Financial Stability, Macroeconomic Cycles and Complex Expectation Dynamics

Inauguraldissertation zur Erlangung des akademischen Grades eines Doktors der Wirtschaftswissenschaften des Fachbereichs Wirtschaftswissenschaften der Universität Osnabrück

vorgelegt von

Florian Hartmann

Osnabrück, Januar 2017

Dekan:	Prof. Dr. Joachim Wilde
Referenten:	Prof. Dr. Valeriya Dinger
	Prof. Dr. Bernd Meyer
Tag der mündlichen Prüfung:	19.01.2017

für Mama und Papa

Contents

1 Introduction

1.1 Papers

The thesis builds on the following papers:

- Hartmann, F., Charpe, M., Flaschel, P. and Veneziani, R., (2016): A Basic Model of Real-Financial Market Interactions with Heterogeneous Opinion Dynamics, Institute of Empirical Economic Research, Osnabrück University, Working Paper No. 104.
- Hartmann, F. and Flaschel, P., (2014): Financial Markets, Banking and the Design of Monetary Policy: A Stable Baseline Scenario, Economies, 2 (1), 1-19.
- Charpe, M., Flaschel, P., Hartmann, F. and Malikane, C., (2014): Segmented Labor Markets and the Distributive Cycle, Economics Research International, Article ID 218353, 15 pages, http://dx.doi.org/10.1155/2014/218353.
- Flaschel, P., Hartmann, F., Malikane, C. and Proaño, C., (2014): A Behavioral Macroeconomic Model of Exchange Rate Fluctuations with Complex Market Expectations Formation, Computational Economics, 45(4), 669-691, doi: 10.1007/s10614-014-9437-8.
- Chiarella, C., Flaschel, P., Hartmann, F. and Proaño, C., (2012): Stock Market Booms, Endogenous Credit Creation and the Implications of Broad and Narrow Banking for Macroeconomic Stability, Journal of Economic Behavior and Organization, 83, 410-423.

- Charpe, M., Flaschel, P., Hartmann, F. and Proaño, C., (2011): Stabilizing an Unstable Economy: Fiscal and Monetary Policy, Stocks, and the Term Structure of Interest Rates, Economic Modelling, 28, 2129-2136.
- Flaschel, P., Hartmann, F., Malikane, C. and Semmler, W., (2010): Broad Banking, Financial Markets and the Return of the Narrow Banking Idea, Journal of Economic Asymmetries, 7(2), 105-138.
- Barens, I., Flaschel, P., Hartmann, F., and Röthig, A., (2010): Kaldorian Boom-Bust Cycles in the Housing Market, European Journal of Economics and Economic Policies: Intervention (EJEEP), 7, 361-375.

1.2 Financial Stability, Macroeconomic Cycles and Complex Expectation Dynamics

The thesis tries to shed light on mechanisms that endanger the macro-financial stability of economies. For that purpose a modeling framework is set-up which allows for cyclical behavior on the macro level and does not automatically enforce monotonic convergence of the dynamics to a stable equilibrium. Thus, the assumption of rational expectation must be replaced by alternative expectation formation schemes which are more relevant from an empirical point of view. We start to put forth a modeling approach of a partial, but crucially important market for the whole economy. As we could learn from the great recession, activities in the housing market can trigger economy-wide crises when financial markets are highly interconnected and exert a lasting impact on real markets. The next step is to construct an integrated macro model which captures the interaction of real and financial markets with respect to possible destabilizing linkages. Policy instruments can work then as remedies as long as they are designed in a manner that takes account of the underlying feedback structure. Step by step the models are extended throughout the chapters by refinement of the macro-financial structure. A banking sector is introduced and many issues arising with this addition are discussed. After having addressed several configurations of the banking sector, the focus is shifted to the expectation formation of agents. Behavioral traders on the micro level then drive complex dynamics on the macro level, which eventually feedback on the distribution of different types of trading strategies. We also investigate the implications of such behavioral expectation formations for open economies. Finally, we look at potential instabilities that arise from the supply side of macroeconomies in the long run. A model with a differentiated labor market structure and an accumulation mechanism is used to display distributive cycle dynamics and their stability implications.

The overall research approach used during this thesis has to be put into the context of the existing literature on macroeconomics and business cycles. During the times of the great moderation in the early 2000s and even after the global recession of 2008/09 macroeconomics was perceived mainly as Dynamic Stochastic General Equilibrium (DSGE) modeling. The DSGE approach to macroeconomics is technically highly sophisticated, but based at least partially on flawed assumptions. At the heart of DSGE models a micro-founded New Keynesian set-up can be found. The microfoundations used are deeply rooted in neoclassical economics. Keynesian elements just seem to be needed to eliminate the worst empirical anomalies that would otherwise occur.

Rational Expectations being at the core of any New Keynesian model, reduce the Keynesian element to staggered wages and prices. What is missing is an animal spirits sentiment in the investment function which might explain endogenously the occurrence of frequent and severe deviations from equilibrium.

The Rational Expectations revolution initiated by Muth (1961) and the emergence of the Lucas critique (1976) started to question the solidity of large-scale Old Keynesian models in the 1960s and 1970s. They were formulated quite ad-hoc and worked in a rather mechanical fashion that failed to show potential to adopt to new policy and institutional environments appropriately. But the prescribed cure of microfoundations of macroeconomics led to empirically irrelevant modeling approaches which lacked emerging feedback channels on the macro level. Policy-relevant theoretical macroeconomics should care about empirics and try to catch and describe interconnections and patterns observable beyond the micro sphere (compare e.g. Da Silva 2009 and Faggini and Parziale 2012).

As crises are recurrently discernible empirical phenomena, we undergo the endeavor to deliver models that feature mechanisms which inherently give rise to cycles and local instability. We conduct our modeling exercises in the spirit of truly Keynesian disequilibrium theorizing and the Minskyan financial instability hypothesis. Addressing these aspects seriously demands financial markets as integral part of macro models and neglecting the neoclassical dichotomy of real and monetary markets. This is of course in stark contrast to the efficient market hypothesis and the real business cycle school which sees any disturbance of equilibrium being induced by outside shocks (Kydland and Prescott 1982).

After the great recession and in face of an ongoing debt crisis in Europe the economics profession has been confronted with the question why the recent crisis was not predicted way ahead and the state-of-the-art models failed to explain what was going on. Taking this challenge seriously one has to ask whether a leap forward in theory has been made after the global financial crises? DSGE modelers are aware of shortcomings, but there is only limited scope of remedy to deeply rooted misconceptions. Agent interactions as an important building bloc of any alternative to the intertemporally optimizing representative agent in the microfoundation part have to be introduced.

This has been done e.g. by Covas and Den Haan (2006) and Den Haan (2006), but the modifications remain partial and are incorporated into an equilibrium set up. Some remedies of the standard approach's shortcomings with respect to heterogeneous expectation formation have also been presented by Branch and McGough (2009), Molnur (2010) and Nunes (2009). The problem with these contributions is that agents remain basically rational and just some kind of friction obstructs learning rational expectations or simply makes it too costly in agents optimizing procedures.

Essentially it should be the following factors when you reason for deviations from the rational expectations limit case: limited cognitive abilities (an individual is restricted with regard to his computational power and information processing capabilities), lack of perfect information (information gathering needs time, which means at least it is not instantaneous) and context-dependent behavior, which might be framed by peers through group dynamics or even manipulation, as well as by mood, emotions and culture. See Helbing and Kirman (2013) for a comparison of similar demands to model building in a more realistic fashion.

Financial crises are potential features of advanced macroeconomies and come with huge economic and social costs which could easily amount to a large fraction of a country's GDP and considerably lasting consequences (Reinhart and Rogoff 2009). Kindleberger and Aliber (2005) discuss very profoundly the characteristics of financial and exchange rate crises throughout the evolution and history of the world economy.

Besides being extremely disruptive and costly, financial crises are recurrent and they raise, of course, important issues for theorists and policy makers alike. The ruling paradigm of Dynamic Stochastic General Equilibrium (DSGE) in macroeconomics has not done a rather compelling job with respect to the explanation of financial crises and especially the recent global downturn as argued by Colander et al. (2009) and admitted also by proponents of the DSGE approach, such as Charie et al. (2009).

Arguably, this unsatisfactory performance has not been the result of a lack of mathematical sophistication. Rather, it derives from the adoption of an equilibrium approach coupled with the assumption of Rational Expectations, which seem methodologically and empirically questionable. Indeed, De Grauwe (2010) has attempted to build DSGE models without Rational Expectations by assuming agents to have limited cognitive abilities. Tovar (2009) among others has also argued that it is necessary to incorporate various transmission mechanisms that had been absent in the DSGE literature for quite a while, but are nonetheless crucial to understand monetary market economies. Improvements like presented in Coenen et al. (2012) have been made to counter this line of critique, but cannot overcome the basic flaws which come with the imposition of Rational Expectations. Even the incorporation of heterogeneous expectations, as it is done in Massaro (2012) or Branch and Evans (2011) only accomplishes partly a change in determinacy respectively policy implications, but sticks to imposed equilibrium considerations which do not allow to map some of the essential dynamic feedbacks.

In the behavioral finance literature – in contrast to the predominant macroeconomic literature – it is widely acknowledged that the rational expectations assumption is not able to explain basic stylized facts of financial markets – not only concerning crises –, see e.g. Hommes (2006) and De Grauwe and Grimaldi (2006), and alternative expectations formation schemes are widely used within that research program instead.

This thesis proposes a number of departures from the DSGE methodology, which can be seen as being part of a new approach in the Keynesian tradition. Characteristic is the joint rejection of Rational Expectations and constant market-clearing, as well as abandoning the intertemporally optimizing representative agent. Instead we pursue in our modeling approach the integration of heterogeneous agents which allow for interaction and the formation of complex opinion dynamics in a disequilibrium framework. Further contributions to this line of research in behavioral macroeconomic modeling are e.g. Chiarella et al. (2013, 2014, 2015), Flaschel and Proaño (2015) and Franke (2014).

One of the key contributions of the thesis, however, is the explicit incorporation of opinion dynamics in financial markets populated by heterogeneous agents which allows us to examine the effects of herding and speculative behavior in combination with real-financial market interactions. More precisely, we adopt the distinction between chartists and fundamentalists originally proposed by Allen and Taylor (1990) and as Brunnermeier (2008) documents, perceived as a main approach in explaining bubbles.

Financial markets are supposed to have the primary function to channel savings into investment in an efficient way, and should not be shaped through the gambling activities of asset holders. This was already clearly stressed in Keynes (1936, p.159) and of course an important subject in the works of Hyman Minsky (1982, 1986). Recent empirical support of the Minsky hypothesis of financial stability breeding its own instability by overly optimistic risk taking of agents in stable phases, is delivered by Danielsson et al. (2016). In order to capture the working of financial markets in a formal way we use a dynamic portfolio approach based on the work by James Tobin (1982) during the thesis which enables to identify the sources of financial market instability and could capture feedback channels from the financial to the real markets and vice versa.

As we consider financial markets with heterogeneous expectation formation we follow Allen and Taylor (1990) and Frankel and Froot (1990) in distinguishing between fundamentalists and chartists. Albeit simple, this description of agent heterogeneity on financial markets is consistent with studies analyzing expectational heterogeneity (see, for example, Menkhoff et al., 2009), and agents' behavior on financial or foreign exchange markets (see, for example, De Grauwe and Grimaldi, 2005 and recently Proaño, 2011) and sufficient to examine some of the core propagation features of financial markets that have played a prominent role in the recent global financial crisis.

Monetary and fiscal policy measures were aimed at preventing the financial market meltdown that started in the US subprime sector and had spread world wide as a great recession. Regarding this background it is worthwhile exploring the fragility and potentially destabilizing feedbacks of advanced macroeconomies in the context of Keynesian macro models.

During chapters 2 to 8 of the thesis we simplify the real side of the macro models to a minimum, though being aware that important feedback mechanisms are at work there which might act as triggers to economic instability as well. The importance of financial side induced challenges for a smooth functioning of real-financial markets interaction is put into the spotlight with the goal of giving as much transparency as possible to the mechanisms being relevant. This is eased of course by focusing on one part in order to isolate crucial effects. Moreover, we try to handle the models analytically as long as possible, but differential equations systems with unavoidable economic non-linearities quickly render the models intractable. When addressing higher-dimensional versions of real-financial interactions we have to rely on simulation exercises as well, but keep real side stability issues out of the picture as we do not discuss wage-price spiral dynamics or real balances effects.

One could extend the class of models with the help of a Phillips curve to integrate these feedbacks as has been done in other contributions to this line of research. The introduction of inventory adjustments could be considered and the investigation of a real interest rate channel accompanied by a Mundell effect. These might all be worthwhile tasks, but would distract the attention from financial side sources of instability and obstruct to some degree the clear cut display of cause and effect. The economic modeler faces a trade-off between comprehensiveness and avoidance of overburdening. We took the decision to leave the real side stable when looked at it in isolation and emphasize instabilities that come about when this stable element interacts with potential financial side triggers which often only materialize as such in the process of interaction.

Starting our tour of unstable economies we show in the first chapter that the Kaldor (1940) trade cycle mechanism can be meaningfully applied to the market for residential housing space, since the demand for houses may be positively related to the housing price in a mid-range price domain, while it is downward sloping for house prices sufficiently small as well as sufficiently large. Confronted with the current supply of houses this gives rise to multiple equilibria. Then the employed nonlinear house demand schedule is coupled with backward-looking house price expectations and a planar dynamics is obtained with the same range of model-consistent expectations equilibria as in the partial situation studied beforehand. The model however is not dependent on the backward oriented expectation scheme, but also applies to the case of myopic perfect foresight. The nonlinear demand function for houses in connection with changes in the housing stock initiates sudden reversals from booms into busts and vice versa, which from a mathematical point of view give locally rise to fold catastrophes at the bifurcation points, with the dynamics being described by relaxation oscillations from the global perspective.

In the second chapter of the thesis we focus in particular on the financial markets and its stability characteristics in the context of a whole economy-wide environment. We use a Tobin-like macroeconomic portfolio approach and the interaction of heterogeneous agents on the financial market to characterize the potential for financial market instability. We show that specific fiscal and monetary policies have to be used to stabilize such unstable macroeconomies.

The banking sector has been an important originator and propagator of shocks to the real economy during recent crises and, therefore, should be paid adequate attention to. That is the reason why we try to integrate its basic working into our disequilibrium approach. First, in a rather basic and stability enhancing way in form of commercial banking. After having set the scene for banking activities, we look at the institutionalized provision of loans from the supply and demand side. Specific implications of narrow and broad banking configurations are studied.

A baseline integration of commercial banks into the in the preceding chapter introduced disequilibrium framework with the behavioral traders is presented in the fourth chapter. At the core of the analysis is the impact the banking sector exerts on the interaction of real and financial markets. Potentially destabilizing feedback channels in the presence of imperfect macroeconomic portfolio adjustment and heterogeneous expectations are investigated. Given the possible financial market instability, various policy instruments have to be applied in order to guarantee viable dynamics in the highly interconnected macroeconomy. Among those are open market operations reacting to the state-of-confidence in the economy and Tobin-type capital gain taxes. The need for policy intervention is even more striking, as the banking sector is modeled in a rather stability enhancing way, fulfilling its fundamental tasks of term transformation of savings and credit granting without engaging in investment activities itself.

Chapter five introduces a banking sector modeling variant that resembles much more to real world institutions as this building bloc serves as a potential source of instability as long as banking is conducted in a broad manner allowing the interference of investments in assets with the task of loan granting.

The financial market meltdown of 2008/09 started in the US subprime sector, but ended up in the international banking system. Yet, the meltdown was not only ending up in banking system, it was also, to some extent, amplified by the banking system. The meltdown has then spread worldwide and developed into a great recession (including the loss of credibility of whole countries in the Eurozone and elsewhere). Thus, in the fifth chapter, we explore the fragility and potentially destabilizing feedbacks of the banking system in the context of a Keynesian macro model. We use a simple dynamic multiplier approach on the market for goods and also a simple rate of return driven adjustment rule for stock prices to study the role of commercial banks and credit when embedded into such an environment. We first consider the implications of a broad banking system where commercial banks are allowed to trade in assets (here equities) as a substitute for lending. We show that such a scenario is likely to be an unstable one, even if an appropriate monetary policy of the central bank is added to the considered dynamics. We then consider narrow banking which is defined by a Fisherian 100 percent reserve ratio for checkable deposits and the exclusion of trade in stocks and other assets for commercial banks. It is shown that in such a scenario stability is guaranteed by some weak assumptions on the behavior of economic agents. Moreover, a sufficient loan supply is guaranteed in such a framework, and disastrous bank runs are avoided, in contrast to what is likely to happen under broad banking. It exemplifies the characteristics with regard to stability and efficiency an alternative banking system can have.

In the following chapter we study the implications of the present broad banking system for macroeconomic stability. Commercial banks are again allowed to trade in financial assets (here equities) as a substitute for lending. In contrast to the previous chapter which concentrated on the supply of credit, this chapter highlights much more the determining role of firms' credit demand in the interaction process with economic activity. It turns out that the so-specified system is also likely to be an unstable one. As a remedy narrow banking, defined by a Fisherian 100% reserve ratio for checkable deposits, is proposed here as well. Within the stylized theoretical framework set up here, we show that in the second system macroeconomic stability is guaranteed by some not too strong assumptions on agent behavior. Though narrow banking is an extreme banking system it highlights the stability and efficiency properties of the separation between commercial and investment banking. The topic of narrow banking has meanwhile also attracted attention of proponents of the DSGE school. Comparable results have been obtained here with respect to the favorability of the narrow banking concept in terms of volatility and stability (e.g. Kumhof and Benes (2012) as well as Jakab and Kumhof (2015)).

Further, unlike in much of the macrodynamic literature existing besides the DGSE approach, we analyze *microfounded* expectation processes on financial markets by incorporating an innovative concept of *animal spirits* developed by Franke (2012) and Lux (1995) instead of the standard rational expectation apparatus in chapters 7 and 8.

The respective part introduces an alternative modeling approach to the mainstream DSGE paradigm, namely a Dynamic Stochastic General Disequilibrium (DSGD) baseline model of continuous and gradual adjustment processes on interacting real and financial markets. Heterogeneous capital gain expectations (chartists and fundamentalists) are introduced in place of rational expectations and we show that the first type of agents tends to destabilize the economy. An additional feature is that the share of prevailing opinion types is able to switch endogenously. Global stability can be ensured if opinions favor fundamentalist behavior far off the steady state. This interaction of expectations and population dynamics is bounding the potentially explosive real-financial market interactions, but can enforce irregular behavior within these bounds when the dynamics is dominated by fundamentalist behavior far off the steady state (at least in the downturn). The size of output and share price fluctuations can be reduced however by imposing suitably chosen policy measures on the dynamics of the private sector.

The following chapter 8 investigates the emergence of complex market expectations (opinion dynamics) around nominal exchange rate adjustments using a DSGD macro-financial model of a small open economy featuring heterogeneous expectation formation (chartists and fundamentalists) and gradual adjustment processes in real and also to a certain degree in financial markets. The model shows among other things the mechanisms through which the first type of agents tends to destabilize the economy. Global stability can be ensured, if opinions turn to fundamentalist behavior far off the steady state. This interaction of expectations and population dynamics is bounding the – due to chartist behavior – potentially explosive real-financial market interactions, but can enforce irregular behavior within these bounds. The size of output and exchange rate fluctuations can be dampened by adding suitable policy measures to the dynamics of the private sector.

Because markets are highly interconnected, we follow Minsky (1982) and consider multiple policy instruments in chapters 7 and 8. We in particular show that a Tobin-type tax on capital gains together with a capital market oriented monetary policy rule can indeed stabilize the economy, in the sense of reducing its volatility. The array of instruments proposed is similiar to those obtained by Farmer (2010) from a different modern 'animal spirits' approach.

For long run considerations of the macroeconomy we make use of the Goodwin model of the distributive cycle in the final chapter. In the same spirit of the modeling approach we used regarding short and medium run, the Goodwin model allows for local instability and therefore, from our point of view, a realistic and empirically relevant capturing of macroeconomic dynamics. Latest empirical findings of Beaudry et al. (2015) also suggest that the macroeconomy is inherently unstable through endogenous forces and not a per se stable system just facing outside shocks. Business and growth cycles might be best perceived as limit cycles of dynamical systems. We study the implications of a segmented labor market in such a model of the growth cycle and derive policy recommendations from it which are in stark contrast to the ones usually obtained from neoclassical supply side approaches.

In order to challenge the neoclassical approach to analyze labor market related issues, we alter only as little as possible compared to that modeling strategy. We leave Say's law in place and, thus, neglect all problems arising from insufficient aggregate demand due to Keynesian considerations for the time being. The Goodwin model takes a Phillips curve mechanism and departs from the assumption of one representative agent as there is a conflicting claim between workers and capitalists being present that cannot be easily resolved by neoclassical distribution theory of marginal products. The induced dynamics, though basically simple of a prey-predator type (Lotka-Volterra) are actually able to produce a stylized pattern of distributional cycles which have been discernible in western post-war economies. Of course, there is no attempt made to fine-tune the theoretical model to empirical data here, but a general explanatory power seems obvious.

Given only little alterations to neoclassical modeling approaches though, one can show how significantly policy derivations for labor markets differ. The argument put forth would be even strengthened if other flaws of neoclassical reasoning were taken into account of which we try to get rid off in the other chapters. We use the Goodwin model to emphasize distributional issues in our analysis instead of trying to capture all factors exercising significant impacts on labor market evolutions. In particular, potential effects arising from technological change are not addressed, since we make use of a limitational production function with constant coefficients.

The core of our critique of the neoclassical approach to labor market questions is here that even a purely supply-side driven model with Say's law holding can give rise to severe labor market disruptions which might not be acceptable from a a societal point of view and, therefore, have to be cured by appropriate policy intervention.

Goodwin's (1967) growth cycle model is one of the truly baseline models of macroeconomic theory, comparable to the orthodox Solow (1956) model in its simplicity, but totally different in its implications from the latter type of growth theory. See Flaschel (2009) for a detailed study of this type of approach. This has indeed also been acknowledged by Solow himself, see Solow (1990), and has led to numerous publications on modifications and extensions of this approach to a distributive cycle.

