic point of view (which are not reviewed in the following characterization of this approach).

Neo-Keynesian monetary growth analysis

- Three regimes of the IS–LM model: the Keynesian regime, the Classical regime, and repressed inflation
- No full capacity growth in the first and the last regime
- Varying capital utilization rates and price dynamics
- Varying labor utilization rates and wage dynamics
- Sluggish wage- as well as price-level adjustments

- Extended investment functions based on profitability measures and the rate of capacity utilization

From the macroeconomic point of view, the work of Benassy and Malinvaud is here of special interest for the purposes of this book, see in particular Benassy (1986b) and Malinvaud (1980), and from the viewpoint of monetary growth theory also the collection of essays in Hénin and Michel (1982). Benassy (1986b) provides in particular a detailed presentation of the three regimes that may be of particular relevance in the analysis of macroeconomic temporary equilibrium positions and dynamic models of inflation, the business cycle and the role of expectations based on this three-regime analysis. Malinvaud (1980) considers investment behavior based on profitability *and* capacity utilization besides a consumption function that is typical for the fixed price approach to temporary equilibrium. He incorporates these behavioral relationships into a three-regime medium-run model of Keynesian depressions, under the additional assumption that the profitability effect of real wage changes is less significant than the consumption effect of such changes.

We will borrow from this literature two important ideas. The first one, which also appears in the quite different macrodynamic approach of Rose (1990), is that there should be two Phillips-type curves in a Keynesian macrodynamic model, one for the wage level and one for the price level. Both of these are expectations augmented (from a cost-push perspective), and both exhibit demand pressure components that (in the first instance) are to be represented through the utilization rates of the two factors of production, labor and capital. The second idea is that the investment behavior of Keynes–Wicksell and dynamic AS–AD models, which was based on Tobin’s q solely, should in addition be augmented by capacity considerations in order to take account not only of profitability differentials, but also of the now varying utilization rate of the capital stock.

These are the main elements (summarized in the list above) of the neo-Keynesian analysis of (the evolution of) fixed price equilibria that we will use in our formulation of a proper Keynesian model of monetary growth with IS-equilibrium or IS-disequilibrium. In this way we overcome important limitations of the growth models of Keynes–Wicksell and the AS–AD growth type by allowing also for fluctuating utilization rates of capital as in neo-Keynesian analyses of the medium or the long run. However, we do not make use of the regime-switching methodology of neo-Keynesian analyses, since we believe that there are significant buffers in the process of capital accumulation that generally prevent the occurrence of hard kinks caused by either labor demand, in the Classical regime, or labor supply, in the regime of repressed inflation.

1.2.2 *Keynesian monetary growth dynamics: new steps in the hierarchical evolution of integrated macrodynamics*

In this subsection we discuss the two basic stages in our development of a proper Keynesian model of monetary growth, i.e., the basic prototype model of this kind investigated in chapter 4 and the working model we develop from it in chapter 6.

Keynesian monetary growth analysis: the basic prototype

- Only the Keynesian regime of IS–LM growth
- Based on excess capacities for labor and capital
- NAIRU-type rate of employment and of capacity utilization
- No normal capacity growth of output outside the steady state
- Varying capital utilization rates and sluggish price level dynamics
- Varying labor utilization rates and sluggish wage level dynamics
- Extended investment function based on Tobin’s q and the rate of capacity utilization of firms

The new features listed above, taken from neo-Keynesian macrodynamics that we have considered on the basis of the “Neo-Keynesian” List on page 17, are employed in chapter 4 (and chapter 5) to formulate, on the basis of the IS–LM part of AS–AD models, our basic prototype model of Keynesian monetary growth both with and without smooth factor substitution. As a Keynesian model this should, and now indeed does, exhibit imbalances in the employment of labor *as well as* capital, independently of whether there are fixed proportions in production (chapter 4) or neoclassical smooth factor substitution (as in chapter 5). This new framework for our models of monetary growth overcomes the basic problems of the Keynes–Wicksell model as well as the AS–AD growth model, namely, to measure goods-market disequilibrium either by IS-disequilibrium coupled with full capacity growth, or to have IS-equilibrium at each point in time and to put the burden of insufficient effective goods demand on the labor market solely, thereby allowing for full capacity growth as in the Keynes–Wicksell approach (of which it is in fact a limit case for price adjustment speeds going to infinity).