Barbosa-Filho and Taylor (2006) have characterized distributional dynamics in the US economy applying this cycle mechanism, see also Taylor (2004, ch.9) in this regard. Recently, the *Cambridge Journal of Economics* devoted a special issue to Goodwin's contribution to economics (Velupillai 2015) and, in 2006, there has been a special issue in the Journal *Structural Change and Economic Dynamics* on Goodwin's legacy and its continuation as well as an edited volume on this subject, see Flaschel and Landesmann (2008). There has also been recent empirical work on this distributive cycle by Harvie (2000), Mohun and Veneziani (2006, 2008), Franke et al. (2006), Fiorio et al. (2013) and others. This indicates that the model of the reserve army mechanism designed by Goodwin (1951, 1967, 1972) is still attracting numerous studies of its further development and its empirical evaluation. Chapter 9 builds on the Goodwin (1967) model which describes the distributive cycle of capitalist economies whereby mass unemployment is generated periodically through the conflict about income distribution between capital and labor. This model type seems to be adequate to address longer-run issues and, thus, the supply side of modern economies that feature unstable dynamics. In order to focus on labor market issues and problems of reforms of it, we do not model demand side issues as we did in the previous chapters. The main reason for that is not that they would not be present in actual labor markets, but that we want to stress instability challenges which arise on the supply side. Thus, we are able to address the topic of labor flexibility prevailing in the mainstream discussion and point out instability traps occurring even under an a priori perfectly working Say's law. The same assumption that is crucial in neo-classical models. We add to the classical baseline model of Goodwin a segmented labor market structure with a fluid, a latent and a stagnant component. The model exhibits a unique balanced growth path which depends on the speeds with which workers are pushed into or out of the labor market segments. We investigate the stability properties of this growth path with segmented labor markets and find that, though there is a stabilizing inflation barrier term in the wage Phillips curve, the interaction with the latent and stagnant portions of the labor market generates potentially (slowly) destabilizing forces, if policy measures are absent that regulate these labor markets. We then introduce an activating labor market policy, where government in addition acts as employer-of-last-resort, thereby eliminating the stagnant portion of the labor market, whilst erecting benefit systems that partially sustain the incomes of workers that have to leave the floating labor market of the private sector of the economy. We show that such policies guarantee the macro-stability of the economy's balanced growth path.

1.3 References

Allen, H. and Taylor, M.P., 1990, Charts, Noise and Fundamentals in the London Foreign Exchange Market, The Economic Journal, 100, 49-59.

Barbosa-Filho, N. and Taylor, L., 2006, Distributive and demand cycles in the US economy - A structuralist Goodwin model. Metroeconomica 57, 389-411.

Beaudry, P., Galizia, D. and Portier, F., 2015, Reviving the limit cycle view of macroeconomic fluctutations, CEPR Discussion Paper 10645, NBER Working Paper 21241.

Branch, W. A. and G.W. Evans, 2011, Monetary Policy and Heterogeneous Expectations, Economic Theory, 47(2), 365-393.

Brunnermeier, M.K., 2008, Bubbles. In: Durlauf, S., Blume, L. (Eds.), The New Palgrave Dictionary of Economics, 2nd Edition, Palgrave Macmillan.

Chari, V., Kehoe, P. and McGrattan, E., 2009, New Keynesian Models: Not yet useful for policy analysis. American Economic Journal: Macroeconomics, 1, 242-266.

Chiarella, C., Flaschel, P. and Semmler, W., 2012, Reconstructing Keynesian Macroeconomics Volume I: Partial Perspectives, Routledge, New York.

Chiarella, C., Flaschel, P. and Semmler, W., 2013, Reconstructing Keynesian Macroeconomics Volume II: Integrated Approaches, Routledge, New York.

Chiarella, C., Flaschel, P. and Semmler, W., 2015, Reconstructing Keynesian Macroeconomics Volume III: Macroeconomic Activity, Banking and Financial Markets, Routledge, New York.

Colander, D., Föllmer, H., Haas, A., Goldberg, M., Juselius, K., Kirman, A., Lux, T. and Sloth, B., 2009, The Financial Crisis and the Systemic Failure of Academic Economics, Discussion Papers 09-03, University of Copenhagen. Department of Economics.

Coenen, G., Erceg, C., Freedman, C., Furceri, D., Kumhof, M., Lalonde, R., Laxton, D., Linde, J., Mourougane, A., Muir, D., Mursula, S., Resende, C., Roberts, J., Roeger, W., Snudden, S., Trabandt, M., Veld, J., 2012, Effects of Fiscal Stimulus in Structural Models, American Economic Review: Macroeconomics, 4(1), 22-68.

Covas, F., Den Haan, W., 2012, The role of debt and equity finance over the business cycle, The Economic Journal, 122, 1262-1286.

Da Silva, S., 2009, Does Macroeconomics need Microeconomic Foundations?, Economics: The Open-Access, Open Assessment E-Journal, Vol. 3, 2009-23. `http://www.economics-ejournal.org/economics/journalarticles/2009-23`

Danielsson, J., Valenzuela, M. and Zer, I., 2016, Learning from history: volatility and financial crises, LSE Working Paper, SSRN.

De Grauwe, P., 2010, The scientific foundation of dynamic stochastic general equilibrium (DSGE) models. Public Choice, 144, 413-443.

De Grauwe, P. and Grimaldi, M., 2005, Heterogeneity of agents and the exchange rate: A nonlinear approach. In: De Grauwe, P. (Ed.), Exchange Rate Economics: Where Do We Stand?, CESifo Seminar Series, MIT Press, Cambridge, pp. 125-168.

De Grauwe, P. and Grimaldi, M., 2006, The Exchange Rate in a Behavioral Finance Framework, Princeton University Press.

Den Haan, W., 2007, Shocks and the unavoidable road to high taxes and high unemployment, Review of Economic Dynamics, 10(3), 248-366.

Faggini, M.and Parziale, A., 2012, The Failure of Economic Theory. Lessons from Chaos Theory, Modern Economy, 3, 1-10.

Farmer, R.E.A., 2010, How to reduce Unemployment: A new Policy Proposal. Journal of Monetary Economics. Carnegie Rochester Conference Series on Public Policy, 57(5), 557-572.

Fiorio, C., Mohun, S. and Veneziani, R., 2013, Social Democracy and Distributive Conflict in the UK, 1950-2010, Working Paper, No. 705, School of Economics and Finance, Queen Mary University of London.

Flaschel, P., 2009, Macrodynamics. Elements for a Synthesis of Marx, Keynes and Schumpeter. Heidelberg: Springer.

Flaschel, P. and Landesmann, M., 2008, Mathematical Economics and the Dynamics of Capitalism. The Legacy of Richard Goodwin Continued. London: Routledge Frontiers of Political Economy.

Flaschel, P. and Proaño, C., 2014, 2D Chaos in the Interaction of Inflation and Unemployment: Moving Averages and the Modeling of High Frequency Macrodynamics, Journal of Chaos, Article ID 515637, 9 pages http://dx.doi.org/10.1155/2014/515637

Franke, R., 2012, Microfounded animal spirits in the new macroeconomic consensus. Studies in Nonlinear Dynamics and Econometrics, 16:4, Article 4.

Franke, R., 2014, Aggregate sentiment dynamics: A canonical modelling approach and its pleasant nonlinearities, Structural Change and Economic Dynamics, 31, 64–72.

Franke, R., Flaschel, P. and Proaño, C., 2006, Wage-price dynamics and income distribution in a semi-structural Keynes-Goodwin model. Structural Change and Economic Dynamics 17, 452–465.

Frankel, J. A. and Froot, K.A., 1990, Chartists, fundamentalists, and trading in the foreign exchange market, The American Economic Review 80(2), 181–185. Papers and Proceedings of the Hundred and Second Annual Meeting of the American Economic Association.

Goodwin, R., 1951, The nonlinear accelerator and the persistence of business cycles, Econometrica, 19(1), 1-17.

Goodwin, R.M., 1967, A growth cycle. In: C.H. Feinstein (ed.): Socialism, Capitalism and Economic Growth. Cambridge, UK: Cambridge University Press, 54–58.

Goodwin, R. M., 1972, A Growth Cycle. In: E.K. Hunt and J.G. Schwartz (eds.): A Critique of Economic Theory. Harmondsworth: Penguin Books, 442-449.

Harvie, D., 2000, Testing Goodwin: growth cycles in ten OECD countries. Cambridge Journal of Economics 24, 349–376.

Helbing, D. and Kirman, A., 2013, Rethinking economics using complexity theory, real-world economics review, 64, 23-52, `http://www.paecon.net/PAEReview/issue64/HelbingKirman64.pdf`

Hommes, C. , 2006, Heterogeneous agent models in economics and finance, in: Handbook of computational economics, Vol.2: Agent-based computational economics, eds L. Tesfatsion and K. L. Judd, 1109-1186, Amsterdam, North-Holland.

Jakab, Z. and Kumhof, M., 2015, Banks are not intermediaries of loanable funds - and why this matters, Bank of England Working Paper Series No. 529, May.

Kaldor, N., 1940, A model of the trade cycle, Economic Journal 50, 78-92.

Keynes, J.M., 1936, The General Theory of Employment, Interest and Money. Macmillan, London.

Kindleberger, C. and Aliber, R., 2005, Manias, Panics and Crashes. A History of Financial Crises, 5th edition. New York: Wiley.

Kumhof, M. and Benes, J., 2012, The Chicago Plan Revisited, IMF Working Papers, 12/202.

Kydland, F.E. and Prescott, E.C., 1982, Time to build and aggregate fluctuations, Econometrica, 50, 1345-1370.

Lucas, R.E., 1976, Econometric Policy Evaluation: A Critique., Carnegie-Rochester Conference Series on Public Policy, 1, 19-46.

Lux, T., 1995, Herd Behaviour, Bubbles and Crashes, The Economic Journal, 105, 881-896.

Massaro, D., 2012, Heterogeneous expectations in monetary DSGE models. CeNDEF Working paper 12-02.

Branch, W.A. and McGough, B., 2009, A New Keynesian Model with heterogeneous expectations, Journal of Economic Dynamics and Control, 33(5), 1036-1051.

Menkhoff, L., Rebitzky, R. and Schröder, M., 2009, Heterogeneity in Exchange Rate Expectations: Evidence on the Chartist-Fundamentalist Approach. Journal of Economic Behavior & Organization, 70(1-2), 241-252.

Mohun, S. and Veneziani, R., 2008, Goodwin cycles and the US economy, 1948 – 2004. In: P. Flaschel and M. Landesmann (2008): Mathematical Economics and the Dynamics of Capitalism. The Legacy of Richard Goodwin Continued. London: Routledge Frontiers of Political Economy.

Molnur, K., 2007, Learning with expert advice, Journal of the European Economic Association, 5(2-3), 420-432.

Muth, J., 1961, Rational expectations and the theory of price movements, Econometrica, 29(3),315-335.

Minsky H., 1982, Can "It" Happen Again? M.E. Sharpe, New York.

Minsky H., 1986, Stabilizing an Unstable Economy. Yale University Press, New Haven, CT.

Nunes, R.C., 2009, Learning the inflation target, Macroeconomic Dynamics, 13(2), 167-188.

Proaño, C.R., 2011, Exchange Rate Determination, Macroeconomic Dynamics and Stability under Heterogeneous Behavioral FX Expectations. Journal of Economic Behavior and Organization, 77, 177-188.

Reinhart, C.M. and Rogoff, K.S., 2009, This Time is Different: Eight Centuries of Financial Folly. Princeton University Press, New Jersey.

Solow, R., 1956, A contribution to the theory of economic growth. Quarterly Journal of Economics 70, 65-94.

Solow, R., 1990, Goodwin's growth cycle: Reminiscence and rumination, in: K. Velupillai (ed.), Nonlinear and Multisectoral Macrodynamics,London: Macmillan, pp. 31–41.

Taylor, L., 2004, Reconstructing Macroeconomics. Structuralist Proposals and Critique of the Mainstream. Cambridge, MA: Harvard University Press.

Tobin, J., 1982, Money and the Macroeconomic Process. Journal of Money, Credit and Banking, 14, 171-204.

Tovar, C.E., 2009, DSGE Models and Central Banks. Economics: The Open-Access, Open Assessment E-Journal, Vol. 3, 2009 - 16.
http://www.economics-ejournal.org/economics/journalarticles/2009-16

Velupillai, K.V., 2015. Perspectives on the contributions of Richard Goodwin. Cambridge Journal of Economics,39(6), 1485 - 1496.

Veneziani, R. and Mohun, S., 2006. Structural stability and Goodwin's growth cycle. Structural Change and Economic Dynamics 17, 437–451.

2 Kaldorian Boom-Bust Cycles in the Housing Market

2.1 Introduction

> Success breeds disregard of the possibility of failures. The absence of serious financial difficulties over a substantial period leads ... to a euphoric economy in which short-term financing of long term positions becomes the normal way of life. As a previous financial crisis recedes in time, it is quite natural for central bankers, government officials, bankers, businessmen and even economists to believe that a new era has arrived. (Hyman P. Minsky, Can "It" Happen Again?, 1982, p.213).

As the bursting bubble in the US housing market was the starting point of the current global financial crisis, it is certainly of great interest and importance to understand which forces drive the housing market and the recurrent boom-bust cycles that could be observed in the US housing market over the past decades. In this respect we want to show that there may be a specific nonlinear economic mechanism at work in the market for residential property which can explain the sudden reversal of a boom into a bust and vice versa.

Our point of departure for the description of such a mechanism characterizing the housing market is Kaldor's (1940) nonlinear approach to the explanation of the trade cycle which we here reinterpret appropriately through a law of motion for housing prices and the expec-

This chapter is based on Barens, Flaschel, Hartmann and Röthig (2010).

tations driven boom-bust cycle it can imply. In Kaldor's original contribution the business cycle was driven by the nonlinear investment function, the dynamic multiplier process and capital accumulation, while we here adopt a mechanism that initiates boom-bust cycles in the housing market through house price dynamics, corresponding price expectations and changes in the stock of houses.

The Kaldor-type nonlinear demand schedule is characterized by two shifts in the relationship to the housing price. Confronted with the supply of houses, multiple equilibria arise, among them a boom and a bust equilibrium. This will be a prerequisite to establish later on boom-bust cycles with the help of movements in the housing stock.

Upwardly adjusting supply in housing can in the case of multiple equilibria lead to the loss of the boom equilibrium, implying that the bust equilibrium becomes a global attractor to which prices and expectations converge. Such bust equilibria are interacting with falling supply in housing which sooner or later gives rise to the disappearance of the bust equilibrium and thereafter an upward dynamics to the again existing boom equilibrium. This process will repeat itself as long as the demand schedule for houses remains fixed. It is not dependent on the backward oriented expectation scheme we start from, but also applies to the case of myopic perfect foresight.

It is known from the literature on the Kaldorian trade cycle model (e.g. Chang and Smith (1971), Varian (1979), Lorenz (1993), Tu (1994) and Flaschel (2009)) that this situation can be further analyzed using methods from catastrophe theory as well as relaxation oscillations. A nonlinear demand function for houses in connection with changes in the housing stock thus initiates sudden reversals from booms into busts and vice versa which from a mathematical point of view give locally rise to fold catastrophes at the bifurcation points, with the dynamics being described by relaxation oscillations from the global perspective.

In order to relate our model to actual events in the housing market and to give some empirical motivation for the applied Kaldorian mechanism put forth, a short overview of the US-housing market is provided in the next section.

2.2 The US Residential House Market: Some Observations

The popular Case-Shiller house price index, which is based on quarterly data of nominal house prices throughout the US, had its peak in the second quarter of 2006. This was an all time high which marked the peak of the successively built-up housing bubble. After that point a rapid decline in the index could be observed which reflected the burst of the bubble and therefore the turn from a boom into a bust. No recovery in form of a halt in the downward trend of the index had been visible until summer 2009. All this followed after a boom of almost a full decade of thriving price increases since the year 2000. For a detailed description of the development see Baker (2008).

In their assessment of housing markets Muellbauer and Murphy (2008) found that agents are driven mainly by psychological forces and therefore cause inherent regularities in the housing price dynamics which seem to be in line with a systematic overvaluation. Housing prices are regarded as being mispriced and markets therefore not efficient. When fundamentals exercise their full pull on prices, corrections may be accompanied by exaggerated expectations of deep falls which are partly self-fulfilling.

In an IMF working paper before the downturn, Schnure (2005) for example gave the following assessment of the market situation:"...while some of these gains reflect catch-up following slow appreciation in previous years, recent increases have been particularly rapid, and may be ahead of fundamentals." A change in the structure of the mortgage market from on-balance sheet lending of banks to a system of securitization of mortgages and loans was intended to smooth the stop-go credit cycle in housing finance and, via several transmission channels, to moderate output volatility of the whole economy. For an investigation of diverse feedback channels between the housing market and the macroeconomy see Goodhart and Hofmann (2008).

This liberalization of mortgage markets meant a shift from the local banks to national and global financial markets. Subprime lending became an important business. A huge number of clients endowed with seemingly cheap mortgages in order to purchase their own homes, had a propensity to consume larger than one. It is a simple economic truth that this is not sustainable. Risks were no longer assessed with reasonable regard to the specific borrower. This led to a tremendous underestimation of default risk and eventually became the reason for breaking credit chains and a continuing distrust among banks. Problems arose when the Fed had to increase interest rates and the monthly installments could no longer be afforded by a large part of the mortgagers.

A variety of explanations were given at that time why the boom could be maintained or might even be followed by a slow appreciation. One reason which was mentioned was the level of house supply. The level was as low as in previous boom-bust cycles when house prices stabilized. In addition, housing supply was less speculative than in the decades before the 1990s, indicated by a low level of inventories in relation to the number of house sales (Schnure 2005). This fact suggests the view that a decline in housing demand would not necessarily lead to a large downswing in prices. However, all these optimistic scenarios have been proven wrong.

Instead of price volatility moderation by improved credit allocation, markets were swept with liquidity. Cheap finance combined with an illegitimate practice of lending to private clients without sufficient income fired the price rally first and the foundation was laid for the following breakdown. One has to conclude that the pattern of boom-bust cycles in the housing market had been by far not obsolete, but then stroke back with a vengeance. The following model should highlight a mechanism at work in this particular market.

2.3 Kaldorian Boom-Bust Cycles in the Housing Market

We explore a highly stylized model of the housing market which features a nonlinear demand function for private housing. The kind of nonlinearity is drawn from the Kaldorian investment function used in his model of the trade cycle. We show that the Kaldor (1940) trade cycle mechanism can be meaningfully applied to the market for private housing, since the demand for houses may be positively related to the housing price in a mid-range price domain, while it is downward sloping for house prices sufficiently small as well as sufficiently large. Confronted with the current supply of houses this gives rise to 1 or 3 equilibria (booms, busts and unstable). We couple the nonlinear house demand schedule with purely backward-looking house price expectations and get a planar dynamics with the same range of model-consistent expectations equilibria as in the partial situation studied beforehand. At first the model has to be set up via the laws of motion for the price formation and expectations. The demand function must be characterized formally as well.

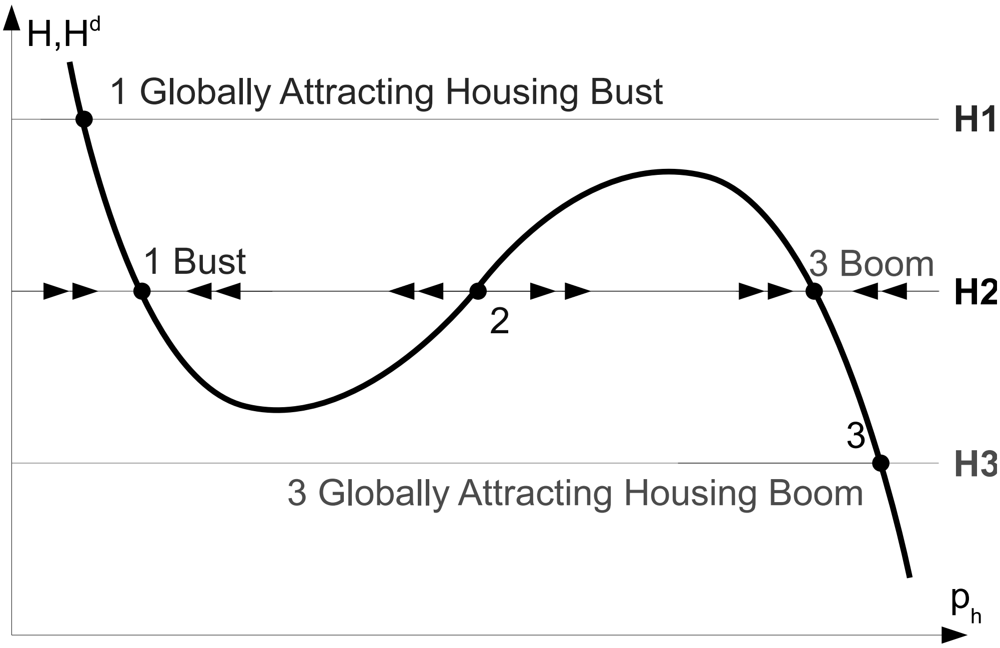

Figure 2.1: Boom / Bust Situations: Single and Multiple Equilibria (for given price expectations)

The demand for houses depends negatively on the price for houses when the stock of houses is either low or high. In the range in between, for a medium domain of the stock of houses, the relationship is however reversed. Rising prices here induce increasing demand and one can interpret that for high as well as low stocks we have the expected normal reaction with respect to house price movements. The reversed reaction can be explained by an overall climate where several factors make people believe that it is generally desirable and practically riskfree to purchase property and become a home-owner. This climate is determined by institutions like the government, the central bank, the media and the financial industry in a rather active way, as well as by social factors like the relative standing in society or demographical developments. All relevant factors for housing demand beside the expected future price of houses could be summarized under this house purchasing climate. Technically speaking all exogenous variables form the climate, whereas the price expectations will be endogenously determined in the model and thus kept static for the moment. Shiller (2007) finds that the housing boom could be best explained in terms of a psychological theory that sees the investment in housing as a kind of social epidemic. In normal times the general mood does not support a buying frenzy when prices go up. But as soon as several non-price impacts culminate to a critical mass, the usually ultimate factor for a buying decision, the purchasing price, becomes secondary. When switching to the midrange regime of a positive dependency of demand from prices, the climate starts dominating buyers' decisions. Former US-President George W. Bush stated in 2002: ”We want everybody in America to own their own home” (Ferguson 2008). A policy promoting this idea contributes to the manifestation of many people's desire to become a home-owner and this the more house prices are rising and thus stimulate their positive attitude to to the housing market. Investing money in houses instead of other assets promises a lot of advantages in such a political environment. Housing has always been seen as a secure investment and real-estate seemed to be especially attractive after equity markets went down in the early 2000s. Other asset prices should influence the climate as well as low-interest rates which enable affordability of houses even when prices are high. Moreover, rising house prices increase the value of the collateral. Loose lending practices of banks offered easy access to mortgages for people who were previously excluded from it because of low income or discrimination. Once an atmosphere of massive attractiveness of home-ownership is generated, a kind of keeping-up-with-the-Joneses effect can give additional momentum to housing demand. As buying decisions are not independent from other people's buying behavior in a socio-economic environment, part of the spending behavior is imitated in order not to fall behind and to maintain a relative social status. Consumption patterns are learned from friends or neighbors (Lavoie 1994, 2004). As a consequence of the climate influence rising prices lead to rising demand via an increasing trust in the housing market. However, at a certain level the demand for houses reaches its peak and then starts to decline again with prices rising further. The normal price effect outweighs the positive climate effect then again. Explanations could be the increase of the interest rate by the central bank, market saturation, recovery of other asset markets or a bust in real markets.

After the verbal description and justification of the proposed housing market demand schedule, it will be formalized in the following: We denote by p_h the price of houses, by p_h^e its expected value, by $H^d(p_h, p_h^e)$ the stock demand for houses with $H_1^d \geq 0$ or $\leq 0, H_2^d > 0$ and by H the stock supply. We assume that this stock demand is not fully active at each point in time, but only a portion of it, measured by the parameter α_h. As percentage excess demand function we therefore postulate the relationship

$$\alpha_h \frac{H^d - H}{H} = \alpha_h h^d(p_h, p_h^e)$$

and assume that this determines the growth rate $\hat{p}_h$ of the housing prices p_h with speed β_h. This basic component of the demand schedule is shown in figure 1 for given values of house price expectations and various levels of the stock of houses. Depending on the level of the housing stock H the model can exhibit up to three price equilibria.