In our framework, however, labor and capital experience varying utilization rates caused by IS–LM equilibrium in the market for goods and money which drive prices and determine the rate of inflation on the market for labor and goods in the fashion of a wage–price spiral (augmented through expectations on wage and price inflation), and which in the case of capital also influence the investment behavior of firms. We thus arrive at

the first truly Keynesian model of monetary growth in this book, and on this level of generality also in the literature. This model is introduced in chapter 4 as a systematic extension and modification of the one-sided Keynes–Wicksell representation of growth in a monetary economy developed in chapter 3. In view of the earlier quotation from Barro (p. 17) we have thus arrived at a model type which may be considered as the internally consistent fixed-price IS–LM alternative to the market-clearing models of monetary growth which are in vogue today. We note in passing that this model type is, however, not the final step in the hierarchy of disequilibrium models of monetary growth that we develop and investigate in this book.

In describing the new (and also old) building blocks of our Keynesian disequilibrium model of monetary growth we have only referred to the Keynesian IS–LM regime of the three-regime scenario generally found in macroeconomic analyses of the neo-Keynesian variety. We have thus made no reference to the other two regimes of Classical unemployment and repressed inflation. In contrast to the views in this strand of neo-Keynesian literature we believe that such an approach is justified from the descriptive point of view as well as from the viewpoint of the monetarist reformulations of the AS–AD growth model, as presented for example in Sargent (1987, part I). In this respect our model of IS–LM growth with sluggish wages and prices has borrowed from the theory of AS–AD growth with perfectly flexible prices⁸ in that it incorporates not only a “natural” level of the employment of labor into its money wage Phillips-curve,⁹ but also proceeds in a similar way with respect to the price level Phillips curve present in it. This latter Phillips curve is, in chapter 4, no longer based on IS-disequilibrium (which is nonexistent there), but refers to deviations of the rate of capacity utilization from a normal or desired rate of capacity utilization (less than one).

At and sufficiently near to the steady state of our IS–LM growth model, therefore, only the Keynesian regime prevails. Situations of repressed inflation or Classical capital shortage may or may not come about far off the steady state depending on how the (nonlinear) dynamics of this IS–LM growth model are formulated far off the steady state of the model. We thus believe that it is not sensible to formulate a Keynesian disequilibrium model of monetary growth from the descriptive point of view in such a way that, when in steady state, it may, by the slightest conceivable disturbance, just as easily switch into a situation of capital shortage or repressed inflation as into a Keynesian effective demand regime. Capitalist economies most of the time exhibit certain excess capacities on the market for

⁸ Based on marginal wage costs.

⁹ In the form of the employment rate complement of the so-called NAIRU.

labor as well as within firms which allow for situations of the overemployment of both factors should there be sufficient effective demand on the market for goods. A very basic example for this observation, probably not intended to support our claim, is indeed provided in Benassy (1986b, ch. 11), where only the IS–LM regime is needed in the derivation of a medium-run wage dynamics (of limit cycle type) within the scope of this regime.

There are not many monetary growth models of the neo-Keynesian variety in the literature; indeed most of them are collected in the cited volume of Hénin and Michel (1982). The reason for this, in our view, is that such growth models are very difficult to formulate and to analyze, due to the various situations of rationing and the wealth of rationing schemes that are possible in their dynamics. We shall not here or in the remainder of this book go into a discussion of these dynamic models with temporarily fixed prices and wages which treat shortages by hard restrictions (strict inequalities) in the place of smooth adjustments in the neighborhood of such shortages (based on appropriate nonlinear adjustment behavior). We have argued above that there is no need to proceed along these lines. This is certainly true from a local perspective, but, in our view, also applicable to more global types of analysis, once the typical reaction patterns of capitalistic market economies that come about in situations that approach labor or capital shortage are taken into account. Neo-Keynesian models of monetary growth have neglected such smooth regime switching processes in the neighborhood of absolute full employment ceilings and have therefore analyzed situations which are not typical for the process of capital accumulation. This is the reason why we do not consider the neo-Keynesian type of monetary growth model in chapter 4 and thereafter.