We thus assume that the housing market is characterized by the following situations: At equilibrium 1 and 3 we have a normal type of housing demand, while around 2 the demand for houses is increasing with their price p_h. Ignoring p_h^e, equilibria 1 and 3 are stable, while point 2 is unstable.

We now extend the above situation to the two laws of motion by going from static to backward looking adaptive expectations.

$$\hat{p_h} = \beta_h \alpha_h h^d(p_h, p_h^e) \tag{2.1}$$

$$\hat{p_h^e} = \beta_e \left(\frac{p_h}{p_h^e} - 1 \right) \tag{2.2}$$

This adds the dynamics of house price expectations to those that drive actual house price formation. Equation (2.2) can be rewritten as

$$\dot{p}_h^e = \beta_e \left(p_h - p_h^e\right) \tag{2.3}$$

We therefore have a growth law for housing prices that is coupled with a differential equation for house price expectations. The study of this system of differential equations is the subject of the following section.

2.4 Stability Analysis

Under suitable parameter constellations in an economically meaningful range, the postulated laws of motions will give rise to three equilibria when the intensive housing demand function h^d equals zero and expected prices equal the current prices. The intensive housing excess demand function h^d is zero when supply is exactly met by demand. This causes the price dynamics to come to a halt and the market is put onto the curved isocline. For infinitely fast adjusting price expectations the housing market becomes located at the 45?line. The intersections of both curves deliver the steady state points of the whole system. Whether the points of rest are stable or not, has to be investigated by evaluating the Jacobians at the respective equilibria. The system has three steady states (see also figure 2), where $p_h^0 = p_h^{e0}$ holds true. The Jacobian reads at the steady states:

$$J_0 = \begin{pmatrix} \beta_h \alpha_h \frac{H_1^d}{H} p_h^0 & \beta_h \alpha_h \frac{H_2^d}{H} p_h^0 \\ \beta_e & -\beta_e \end{pmatrix} = \begin{pmatrix} \pm & + \\ + & - \end{pmatrix}$$

We assume that

$$H_1^d(p_{ho}, p_{ho}^e) + H_2^d(p_{ho}, p_{ho}^e) < 0 \quad \text{if and only if} \quad \frac{-H_1^d(p_{ho}, p_{ho}^e)}{H_2^d(p_{ho}, p_{ho}^e)} > 1 \tag{2.4}$$

holds in cases 1 and 3, which states that the positive effect of changing house price expectations is dominated by the actual and negative housing price effect as far as marginal changes are concerned. This sum is > 0 in equilibrium 2. For $\det J$ there holds:

$$detJ = \beta_h \beta_e \alpha_h \frac{p_h^0}{H} \left| \begin{pmatrix} H_1^d & H_2^d \\ 1 & -1 \end{pmatrix} \right| = -\beta_h \beta_e \alpha_h \frac{p_h^0}{H} [H_1^d + H_2^d]$$

i.e., we get $\det J > 0$ in the equilibria 1 and 3 and $\det J < 0$ in the equilibrium 2, which in the latter case gives a saddle point.

The kind of adjustment to the asymptotically stable equilibria can be stated more precisely. One can show that the stable equilibria are nodes, not spirals by showing that the discriminant $\Delta = (\frac{1}{2}trA)^2 - detA$ is of the form $(a-b)^2$ and subsequently larger than zero.

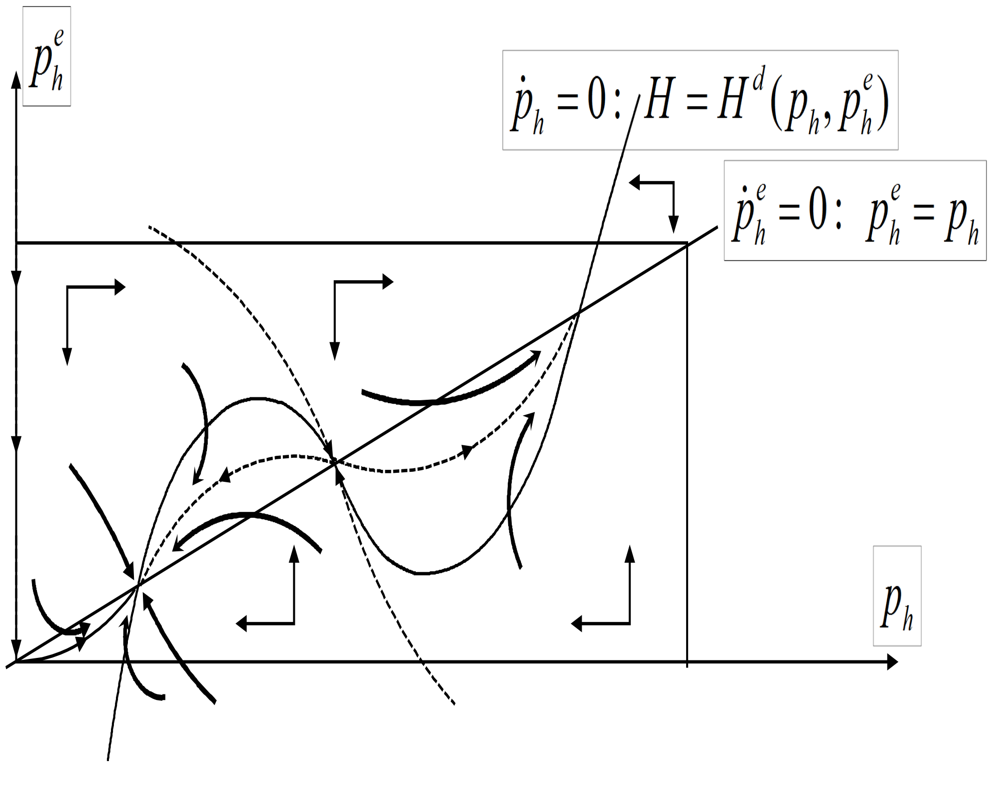

Figure 2.2: The Dynamics around the 3 interior Equilibria of the Model

The Implicit Function Theorem allows to calculate the slope of the $\dot{p}_h = 0$-isocline as follows:

$$p_h^{e\prime}(p_h) = -\frac{H_1^d}{H_2^d} > 0 \text{ in points 1 and 3 and } p_h^{e\prime}(p_h) < 0 \text{ in point 2.}$$

The implied situation is depicted in the form of a phase diagram of the dynamics in figure 2. This figure expands what is shown in figure 1 if assumption (4) holds and if $H^d(0,0) > 0$ is assumed, in which case the origin of the phase space is a saddlepoint. Note however that the basins of attraction of the two stable equilibria are no longer easy to determine though one can conjecture that they are separated by the stable arms of the saddlepoint dynamics.

After having shown that local stability exists at least for two of the three equilibria, our concern now is the viability of the global dynamics. We will restrict our analysis to graphical means that will allow for a proper treatment nonetheless. The assumptions made above imply the following global situation in the case where three stationary housing market equilibria exist. Figure 2 shows the dynamics of housing prices and of adaptively adjusting housing price expectations. The drawn box reduces the range of possible values for the variables on economic grounds. A sensitive analysis is needed to restrict the phase space to economically meaningful values of the price variables. First, all negative values can be excluded from the analysis. Furthermore all dynamics on the boundary of the compact subdomain of the phase space point into this domain. This is fairly easy to see, since the housing stock H has not started to move yet and is therefore still a given parameter. The phase diagram as such offers sufficient insight as an analytical device for the moment. Any trajectory starting inside the indicated box will stay inside and converge to one of the two attracting equilibria. The basins of attraction are divided by a separatrix which is equivalent to the stable arm of the saddle equilibrium's dynamics. The global dynamics is not attracted by this equilibrium. Its attracting domain is of measure zero in the domain of all converging trajectories. Therefore an arbitrarily chosen starting point within the box necessarily leads to one of the locally stable equilibria, because the economy is in the basin of attraction of either the lower or the upper equilibrium.

2.5 The Dissolution of Boom and Bust Equilibria through Slowly Adjusting Housing Supply

Our considerations so far have been concerned with the short run where the housing stock remained fixed. When we take into account that this variable starts moving in time, the situation gives rise to permanently changing regimes with respect to booms and busts similar to what has been investigated for the Kaldorian trade cycle in Varian (1979), see also Flaschel (2009, ch.s 3,7). The driving force behind these regime changes is the continuously moving stock of houses. Given that the assumption above made regarding the direction of the stock adjustment is true, the increase of housing supply associated with a boom phase gives way to the disappearance of the upper equilibrium. A reduction of the housing supply in connection with an unaltered demand schedule in a bust, causes the lower equilibrium to vanish at one point. In order to leave the analysis tractable in the easiest way without restricting the results, the dissolution of the equilibria shall be done under a perfect foresight expectation scheme which saves us one law of motion, since we have already shown before that the qualitative characteristics with regard to existence and stability of the boom and bust equilibria do not depend on the employed expectation formation scheme.

The situation shown in figure 2 has a well-defined limit case, as presented in figure 3, the case of myopic perfect foresight. In this limit case the economy is always on the 45 degree line which is approached vertically with infinite speed. We note that the curved isocline is shifting upwards with increasing housing supply (and thus in the boom phase of this market) and downwards in the bust phase. The housing market is therefore characterized by a tendency that leads to the disappearance of boom equilibria in the boom phase as well as the dismantling of bust equilibria in the bust phase in the course of time. The naive adaptive expectations mechanism leads to results that do not differ qualitatively from the results obtained under the assumption of myopic perfect foresight.

The housing stock H can therefore be interpreted in correspondence to Kaldor (1940)

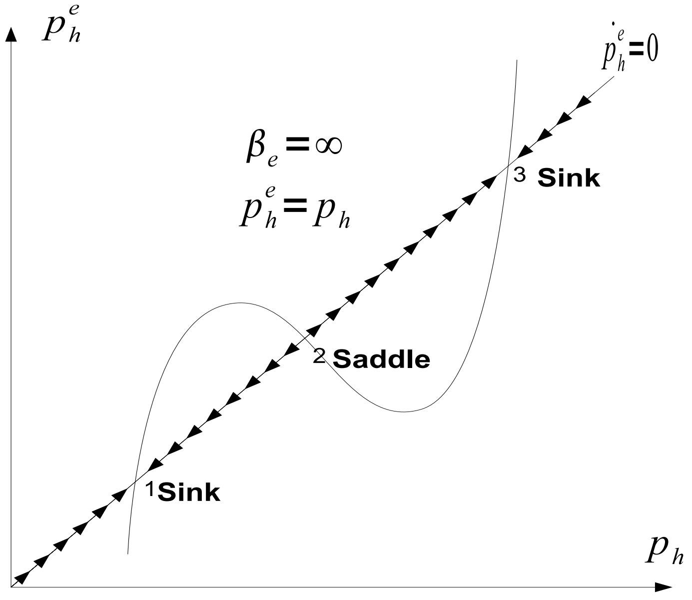

Figure 2.3: The Ideal Limit Case: Price Adjustment under Myopic Perfect Foresight

as a slow, continuously changing variable which causes shifts of the $\dot{p_h} = 0$ - isocline. As these shifts might eventually result in the loss of one of the stable equilibria and the saddle point, we then get stable booms or busts for a given stock of houses at specific points in time. Adjustment to the unique equilibrium points is ensured by the fast price and price expectation variables. But as the movement of H goes on, e.g. in a boom situation, the market becomes saturated and the supply of houses decreases again. This supply squeeze causes a shift of the isocline back into the direction where three equilibria are reestablished. After some time a point could be reached when the shortage in housing supply becomes so severe in connection with slightly falling prices, that the isocline moves far enough to lose the upper equilibrium and the unstable saddle equilibrium.

A sudden downward jump in housing prices and subsequently in expectations about them occurs. The consecutive process could be characterized by slowly upward moving prices and expectations. Excess capacities are decumulated and the bust reaches its floor. If this process continues with sufficient strength, the $\dot{p_h} = 0$-isocline will once again intersect with the $\dot{p_h^e} = 0$-isocline in the three equilibrium points. The bust continues as long as all three equilibria are kept in existence. The bust turns into a boom when supply scarcity requires

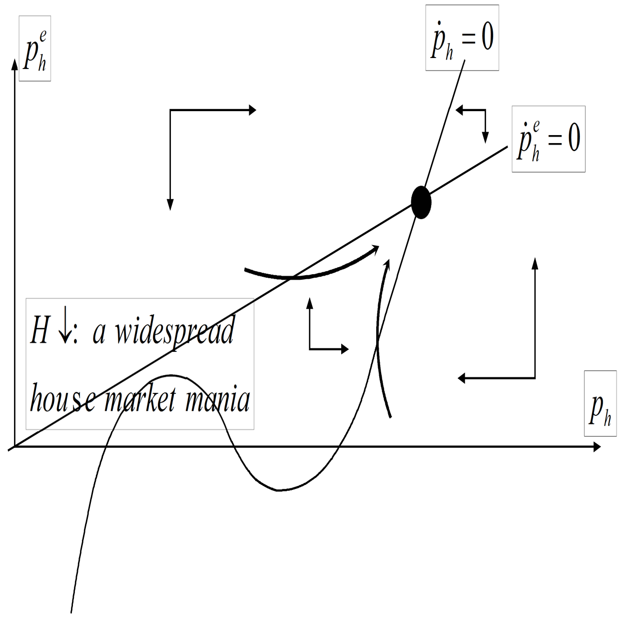

Figure 2.4: Bust-driven Downward Shifting Housing Supply and the Emergence of a Single Globally Attracting Boom Equilibrium

an upward jump in p_h, initiated by the loss of the lower stable equilibrium. Figure 2 shows that there should exist a compact subdomain of the whole phase space where all dynamics point inwards everywhere on the boundary. The drawn box only contains values of p_h and $p_h^e > 0$. Moreover it should be restricted to non- catastrophic values, since p_h and $p_h^e = 0$ are economically not justifiable and might deliver nonreliable results. The subdomain must be limited to price values that are economically reasonable and empirically observable. This would allow to construct a stable limit cycle in the p_h,p_h^e- dynamics. This limit cycle would attract all relevant trajectories. No trajectory that originates in the box can leave it. The analysis of the resulting limit cycle must be left here to a graphical treatment.

2.6 Fold Catastrophes and Relaxation Oscillations in the Housing Market

In order to further simplify the analysis we assume myopic perfect foresight of agents in the housing market with respect to the evolution of prices. One of the two laws of

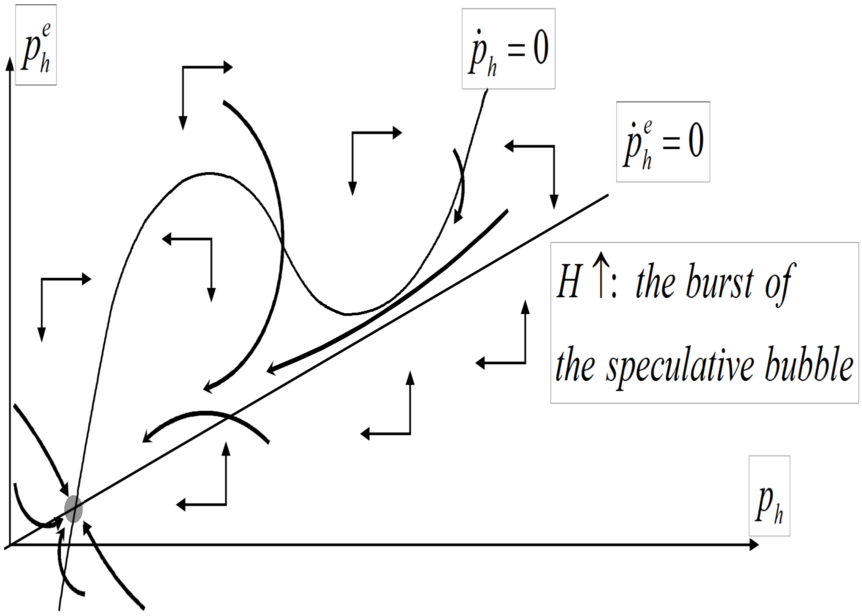

Figure 2.5: Boom-driven Increasing Housing Supply and the Return of a Globally Attracting Bust Equilibrium

motion collapses into an equilibrium condition. For infinitely fast adjustment of the price level expectations, the steady state condition $p_h^e = p_h$ is fulfilled in every point of time. The parameter β_e approaches infinity in this extreme case. This means instantaneous adjustment to the housing market equilibrium curve, the $\dot{p_h} = 0$-isocline. So we are left with just one law of motion for the price level. The housing supply can be regarded as a parameter in the short run, but should become a variable in the long run. Employing catastrophe theory the local behavior of the system dynamics can be studied in more detail at the critical points where the boom phase ends and the switching to a bust occurs, respectively the bust ceases and the boom starts. These transitions must be executed by jumping processes of the fast variable, in this case the house price level, from one area of the state space to another. These jumps are called catastrophes. We will investigate here the simplest form of catastrophe, the so-called fold catastrophe. Having classified the stock of houses as the slow and the price level as the fast variable, we can track the interaction of the upper and lower short run equilibria with the long-term dynamics in the H,p_h-phase space.

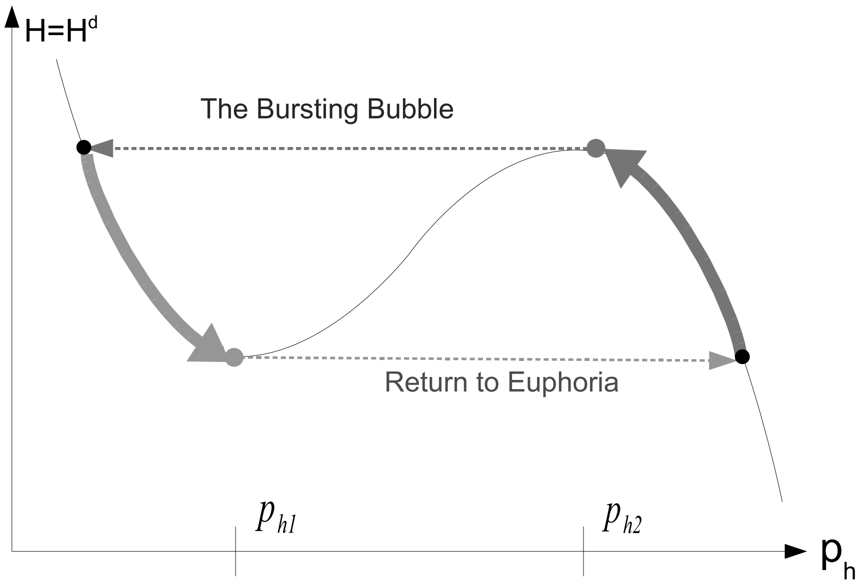

Figure 2.6: Singularities, Fold Catastrophes and Relaxation Oscillations in the Myopic Perfect Foresight Case

The points p_{h1} and p_{h2} are stable equilibria in the short run, as long as H, the housing stock, does not evolve. But H is no more a given magnitude and starts to move. Boom situations are associated with upward adjusting housing supply, whereas busts interact with downward corrections of the supply. Nothing happens until the housing stock arrives at a sensible value that allows no more to maintain the prevailing equilibrium, but gives rise to a bifurcation point. The bifurcation set of the catastrophe manifold are exactly the short-run equilibrium positions p_{h1} and p_{h2} where the qualitative characteristic of the economic situation turns around. These short-run equilibria have continuously moved to these states as a result of the slow motion of H. Taking a look at the lower equilibrium p_{h1}, shows that the point of rest has moved that far downwards that no further movement in the same direction is possible along the housing demand curve. The downward shifting supply of houses therefore enforces the loss of the stable point here and necessitates a jump in p_h to the right. A new stable equilibrium is established on the housing demand curve's descending right arm. The market jumps from a bust into a boom. Being initially in a boom, the description applies just the other way around.

The extension to the situation of backward-looking behavior is straightforward. The difference is that the singularities lie on the house market equilibrium curve in the p_h,p_h^e-space. Then the housing supply would only in the background determine the long-run position. As the analysis is of purely local nature, it only tells us that at the bifurcation points singularities exist which are of a fold catastrophe type and lead to qualitative changes of the economic characteristics.

With only one law of motion left for the short-run, we are able to study the global dynamics of the housing market system in an easy way. Global dynamics are restricted to a compact domain in the p_h,p_h^e-space. All dynamics from outside this domain are attracted by it. All dynamics within the domain are bound in it. This is guaranteed by the motion of the housing stock which is in the short run a given parameter. As the stock becomes a slowly changing variable it continuously moves upward in association with boom states and shrinks in bust environments. This more long- run oriented view on the housing market shows the switching processes inherent.

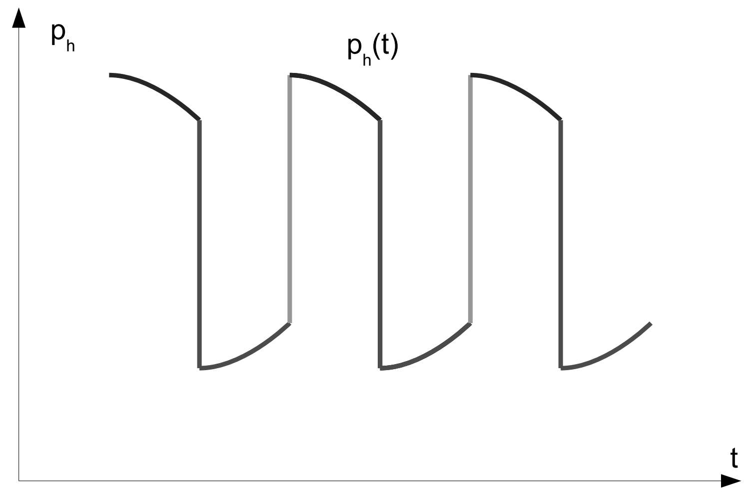

Figure 2.7: The Long-Run Volatility of Housing Prices from the Perspective of Relaxation Oscillations

The movement of H causes the prevailing (short-run)equilibrium to vanish eventually. Booms suddenly turn into busts, busts immediately turn into booms. But from a long-run perspective the process is stable in the sense that it repeats itself as long as the demand schedule remains fixed. Mathematically speaking the interaction of the short-run equilibria with the very sluggish adjustment in the supply of houses and subsequently the housing stock, gives rise to a stable relaxation oscillations limit cycle. Relaxations oscillations here come about because of the reduction in dimension of the model due to the transition of a dynamic into an algebraic equation. Being noted that it is necessary to demonstrate that the characteristics of the dynamics are not affected by this procedure. The method is only appropriate if the dynamics are structurally stable, meaning equivalent for finite adjustment speeds and the limit case.

Plotting these dynamic patterns for the housing price against time delivers ongoing wave-like fluctuations. Overtime an extremum is obtained, the price falls sharply down or increases rapidly. Figure 7 captures the course of the time pattern of p_h.[1]

2.7 Conclusions

We have shown in this chapter that a demand function for residential property which is upward sloping in housing prices in a midrange area of the price space (and as usual downward sloping outside of this range) can give rise to multiple equilibria under static housing price expectations. In addition, making such expectations endogenous through a simple adaptive adjustment, we show the existence of two stable and one (midrange) unstable equilibrium in the phase space composed of housing prices and their expected values. This situation also extends to the case of myopic perfect foresight as the natural limit case of adaptive expectations that adjust with ever increasing speed.

Next the basins of attraction of the obtained boom and bust situations were investigated in more detail and also their change in the case of a sluggishly adjusting supply of residential space, which lead to fold catastrophes for sufficiently large changes in the supply of houses. Combining these isolated boom and bust situations in a joint phase diagram, we finally showed from the global point of view the emergence of so called relaxation oscillations in the housing market where booms suddenly change into bust situations and vice versa when

[1] The relaxation of the assumption of myopic perfect foresight in favor of adaptive expectations would enable a better empirical fit of the time series. The vertical parts would flatten and could respectively show negative or positive slopes instead of jumps.

critical thresholds in the supply of residential space are passed, giving rise to the existence of boom-bust cycles in planar systems for myopic perfect foresight and in a 3D phase space in the case of adaptively formed house price expectations.

Future work along these lines should integrate a debt financing process (mortgages) into such boom-bust cycle generating mechanisms and consider the specific contributions of debt accumulation and of changes in the loan rate in the formation of such boom-bust cycles.

2.8 References

Baker, D., 2008, The housing bubble and the financial crisis, Real-world economics review, 46, 73-81.

Flaschel, P., 2009, Macrodynamics: Elements for a Synthesis of Marx, Keynes and Schumpeter. Heidelberg: Springer (2nd edition).

Ferguson, N., 2008, The Ascent of Money. A Financial History of the World, New York: Penguin Press.

Goodhart, C. and Hofmann, B., 2008, House prices, money, credit, and the macroeconomy, Oxford Review of Economic Policy, 24 (1), 180-205.

Kaldor, N., 1940, A model of the trade cycle, Economic Journal 50, 78-92.

Lavoie, M., 1994, A Post Keynesian Approach to Consumer Choice, Journal of Post Keynesian Economics, Vol. 16, No. 4, 539-562.

Lavoie, M., 2004, Post Keynesian consumer theory: Potential synergies with consumer research and economic psychology, Journal of Economic Psychology 25, 639-649.

Lorenz, H.-W., 1993, Nonlinear Dynamical Economics and Chaotic Motion, Heidelberg: Springer (2nd edition).

Chang, W.W. and Smith, D.J., 1971, The existence and persistence of cycles in a nonlinear model: Kaldor's 1940 Model Re-examined, Review of Economic Studies 38, 37-44.

Minsky H., 1982, Can "It" Happen Again?, New York: M.E. Sharpe.

Muellbauer, J. and Murphy, A., 2008, Housing markets and the economy: the assessment, Oxford Review of Economic Policy, 24 (1), 1-33.

Shiller, R.J., 2007, Understanding Recent Trends in House Prices and Home Ownership, Economics Department Working Paper No. 28, Yale University, New Haven.

Schnure, C., 2005, Boom-Bust Cycles in Housing: The changing role of financial structure, IMF Working Paper 200.

Tu, P.N.V., 1994, Dynamical Systems, Heidelberg: Springer (2nd edition).

Varian, H., 1979, Catastrophe theory and the business cycle, Economic Inquiry 17, 14-28.

3 Stabilizing an Unstable Economy: Fiscal and Monetary Policy, Stocks, and the Term Structure of Interest Rates

3.1 Introduction

Financial crises are potential features of advanced macroeconomies and come with huge economic and social costs which could easily amount to a large fraction of a country's GDP and considerably lasting consequences (Reinhart and Rogoff 2009). Motivated by the events that triggered the financial crises which spread worldwide as a great recession we set up a theoretical macroeconomic framework with an elaborated financial sector characterized by disequilibrium adjustment processes. Using a dynamic portfolio approach based on the work by James Tobin (1982), we are able to identify the sources of financial market instability on the one hand, and the feedback channels from the financial to the real markets and vice versa which, on the other hand, via Tobin's q may give rise to additional sources of macroeconomic fragility.

Furthermore, due to an extension of the portfolio model of Asada et al. (2011b) by risk-bearing long-term bonds, besides equities, for which capital gains have to be taken

This chapter is based on Charpe, Flaschel, Hartmann and Proaño (2011).

into account, the term structure of interest rates will now also be addressed. We show the perilous consequences of speculation by employing a chartist-fundamentalist scheme like Brunnermeier (2008). Chartists behave like speculators and are kind of technical traders that use here simple adaptive expectation mechanisms. On the contrary fundamentalists care for basic economic data and expect variables to return to steady state values with a certain adjustment speed. Regarded in isolation from the rest of the economic system the first type of agent exerts a destabilizing influence, whereas the latter one is principally stabilizing in the financial markets. Market expectations for equities and long-term bonds evolve then according to a weighted average of fundamentalists?and chartists' expectations schemes.

Since our focus here is on the financial markets and their specific sources of instability, the real side of the economy is kept as simple as possible. Moreover, this has the advantage that the dynamics of the model is rendered analytically tracktable and that closed-form solutions implying precise propositions on the (in-)stability of the considered dynamics can be obtained. [2]

The modeled economy has to face two major channels of instability. On the one hand, the interaction of the real and the financial markets through Tobin's q, and on the other hand the interaction of heterogeneous agents on the asset markets. In view of these feedback structures we propose specific policy measures to tame their centrifugal forces around the steady state of the private sector of the economy. Since it is the interconnectedness of markets which is at the core of our considerations, there is not a single policy instrument that is capable of doing the stabilizing job alone. From the large set of candidates that might be suited to counteract the explosive dynamics, we pick those we regard as being most appropriate and effective to stabilize such potentially unstable macroeconomies. In particular Minsky (1982) has put forth various ideas in this respect. At the end and on the basis of our stability analysis, we will be able to show that a Tobin-type tax of capital gains together with a equity market oriented monetary policy and an open market policy

[2] A detailed investigation of real markets dynamics based on Keynesian disequilibrium processes and a Tobinian financial sector has been conducted in Asada, Flaschel, Mouakil and Proaño (2011a).

that trades in long-term bonds might indeed be able to stabilize the model, in contrast to conventional types of Taylor rules, which may not be sufficient for the stabilization of such economies.

In the next section we investigate the asset market structure considered in our model type by contrasting it with a traditional Keynesian approach presented in Turnovsky (1995), where static stock price expectations are used for deriving an IS-LM analysis of conventional type. We then investigate in section 3.3 the stability of the real-financial market interaction of our model and provide in section 3.4 an extension of the core model via the endogenization of capital gain expectations. In section 3.5 we use dynamic stability analysis to investigate the specific policy measures that can tame the unstable working of the private sector of the economy. Section 3.6 concludes.

3.2 Tobinian Asset Price Dynamics and the Keynesian Multiplier

In this section we set up the model including the real side of the economy and the asset markets consisting of stock and bond markets. Capital gain expectations will be first treated as given and later on endogenized. In order to make the argument for our modeling strategy, the dynamic portfolio balance macroeconomic model of Turnovsky (1995) shall be contrasted with the Tobin-like approach we put forth to represent the financial markets.

Regarding the goods market we simplify the real part of the Turnovsky (1995) model by ignoring inflation and growth altogether and by representing the quantity adjustment process by a simple dynamic multiplier approach. This simplifies the Metzlerian inventory accelerator mechanism of the real-side oriented KMG (Keynes-Metzler-Goodwin) model of Chiarella and Flaschel (2000), thus suppressing it as a source of instability besides the wage price spiral of the KMG approach. It makes the real part of the economy always a stable one (from this partial perspective) if the propensity to spend is less than one. We however now take the stock market effect on investment (and consumption) behavior into account, by the impact of Tobin's q on these goods demand functions, since we conceive the share prices here as measuring the state of confidence in the economy and thus use it as argument in the investment (and consumption) function in place of the commonly used short-term rate of interest.

This gives as representation of the real side the law of motion for output (denoted by Y)

$$\hat{Y} \;=\; \beta_y[(Y^d - Y)/Y] = \beta_y[(a_y Y + a_q(q - q^o) + \bar{A} - Y)/Y] \tag{3.1}$$

where $a_y \in (0,1)$, $a_q > 0$, and where $\bar{A}$ summarizes autonomous expenditures (fiscal policy and more). This is a standard textbook dynamic multiplier process, with a change however in the employed aggregate demand function where Tobin's average q, in its deviation from its steady state value q^o, is now used in place of the short-term interest rates. Since prices, the capital stock and the stock of equities are considered as given in this section we assume $\frac{E}{pK}$ (equity(E) in relation to capital(K) times its price(p)) to be equal to one for simplicity so that Tobin's average $q = \frac{p_e E}{pK}$ is equal to the share price p_e in the following.

Discussing and investigating the implications of traditional macroeconomics, Turnovsky (1995, part I) also makes use of a dynamic portfolio balance macroeconomic model where he in particular considers the following representation of the financial part of his portfolio model.[3]

$$M^d \;= f_m(Y, r, \rho)(M + B + p_k K) \tag{3.2}$$

$$B^d \;= f_b(Y, r, \rho)(M + B + p_k K) \tag{3.3}$$

$$p_k K^d \;= f_k(Y, r, \rho)(M + B + p_k K) \tag{3.4}$$

with r the rate of interest, and $\rho p_k = r_k p,\ \rho, r_k$ the rate of profit on value and on physical

[3] In order to make it comparable to our subsequent modeling of such an approach we ignore here however inflation (assuming a given price level p instead) and also transfer the Turnovsky model to the notation used in this thesis.

capital, respectively, and with

$$f_{m2}(Y,r,\rho) + f_{b2}(Y,r,\rho) + f_{k2}(Y,r,\rho) \equiv 0, f_{m3}(Y,r,\rho) + f_{b3}(Y,r,\rho) + f_{k3}(Y,r,\rho) \equiv 0$$

and $M^d + B^d + p_k K^d = M + B + p_k K$ and with the gross substitution assumption being made.[4] This representation of the asset market structure of the economy is similar in scope to the one considered in this chapter, since the variable ρ is defined as the (statically expected) rate of return on holding capital at the market value $p_k K$. In the following we however prefer to represent the capital market by means of equities E and their price p_e in an explicit manner and therefore define Tobin's average q in the usual way (and not via the asset price of the capital stock p_k). We also will use heterogeneous and partly forward-looking expectations in our model (in place of Turnovsky's static ones) and will add long-term bonds as a further risky asset to the portfolio structure to be investigated.

Though the rate of return on capital is determined in Turnovsky's approach in equivalence to our equity market representation, it is the lack of (heterogeneous) expectation formation processes with regard to capital gains that is making the Turnovsky (1995) very traditional type of IS-LM analysis of his model unsatisfactory. Turnovsky (1995) rightly stresses the need to theorize and analyze how individual balance risk and returns in their portfolio choices, which he considers as a formidable task. This may be true in the context of stochastic differential equations, employing a mean-variance approach, but in a still deterministic framework such an approach boils down to point expectations. There are now many models available that describe heterogeneous expectations formation of chartists' and fundamentalists' or also of herding type. We will use the chartist - fundamentalists distinction in this following in a relatively simple way in order to obtain precise propositions on the (in-)stability of the considered dynamics. Numerical methods – as they are used in New Keynesian DSGE explorations – can of course also be used in our approach towards a macrodynamics of DSGD(isequilibrium) type.

By contrast, Turnovsky's (1995) traditional Keynesian macroeconomic model is a very

[4] This makes price adjustments on the asset markets a stable process (under static expectations).

tranquil representation of financial markets where expectations play no role at all, since there are no expected capital gains, and where the rate of return on capital owned, ρ, is determined by the rate of profit of firms, r_k, in a straightforward way. Such a situation is usually not considered in the Keynes-Tobin approach to macrodynamics. In this model monetary policy can influence the rate of return ρ on capital $p_k K$ of the economy directly through the financial market structure of the economy which determines the levels of r, p_k), which in Turnovsky's approach however only impacts the real economy through the real rate of interest in the usual way, and not directly through the rate of return ρ, interpreted as a measure of the state of confidence, as we will do it in the rest of this chapter. In the light of the actual global financial crisis, the above traditional Keynesian structure therefore cannot be considered as adequate for the building a Keynesian portfolio model of the real-financial market interaction. As Keynes wrote already in 1936:

> *Speculators may do no harm as bubbles on a steady stream of enterprise. But the position is serious when enterprise becomes the bubble on a whirl-pool of speculation. When the capital development of a country becomes a by-product of the activities of a casino, the job is likely to be ill-done. The measure of success attained by Wall Street, regarded as an institution of which the proper social purpose is to direct new investment into the most profitable channels in terms of future yield, cannot be claimed as one of the outstanding triumphs of* laissez-faire *capitalism – which is not surprising, if I am right in thinking that the best brains of Wall Street have been in fact directed towards a different object.* Keynes (1936, p. 159).

In order to represent the asset markets of the model in a more appropriate manner, we start from (and extend) the the widely employed simplifying practice in theoretical macroeconomic modeling is to use as array of financial assets the set: money M (issued by the central bank), fix-price bonds B (issued by the government, with $p_b = 1$) and equities E (issued by firms at price p_e), see e.g. Sargent (1987). Such a practice has the advantage that money and bonds can be aggregated without any price interference. Moreover there is then only one risky asset (equities) for which capital gains and capital gain expectations have to be taken into account.[5]

Should we really use as baseline financial structure for a model of the real-financial market interaction a scenario where government can issue money (perfectly liquid – and thus riskless – fixed price interest bearing bonds)? There of course exist some financial assets, issued by the government, which exhibit a high degree of liquidity (due to their short-term maturity horizon), but the bulk of government expenditures is not financed in this way, and in particular not at a constant price for the new issue, since this not only interferes with the objectives of the central bank, but would also be an ideal objective for rising liquidity preference (hoarding), due to the positive yield this asset provides (especially when it is considered as perfect substitute for equities as in Sargent (1987)).[6]

In order to keep our theoretical framework tractable, we will now however use the – from a theoretical perspective – polar case to fix-price bonds, namely perpetuities in place of the short-term bonds for the financing the government deficit.[7] Solely replacing B by long-term bonds B^l with a variable price p_b and with rate of return the rate of interest $r = 1/p_b$, to be augmented by capital gains $\hat{p}_b$: $1/p_b + \hat{p}_b$, raises however the question how the short-term interest rate is now provided, since there is no longer a market for it. We therefore go one important step further and assume that the central bank is issuing short-term bonds B in place of money M and is therefore paying interest on its money supply B in the following. This may at first sight look unorthodox and even exceptional, but will indeed prove adequate for the model types we are considering in this chapter.

[5] Sargent (1987, p.12) notes with respect to the variable B that it **'is a variable-coupon bond that is issued by the government. The bond is essentially a savings deposit, changes in the interest rate altering the coupon, but leaving the dollar value of bonds outstanding unchanged.'** This characterization implies that the supplies of money and bonds $\bar{M} + \bar{B}$ can be characterized as providing the money supply $M2$ from the various definitions of such money supplies.

[6] Moreover, we have shown in a Tobinian portfolio choice framework under mild assumptions on the employed portfolio demand functions for such a range of financial assets that monetary policy is then completely ineffective, since it only influences in this case the cash management process between money and bonds, but does not at all reach the equity market and thus the financing structure of firms, see Asada et al. (2011b) for details.

[7] This is the other typical bond configuration that is used in macroeconomics, see Turnovsky (1995, p.22) for a brief discussion of bonds with a finite maturity date T in a continuous time framework.

Furthermore, since the central bank has full control over the short-term rate of interest we assume in the following either an interest rate peg or an interest rate policy rule as the monetary policy of the central bank. Note that the central bank can set the short-term rate of interest here without any open market operation (through simple announcement), since it pays this interest on the money it has issued. The money supply is therefore under the full control of the central bank even in the case of an interest rate peg.

We thus assume for our set-up that the financial assets B, B^l, E are imperfect substitutes and that capital gain expectations are also imperfect and working in a portfolio structure as in Tobin (1982). We assume that the stocks of the financial assets B, B^l, E are exogenously given, despite a given interest rate peg (see the argument given before):

$$\bar{B} = B^d = f_b(r, r_e^e, r_b^e)W_p^n, \tag{3.5}$$

$$p_e\bar{E} = p_eE^d = f_e(r, r_e^e, r_b^e)W_p^n, \tag{3.6}$$

$$p_b\bar{B}^l = p_bB^{ld} = f_{b^l}(r, r_e^e, r_b^e)W_p^n \tag{3.7}$$

with r given from the outside, $f_b(r, r_e^e, r_b^e) + f_{b^l}(r, r_e^e, r_b^e) + f_e(r, r_e^e, r_b^e) \equiv 1$, $r_e^e = \frac{pY - wL^d}{p_e\bar{E}} + \bar{\pi}_e^e = r_k/q + \bar{\pi}_e^e$, $r_b^e = 1/p_b + \pi_b^e$, and $W_p^n = \bar{B} + p_b\bar{B}^l + p_e\bar{E}$.

We have for the rate of profit the expression:

$$r_k = \frac{pY - wL^d}{pK} = \frac{Y}{K}(1 - \omega/z), \quad \omega = w/p < z = Y/L^d = const$$

where we assume a constant value for the labor productivity coefficient $z > w/p$ that has to exceed the real wage $\omega = w/p$ of course.

Only two of these equations are independent from each other and can be used to determine the bond and the stock price, p_b and p_e. Note that the expression r_e^e defines the rate of return on equities (the sum of the dividend rate of return r_k/q and expected capital gains on equities π_e^e), since all profits are assumed to be paid out as dividends. As previously mentioned, we moreover assume that the Central Bank is fixing the rate of interest

r on its outstanding bonds at each moment in time and changes the number of interest bearing bonds B (if desired) through open market operations of the type $dB = p_b dB^l$. We assume finally that the demands for financial assets exhibit the gross substitute property and therefore depend positively on their own rate on return and negatively on the rates of return of the other assets, i.e. in particular, money demand B^d depends positively on the rate of interest and negatively on the rates of return on equities and long -term bonds.[8]

In contrast to Asada et al. (2011b), where three equilibrium conditions for short-term and long-term bonds and equities were assumed, we are now considering adjustment processes for bond prices as well as equity prices based on the following stock disequilibria (which may arise from frictions like information asymmetries, adjustment costs or institutional restrictions), similar to what we have already modeled for an open economy in Asada, Flaschel, Mouakil and Proaño (2011a):

$$\hat{p}_e = \beta_e \alpha_e \frac{f_e(r, r_e^e, r_b^e)W_p^n - p_e \bar{E}}{p_e \bar{E}}, \quad \alpha_e \in (0,1) \tag{3.8}$$

$$\hat{p}_b = \beta_b \alpha_b \frac{f_{b^l}(r, r_e^e, r_b^e)W_p^n - p_b \bar{B}^l}{p_b \bar{B}^l}, \quad \alpha_b \in (0,1) \tag{3.9}$$

We therefore assume that only a fraction α_b of current stock disequilibria, $f_{b^l}(r, r_e^e, r_b^e)W_p^n - p_b \bar{B}^l$ in the case of bonds, is entering the asset markets as demand or supply (based on adjustment costs arguments), i.e., $1/\alpha_e$ for example represents the delay with which for example the stock imbalance $f_e(r, r_e^e, r_b^e)W_p^n - p_e \bar{E}$ is intended to be balanced. Such an approach was seen to be necessary in an open economy, where flows but not stock imbalances enter the capital account of the balance of payments. It is definitely also a plausible modeling procedure in a continuous time setup in the case of closed economies. The flow processes on the asset markets are then translated into asset price changes by using speed parameters β in the front of these expressions. For the proof of the existence of an overall equilibrium of the model see the appendix.

[8] Note that – in contrast to Asada et al. (2011b) – there is no longer a hierarchy present in this setup of financial assets and the portfolio choice of asset holders.

3.3 Stable Real-Financial Market Interactions?

Of most interest should be now whether the working of the private sector of the economy can be left to its own or not. For a long period of time the view that the economic system is a self-correcting one and should be better left to market forces alone, even (or especially) in the presence of a huge and differentiated financial sector, was almost undefeated, and is only now due to the actual global financial crisis that the believe in the intrinsic stability of the market society has become shattered.

In order to investigate if this ideal picture of an intrinsically stable market economy holds in the sketched model economy of this chapter, we first consider the stability properties of the financial markets and thereafter couple this dynamics with the real side and derive its stability implications. For now the expectations of future capital gains are still assumed to be static. The real markets influence the asset markets through output Y as the determining variable in the rate of profit of firms and subsequently through the rate of return on the stock market. The financial markets feedback to the real side through Tobin's q as argument in the aggregate demand function, either through a consumption or an investment effect.

The core dynamics of the real-financial market interaction written as differential equations for simplicity read as follows:

$$\dot{Y} = \beta_y[(a_y - 1)Y + a_q(q - q^o) + \bar{A}] \tag{3.10}$$

$$\dot{p}_e\bar{E} = \beta_e\alpha_e(f_e(r, r_e^e, r_b^e)W_p^n - p_e\bar{E}) \tag{3.11}$$

$$\dot{p}_b\bar{B}^l = \beta_b\alpha_b(f_{b^l}(r, r_e^e, r_b^e)W_p^n - p_b\bar{B}^l) \tag{3.12}$$

On the basis of the core model with static capital gain expectations we can state the following propositions for the stability of the economy (the proofs of the propositions are given in the appendix). Since the dynamic law of the real side given by the simple dynamic multiplier is of course stable when treated separately, the first proposition concerns the asset markets in isolation without capital gains endogenized yet.

Proposition 1: Stable Financial Markets Interaction

Assume that capital gain expectations are static. Then: The dynamics

$$\dot{q} = \beta_e \alpha_e (f_e(r, r_e^e, r_b^e) W_p^n - q), \quad q = p_e \bar{E} \tag{3.13}$$

$$\dot{b} = \beta_b \alpha_b (f_{b^l}(r, r_e^e, r_b^e) W_p^n - b), \quad b = p_b \bar{B}^l \tag{3.14}$$

converges to the current stationary state of the asset markets for all adjustment speeds of asset prices p_e, p_b.

The equity and long-term bond markets are characterized by their excess demand functions and interact in a smooth way without the presence of heterogeneous capital gain expectation mechanisms. We therefore in sum have that the real and the financial markets, when considered in isolation (and with sufficiently tranquil capital gain expectations) are both stable. The next step therefore is to investigate what happens when they are interacting as a full 3D dynamical system.

Proposition 2: Stable 3D Real-Financial Markets Interaction

Assume that the parameter β_y is sufficiently large and the parameter β_e sufficiently small. Assume moreover that the parameter a_y is sufficiently close to one (but smaller than one). Then: The dynamics

$$\dot{Y} = \beta_y [(a_y - 1)Y + a_q(q - q^o) + \bar{A}] \tag{3.15}$$

$$\dot{q} = \beta_e \alpha_e (f_e(r, r_e^e, r_b^e) W_p^n - q) \tag{3.16}$$

$$\dot{b} = \beta_b \alpha_b (f_{b^l}(r, r_e^e, r_b^e) W_p^n - b) \tag{3.17}$$

is locally asymptotically stable around its steady state position.