Instead, chapters 4 and 5 will provide various extensions of our prototype model of Keynesian monetary growth of chapter 4. These extensions (see page 19 for a summary list) enrich the descriptive relevance of this prototype model, but they do not add much in the direction of a significant further level in the hierarchy of disequilibrium models of monetary growth. It is in chapter 6 that the next decisive step in the systematic evolution of such disequilibrium growth models is taken, in particular motivated by some strange instability scenarios of the ultra-short-run features of our IS–LM growth prototype observed in chapter 4 as well as by the implausible asymmetric treatment of prices and quantities of that chapter. As stated above, wages and prices adjust sluggishly in the IS–LM growth model of chapter 4, yet quantities, due to the assumed IS–LM equilibrium, adjust with infinite speed to always ensure goods- (and money-) market equilibrium. Furthermore it is observed in chapter 4 that this equilibrium may be unstable when viewed from a dynamic multiplier perspective. A more symmetric treatment of the adjustment speeds of prices as well as

quantities may here be preferable, and may lead to more convincing results in the explanation of growth and fluctuations. In strict contrast to the market-clearing approach to monetary growth we thus assume here that price, wages, and the output of firms all adjust with finite speed in view of the imbalances that are relevant for them. Incorporating this into the approach of chapter 4 leads to the next stage in the evolution of our disequilibrium models of monetary growth.

Keynes–Metzler monetary growth theory

- Sluggish wage and price adjustments as in IS–LM growth
- Extending IS–LM growth towards IS-disequilibrium
- Inventory adjustment mechanism of Metzlerian type coupled with a sales expectations mechanism
- The working Keynesian model of monetary growth which puts the modules of traditional Keynesian macrodynamics together
- An internally consistent Keynesian model of monetary growth to be compared with more recent developments in the literature

With this stage in the hierarchy of Keynesian models of monetary growth we arrive at our working Keynesian model, whose main elements are outlined above. This model overcomes the weaknesses of the still one-sided IS–LM growth dynamics and allows for a variety of results for a Keynesian theory of fluctuations and growth, as we shall see in chapter 6, from partial perspectives as well as an integrated or total one. Assuming a Metzlerian inventory adjustment process in the place of an instantaneous clearing of the market for goods increases the dynamics by two dimensions and leads to further buffers that can prevent a switch from the Keynesian regime to one of capital or labor shortage. As chapter 6 will show, the stability analysis of the resulting model type is already fairly demanding so that many more interesting results on this (from an economic perspective still basic) integrated prototype model of monetary growth can be expected to be obtained from future research.

This highest level in the hierarchy of our models of monetary growth is therefore but the beginning of a meaningful analysis of the Keynesian approach to the theory of fluctuations and growth. The theory obtained from our integrated perspective is thus still in its infancy. In fact, one might claim at the end of this book that our prototype model of Keynes–Metzler type is but the completion of the oversimplistic Keynes–Wicksell project of describing the macroeconomics of Keynesian monetary growth, since we have arrived again at IS-disequilibrium as a theory of quantity adjust-

ments, but now without full capacity growth, the implied varying rate of capacity utilization being in turn one of the reasons for a changing rate of inflation.

In our view there is an urgent need for a better understanding of the dynamics of this integrated Keynesian prototype model in order to put at the disposal of economists a consistent theory of fluctuations, inflation, and growth against which the (mostly partial) achievements of newer and more modern approaches of new- or post-Keynesian type can really be judged. Otherwise, the statement that traditional Keynesian approaches to money and growth (which, as we hope to have shown, have not existed so far from a truly integrated perspective) are outdated in their potential to describe the evolution of capitalistic economies, will remain fairly superficial.

We will not pursue in this book the task of overhauling the modules of our working model of chapter 6 from the perspective of the new- or post-Keynesian theory, proceeding thereby to probably still more advanced models of Keynesian monetary growth, but leave this topic for future investigations.¹⁰ Instead we will provide in the concluding chapter 7, on the basis of a suitable simplification of the Metzlerian inventory mechanism, a modification of our working model which proposes simple endogenous determinations of the NAIRU rate of employment and of the natural rate of growth of the economy. This modification in addition improves the formulation of the money wage Phillips curve by taking account of insider–outsider effects on the labor market and the possibility of overtime and short time working within the firm. In this way we provide one final example of how to proceed further in the development of a hierarchy of disequilibrium approaches to monetary growth which bring the modeling framework closer and closer to a situation where macroeconomic applications become reasonable and also compelling.

Looking ahead

- Further module variations of the Keynes–Metzler working model
- Toward the new-Keynesians (monopolistic wage and price sectors)
- Towards the post-Keynesians (more sophisticated asset markets) or whatever else
- Further module variations: towards modern macroeconomic model building

By the end of chapter 7 the stage is set for the development of a body of more and more consistent and convincing descriptive Keynesian macro-

¹⁰ See Chiarella et al. (1999) for work in this direction.

models of monetary growth, on the basis of which a systematic and new analysis of this type of macrodynamic modeling is within reach. The way that we have chosen to arrive at this stage represents, in our terminology, the macro foundations of (disequilibrium) macroeconomics, which stresses and develops sophisticated integrated macrodynamic interaction and feedback structures in the place of more or less partial microeconomic underpinnings. Of course, our approach does not deny the value of such underpinnings. Indeed, research on these needs to proceed in parallel with the development of the framework we have outlined in order that the various macrodynamic interactions and feedbacks can have a firm theoretical basis.

We therefore start in this book from known (already fairly integrated) macrodynamic presentations of monetary growth in disequilibrium. We then make these models complete models on their respective level of abstraction and arrange them in a systematic order such that each subsequent model type can be understood as an improvement of certain important weaknesses of the preceding model. We show finally that one can arrive thereby at a model type that allows for labor- as well as goods-market disequilibrium, both with components that lie inside as well as outside the firm. We believe that this approach for the first time provides a proper starting point and integrated working model for the Keynesian analysis of business fluctuations in the utilization rates of both labor and capital and of growth in a monetary framework. We also stress once again that this synthesis of earlier attempts to provide a truly Keynesian model of disequilibrium monetary growth is at the same time a very traditional one. In our view it is remarkable that this task has been, and is still, very much neglected in the literature on Keynesian macrodynamics, even though it is now more than sixty years since the appearance of Keynes' *General Theory*.

1.3 Basic Tobin models of monetary growth

This and the following two sections consider in some detail traditional macrodynamic model building of the Tobin, the Keynes–Wicksell, and the AS–AD growth type in order to lay foundations for the generalized models of this type considered in chapters 2 and 3. Further presentations of traditional models of monetary growth can be found in Turnovsky (1977a,b, 1995), Sargent (1987), Sijben (1977).

Tobin (1955, 1961, 1965) was the first to attempt, and to succeed, in integrating possible influences of the growth in money supply into the real model of growth and capital accumulation of Solow (1956). In particular, his 1965 contribution can be viewed as laying the foundations and posing the basic questions for models of monetary growth, there in a neoclassical

framework where Say's Law is assumed to hold (no independent investment function) in a refined form. He added to this neoclassical model a portfolio choice mechanism¹¹ and thereby connected money growth and capital formation. Other early treatments of monetary growth along the same lines were provided by Johnson (1966, 1967a,b).