Summing up we thus get in the case of static capital gain expectations for equities and long-term bonds ($\bar{\pi}_e^e$ =const.& $\bar{\pi}_b^e$ =const.) the above stability proposition. It makes clear that the coupling of two stable, but partial processes need not provide a stable interaction of the two partial processes. The interaction adds complexity and a potentially destabilizing feedback channel through Tobin's q in the aggregate demand function and the output determined rate of profit in the equity demand function arises. As this proposition makes clear, "the market proponents" perspective cannot be thus upheld in general because the parameter space for stable outcomes is heavily restricted and thus only presents a special case. Note that this result does not depend on the presence of behavioral traders on the financial markets (to be incorporated below), but is purely driven by the interaction of the real and the financial side.

3.4 Endogenizing Capital Gain Expectations

We now extend the model by endogenizing capital gain expectations. We distinguish between fundamentalists f and chartists c and assume for the former that they expect capital gains to converge back with speeds $\beta_{\pi_{ef}}, \beta_{\pi_{bf}}$ to their steady state position which is zero. Chartists by contrast (for analytical simplicity) make use of a simple adaptive mechanism to forecast the evolution of capital gains $\dot{\pi}_e^e$ in the equity market and $\dot{\pi}_b^e$ in the market for long-term bonds. Market expectations π^e are then an average of fundamentalist and chartist expectations with weight γ. Justification for this scheme is twofold: Many empirical studies argue in favor of this kind of expectation mechanisms in order to explain agent's behavior on financial or FX markets and the ability to be insightful despite its relatively simple structure. De Grauwe and Grimaldi (2005) employ this kind of scheme to characterize the behavior of agents on the foreign exchange market and Brunnermeier (2008) shows how bubbles can evolve in a market when this agent constellation underlying.[9] We stress here that these simple expectations formation mechanisms are chosen to make the dynamics analytically tractable. They can of course be replaced by much more refined forward and backward looking expectation rules when the model is treated numerically.

[9]See also Proaño (2011) for the incorporation of heterogeneous expectations in an two-country model along the lines of the disequilibrium approach to macroeconomics pursued also in this thesis. For empirical evidence on the chartist-fundamentalist framework in explaining expectational heterogeneity see Menkhoff et al.(2009).

However, we do not expect that this changes the results in a significant way if these learning mechanisms are built in the spirit of the ones we introduce and employ below:

$$\dot{\pi}^e_{ef} = \beta_{\pi_{ef}}(0 - \pi^e_{ef}) \tag{3.18}$$

$$\dot{\pi}^e_{ec} = \beta_{\pi_{ec}}(\hat{q} - \pi^e_{ec}) \tag{3.19}$$

$$\dot{\pi}^e_{bf} = \beta_{\pi_{bf}}(0 - \pi^e_{bf}) \tag{3.20}$$

$$\dot{\pi}^e_{bc} = \beta_{\pi_{bc}}(\hat{p}_b - \pi^e_{bc}) \tag{3.21}$$

$$\pi^e_e = \gamma_e \pi^e_{ef} + (1 - \gamma_e)\pi^e_{ec} \tag{3.22}$$

$$\pi^e_b = \gamma_c \pi^e_{bf} + (1 - \gamma_b)\pi^e_{bc} \tag{3.23}$$

On the basis of the 3D stability proposition one then easily gets:

Proposition 3: Stable 5D Real-Financial Markets Interaction

Assume that the conditions of the preceding proposition are met and that the speed parameters for chartists are sufficiently small (or the parameter γ_e, γ_b sufficiently close to 1). Then: The dynamics of equations (15) - (17)

$$\begin{aligned}
\dot{Y} &= \beta_y[(a_y - 1)Y + a_q(q - q^o) + \bar{A}] \\
\dot{q} &= \beta_e \alpha_e (f_e(r, r_k/q + \pi^e_e, 1/p_b + \pi^e_b)W^n_p - q) \\
\dot{b} &= \beta_b \alpha_b (f_{b^l}(r, r_k/q + \pi^e_e, 1/p_b + \pi^e_b)W^n_p - b),
\end{aligned}$$

augmented by the above adjustment rules for the two processes describing capital gain expectations (equations (18) and (20)), is locally asymptotically stable around its steady state position.

The proof of Proposition 3 is straightforward, since the absence of chartists implies a 5D Jacobian matrix given by the investigated 3D one and the negative entries $J_{44} = \beta_{\pi_{ef}}\gamma_e$, $J_{55} = \beta_{\pi_{bf}}\gamma_b$. Fundamentalists – if sufficiently dominant – may therefore calm down the situation that chartists may create. By contrast if there are only chartists present, we get positive entries in the entries J_{44}, and J_{55} in the trace of J, if the parameters β_e, β_b are sufficiently large. These entries will outperform the other entries in the trace of J if the parameters $\beta_{\pi_{ec}}, \beta_{\pi_{bc}}$ are chosen sufficiently large. Depending on the choice of other parameters the behavior of chartists may however be neutralized to a larger degree if all the other stability conditions apply.[10]

Note also that the positive feedback loop (for example in the case of the stock market) between:

$$\begin{aligned} \dot{q} &= \beta_e \alpha_e (f_e(\,\cdot\,, ... + \bar{\pi}_e^e, \,\cdot\,) W_p^n - q) \\ \dot{\pi}_{ec}^e &= \beta_{\pi_{ec}} (\hat{q} - \pi_{ec}^e) \end{aligned}$$

is of no importance (if present in the minors of order higher than 1), since the implied rows in the Jacobian matrix J can be simplified as indicated by the following reduced form laws of motion:

$$\begin{aligned} \dot{q} &= \beta_e \alpha_e (f_e(\,\cdot\,, ... + 0, \,\cdot\,) W_p^n - q) \\ \dot{\pi}_{ec}^e &= \beta_{\pi_{ec}} (0 - \pi_{ec}^e) \end{aligned}$$

Depending on its parameter sizes the economy may therefore at one time be fairly robust to chartists' centrifugal behavior, while it may be fairly vulnerable in other constellations.[11]

[10] If the determinant of the considered three dimensional dynamics is made negative (by an appropriate choice of the parameter a_y), we get by appropriate row manipulations in the full 5D Jacobian that its determinant must be negative as well. Increasing adjustment speeds can then imply loss of stability only by way of so-called Hopf-bifurcations, i.e. in general, by way of the death of a stable corridor around the steady state position of the economy or the birth of a stable persistent fluctuations around it. The dynamical system of this chapter therefore can provide a theory of business fluctuations caused through the interaction of the real with the financial markets.

[11] The above row reduction methods again show that the upper 4D minor must be positive and the determinant of the full 5D Jacobian negative if the latter also holds for the upper 3D minor. As already indicated, stability through excessive chartist behavior can therefore only get lost by way of Hopf-bifurcations, i.e., in a cyclical fashion, by the birth of a stable persistent oscillation or by the death of a stability basin around the steady state (or in exceptional cases by passing through a center type dynamics).

We briefly contrast the above analysis with the case where neoclassical perfectness is given. This perfectness assumes that there holds $\beta_e,\ \beta_b = \infty,\ \alpha_e,\ \alpha_b = 1$, assumes perfect asset substitution, and assumes myopic perfect foresight with respect to capital gains ($\beta_{\pi bc}, \beta_{\pi ec} = \infty$). These assumptions taken together imply that there always holds:

$$r = r_k/q + \hat{q} = 1/p_b + \hat{b}.$$

The dynamical system is in its core dynamics then reduces to

$$\dot{Y} = \beta_y[(a_y - 1)Y + a_q(q - q^o) + \bar{A}] \tag{3.24}$$

$$\hat{q} = r - r_k(Y)/q \tag{3.25}$$

which is of the usual saddlepoint type if the 2D determinant in the former expression J_3 is positive and thus there stabilizing for all considered adjustment speeds. Yet the perfect limit case is then unstable, but it exhibits a stable submanifold that – when the economy is on it – leads it back to the stationary state (see Blanchard (1981)).

Since Sargent and Wallace (1973), the neoclassical procedure was to assume that the economy always jumps to this stable submanifold and is thus made stable by assumption (in the case of anticipated shocks via a bubble in the old dynamics until the shock actually occurs). The jump variable technique of the rational expectations school therefore simply excludes the possibility of an unstable economy by assumption. The reader is referred to Chiarella, Flaschel, Franke and Semmler (2009) for detailed evaluations of this methodology, its attractiveness and its various anomalies.

In the following section we therefore return to the case of imperfect asset substitution and imperfect capital gain expectations and will investigate for this case what fiscal and monetary policy can do in order to (further) stabilize the economy, in particular in cases where the private sector is generating a repelling steady state. We conclude this section with the observation that the model, we are going to study further below, provides one example for a proper Keynesian representation of the real- financial market interaction, in contrast to both the expectations-free Turnovsky (1995) representation of the financial markets at the one extreme and the superperformance of rational expectations agents at the other one.

3.5 Stabilizing an Unstable Economy: Tobin Type Taxes, Interest Rate Rules and Open Market Policies

> *As we approach the last decade of the twentieth century, our economic world is in apparent disarray. After two secure decades of tranquil progress following World War II, in the late 1960s the order of the day became turbulence – both domestic and international. ... What is needed now is a new approach, a policy synthesis fundamentally different from the mix that results when today's accepted theory is applied to today's economic system.* Minsky (1982, p.3)

The present section is only a simple illustration of how this can be done in our model economy. It first of all suggests that the feedback structure of the economy must be taken into account in order to find the proper measures or rules for monetary policy. Moreover, significant institutional change may be needed for the implementation of the simple theoretical rules proposed below. Though simple in its theoretical structure, this section nevertheless breaks new grounds for monetary policy making, concerning the role of money and the interest rate policy of the central bank. For other innovative monetary policies in the same spirit see e.g. Bernanke et al. (2004) and Farmer (2010).

In view of the considered 5D extension of our model where expectations were no longer static, but are impacting the asset market in significant ways, the most obvious thing to do as policy maker is to raise taxes on capital gains in order to reduce the casino-component in the market for equities and for long-term bonds. This is necessary since these markets have or should have the primary function to channel savings into investment in an efficient way, and not be shaped through the gambling activities of asset holders. This was already clearly stressed in Keynes (1936, p.159) and of course an important subject in the works of Hyman Minsky (1982, 1986).

We therefore now apply the **Tobin type tax rates** $\tau_e, \tau_b \in (0,1)$ to the capital gains achieved by chartists and get on this basis as reformulation of their expectations formation process the net capital gains expectation rules:[12]

$$\begin{aligned}
\dot{\pi}_e^e &= \gamma_e \dot{\pi}_{ef}^e + (1-\gamma_e)\dot{\pi}_{ec}^e = \gamma_e \beta_{\pi_{ef}}(0 - \pi_{ef}^e) + (1-\gamma_e)\beta_{\pi_{ec}}((1-\tau_e)\hat{q} - \pi_{ec}^e) \\
\dot{\pi}_b^e &= \gamma_b \dot{\pi}_{bf}^e + (1-\gamma_b)\dot{\pi}_{bc}^e = \gamma_b \beta_{\pi_{bf}}(0 - \pi_{bf}^e) + (1-\gamma_b)\beta_{\pi_{bc}}((1-\tau_b)\hat{p}_b - \pi_{bc}^e)
\end{aligned}$$

In view of the 5D stability analysis of the preceding section we immediately get the proposition that *Tobin tax rates that are chosen sufficiently high will eliminate all instability caused through the expectations formation* of the model. In order to guarantee stock-flow consistency, we assume these Tobin-type taxes to be collected by a financial authority which is independent of other public institutions. It just accumulates or decummulates reserves from the tax (subsidy) flow without altering the budget position of the government and thus impacting the issue of bonds. It should be equipped with enough financial resources at the beginning to be able to subsidize capital losses in downswing situations. Therefore such a tax declaration scheme would not be entirely to the disadvantage of asset holders. Only in boom phases the authority would enforce speculators to pay part of their capital gains as tax.

It therefore then suffices to concentrate on the 3D core dynamics of the model and to investigate what policy options are conceivable in these subdynamics that allow to increase the range of parameter choices where the private sector of the economy is subject to converging dynamics.

We consider first a **conventional type of Taylor rule**, based on the output gap solely, since there is no inflation gap in this model. This gives the simple interest rate policy rule. We stress again that this rule can be applied without any need for open market operations

[12] The Tobin tax was originally formulated as a transactions tax which should have similar stabilization effects, but which acts on the $\alpha-$parameters of the capital market adjustment rules in a way that would introduce a kink at $\alpha = 0$ and thus a mathematical complexity we try to avoid in this chapter.

by the central bank in our model.

$$r = r^o + \beta_r(Y - Y^o), \quad \beta_r > 0.$$

The considered 3D Jacobian of the private sector of the model

$$J \;=\; \begin{pmatrix} - & + & 0 \\ + & - & + \\ - & + & - \end{pmatrix}$$

is then augmented by a matrix of the qualitative form

$$J^{+} \;=\; \begin{pmatrix} 0 & + & 0 \\ - & - & + \\ - & + & - \end{pmatrix} \quad \text{with} \quad \begin{vmatrix} 0 & + & 0 \\ - & - & + \\ - & + & - \end{vmatrix} < 0$$

The original determinant is thereby made a smaller one and thus more likely to be negative as compared to the situation without a Taylor rule. Choosing β_r large enough will in particular make any initially given determinant negative.

The only further change in the minors of the original J happens in the principal minor J_3 which is augmented by

$$J_3^{+} \;=\; \begin{pmatrix} 0 & + \\ - & - \end{pmatrix} \quad \text{with} \quad \begin{vmatrix} 0 & + \\ - & - \end{vmatrix} > 0$$

We thus get the further proposition that the *stability condition* we have imposed on the matrix J_3 is thereby *relaxed* and this to a significant degree if the parameter β_r is sufficiently increased. All other minors of the original matrix J are the same as before. The change in the Routh Hurwitz condition

$$(-trJ)(J_1 + J_1 + J_3 + J_3^+) + (|J| + |J^+|)$$

is however ambiguous and must eventually be improved by the choice of a higher adjustment speed in the employed dynamic multiplier process. This condition should however not be of a really significant nature.

At least from the theoretical perspective one may also consider and investigate the following **Tobin's q-based extension of the Taylor rule**:[13]

$$r = r^o + \beta_{ry}(Y - Y^o) + \beta_{rq}(q - q^o), \quad \beta_{ry}, \beta_{rq} > 0.$$

This rule now raises the interest rate further if the stock market is strong and vice versa and thus takes the stock market index now as some further expression for the state of confidence in the economy. Note that this rule is here superior to a rule that concentrates on long-term bond prices in place of share prices, since aggregate demand does not depend on the long-term rate of interest here.

The 3D Jacobian $J + J^+$ is thereby augmented by a matrix of the qualitative form

$$J^{++} = \begin{pmatrix} - & 0 & 0 \\ + & - & + \\ - & - & - \end{pmatrix} \quad \text{with} \quad \begin{vmatrix} - & 0 & 0 \\ - & - & + \\ - & - & - \end{vmatrix} < 0$$

The original determinant is thereby made again a smaller one and thus more likely to be negative as compared to the situation without a Taylor rule. In this situation all minors of order 2 are also improved in their stability implications and also the trace of J. Moreover the addition to the 3D determinant is now of the qualitative type $J_{11}J_1$ and thus does not

[13] A type of 'quantitative easing' strategy of the central bank.

question the positivity of the final Routh-Hurwitz condition:

$$(-trJ)(J_1 + J_1 + J_3) + |J|.$$

We thus get the proposition that an *interest rate policy which takes the state of the equity market into account* and tries to make it less volatile *is unambiguously successful* in its implications for the working of the economy. This result is not so obvious when the central bank uses the gap $p_b - p_b^o$ in place of the stock market gap which moreover is not considered with so much public interest and emphasis as is the market for shares as far as the state of confidence for the considered macroeconomy is concerned.[14]

Concerning long-term bonds the central bank might however use open market operations and thus for example the following static **open market policy rule** which changes the supply of short-term against long-term bonds according to the rule:

$$\bar{B}(p_b) = -p_b \bar{B}^l(p_b), \quad d\bar{B}(p_b)/dp_b < 0.$$

The central bank increases the supply of money in form of short-term bonds in opposite direction to the movements of the state of the long-term bond market. When prices decrease, more short-term bonds are put onto the market and the supply of long-term bonds is lowered. When the long-term bond market is booming on the contrary, the supply of short-term bonds will be reduced in favor of long-term bonds. This rule is assumed to impact supply conditions solely, while demand is still articulated on the basis of the original wealth position of the asset holders. In this case, the 3D Jacobian J is augmented by a

[14] This may change however if the prices of long-term bonds act on output dynamics in the same way we have assumed for share prices q.

matrix of the qualitative form

$$J^{+++} \quad = \quad \begin{pmatrix} - & + & 0 \\ + & - & 0 \\ - & + & - \end{pmatrix}$$

with similar properties as the case of equities we have just considered (if the upper principal minor of order 2 is positive). We thus finally get the proposition that *trading in long-term bonds* in the above way therefore *provides additional stability* to the considered dynamics of the private sector. We therefore in sum get that monetary policy can do a lot in this still simple framework in order to improve the working of the economy through its impact on the financial sector of the model. This result is in line with Romer (1991, 2009) who argued that monetary impulses ended the Great Depression and not self-stabilizing market forces and that monetary policy is an important tool in fighting the present financial crisis.

3.6 Conclusions and Outlook

Financial slumps and even huge crises are no unique events in economic history (as is shown by Reinhart and Rogoff 2009), but are recurrent features of capitalist economies. In view of this, we have developed in this chapter a macro model with sources of instability within the real-financial markets interaction in particular. Since it was policy interventions that ended the Great Depression and averted a second global depression after the financial market meltdown in the late 2000s, we modeled an unstable private sector which had to be safeguarded by appropriate policy measures in order to make the dynamics of the economy viable. These policy instruments were close in spirit to Minsky (1986) and similar suggestions by Farmer (2010) and Bernanke et al.(2004).

The integrated macromodel of this chapter exhibited a rich asset market structure with all fundamental financial instruments (except credit relationships) being present regarding the financing decisions of firms (if the assumed long-term bonds are also considered as corporate bonds besides government bonds). Though we cannot claim to be able to represent highly elaborated financial derivatives in the model's financial part, from the macroeconomic perspective the modeling stage can considered to capture a very broad range of basic financial instruments. The model featured the incorporation of the term-structure of interest rates (besides stock price dynamics) and the behavior in the financial markets was characterized by dynamic portfolio decisions of economic agents with heterogeneous capital gains expectations.

We have considered in such a framework the stability properties of the private sector of the economy and – in the case of instability – the policy measures that are capable of overcoming the centrifugal forces around the steady state of the economy. These policy measures were given by a Tobin type tax on capital gains for long term bonds as well as equities, certain interest rate policy rules concerning equity prices (and long-term bond prices) and also open market operations of the central bank in the market for long-term bonds. To some extent the proposed policies resemble real world policy actions taken by the FED and other central banks during the crisis with respect to open market interventions. Other instruments like the Tobin-type capital gains taxation remain to be implemented however. A quantitative assessment of the specific interest rate policies remains here a question for future research and empirical application of the model.

3.7 References

Asada, T., Chiarella, C., Flaschel, P., Mouakil, T., Proaño, C. and Semmler, W., 2010. Stabilizing an Unstable Economy: On the Choice of Proper Policy Measures. Economics: The Open-Access, Open-Assessment E-Journal, Vol. 3, 2010-21. http://www.economics-ejournal.org/economics/journalarticles/2010-21

Asada, T., Flaschel, P., Mouakil, T. and Proaño, C.R., 2011a, Asset Markets, Portfolio Choice & Macroeconomic Activity, Basingstoke: Macmillan.

Asada, T., Charpe, M., Flaschel, P., Malikane, C., Mouakil, T. and Proaño, C., 2011b, Output, Stock Markets and Macro-Policy Measures in a Keynesian Portfolio Model. Intervention, European Journal of Economics and Economic Policies, 8(2), 341-360.

Bernanke, B., Reinhard, V.R. and Sack, B., 2004. Monetary Policy Alternatives at the Zero Bound: An Empirical Assessment. Finance and Economics Discussion Series, 48, The Federal Reserve Board, Washington D.C.

Blanchard, O. 1981. Output, the Stock Market, and Interest Rates. American Economic Review, 71(1), 132-143.

Brunnermeier, M.K., 2008, Bubbles. In: Durlauf, S., Blume, L. (Eds.), The New Palgrave Dictionary of Economics, 2nd Edition, Palgrave Macmillan.

Chiarella, C. and Flaschel, P., 2000. The Dynamics of Keynesian Monetary Growth: Macrofoundations. Cambridge University Press, Cambridge.

Chiarella, C., Flaschel, P., Franke, R. and Semmler, W., 2009. Financial Markets and the Macroeconomy. A Keynesian Perspective. Routledge, New York.

De Grauwe, P. and Grimaldi, M., 2005, Heterogeneity of agents and the exchange rate: A nonlinear approach. In: De Grauwe, P. (Ed.), Exchange Rate Economics: Where Do We Stand?, CESifo Seminar Series, MIT Press, Cambridge, pp. 125-168.

Farmer, R.E.A., 2010, How to reduce Unemployment: A new Policy Proposal, Journal of Monetary Economics, Carnegie Rochester Conference Series on Public Policy, 57(5), 557-572.

Keynes, J.M. 1936. The General Theory of Employment, Interest and Money. Macmillan, London.

Menkhoff, L., Rebitzky, R. and Schröder, M., 2009. Heterogeneity in Exchange Rate Expectations: Evidence on the Chartist-Fundamentalist Approach. Journal of Economic Behavior and Organization, 70(1-2), 241-252.

Minsky H., 1982. Can "It" Happen Again? M.E. Sharpe, New York.

Minsky H., 1986. Stabilizing an Unstable Economy. Yale University Press, New Haven, CT.

Proaño, C.R., 2011. Exchange Rate Determination, Macroeconomic Dynamics and Stability under Heterogeneous Behavioral FX Expectations. Journal of Economic Behavior and Organization, 77, 177-188.

Reinhart, C.M., Rogoff, K.S., 2009. This Time is Different: Eight Centuries of Financial Folly. Princeton University Press, New Jersey.

Romer, C.D., 1991. What Ended the Great Depression? NBER Working Paper No. 3829.

Romer, C.D., 2009. Lessons from the Great Depression for Economic Recovery in 2009. Speech at the Brookings Institution, Washington D.C., March 9, `http://www.brookings.edu/~/media/...lessons/0309_lessons_romer.pdf`

Sargent, T., 1987. Macroeconomic Theory. Academic Press, New York, 2nd edn.

Sargent, T. and Wallace, N., 1973. The stability of models of money and growth with perfect foresight. Econometrica, 41, 1043-48.

Tobin, J., 1982. Money and the Macroeconomic Process. Journal of Money, Credit and Banking, 14, 171-204.

Turnovsky, S., 1995. Methods of Macroeconomic Dynamics. MIT Press, Cambridge, MA.

3.8 Appendix

Financial Market Equilibrium:

We show the existence of an overall equilibrium for the above equations and demonstrate thereafter that this equilibrium is stable under the above adjustment of asset prices in a neighborhood of the steady state position. In the steady state we have (since expected capital gains are zero then):

$$\begin{aligned}
\bar{B} &= f_b(r, r_k/q, 1/p_b)(\bar{B} + p_b\bar{B}^l + p_e\bar{E}), \quad r \text{ given} \\
p_e\bar{E} &= f_e(r, r_k/q, 1/p_b)(\bar{B} + p_b\bar{B}^l + p_e\bar{E}) \\
p_b\bar{B}^l &= f_{b^l}(r, r_k/q, 1/p_b)(\bar{B} + p_b\bar{B}^l + p_e\bar{E})
\end{aligned}$$

We use the first and the third equation in order to determine the steady state. The first equation generally defines a negative relationship between the prices p_e, p_b, due to the implicit function theorem, the slope of which is given by:

$$\frac{\partial p_b}{\partial q} = -\frac{f_{b2}(\cdot)(-r_k/q^2)W_p^n + f_bE}{f_{b3}(\cdot)(-1/p_b^2)W_p^n + f_bB^l} < 0,$$

For the slope of the function that is implicitly defined by the third equilibrium condition we get in a similar way:

$$\frac{\partial p_b}{\partial q} = -\frac{f_{b^l2}(\cdot)(-r_k/q^2)W_p^n + f_{b^l}E}{f_{b^l3}(\cdot)(-1/p_b^2)W_p^n + (f_{b^l} - 1)B^l} > 0.$$

This time the slope of the curve defined by the implicit function theorem is positive, since there holds $f_{b^l2}(\cdot) < 0, f_{b^l3}(\cdot) > 0$ and $f_{b^l} \in (0, 1)$. We note that these two features also hold for all other capital gain expectations as long as these expectations are given (are static).

We thus have that the stationary state q, p_b on the financial markets is uniquely determined and assume that the parameters behind the functions f_b, f_{b^l} are such that it exists everywhere in the neighborhood of the steady state q^o, p_b^o of the full dynamical system (where $Y^o = \frac{\bar{A}}{1-a_y}$ holds in addition).

Proof of Proposition 1:

The matrix J of partial derivatives of the considered two laws of motion is given by:

$$\begin{pmatrix} \beta_e\alpha_e[f_{e2}(\cdot)(-r_k/q^2)W_p^n + (f_e - 1)\bar{E}] & \beta_e\alpha_e[f_{e3}(\cdot)(-1/p_b^2)W_p^n + f_e\bar{B}^l] \\ \beta_b\alpha_b[f_{b^l2}(\cdot)(-r_k/q^2)W_p^n + f_{b^l}\bar{E}] & \beta_b\alpha_b[f_{b^l3}(\cdot)(-1/p_b^2)W_p^n + (f_{b^l} - 1)\bar{B}^l] \end{pmatrix}$$

The trace of this matrix is obviously negative, while for the determinant we obtain the expression:

$$J = \beta_e\alpha_e\beta_b\alpha_b \begin{vmatrix} -f_{e2}(\cdot)r_k/q^2W_p^n + (f_e - 1)\bar{E} & -f_{e3}(\cdot)/p_b^2W_p^n + f_e\bar{B}^l \\ -f_{b^l2}(\cdot)r_k/q^2W_p^n + f_{b^l}\bar{E} & -f_{b^l3}(\cdot)/p_b^2W_p^n + (f_{b^l} - 1)\bar{B}^l \end{vmatrix}$$

We have

$$-(f_{e2} + f_{b^l2})(\cdot)r_k/q^2W_p^n + (f_e + f_{b^l} - 1)\bar{E} = f_{b2}(\cdot)r_k/q^2W_p^n - f_b\bar{E} < 0$$

and

$$-(f_{e3} + f_{b^l3})(\cdot)/p_b^2W_p^n + (f_e + f_{b^l} - 1)\bar{B}^l = f_{b3}(\cdot)/p_b^2W_p^n - f_b\bar{B}^l < 0$$

and thus get that the negative entries in the diagonal dominate the positive entries in the off-diagonal. This implies that the determinant of J must be positive and thus proves the validity of the Routh-Hurwitz stability conditions for such a planar dynamical system.

Proof of Proposition 2:

The Jacobian of the full 3D system at the steady state is given by:

$$J = \begin{pmatrix} \beta_y(a_y-1) & \beta_y a_q & 0 \\ \beta_e\alpha_e f_{e2} r'_k/qW_p^n & \beta_e\alpha_e[-f_{e2}r_k/q^2W_p^n + (f_e-1)\bar{E}] & \beta_e\alpha_e[-f_{e3}/p_b^2W_p^n + f_e\bar{B}^l] \\ \beta_b\alpha_b f_{b^l2} r'_k/qW_p^n & \beta_b\alpha_b[-f_{b^l2}r_k/q^2W_p^n + f_{b^l}\bar{E}] & \beta_b\alpha_b[-f_{b^l3}/p_b^2W_p^n + (f_{b^l}-1)\bar{B}^l] \end{pmatrix}$$

$$= \begin{pmatrix} - & + & 0 \\ + & - & + \\ - & + & - \end{pmatrix}$$

The trace of J is obviously negative and the principal minor of order 2

$$J_1 = \begin{vmatrix} \beta_e\alpha_e[-f_{e2}r_k/q^2W_p^n + (f_e-1)\bar{E}] & \beta_e\alpha_e[-f_{e3}/p_b^2W_p^n + f_e\bar{B}^l] \\ \beta_b\alpha_b[-f_{b^l2}r_k/q^2W_p^n + f_{b^l}\bar{E}] & \beta_b\alpha_b[-f_{b^l3}/p_b^2W_p^n + (f_{b^l}-1)\bar{B}^l] \end{vmatrix}$$

is positive according to the proposition of financial markets interaction as is the principal minor J_2. And for the remaining principal minor of order 2 we get

$$J_3 = \begin{vmatrix} \beta_y(a_y-1) & \beta_y a_q \\ \beta_e\alpha_e f_{e2} r'_k/qW_p^n & \beta_e\alpha_e[-f_{e2}r_k/q^2W_p^n + (f_e-1)\bar{E}] \end{vmatrix}$$

$$= \beta_y\beta_e\alpha_e f_{e2}/qW_p^n \begin{vmatrix} a_y-1 & a_q \\ r'_k & -r_k/q \end{vmatrix} + \beta_y(a_y-1)(f_e-1)\bar{E}$$

which is positive if the speed parameter β_e is chosen sufficiently small. Note however that the Routh-Hurwitz conditions only demand that the sum of principal minors of order 2 is to be positive which provides a much weaker condition then the one just stated.

For the determinant of the Jacobian J one gets from the above:

$$\begin{aligned}
|J| &= \beta_y\beta_e\alpha_e\beta_b\alpha_b \begin{vmatrix} a_y-1 & a_q & 0 \\ f_{e2}r'_k/qW_p^n & -f_{e2}r_k/q^2W_p^n+(f_e-1)\bar{E} & -f_{e3}/p_b^2W_p^n+f_e\bar{B}^l \\ f_{b^l2}r'_k/qW_p^n & -f_{b^l2}r_k/q^2W_p^n+f_{b^l}\bar{E} & -f_{b^l3}/p_b^2W_p^n+(f_{b^l}-1)\bar{B}^l \end{vmatrix} \\
&= J_3J_{33}+\beta_y\beta_e\alpha_e\beta_b\alpha_b(f_{e3}/p_b^2W_p^n-f_e\bar{B}^l) \begin{vmatrix} a_y-1 & a_q \\ f_{b^l2}r'_k/qW_p^n & -f_{b^l2}r_k/q^2W_p^n+f_{b^l}\bar{E} \end{vmatrix}
\end{aligned}$$

In order to get a negative determinant we therefore have to show that the determinant

$$\begin{vmatrix} a_y-1 & a_q \\ f_{b^l2}r'_k/qW_p^n & -f_{b^l2}r_k/q^2W_p^n+f_{b^l}\bar{E} \end{vmatrix}$$

is positive – in addition to the already assumed positivity of the minor J_3. The last expression here shows that this *for example* holds if the marginal propensity to purchase goods $a_y \in (0,1)$ is sufficiently close to 1.

The condition $(-tr J)(J_1+J_2+J_3)-|J|>0$ can be fulfilled by choosing the adjustment speed of the dynamic multiplier process sufficiently large, since it enters the product term with power 2 and the determinant only in a linear form.

4 Financial Markets, Banking and the Design of Monetary Policy: A Stable Baseline Scenario

4.1 Introduction

Monetary and fiscal policy measures have been applied in order to avert the financial market collapse of 2008 and counteract the global recession, which has still not been fully overcome. The financial crisis started in the U.S. housing market and was amplified by the bankruptcies of large banks and transmitted, finally, to the real economy. Obviously, it is the interconnectedness of real and financial sectors that makes the working of the whole economy so vulnerable to crashes in one part. We do not claim to capture the recent crisis in its specific lines in our model, but we want to stress that crisis phenomena (even large ones) might not be unique and extremely rare events in capitalist economies, as long as the complex interactions of (macro-) markets remain unfettered.

A basic framework will be delivered, which allows for a unique and attracting steady state despite its high dimension. The model ends up in dimension eight, which implies that the dynamics become easily non-trivial. The strategy to guarantee analytical tractability is to set up the model step-by-step and infer stability properties from the added eigenvalues.

Since the focus of the chapter is on the financial side, we model, in addition to basic

This chapter is based on Hartmann and Flaschel (2014).

assets, like bonds and equities, credit relations in detail. Therefore, a baseline integration of commercial banks into the behavioral Keynesian disequilibrium framework of Charpe et al. (2011, 2012) will be conducted; noting that we will only use the deterministic part here to set up the framework, though stochastic shocks might be easily reintroduced.[15]

Potentially destabilizing feedback channels of advanced macroeconomies shall be detected and investigated throughout the chapter. After the sources of instability are identified, we will design appropriate policy instruments, taking into account the causal structure of the economy. This procedure enables us to display endogenous crisis mechanisms and to highlight conditions (parameter relations) that restrict the occurrence of dynamic instability.

In the model of the chapter, we consider, on the one hand, the interaction of asset markets with real economic activity and, on the other hand, the interaction of real activity with the credit channel, here based on commercial banking controlled by the central bank by its money supply policy. Secondary asset markets and real activity are linked via asset price-based demand effects and output-dependent profitability results. Tobin's q will be used here as measure of confidence in the economy, as in Blanchard (1981). This state of confidence matters, then, for consumption and investment decisions, which ultimately drive aggregate demand.

The potential for asset market instability is shown via the coupling of a dynamic Tobinian portfolio approach with the interaction of heterogeneous agents in this market. Brunnermeier (2008) reports that the existence of different types of agents in asset markets implying heterogeneous expectation formation is perceived to be one of the main source of bubbles and, thus, instability in financial markets. Therefore, we will use expectation formation schemes of the chartist-fundamentalist variety, as advocated by Menkhoff et al. (2009) or De Grauwe and Grimaldi (2005).

Since we aim to show the potential fragility of the whole economy and not only of cer-

[15] The chapter's contribution is part of a larger attempt in order to develop a Dynamic Stochastic General Disequilibrium (DSGD) approach to macroeconomics. See, also, Charpe et al. (2013) and Flaschel et al. (2013).

tain parts, a bundle of instruments will be needed for an effective cure. Especially Minsky (1982, 1986) developed many ideas of how to stabilize an unstable economy. In our model, Tobin-type capital gain taxation coupled with volatility reducing asset market open market operations of the central bank are capable of making the interaction of goods market results with financial markets a stable one, while additional countercyclical money supply rules can make the credit supply a countercyclical one. Taken together, they create the situation of a real financial interaction that allows for attracting steady states despite the high dimensional nature of this interaction, due to the facts that gross substitutability makes financial markets, in principle stable ones (if chartists behavior is not dominating the outcomes on these markets, in particular if supported by countercyclical open market operations on these markets), while the implied credit supply is counteracting booms through credit reductions and busts through credit expansions.

The need for policy intervention is more striking, as the banking sector is modeled in a stability enhancing way, fulfilling its fundamental tasks of term transformation of savings and credit granting without engaging in investment activities itself. This implies that a strict separation between commercial and investment banks is an additional necessary condition for the stable configuration obtained in the end.

4.2 Tobinian Asset Price Dynamics and the Multiplier

In the Keynesian modeling framework of Charpe et al. (2011), the interaction of real and financial markets via several potentially destabilizing feedback channels has been investigated. In the following, we start from this framework and integrate a banking sector with the help of credit relationships.

The financial side is described by a Tobin-portfolio structure along the lines of Tobin (1982). The array of financial assets contains equities E, long-term bonds B^l and money represented by short-term bonds B, which are issued by the central bank.

The expectation formation process for capital gains on financial markets is driven by two kinds of agents, namely chartists (showing speculative behavior by making use of a simple adaptive mechanism to forecast price evolution) and fundamentalists (who expect the convergence of capital gains back to their steady-state positions).

At this modeling stage, diverse fiscal and monetary policies are needed in order to stabilize such unstable macroeconomies. One particular policy instrument is the taxation of capital gains. In this chapter, the Tobin tax income of the central bank is made explicit contrary to the former approach. The tax revenues are simply transferred into the government sector. When combined with an additionally stabilizing open market policy $\dot{M}$ that buys (sells) the respective assets if the corresponding asset markets are weak (strong), the magnitude of equities and long-term bonds available for private trading becomes endogenous, though overall stocks remain exogenously given. We do not yet consider the issue of new equities by firms or of long-term bonds by the government, i.e., there is no asset accumulation taking place, so far. In this respect, we still ignore the budget equations of firms, the government (and also of the households), due to the simple dynamic multiplier approach we shall be using for the description of the dynamics of the real part of the model.

Complexity on the real side is reduced to a minimum, but the financial structure is extensively modeled. The financial assets are imperfect substitutes, and only a fraction, α, of current stock disequilibria enters the markets for bonds or equities in the form of supply or demand. This is due to the assumption that adjustment costs are implicitly present. Moreover, capital gain expectations are imperfect in the model. This can be justified on empirical grounds: in reality, the gathering of information is quite costly, and information processing capabilities are limited. Attaining perfect foresight (the deterministic correspondence to rational expectations) is out of reach for at least part of the agents acting in financial markets. There might be even a rationale for chartist expectations in the presence of the knowledge of the fundamental positions of the economy. Some agents could perceive that riding the bubble is a favorable strategy, as long as they assume to be smarter than others and exit the market before a potential burst.

In the following, the time derivative of a variable, x, is denoted by $\dot{x}$, the growth rate by $\hat{x}$ and by f_x, the first derivative of a function, $f(\cdot)$, with respect to x. Goods price inflation is not considered, and the corresponding price level normalized to one. Only the equity price,

p_e, and the price for long-term bonds, p_b, is assumed to be variable. Y denotes output, $\bar{A}$ autonomous expenditure, r the profit rate, π^e expected capital gains, r_e^e the expected rate of return on equities and r_b^e the expected rate of return on bonds.

The core dynamical system of Charpe *et al.* (2011), slightly extended, reads as follows (with $\bar{E}/(pK) = 1$ in Tobin's average q for expositional simplicity, i.e., $q = p_e$):

$$\dot{Y} = \beta_y[(a_y - 1)Y + a_q(p_e - p_e^o)E_h + \bar{A}] \quad (4.1)$$

$$\dot{p}_e\bar{E} = \beta_e\alpha_e(f_e(r_e^e, r_b^e)W_h^n - p_e\bar{E}), \quad r_e^e = \frac{r(Y)}{p_e} + \pi_e^e, 0 < f_e < 1 \quad (4.2)$$

$$\dot{p}_b\bar{B}^l = \beta_b\alpha_b(f_{b^l}(r_e^e, r_b^e)W_h^n - p_b\bar{B}^l), \quad r_b^e = \frac{1}{p_b} + \pi_b^e, 0 < f_b < 1 \quad (4.3)$$

with $W_h^n := M + D + p_b B_h^l + p_e E_h$; nominal wealth of households equals money, deposits, the value of long-term bonds and the value of equities.

For further details, see also the accounts shown below. The block of Equations (1)–(3) shows the impact of asset markets on real economic activity, as well as the impact of the profitability[16] $r = \frac{\Pi}{pK}, \frac{r}{p_e} = \frac{\Pi}{p_e\bar{E}}$ of firms on the dynamics of financial markets, where there is also a pronounced self-referencing dynamics at work.

The first law of motion is just the textbook multiplier dynamics, based on Tobin's $q = p_e$, measuring the state of confidence, driving the economy, as far as the feedback from financial markets to the real markets is concerned. The second and third law of motion shows the excess demand pressures, $\alpha_e(\cdot), \alpha_b(\cdot)$, on the respective asset markets, which lead to asset price adjustments with speed β_e, β_b, but in the end, to no change in the stocks actually held in the private sector. Note also that the shown excess demands for equities and bonds must be balanced (here, implicitly) by a corresponding excess supply of money $M_2 = M + D$ (and *vice versa*). Note further that the stock demand function, f, is characterized by the gross substitute property, i.e., the demand for the respective asset depends positively on its own rate of return, r_x^e,, and negatively on the other one's rate of return ($x = e, b$).

[16] Π profits = dividends.

4.3 Stability Propositions

At the heart of our investigation into the interaction of aggregate demand, stock market performance and credit relationships is the question of economic stability. A very convenient way to assess the stability characteristics of dynamic systems is to use eigenvalue analysis of the constituting dynamic equations for the state variables. Whenever an eigenvalue of a characteristic polynomial shows a negative real part, convergence can be asserted for the respective law of motion. Associated with deviations from negativity of the real part of an eigenvalue are instability and saddle-point outcomes, whereas even the latter one has to be considered an instability situation from our point of view.[17]

Whether the eigenvalues of low-dimensional systems are positive or negative can be evaluated by means of Routh–Hurwitz conditions, which make use of the Jacobian matrices. The Jacobian matrices contain the partial derivatives evaluated at the steady state. From these, one has to determine the trace and determinant in order to check the fulfillment of the theorems.[18]

All proofs are given directly in the text, except those establishing the core system of real-financial interactions without a banking sector, which can be found in the Appendix.

We get from the above the following proposition for the stability of the asset markets when capital gain expectations are static.

Proposition 1: Stable Financial Markets Interaction

Assume that capital gain expectations are static. Then, the dynamics:

$$\dot{q} = \beta_e \alpha_e (f_e(r_e^e, r_b^e) W_h^n - q), \quad q = p_e \bar{E}, \alpha_e \in (0,1) \tag{4.4}$$

$$\dot{b} = \beta_b \alpha_b (f_{b^l}(r_e^e, r_b^e) W_h^n - b), \quad b = p_b \bar{B}^l, \alpha_b \in (0,1) \tag{4.5}$$

converges to the current asset market equilibrium for all adjustment speeds of asset prices p_e, p_b.

[17] A very extensive discussion on this point can be found in Chiarella *et al.* (2009), as well as in Chiarella, Flaschel and Semmler (2012).

[18] Compare e.g., Tu (1994)

The proof of Proposition 1 is presented in the Appendix and is based on Charpe et al. (2011). Since the dynamic multiplier of the real side is stable on its own, we can state that in sum, the real and the financial markets, when considered in isolation (and with sufficiently tranquil capital gain expectations) are both stable. The next step, therefore, is to investigate what happens when they are interacting as a full 3D dynamical system.

In the case of static chartist capital gain expectations, we obtain the following proposition:

Proposition 2: Stable 3D Real-Financial Markets Interaction

Assume that the parameter, β_y, is sufficiently large and the parameter β_e sufficiently small. Assume, moreover, that the parameter, a_y, is sufficiently close to one (but smaller than one). Then, the dynamics:

$$\dot{Y} = \beta_y[(a_y - 1)Y + a_q(q - q^o) + \bar{A}] \tag{4.6}$$

$$\dot{q} = \beta_e\alpha_e(f_e(r_e^e, r_b^e)W_h^n - q) \tag{4.7}$$

$$\dot{b} = \beta_b\alpha_b(f_{b^l}(r_e^e, r_b^e)W_h^n - b) \tag{4.8}$$

is locally asymptotically stable around its steady-state position.

This proposition and its proof (modified from Charpe et al. 2011; see the Appendix) show, however, that the coupling of two stable, but partial, processes need not provide a stable interaction of the two partial processes. The stability proposition is restricted with respect to several parameters and their possible values. In general, stability cannot be ascertained for the whole parameter space. Moreover, until now, the working of financial markets has been relatively tranquil compared to the stage when capital gains will be considered. These capital gain expectations will be a serious source of instability if the weight of chartists in the average market expectations is high.

Contrasting these propositions with the case of neoclassical perfectness with regard to substitution and expectations delivers, basically, the Blanchard (1981) model and its stability implications. Perfectness demands $\beta_e, \beta_b = \infty$ and $\alpha_e, \alpha_b = 1$, which means perfect substitution of assets and myopic perfect foresight of the capital gains evolution. The 3D core system then collapses into a two-dimensional one in Y and q. The system is unstable, but exhibits a saddle path. The neoclassical treatment of such a stability situation requires the usage of the jump-variable technique of Sargent and Wallace (1973). It is assumed that the economy always jumps to the converging trajectory. The possibility of an unstable economy is ruled out by assumption. An in-depth demonstration and critique of this technique can found in Chiarella et al. (2009).

4.4 Commercial Banking and Central Bank Behavior

This model of the private sector of the economy is now augmented by a detailed description of the banking sector and the policy actions of the central bank. In particular, the central bank's income of the required Tobin capital gain taxation is dealt with in detail, and the credit channel of the economy will be introduced explicitly. First, the stock and flow accounts of the central bank (Tables 1 and 2) are presented in order to capture its full activities.

Central Bank:

Balance Sheet	
Assets	***Liabilities***
Treasury bonds (perpetuities): $p_b B_c^l$ $[B_c^l = \bar{B}^l - B_h^l]$	High powered money: $\mathcal{M} = M + R$
Equities (from firms): $p_e E_c$ $[E_c = \bar{E} - E_h]$	CB: net worth

Monetary Policy (Flows):

Uses	***Resources***
	OMP: $\dot{\mathcal{M}} = c_{p_e}(p_e^o - p_e)E_h + c_{p_b}(p_b^o - p_b)B_h^l$
Equity demand $p_e\,\dot{E}_c^{[} = c_{p_e}(p_e^o - p_e)E_h$	Tobin capital gains taxes $\tau_e\,\dot{p}_e\,E_h$
Bond demand $p_b\dot{B}_c^l = c_{p_b}(p_b^o - p_b)B_h^l$	Tobin capital gains taxes $\tau_b\dot{p}_b B_h^l$
CB surplus (-> government budget constraint (GBR)): $rE_c + B_c^l + \tau_e\dot{p}_e E_h + \tau_b\dot{p}_b B_h^l$	Dividends and interest $rE_c + B_c^l$

The balance sheet simply states that the central bank can hold treasury bonds issued by the government or equities issued by firms. Since the stock of these assets is assumed to be fixed for the time being, the difference between total stocks and central bank's holdings must be private holdings.