This first prototype model of monetary growth is usually presented in the literature in the following way.¹²

$$\dot{K} + (\dot{M}/p) = s(Y + (\dot{M}/p)), (s = \text{const.}) \quad (1.1)$$

$$M = pYh(\rho + \pi), (h' < 0) \quad (1.2)$$

$$Y = F(K, L^d), \omega = F_L, \rho = F_K \quad (1.3)$$

$$L^d = L, w = \omega p, L = nL, (n = \text{const.}) \quad (1.4)$$

$$\dot{M} = p(TR - T) = \mu M, (\mu = \text{const.}) \quad (1.5)$$

$$\pi = \hat{p}. \quad (1.6)$$

In our following brief reconsideration of this model we assume that the reader is familiar with the Solow–Swan model of real economic growth which is built on equations (1.1), (1.3), and (1.4) of the above model, but with the simplified savings function $\dot{K} = sY$ in the place of (1.1). This real model of economic growth gives rise to the following so-called fundamental equation of economic growth¹³

$$\dot{k} = sf(k) - nk, k = K/L,$$

which states that the time-rate of change of the capital intensity, \dot{k} , must be equal to the difference between savings per head and nk , the amount of investment needed for pure capital-widening.

In this real growth model we have no government and no depreciation of capital. Disposable income of households Y^D is therefore simply given by output Y . In the Tobin monetary growth model, disposable income of households is not so simply handled. Instead of $Y^D = Y$, equation (1.1) is used, and is usually explained by stating that real private savings are a fixed proportion of real disposable income and are spent on either capital or real balances formation: \dot{K} or (\dot{M}/p) (see Orphanides and Solow 1990, p. 230, for example). Such a statement is, however, a rather condensed one; what is really involved in household savings decisions can be made more transparent in the following way.

¹¹ And a particular concept of disposable income, as we shall see below.

¹² See Orphanides and Solow (1990) for details and notation and also pp. xxii–xxiv for a list of symbols (which are fairly standard in the presently considered model type). Note also that we use (\dot{M}/p) to denote the time derivative of real balances M/p and $\widehat{M/p}$ for its rate of growth. ¹³ By way of $\dot{k} = \dot{K} - n = sY/K - n = sf(k)/k - n(\dot{k} = \dot{k}/k)$.

Define perceived disposable income of households by

$$Y^{De} = Y - \frac{M}{p}\pi - T + TR,$$

where π is the expected (here equal to the actual) rate of inflation, T are taxes and TR are transfers. Besides capital, the Tobin extension of the Solow model has one further asset, i.e. money, here considered in the form of real balances M/p . The above concept of perceived disposable income is exactly equal to the rate at which private households can consume while leaving their real wealth, defined by $K + M/p$, intact.¹⁴ This is a well-known definition of perceived disposable income in the macroeconomic literature and it leads to the formulation of the following consumption function (where c is equal to $1 - s$):

$$C = cY^{De} = c\left(Y - \frac{M}{p}\pi - T + TR\right).$$

Private savings S_p is then given by actual disposable income ($Y^D = Y - T + TR$) minus consumption, i.e.

$$S_p = Y - T + TR - cY^{De} = \dot{K} + \dot{M}/p, \quad (1.7)$$

and it is spent on capital formation and the increase in nominal balances as shown in the above flow budget restriction of households (1.7). By means of the government budget restriction (1.5) this budget restriction can be further reformulated as

$$Y + \dot{M}/p - c\left(Y - \frac{M}{p}\pi + \dot{M}/p\right) = \dot{K} + \dot{M}/p,$$

or

$$(1 - c)\left(Y - \frac{M}{p}\pi + \dot{M}/p\right) = \dot{K} + \dot{M}/p - \frac{M}{p}\pi.$$

Due to $\pi = \dot{p}/p$ and $(\dot{M}/p) = \dot{M}/p - M\dot{p}/p^2 = \dot{M}/p - (M/p)(\dot{p}/p)$ this last equation then gives rise to equation (1.1). We therefore see that equation (1.1) is more than just a description of private savings behavior.