The flow account[19] shows on the right-hand side the resources that accrue to the central bank, namely dividends on its stock holdings (r, the rate of profit of firms) and interest on its long-term bond holdings, the taxes that are obtained by capital gain taxation and the changes in its inventory of equity and long-term bonds through its open market operations $\dot{\mathcal{M}}$. These changes are the uses (if positive) of the issue of new money, $\dot{M}$, and are reported on the left-hand side of its income account again.[20]

Against this background, we have to consider now the two laws of motion for the households' holdings of equities and long-term bonds, i.e., of the endogenous variables, E_h, B_h^l,

[19] $rE_c = \Pi \frac{E_c}{E}$; all dividends are paid out as profits.

[20] We assume that the central bank surplus is transferred into the government sector for expositional simplicity, i.e., it affects the government budget constraint (GBR).

which are given by:[21]

$$p_e\dot{E}_h = -c_{p_e}(p_e^o - p_e)E_h, \quad E_h = \bar{E} - E_c \tag{4.9}$$

$$p_b\dot{B}_h^l = -c_{p_b}(p_b^o - p_b)B_h^l, \quad B_h^l = \bar{B}^l - B_c^l \tag{4.10}$$

They imply, as laws of motion for private equity and long-term bond holding:

$$\hat{E}_h = -c_{p_e}(p_e^o/p_e - 1) \tag{4.11}$$

$$\hat{B}_h^l = -c_{p_b}(p_b^o/p_b - 1) \tag{4.12}$$

We only observe here that these two laws of motion do not endanger the stability of the 3D baseline structure, at least when operated in a sufficiently cautious way, since the implied 4D system exhibits a positive determinant and the implied 5D dynamics, when the second law is added, a negative one, so that parameter changes with respect to c_{p_e} and c_{p_b}, from zero to small values of them, will add negative eigenvalues to the already existing three eigenvalues with their negative real parts.

Next, we introduce commercial banks into the model and enlarge therewith the assumed financial structure of money, M, long-term bonds B^l and equities E by deposits D and loans L. Commercial banks are here conceived as firms that hold saving deposits D from households and transform them into credit to firms, based on reserve requirements $R = \delta_r D$. Banks are borrowing short and lending long, which means that they provide for the term transformation of savings.[22] This is their only proper function, i.e., they, in particular, do not trade on financial markets in an active way, but only passively adjust their interest rate on deposits, i_d, such that the flow account shown below is a balanced one with respect to the new loan supply, $\dot{L}$, they intend to provide.[23]

[21]Note that we do not yet integrate the new issue of equities by firms and of new bonds issued by the government.

[22]This is the basic and fundamental task attributed to banks. On this, see, for example, Gorton and Winton (2003) or Freixas and Rochet (2008). The latter, moreover, deliver rigorous microeconomic justifications for the existence of financial intermediaries.

[23]We abstract from labor input and equipment in the banking sector here.

We assume, as in the multiplier approach to money holdings $M_2 = M + D$, that households are hoarding (in secured deposit boxes) as 'cash' $M = \delta_h D$ a certain amount of money, M of the central bank, assumed to be proportional to the deposit, D, they have accumulated, i.e., they do not deposit all their money holdings, M_2, into the credit circuit operated by commercial banks. The supply of money by the central bank is then characterized by:

$$\mathcal{M} = M + R = (\delta_h + \delta_r)D$$

as the relationship between the money supplied by the central bank and the deposits held in the household sector. The total amount of money, M_2, held in the household sector, moreover, by definition is:

$$M_2 = D + M = (1 + \delta_h)D$$

This gives, as usual, the money multiplier formula:

$$M_2 = M + D = \frac{1 + \delta_h}{\delta_h + \delta_r}\mathcal{M} = \alpha_m \mathcal{M}$$

between the money supply concept, M_2, and the money supply, $M + R$, issued by the central bank. Based on this multiplier formula, we can now redefine the nominal wealth of households into the four assets $M + D, B_h^l, E_h$, that households now possess by:

$$W_h^n := \alpha_m \mathcal{M} + p_b B_h^l + p_e E_h$$

We assume here that the interest rate on savings deposits, i_d, only concerns the allocation of M_2 into cash and savings deposits and, thus, the cash management process of the households $M = \delta_h(i_d)D$, while the allocation of financial assets between liquid assets M_2 and bonds and equities is driven by the rates of return on the risky assets solely. Moreover, we could also assume that the reserve rate is a given magnitude, controlled (fixed) by the central bank, which, thereby, then influences the supply of new credit, a scenario that does impact the model in its present formulation.

Commercial banks adjust the loan rate, i_l, in order to bring credit supply in line with credit demand. The credit multiplier can then be easily calculated, providing the expression:[24]

$$L = (1-\delta_r)D = \frac{1-\delta_r}{\delta_h+\delta_r}\mathcal{M} = \alpha_l \mathcal{M}$$

Based on the total supply of high powered money: $\mathcal{M} = M + R = \delta_h D + \delta_r D$ and the shown demand for it, as well as the subsequent derivation of the multiplier formulae for money and credit, the banking sector exhibits the following balance sheet and flow account(Tables 3 and 4).[25]

Commercial Banks (Private Ownership):

Balance Sheet	
Assets	***Liabilities***
Loans $L = \frac{1-\delta_r}{\delta_r+\delta_h}\mathcal{M}$	Households' saving deposits $D = (1-\delta_h)\frac{1+\delta_h}{\delta_r+\delta_h}\mathcal{M}$
Reserves $R = \delta_r D$	

Flow Account:	
Uses	***Resources***
Interest rate payments $i_d D, i_d = \frac{i_l^o}{1+\mu}$	Loan rate income $i_l^o L$ i_l^o; the market clearing loan rate
Reserve adjustment $\delta_r \dot{D}$	New deposits $\dot{D}$
New loan supply $\dot{L}$	

[24]When the deposits that flow back from the granted loans via the circuit of money were considered to become new loans again, the loan multiplier would alter to $L = \frac{1-\delta_r}{\delta_r}D$. The magnitude of the multiplier would change, but, of course, not its qualitative direction.

[25]It should be noted that we assume banks to be privately owned for reasons of expositional simplicity.

The maturity transformation function of banks is reflected in the balance sheet. Banks collect private savings, which are checking deposits, and transform them into loans that possess a longer maturity horizon. The creation of loans is constrained by the reserve obligation in the form of a certain fraction of deposits, $\delta_r D$, not to be granted as loans.[26]

The relationship between high powered money, $\mathcal{M}$, and the volume of loans, L, gives rise to the following law of motion for the loans of commercial banks to firms:

$$\dot{L} = \alpha_l \dot{\mathcal{M}} = \alpha_l [c_{p_e}(p_e^o - p_e)E_h + c_{p_b}(p_b^o - p_b)B_h^l] \quad (4.13)$$

$$\hat{E}_h = -c_{p_e}(p_e^o/p_e - 1) \quad (4.14)$$

$$\hat{B}_h^l = -c_{p_b}(p_b^o/p_b - 1) \quad (4.15)$$

This shows that this specific integration of commercial banks into our model adds one further law of motion (for loans) to the ones already considered.

Moreover, we postulate now as a law of motion for the output of firms on the basis of an extended aggregate demand schedule (now based on the excess debt level, $L - L^o$, transmitted through firms' investment demand schedule, as well as the state of confidence measure q):

$$\dot{Y} = \beta_y[(a_y - 1)Y + a_q(p_e - p_e^o)E_h - a_l(L - L^o) + \bar{A}]$$

if we assume that the private sector considers the steady-state loan volume as normal and deviations from it as impacting investment and the economy in a negative way. This can be justified by the assumption that firms take into account their stock of debt in their investment decisions. High leverage levels expose firms to the risk of insolvency; low leverage states induce expansions of investment projects. The incorporation of the credit channel makes the dynamical system now an eight-dimensional one.

[26] The framework would allow for a separate treatment of time and checkable deposits. The distinction between time and checkable deposits plays an important role in Chiarella et al. (2012) and Flaschel et al. (2011) when the narrow banking idea of Irving Fisher is discussed in such a disequilibrium modeling approach.

4.5 Credit and Credit-Dependent Multiplier Dynamics

We already described the banking activity as a transformational one: Private savings are channeled into loans and enable investment activities. Banks serve as financial intermediaries that allow for term conversion. The link between the real side and the credit channel implies the interaction of the output multiplier with the loan multiplier and should be investigated first in isolation from the overall dynamics.

Adding the debt dynamics to the financial markets gives, by means of the money supply rule of the central bank, the two further laws of motion:

$$\dot{L} = \alpha_l [c_{p_e}(p_e^o - p_e)E_h + c_{p_b}(p_b^o - p_b)B_h^l]$$

$$\dot{Y} = \beta_y [(a_y - 1)Y + a_q(p_e - p_e^o)E_h - a_l(L - L^o) + \bar{A}]$$

Concerning the first law of motion, we have zero root hysteresis in the evolution of the state variable, L, while the output dynamic, $\dot{Y}$, adds a stable dynamic multiplier process to the financial sector of the economy. Moreover, a monetary policy, which increases credit in busts and decreases its volume in the boom, should also contribute to the stability of the overall real-financial market interaction.

We now augment the dynamics of the money supply, however, as follows:

$$\dot{\mathcal{M}} = c_{p_e}(p_e^o - p_e)E_h + c_{p_b}(p_b^o - p_b)B_h^l + \gamma_y Y - \gamma_m \mathcal{M}$$

We here assume that the time rate of change of the money supply (and, thus, credit) is also influenced by the state of the business cycle in a countercyclical way and that there is also a negative feedback of the level of money supply on its current rate of change. We assume that this change in money supply is deducted from the central bank gains that are distributed to the government.

The output-debt subdynamics of the model then read:

$$\dot{L} = \alpha_l[c_{p_e}(p_e^o - p_e)E_h + c_{p_b}(p_b^o - p_b)B_h^l + \gamma_y Y - \gamma_m L/\alpha_l]$$

$$\dot{Y} = \beta_y[(a_y - 1)Y + a_q(p_e - p_e^o)E_h - a_l(L - L^o) + \bar{A}]$$

and are, in themselves, asymptotically stable if the propensity to spend is less than one (as it is usually assumed):

$$J(L,Y) = \begin{pmatrix} - & + \\ - & - \end{pmatrix}$$

The trace is negative, and the determinant is positive, which implies two negative eigenvalues according to Routh–Hurwitz conditions.

4.6 Financial Markets, Accelerating Capital Gain Expectations and Tobin-Type Taxes

The picture of the fully interacting eight-dimensional system is still not complete. For the moment, we concentrate on the dynamics of financial markets and the impact of monetary policy on these dynamics, by keeping the real sector and credit fixed at their steady-state values. The output and loan dynamics is thereby ignored in the following, as is the dynamics of asset accumulation through investment and the corresponding issue of equities, as well as the government budget constraint and the corresponding issue of new government bonds.

We thus first study the financial markets in isolation. We add to them now expectations schemes, as far as static expected capital gains were employed before. By endogenizing capital gain expectations, we distinguish between fundamentalists f and chartists c and assume for the former that they expect capital gains to converge back with speeds $\beta_{\pi_{ef}}, \beta_{\pi_{bf}}$

to their steady-state position, which is zero. Chartists, by contrast (for analytical simplicity), make use of a simple adaptive mechanism to forecast the evolution of capital gains, $\dot{\pi}_e^e$, in the equity market and $\dot{\pi}_b^e$ in the market for long-term bonds. Market expectations π^e are then an average of fundamentalist and chartist expectations.

Justification for this scheme is two-fold: Many empirical studies argue in favor of this kind of expectation mechanisms in order to explain agents' behavior on financial or FX markets and the ability to be insightful despite its relatively simple structure. De Grauwe and Grimaldi (2005) employ this kind of scheme to characterize the behavior of agents on the foreign exchange market, and Brunnermeier (2008) shows how bubbles can evolve in a market when this agent constellation is underlying.[27]

We stress here that these simple expectation formation mechanisms are chosen to make the dynamics analytically tractable. They can, of course, be replaced by much more refined forward- and backward-looking expectation rules when the model is treated numerically. However, we do not expect that this changes the results in a significant way if these learning mechanisms are built in the spirit of the ones we introduce and employ below.

The incorporation of imperfect expectation schemes gives, finally, a rise to the following set of equations:

$$\dot{p}_e E_h = \beta_e \alpha_e (f_e(r_e^e, r_b^e) W_h^n - p_e E_h), \quad r_e^e = \frac{r(Y)}{p_e} + \pi_e^e \tag{4.16}$$

$$\dot{p}_b B_h^l = \beta_b \alpha_b (f_b(r_e^e, r_b^e) W_h^n - p_b B_h^l), \quad r_b^e = \frac{1}{p_b} + \pi_b^e \tag{4.17}$$

$$\hat{E}_h = -c_{p_e}(p_e^o/p_e - 1) \tag{4.18}$$

$$\hat{B}_h^l = -c_{p_b}(p_b^o/p_b - 1) \tag{4.19}$$

$$\dot{\pi}_e^e = \beta_{\pi_e^{ec}}((1-\tau_e)\hat{p}_e - \pi_e^e) + \beta_{\pi_e^{ef}}(0 - \pi_e^e) \tag{4.20}$$

$$\dot{\pi}_b^e = \beta_{\pi_b^{ec}}((1-\tau_b)\hat{p}_b - \pi_b^e) + \beta_{\pi_b^{ef}}(0 - \pi_b^e) \tag{4.21}$$

[27] See Charpe et al. (2012) for endogenizing the population weights of each type of agent and also Proaño (2011) for the incorporation of heterogeneous expectations in a two-country model along the lines of the disequilibrium approach to macroeconomics pursued also in this thesis. For empirical evidence on the chartist-fundamentalist framework in explaining expectational heterogeneity, see Menkhoff et al. (2009).

with $W_h^n = \alpha_m \mathcal{M} + p_b B_h^l + p_e E_h$. Note that we, in addition, have the law of motion:

$$\dot{\mathcal{M}} = c_{p_e}(p_e^o - p_e)E_h + c_{p_b}(p_b^o - p_b)B_h^l$$

which feeds back into the rest of the dynamics through the definition of private wealth. This law of motion, when added to the above dynamics, does, however, not alter them very much, since it gives rise to a zero root and, thus, to zero root hysteresis in the money supply, $\mathcal{M}$, solely. Nominal money supply and its steady-state value, and, thus, private wealth, is, therefore, a path-dependent state variable in this version of the model.

The remaining steady-state values of the above dynamics are, of course, simply given by:

$$p_e = p_e^o, p_b = p_b^o, \pi_e^{eo} = 0, \pi_b^{eo} = 0$$

For the financial markets subdynamics, the following propositions are obtained:

Proposition 3: Gross substitutes, stabilizing expectations and absence of monetary policy

Assume that output Y is fixed at its steady-state value. Then, the 4D dynamics, (16), (17), (20), (21), of asset prices is asymptotically stable around its steady-state position if capital gain expectations are dominated by fundamentalists to a sufficient degree (which can be enforced by choosing the Tobin tax parameters as sufficiently high).

Proof: The proposition is a consequence of the inherently stabilizing Tobinian gross substitute assumption for equities and long-term bonds; see Flaschel et al.(2011). □

This shows that the financial core of the model can work in a proper way with respect to local stability under conditions that favor fundamentalist behavior in the asset markets, a prerequisite that cannot be easily regarded as being given *per se* without policy intervention, as it is by no means clear that fundamentalist expectations will dominate chartistic ones. At least the gross substitution characteristic facilitates the demands for convergence, since negative dependence of demand for one asset on the rate of return of the other one excludes explosiveness from this source of interaction.

Proposition 4: Gross substitutes, static expectations and monetary policy

Assume that output Y is fixed at its steady-state value. Then, the 4D dynamics, (16)–(19), of asset prices, with one or two policy rules switched on, is asymptotically stable around the steady-state position for all choices of the policy parameters in laws of motion (20)–(21).

Proof: Consider the countercyclical equity policy rule of the central bank. Then, it is easy to show that the resulting 3D Jacobian of the considered subdynamics fulfills that $a_1 = -\text{trace } J$ is positive; the positive 2D upper principal minor is increased by $-J_{13}J_{31}$, and $a_3 = -\det J$ is positive and equal to $J_{22}J_{13}J_{31}$, so that all Routh–Hurwitz polynomial coefficients are positive. The expression, $a_1a_2 - a_3$, finally is positive, since $a_3 = J_{11}J_{13}J_{31}$ is contained in a_1a_2. The same applies to the bond-oriented monetary policy.

The combination of the two policies leads to a positive 4D determinant (obtained by several appropriate row operations), so that the stability results are preserved for small positive policy parameters, since the determinant is the product of the four eigenvalues and since three of them already have negative real parts. However, the final Routh–Hurwitz condition:

$$a_1a_2a_3 - a_1^2a_4 - a_3^2 = (a_1a_2 - a_3)a_3 - a_1^2a_4$$

leads to lengthy expressions, where the dominance of the positive terms over the negative terms is not so obvious, as in the discussed 3D case. □

Therefore, Proposition 4 provides the foundation for the impact of monetary policy. The potentially beneficial effects of the countercyclical policy rules of the central bank for the real sector of the economy do not lead to instability in its financial part. The interaction of asset demand and asset supply works smoothly when regarded in isolation.

Proposition 5: Tobin type transactions costs or capital gains taxation

The full 6D dynamics is asymptotically stable around the steady-state position of its state variables if the Tobin-type capital gain taxation parameters are chosen as sufficiently high or if Tobin-type transaction costs on financial markets make the parameters, α_e, α_b, sufficiently small.

Proof: In the limit case where zero is enforced for transactions or capital gains, we get:

$$\dot{\pi}_e^e = \beta_{\pi_e^e}(0 - \pi_e^e) \tag{4.22}$$

$$\dot{\pi}_b^e = \beta_{\pi_b^e}(0 - \pi_b^e) \tag{4.23}$$

as further laws of motion, which makes the 6D dynamics, in a trivial way, locally asymptotically.

□

This proposition thus demands, as a lot of literature starting with Tobin (1978), Tobin-type taxation rules concerning financial market transactions or sufficiently high taxes on capital gains.[28]

Inserting the various equations of the model into each other as far as the structure of financial markets is concerned gives, however:

$$\dot{\pi}_e^e = \beta_{\pi_e^e}((1-\tau_e)\beta_e[\alpha_e(f_e(\frac{1}{p_e} + \pi_e^e, \frac{r(Y)}{p_b} + \pi_b^e)[\alpha_m \mathcal{M} + p_b B_h^l + p_e E_h] - p_e E_h)] - \pi_e^e) \tag{4.24}$$

$$\dot{\pi}_b^e = \beta_{\pi_b^e}((1-\tau_b)\beta_b[\alpha_b(f_b(\frac{1}{p_e} + \pi_e^e, \frac{1}{p_b} + \pi_b^e)[\alpha_m \mathcal{M} + p_b B_h^l + p_e E_h] - p_b B_h^l)] - \pi_b^e) \tag{4.25}$$

These equations show that the trace of the Jacobian can be made positive (by means of its fifth and sixth component) if, for example, the parameter combinations:

$$\beta_{\pi_e^e}(1-\tau_e)\beta_e\alpha_e f_{e\pi_e^e} > 1, \beta_{\pi_b^e}, (1-\tau_b)\beta_b\alpha_b f_{b\pi_b^e} > 1$$

are made sufficiently large through an appropriate choice of the β_{π^e}-adjustment speed

[28] Westerhoff (2003), as well as Dieci and Westerhoff (2006) show the volatility-reducing effect of Tobin taxes also in a heterogeneous trader's framework.

variables.

These speeds of adjustment must be dampened in any case through monetary policy measures in order to avoid the emergence of asset market bubbles that can endanger the stability of the economy. The trace of J becomes positive only after the system has already lost its stability by way of a Hopf-bifurcation. The trace = 0 condition, therefore, supplies only an upper bound for the parameter region, where the system can be expected to be stable.

4.7 Financial Markets, Credit and Output Dynamics: A Stable Baseline Scenario

The full system describes an economy being complete with regard to all basic financial instruments from a macro perspective. Therefore, the full interaction of the financial side (including credit and the capital gains acceleration process) with the real side (including a Tobinian investment accelerator) can be investigated now.

$$\text{J(8,8)} =$$

$$\begin{pmatrix}
\delta\dot{p}_e E_h/\delta p_e & \delta\dot{p}_e E_h/\delta p_b & \delta\dot{p}_e E_h/\delta E_h & \delta\dot{p}_e E_h/\delta B_l & \delta\dot{p}_e E_h/\delta p_e & \delta\dot{p}_e E_h/\delta p_e & \delta\dot{p}_e E_h/\delta L & \delta\dot{p}_e E_h/\delta Y \\
\delta\dot{p}_b B_h^l/\delta p_e & \delta\dot{p}_b B_h^l/\delta p_b & \delta\dot{p}_b B_h^l/\delta E_h & \delta\dot{p}_b B_h^l/\delta B_l & \delta\dot{p}_b B_h^l/\delta & \delta\dot{p}_b B_h^l/\delta & \delta\dot{p}_b B_h^l/\delta L & \delta\hat{p}_b B_h^l/\delta Y \\
\delta\hat{E}_h/\delta p_e & \delta\hat{E}_h/\delta p_b & \delta\hat{E}_h/\delta E_h & \delta\hat{E}_h/\delta B_l & \delta\hat{E}_h/\delta & \delta\hat{E}_h/\delta & \delta\hat{E}_h/\delta L & \delta\hat{E}_h/\delta Y \\
\delta\hat{B}_l/\delta p_e & \delta\hat{B}_l/\delta P_b & \delta\hat{B}_l/\delta E_h & \delta\hat{B}_l/\delta B_l & \delta\hat{B}_l/\delta & \delta\hat{B}_l/\delta & \delta\hat{B}_l/\delta L & \delta\hat{B}_l/\delta Y \\
\delta\dot{\pi}_e^e/\delta p_e & \delta\dot{\pi}_e^e/\delta p_b & \delta\dot{\pi}_e^e/\delta E_h & \delta\dot{\pi}_e^e/\delta B_l & \delta\dot{\pi}_e^e/\delta & \delta\dot{\pi}_e^e/\delta & \delta\dot{\pi}_e^e/\delta L & \delta\dot{\pi}_e^e/\delta Y \\
\delta\dot{\pi}_b^e/\delta p_e & \delta\dot{\pi}_b^e/\delta p_b & \delta\dot{\pi}_b^e/\delta E_h & \delta\dot{\pi}_b^e/\delta B_l & \delta\dot{\pi}_b^e/\delta & \delta\dot{\pi}_b^e/\delta & \delta\dot{\pi}_b^e/\delta L & \delta\dot{\pi}_b^e/\delta Y \\
\delta\dot{L}/\delta p_e & \delta\dot{L}/\delta p_b & \delta\dot{L}/\delta E_h & \delta\dot{L}/\delta B_l & \delta\dot{L}/\delta & \delta\dot{L}/\delta & \delta\dot{L}/\delta L & \delta\dot{L}/\delta Y \\
\delta\dot{Y}/\delta p_e & \delta\dot{Y}/\delta p_b & \delta\dot{Y}/\delta E_h & \delta\dot{Y}/B_l\delta & \delta\dot{Y}/\delta & \delta\dot{Y}/\delta & \delta\dot{Y}/\delta L & \delta\dot{Y}/\delta Y
\end{pmatrix}$$

For the full dynamics with L as the seventh and Y as the eighth state variable, we have as signs of the Jacobian at the steady state:

$$J(8,8) \quad = \quad \begin{pmatrix} - & + & - & 0 & + & - & 0 & + \\ + & - & 0 & - & - & + & 0 & 0 \\ + & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & + & 0 & 0 & 0 & 0 & 0 & 0 \\ - & + & 0 & 0 & \pm & 0 & 0 & + \\ + & - & 0 & 0 & 0 & \pm & 0 & 0 \\ - & - & 0 & 0 & 0 & 0 & - & + \\ + & 0 & 0 & 0 & 0 & 0 & - & - \end{pmatrix}$$

By the usage of appropriate row operations, one can remove the influence of the first six state variables from the last two rows, i.e., in the full 8D case, the 2D subdeterminant can be isolated in its row representation from the first six state variables and the corresponding subdeterminant. The 8D determinant is, therefore, positive.