Equation (1.2) adds a simple LM equation to this description of asset accumulation where the nominal rate of interest is given by the rate of profit $\rho = F_K = (Y - \omega L)/K$ plus the expected rate of inflation π . Note that here the expected rate of inflation is equal to the actual rate of inflation since the present formulation of the model is based on the assumption (1.6) of myopic perfect foresight. Equations (1.3) and (1.4) are the conventional

¹⁴ See Sargent (1987, pp.18–19) for details.

equations of neoclassical full employment growth (based on the neoclassical theory of income distribution). Equations (1.5) and (1.6) have already been explained above.

Comparing this model of monetary growth with the Solow growth model we thus find that its new features are,

- a capital accumulation equation¹⁵ which is based on a new concept of perceived disposable income and a simple, but consistent government budget equation;
- a description of money-market behavior;
- the assumption of myopic perfect foresight with respect to the rate of inflation, where inflation, as a new feature, is generated by the growth in money supply.

Instead of the crude version of Say's Law employed in the Solow model ($I \equiv S = sY$) we have a more refined version of this law in the present model which follows from the two relationships (see above) $S_p = Y - T + TR - C \equiv \dot{K} + \dot{M}/p$, and $S_g = T - TR \equiv -\dot{M}/p$, i.e. $S_p + S_g = S = Y - C \equiv \dot{K}$, which states that all output not consumed will in fact be invested, since any investment in real balances must be equal to the difference between actual disposable income and output if it is assumed, as is the case here, that households absorb the increase in money supply \dot{M} .¹⁶

The above model is, as is Solow's growth model, a model of full temporary equilibrium (on the markets for goods, labor, and money), which, however, is based on Say's Law and not on some sort of Walras' Law as is sometimes believed to be the case. This is of importance when considering and interpreting its conventional extensions where money market disequilibrium is considered side by side with equilibrium in the market for both goods and for labor.

In intensive form, the above model gives rise to ($k = K/L, x = Y/L = f(k), m = M/(pL)$),¹⁷

$$\dot{k} = sf(k) - nk - (1 - s)m(\mu - \hat{p}), \quad (1.8)$$

$$\dot{m} = \mu - \hat{p} - n, \quad (1.9)$$

where \hat{p} is obtained from (see equations (1.1), (1.2), and (1.6)) $m = h(f'$

¹⁵ $\dot{K} = Y - C = S = S_p + S_g$, see the following.

¹⁶ This formulation of Say's Law implies that the goods market will always be in equilibrium, quite independently of the state of the market for money or for labor. Such a situation is not possible in models that rely on some form of Walras' Law.

¹⁷ If $Y^{De} = Y^D = Y - T + TR$ is assumed instead of the above we would obtain here: $\dot{k} = sf(k) - nk - (1 - s)\mu m$.

$(k) + \hat{p})f(k)$, by making use of $\dot{k} = (\hat{K} - n)k = \dot{K}/L - nk$ and equation (1.1), since $(\dot{M}/p) = (\mu - \hat{p})M/p$.

The model therefore exhibits a new term in its fundamental equation, namely $-(1 - s)m(\mu - \hat{p})$, which makes capital accumulation now also dependent on real balances per head and money market phenomena. Furthermore, it now consists of two dynamical laws (for k and m) instead of the single law (for k) of the Solow model.

The steady state of the model (where $\mu = \hat{p} + n$ holds) is described by

$$\begin{aligned} 0 &= sf(k) - nk - (1 - s)nm \\ m &= h(f'(k) + \mu - n)f(k). \end{aligned}$$

Assuming that there is a unique solution to these equations¹⁸ it follows immediately by total differentiation ($f' > 0$, $f'' < 0$, $h' < 0$) that $dk/d\mu > 0$ must hold true, which is the so-called Tobin effect. This intuitively plausible effect states that if the return of holding money as an asset is reduced (by increasing the steady state rate of inflation $\mu = \dot{M}/M$), the relative composition of assets will shift toward capital, increasing thereby capital intensity k and output per head $y = f(k)$. Instead of the superneutrality of money (where μ does not influence the real part of the economy in the steady state), we thus have a positive influence of the growth rate of money supply on capital, output, and consumption per head.

This steady-state result has been extended, turned into a negative Tobin-effect and also shown to be non-existent through a variety of modifications of the original Tobin model in descriptive as well as optimizing macro-economic frameworks. This literature is surveyed in Orphanides and Solow (1990) and will not be considered here, since we only want to give a brief survey on the dynamic properties of the Tobin model and its extension to adaptive expectations in this section.

Nagatani (1970) has investigated the stability of the Tobin model under the assumed situation of myopic perfect foresight and found that it exhibits saddlepoint instability. As Orphanides and Solow (1990) state: "At this time this was considered to be a fatal flaw of the model, . . ." Thus it appeared at that time that the steady-state analysis of Tobin was not supported by dynamic analysis as far as the myopic perfect foresight case (1.6) was concerned.

Yet, Sidrauski (1967a) had already shown that if inflationary expectations π are formed adaptively and at a sufficiently slow rate, then the Tobin model was globally asymptotically stable. This modification, instead of (1.8), (1.9) gives rise to

¹⁸ Which can easily be shown by means of simple assumptions on f and h , since the function $nk/f(k) + (1 - s)nh(f'(k) + \mu - n)$ involved in the determination of the steady state is strictly increasing.

$$\begin{aligned}\dot{k} &= sf(k) - nk - (1 - s)m(\mu - \pi), \\ \dot{\pi} &= \beta_{\pi}(\hat{p} - \pi) = \beta_{\pi}(\mu - n - \pi - \hat{m}), (\beta_{\pi} > 0),\end{aligned}$$

where m is given by $m = h(f'(k) + \pi)f(k)$, which would therefore support the steady-state arguments of Tobin again.¹⁹ To explore the stability properties of this steady-state solution further it was also often assumed, in particular by Hadjimichalakis (1971a,b),²⁰ that prices are not always equilibrating, but are responding sluggishly to money market disequilibrium and, due to Fischer's (1972) proposal, also dependent on the expected rate of inflation π , as for example in the following determination of the rate of inflation:

$$\hat{p} = \beta_p(m - h(f'(k) + \pi)f(k)) + \pi.$$

The dynamic system thereby becomes a three-dimensional one and of the form

$$\begin{aligned}\dot{k} &= sf(k) - nk - (1 - s)m(\mu - \pi), \\ \dot{m} &= m(\mu - \hat{p} - n) = m(\mu - n - \pi - \beta_p(m - h(f'(k) + \pi)f(k))), \\ \dot{\pi} &= \beta_{\pi}(\hat{p} - \pi) = \beta_{\pi}\beta_p(m - h(f'(k) + \pi)f(k)).\end{aligned}$$

The advantage of this formulation of the dynamics around Tobin's steady state is that its feedback structure is more easily understood (or more disentangled), but at the cost of increasing the dimension of the dynamics by one and by a perhaps not widely accepted adjustment rule for the price level p . Be that as it may, this generalization of the dynamics (and modifications of it) have been extensively studied in the literature. Hayakawa (1984), for example, uses a general flow disequilibrium concept in the market for money in order to systematize the local stability properties of various approaches to the determination of \hat{p} by means of special cases of it. Benhabib and Miyao (1981) show that the generalized Tobin model loses stability in a cyclical fashion by way of a Hopf bifurcation if the parameter β_{π} of the expectations mechanism becomes sufficiently large. The general impression that arises from these treatments of the stability problems of the Tobin model is that adaptive expectations support instability if they are formed with sufficient strength (with a lag that is sufficiently short), while their limit case $\beta_{\pi} = \infty$ of myopic perfect foresight directly gives instability in the form of a (local) saddlepath dynamics.

In our view, the basic explanation for such a result is that there is a positive feedback mechanism in this model and its variants, of the form

$$\pi \uparrow m - h(f'(k) + \pi)f(k) \uparrow \hat{p} \uparrow \pi \uparrow,$$

which becomes stronger the larger the adjustment speeds β_p, β_{π} of prices

¹⁹ The steady state of this model is the same as that of the Tobin model (1.1)–(1.6).

²⁰ See Sijben (1977) for an early systematic treatment of the literature on the Tobin model.