Positive feedback loops, leading to instability via the $a_2 > 0$ Routh–Hurwitz stability condition, are $J_{18}J_{81}, J_{55}J_{88}, J_{66}J_{88}$. They appear to imply instability if β_y is made sufficiently large (a_y is sufficiently close to one). The system is therefore generally not stable, even if the 6D and the 2D systems are assumed as stable when isolated from each other. This is basically due to the fact that economic activity depends positively on Tobin's q and Tobin's q positively on economic activity via the rate of profit. The dynamics is, however, 8D stable if β_y is chosen as sufficiently small, since the zero eigenvalue must become negative if β_y is made positive (the full determinant is positive).

There is, therefore, only a limited reason that the full 8D dynamics can be made asymptotically stable through the policy instruments of the central bank (Tobin taxes and open market operations and countercyclical money supply actions) if the positive feedbacks, $J_{18}J_{81}$, $J_{55}J_{88}$ and $J_{66}J_{88}$, become sufficiently large.

If asset markets are booming, the money supply is decreased by the selling of financial assets through the central bank (and *vice versa*). This, in particular, should moderate the volatility in the financial markets and, thus, contribute to the overall stability of the interaction of the real with the financial sector.

Assume that the 6D system characterizing the financial markets is stable and that capital gain taxes are sufficiently large for this purpose, as well as for a reduction of the entry, J_{58}. Assume, finally, that dividends are taxed, such that $r'(Y)$ becomes sufficiently small. In the limit, the sign structure of the Jacobian is then characterized by:

$$J(8,8) = \begin{pmatrix} - & + & - & 0 & + & - & 0 & 0 \\ + & - & 0 & - & - & + & 0 & 0 \\ + & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & + & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & - & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & - & 0 & 0 \\ - & - & 0 & 0 & 0 & 0 & - & + \\ + & 0 & 0 & 0 & 0 & 0 & - & - \end{pmatrix}$$

which implies the stability of the full dynamics, since $|\lambda I - J|$ can then be decomposed into the financial and the real part of the model. The eigenvalue structure of the full 8D system is identical with the eigenvalue structure that results when the 2D subsystem and 6D subsystem are regarded consecutively. The entry, $J_{18}J_{81}$, is then no longer causing problems (also, if chosen as sufficiently small), because it only appears in the determinant and not in a subdeterminant.

Without a limitation of the results obtained beforehand, a credit expansion effect could be added to the aggregate demand schedule. Obviously, $\dot{L}$ should feed back into the output dynamics. The expression for the dynamic multiplier would alter to:

$$\dot{Y} = \beta_y[(a_y - 1)Y + a_q(p_e - p_e^o)E_h - a_l(L - L^o) + \dot{L} + \bar{A}]$$

since loan increases immediately generate the same amount of aggregate demand.

Regarded in isolation, this would add another source of instability, but embedded into the full dynamics, its destabilizing potential vanishes. The slightly modified Jacobian looks like:

$$J(8,8) \quad = \quad \begin{pmatrix} - & + & - & 0 & + & - & 0 & 0 \\ + & - & 0 & - & - & + & 0 & 0 \\ + & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & + & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & - & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & - & 0 & 0 \\ - & - & 0 & 0 & 0 & 0 & - & + \\ \pm & - & 0 & 0 & 0 & 0 & - & \pm \end{pmatrix}$$

and shows, now, an ambiguity concerning the sign in J_{81} and J_{88}, as well as a negative entry in J_{82}. In the limit case, J_{81} cancels out again as J_{82} does. The positive influence of output on its rate of change is caused by the monetary policy that cares about the state of the business cycle via $\gamma_y Y$. For a stable working of the whole economy, it is just necessary to conduct this policy carefully enough in order not to fully counteract the stable dynamic multiplier.

4.8 Conclusions and Outlook

A framework with all basic financial markets (including credit relationships) from a macroeconomic perspective was presented. Sources of instability were highlighted and remedies to overcome these fragilities proposed. Financial market-oriented open market policies, augmented by a procyclical term and Tobin-type capital gain taxation do the job of stabilizing the economy characterized by a Tobinian financial structure and heterogeneous expectation formation. Summing up, we therefore get that the financial markets must be regulated and also handled by open market policy with care, in order to ensure the stability of the real-financial market interaction in the considered economy. Of course, these conditions are only sufficient ones and, thus, not necessary ones, in order to have such stability assertions. The provided stable baseline model might serve as a reference framework and point of departure for the discussion of further topics of banking and asset markets in a macroeconomic context.

4.9 References

Blanchard, O. Output, the stock market, and interest rates. 1981, American Economic Review, 71, 132–143.

Brunnermeier, M., 2008, Bubbles. In The New Palgrave Dictionary of Economics, 2nd ed.; Durlauf, S., Blume, L., Eds.; Palgrave Macmillan: UK doi:10.1057/9780230226203.0168.

Charpe, M., Flaschel, P., Hartmann, F. and Proaño, C.R. Stabilizing an unstable economy: Monetary and fiscal policy, stocks, and the term structure of interest rates. 2011, Economic Modelling, 28, 2129–2136.

Charpe, M., Flaschel, P., Hartmann, F. and Veneziani, R., 2012, Towards Keynesian DSGD (isequilibrium) Modelling: Heterogenous Expectations and Policy Issues; IMK-Working Paper; Macroeconomic Policy Institute: Düsseldorf, Germany.

Chiarella, C., Flaschel, P., Franke, R. and Semmler, W., 2009, Financial Markets and the Macroeconomy. A Keynesian Perspective; Routledge: New York, NY, USA.

Chiarella, C., Flaschel., P. and Semmler, W., 2012, Reconstructing Keynesian Macroeconomics; Routledge: New York, NY, USA, 2012; Volume 1, Partial Perspectives.

Chiarella, C., Flaschel, P., Hartmann, F. and Proaño, C.R., 2012, Stock market booms, endogeneous credit creation and the implications of broad and narrow banking for macroeconomic stability. Journal of Economic Behavior and Organization, 83, 410–423.

De Grauwe, P. and Grimaldi, M., 2005, Heterogeneity of Agents and the Exchange Rate: A Nonlinear Approach. In Exchange Rate Economics: Where Do We Stand? CESifo Seminar Series; De Grauwe, P., Ed.; MIT Press: Cambridge, USA, 2005; pp. 125–168.

Flaschel, P., Hartmann, F., Malikane, C. and Semmler, W., 2011, Broad banking, financial markets and the return of the narrow banking idea. Journal of Econonomic

Asymmetries, 7, 105–138.

Flaschel, P., Hartmann, F., Malikane, C. and Proaño, C.R., 2013, A Behavioral Macroeconomic Model of Exchange Rate Fluctuations with Complex Market Expectations Formation; CEMM-Working Paper, Bielefeld University: Bielefeld, Germany.

Freixas, X. and Rochet, J.-C., 2008, Microeconomics of Banking, 2nd ed., MIT Press: Cambridge, MA, USA, 2008.

Gorton, G. and Winton, A., 2003, Financial Intermediation. In Handbook of the Economics of Finance; Constantinides, G., Harris, M., Stulz, R., Eds.; North Holland: Amsterdam, The Netherlands, 431–552.

Menkhoff, L., Rebitzky, R. and Schröder, M., 2009, Heterogeneity in exchange rate expectations: Evidence on the chartist-fundamentalist approach. Journal of Economic Behavior and Organization, 70, 241–252.

Minsky, H., 1982, Can It Happen Again?; M.E. Sharpe: New York, NY, USA.

Minsky, H., 1986, Stabilizing an Unstable Economy; Yale University Press: New Haven, CT, USA.

Proaño, C.R., 2011, Exchange rate determination and macroeconomic dynamics under heterogeneous behavioral FX expectations. Journal of Economic Behavior and Organization 77, 177–188.

Sargent, T. and Wallace, N., 1973, The stability of models of money and growth with perfect foresight. Econometrica, 41, 1043–1048.

Tu, N.V.P., Dynamical Systems, 2nd ed.; Springer: Heidelberg, Germany, 1994.

Tobin, J., 1978, A proposal for international monetary reform. Eastern Economic Journal, 4, 153–159.

Tobin, J., 1982, Money and finance in the macroeconomic process. Journal of Money, Credit and Banking, 14, 171–204.

Westerhoff, F. 2003, Heterogeneous traders and the Tobin tax. Journal of Evolutionary Economics, 13, 53–70.

Westerhoff, F. and Dieci, R., 2006, The effectiveness of Keynes-Tobin transaction taxes when heterogeneous agents can trade in different markets: A behavioral finance approach. Journal of Economic Dynamics and Control, 30, 293–322.

4.10 Appendix

Proof of Proposition 1:

The matrix of partial derivatives of the two considered laws of motion is given by:

$$J = \begin{pmatrix} \beta_e\alpha_e[f_{e1}(\cdot)(-r/q^2)W_h^n + (f_e - 1)\bar{E}] & \beta_e\alpha_e[f_{e2}(\cdot)(-1/p_b^2)W_h^n + f_e\bar{B}^l] \\ \beta_b\alpha_b[f_{b^l1}(\cdot)(-r/q^2)W_h^n + f_{b^l}\bar{E}] & \beta_b\alpha_b[f_{b^l2}(\cdot)(-1/p_b^2)W_h^n + (f_{b^l} - 1)\bar{B}^l] \end{pmatrix}$$

The trace of this matrix is obviously negative, while, for the determinant, we obtain the expression:

$$J = \beta_e\alpha_e\beta_b\alpha_b \begin{vmatrix} -f_{e1}(\cdot)r/q^2W_p^n + (f_e - 1)\bar{E} & -f_{e2}(\cdot)/p_b^2W_h^n + f_e\bar{B}^l \\ -f_{b^l1}(\cdot)r/q^2W_h^n + f_{b^l}\bar{E} & -f_{b^l2}(\cdot)/p_b^2W_h^n + (f_{b^l} - 1)\bar{B}^l \end{vmatrix}$$

We have:

$$-(f_{e1} + f_{b^l1})(\cdot)r/q^2W_h^n + (f_e + f_{b^l} - 1)\bar{E} = f_{b1}(\cdot)r/q^2W_h^n - f_b\bar{E} < 0$$

and:

$$-(f_{e2} + f_{b^l2})(\cdot)/p_b^2W_h^n + (f_e + f_{b^l} - 1)\bar{B}^l = f_{b2}(\cdot)/p_b^2W_h^n - f_b\bar{B}^l < 0$$

and, thus, get that the negative entries in the diagonal dominate the positive entries in the off-diagonal. This implies that the determinant of J must be positive and, thus, proves the validity of the Routh–Hurwitz stability conditions for such a planar dynamical system. □

Proof of Proposition 2:

The Jacobian of the full 3D system at the steady state is given by:

$$J = \begin{pmatrix} \beta_y(a_y-1) & \beta_y a_q & 0 \\ \beta_e\alpha_e f_{e1}r'/qW_h^n & \beta_e\alpha_e[-f_{e1}r/q^2W_h^n+(f_e-1)\bar{E}] & \beta_e\alpha_e[-f_{e2}/p_b^2W_h^n+f_e\bar{B}^l] \\ \beta_b\alpha_b f_{b^l1}r'/qW_h^n & \beta_b\alpha_b[-f_{b^l1}r/q^2W_h^n+f_{b^l}\bar{E}] & \beta_b\alpha_b[-f_{b^l2}/p_b^2W_h^n+(f_{b^l}-1)\bar{B}^l] \end{pmatrix}$$
$$= \begin{pmatrix} - & + & 0 \\ + & - & + \\ - & + & - \end{pmatrix}$$

The trace of J is obviously negative, and the principal minor of order two:

$$J_1 = \begin{vmatrix} \beta_e\alpha_e[-f_{e1}r/q^2W_h^n+(f_e-1)\bar{E}] & \beta_e\alpha_e[-f_{e2}/p_b^2W_p^n+f_e\bar{B}^l] \\ \beta_b\alpha_b[-f_{b^l1}r/q^2W_h^n+f_{b^l}\bar{E}] & \beta_b\alpha_b[-f_{b^l2}/p_b^2W_h^n+(f_{b^l}-1)\bar{B}^l] \end{vmatrix}$$

is positive according to the above proposition, as is the principal minor, J_2. Additionally, for the remaining principal minor of order two, we get:

$$J_3 = \begin{vmatrix} \beta_y(a_y-1) & \beta_y a_q \\ \beta_e\alpha_e f_{e1}r'/qW_h^n & \beta_e\alpha_e[-f_{e1}r/q^2W_h^n+(f_e-1)\bar{E}] \end{vmatrix}$$
$$= \beta_y\beta_e\alpha_e f_{e1}/qW_h^n \begin{vmatrix} a_y-1 & a_q \\ r' & -r/q \end{vmatrix} + \beta_y(a_y-1)(f_e-1)\bar{E}$$

which is positive if the speed parameter, β_e, is chosen as sufficiently small. Note, however, that the Routh–Hurwitz conditions only demand that the sum of principal minors of order two is to be positive, which provides a much weaker condition than the one just stated.

For the determinant of the Jacobian, J, one gets from the above:

$$\begin{aligned} |J| &= \beta_y\beta_e\alpha_e\beta_b\alpha_b \begin{vmatrix} a_y-1 & a_q & 0 \\ f_{e1}r'/qW_h^n & -f_{e1}r/q^2W_h^n+(f_e-1)\bar{E} & -f_{e2}/p_b^2W_h^n+f_e\bar{B}^l \\ f_{b^l1}r'/qW_h^n & -f_{b^l1}r/q^2W_h^n+f_{b^l}\bar{E} & -f_{b^l2}/p_b^2W_h^n+(f_{b^l}-1)\bar{B}^l \end{vmatrix} \\ &= J_3J_{33}+\beta_y\beta_e\alpha_e\beta_b\alpha_b(f_{e2}/p_b^2W_h^n-f_e\bar{B}^l) \begin{vmatrix} a_y-1 & a_q \\ f_{b^l1}r'/qW_h^n & -f_{b^l1}r/q^2W_h^n+f_{b^l}\bar{E} \end{vmatrix} \end{aligned}$$

In order to get a negative determinant, we, therefore, have to show that the determinant:

$$\begin{vmatrix} a_y-1 & a_q \\ f_{b^l1}r'/qW_h^n & -f_{b^l1}r/q^2W_h^n+f_{b^l}\bar{E} \end{vmatrix}$$

is positive, in addition to the already assumed positivity of the minor, J_3. The last expression here shows that this *for example* holds if the marginal propensity to purchase goods, $a_y \in (0,1)$, is sufficiently close to one.

The condition $(-tr\,J)(J_1+J_2+J_3)-|J|>0$ can be fulfilled by choosing the adjustment speed of the dynamic multiplier process as sufficiently large, since it enters the product term with power two and the determinant only in a linear form. □

5 Broad Banking, Financial Markets and the the Narrow Banking Idea

5.1 Introduction

The role and extent of commercial banking and the issue whether it adds to macroeconomic instability is currently in the focus of a large body of literature. See Adrian et al. (2010), Brunnermeier and Sannikov (2010), Gorton (2009, 2010), and Shleifer and Vishny (2010). There are also a lot of historical studies that demonstrate that many of the historical financial crises may have originated in adverse shocks to firms, households, foreign exchange, stock market or sovereign debt. Yet, as has been shown the banking sector could seldom escape the crises. See Reinhart and Rogoff (2009) and Gorton (2009, 2010). In fact most of crises ended up as a meltdown of the banking sector and the banking sector has usually exacerbated and amplified the crisis whatever origin it had and this even more since traditional banks have been turned into investment banks. As Gorton (2010) shows in earlier times loan losses and bank runs where usually the way the crises were triggered, but in recent times banking crises seem to be strongly related to adverse shocks in asset prices. This is occurring when banks have significantly invested in capital assets. One might want to show of how such asset accumulation of banks can lead to a channel through which some exacerbating or even destabilizing effects on the macroeconomy can be generated.

The issue is whether we do have proper models to explain this. Do we have models that help to understand this central aspect of the instability of the banking system? There are

This chapter is based on Flaschel, Hartmann, Malikane and Semmler (2010).

the earlier non-conventional studies by Kindleberger and Aliber (2005) and Minsky (1986, 1982) that view the role of credit as significantly amplifying forces. In Kindleberger it is the instability of credit and in Minsky it is the way financing becomes de-linked from collaterals that contributes to a downward spiral once large real or financial shocks occur. This is surely an important tradition that captured many of the aspects of the boom-bust scenarios that we have seen historically.

On the other hand, recent vintages of the DSGE model, for example of the Bernanke et al (1999) type, have considered financial markets as accelerating force. In principle such models can explain amplifications of the macroeconomy through the financial side, the financial accelerator, but those models are locally stable. The amplification through shocks is there, but the financial and real sides are mean reverting: After an amplified shock the variables revert back to their mean level. This is shown through local linearizations where the locally approximated linear system shows the mean reverting tendencies in spite of some amplifications of shocks.[29] Moreover, in those DSGE models with a built-in financial accelerator the banking system is often not specifically modeled.

Here we pursue a rather traditional root and model the banking system as commercial banks that can accumulate capital assets in particular equity. In this chapter we use a minimal structure of assets to reconsider the issue of broad versus narrow banking. Broad banking means that the bank can accumulate capital assets, but in our set up there is only one risky asset (equities E) and no further tradable financial asset, but only two types of deposits (checkable deposits D_1 and time (saving) deposits D_2) besides high powered money H supplied by the central bank. The central bank can therefore only perform open market policies by trading in equities and it can enforce reserve requirements in our model. We assume in this respect that these requirements are only made for checkable deposits (commercial banks' money creation).

Policy actions are therefore narrowly defined, but open market policies do reach the financial markets here in a direct way (and not indirectly via the federal funds rate). Financial markets are modeled as portfolio choice of households between E and $M2$ (money

[29]For a details of such an evaluation, see Brunnermeier and Sannikov (2010).

and deposit holdings of households), who thereafter adjust the structure of their M2 money holdings as described by the textbook money multiplier (concerning high powered money and checkable deposits). Time deposits are treated in a fairly standard way and are used to balance certain operations of the commercial banks in this chapter. The goods market is modeled via a textbook multiplier approach and the labor market is assumed to be simply appended to what happens on the market for goods.

We show that there are two sources of instability in the financial markets (first, a Tobinian investment accelerator and secondly, accelerating capital gains or losses and expectations about them). Moreover, there is a destabilizing credit channel effect which comes into operation if commercial banks are strongly stock market oriented in their decision on new loan supplies. [30] These feedback channels make the considered situation of broad banking a fairly unstable one if the parameter that characterizes their stock market orientation becomes large enough. Central banks can influence this situation through wealth effects in the financial markets and through the goods market dynamics if changes in high powered money have an influence on economy activity.

Taken together it is however questionable if broad commercial banking can be influenced to such a degree that instability, the occurrence of banking crises and bank runs can be safely excluded from the working of the financial part of the economy. We therefore propose – based on Fisher's (1935) 100 % money proposal – that money creation (in the form of checkable deposits) should be excluded – or at least to a great extent – from the operations performed by commercial banks. This would mean that the banks had to reduce proprietary trading significantly. Noting that this has already become a major corner stone of the Obama financial market reform.

We explore what it means if the banking sector of the economy is simply a narrowly defined depository institution with respect to pure money holdings and is primarily concerned with channeling the flow of savings (time deposits) into investment flows where they

[30] Note we will see in our model that as banks go into capital assets they reduce the loan supply. One might argue that empirically one might observe a comovement of credit expansion and rising asset or equity prices. We will come back to this issue at the end of the chapter.

act as credit creators, generating endogenous credit, but not endogenous money. As we will show, such an economy is characterized by strong stability features. In our view this case is to be preferred to the situation of broad or excessive banking. Commercial bank money and credit creation may sometimes be more flexible with respect to large upturns in investment booms, but may be dangerous in opposite situations, where risk management has failed to work and in cases where large bankruptcy scenarios (banks, firms and also governments) can have dramatic chain effects on the working of the national and the world economy.

We consider the model first from the perspective of stock-flow consistency and thereafter study, through the introduction of laws of motions for the real and the financial markets, the stock-flow interactions generated by the model under the assumption of a 'broad banking' scenario. Due to the analytical difficulties that pile up when the model is extended too rapidly, we are limiting our analysis to a set of special cases here, before we contrast the obtained results with a 'narrow banking' scenario. This part of the thesis is closed by comparing the obtained results with actual financial market reforms of the past and the presence. Longer proofs are collected in an appendix to the chapter.

5.2 The basic accounting framework for investment, credit, and consumption behavior

In this section we introduce the model by way of balance sheets and flow accounts for the four sectors: firms, commercial banks, households and the central bank. We first model the economy with a completely passive central bank and commercial banks that can create deposits (ink stroke money) by purchasing equities on the stock market from the household sector. We denote in the following by $\dot{x}$ the time derivative of a variable x, and by $\hat{x}$ the growth rate of x, and by f' derivative of f.

Firms (f, external loan and equity financing):

Balance Sheet:	
Assets	***Liabilities***
Capital Stock pK [$p = 1$in the following]	Loans L
Inventories V	Equities p_eE
	Net Worth

Flow Account:	
Uses	***Resources***
Wages $wN(Y), N'(Y) > 0$	
Interest Payments $i_l(Y)(1-\delta)L,\ i_l'(Y) > 0$	
Dividends $r(Y)(1-\delta)E, \quad r'(Y) > 0$	
Retained Profits or Losses Π_f	
Unintended Inventory Changes $\dot{V} = \mathcal{I}$	Output and Demand $Y = Y^d + \mathcal{I}$
Investment Function $I = i_1Y + i_2p_eE + a_l(L_o - L) + \bar{I}$	Investment Funds $\dot{L}+\delta L+\Pi_f+p_e\dot{E}_f^s, \quad \dot{E}_f^s-\delta E = \dot{E}$

5.2.1 Production and Investment

The balance sheet of firms is a simple one. Firms have issued equities E and have used credit L as external sources to finance their past investment into the capital stock K. We do not consider goods price inflation and normalize the corresponding price level by 1. The only variable price of the model is the share price p_e. We ignore the accumulation of assets $\dot{E}$ and $\dot{K} = I$ in this chapter. We will use a dynamic multiplier process later on for the description of output dynamics which means (since the Metzlerian inventory adjustment process is still absent) that inventories V are adjusted passively by just the difference between aggregate demand and aggregate supply $Y^d - Y = -\dot{V}$.

We next consider the flow account of firms concerning production and and their investment behavior. We assume that the level of economic activity determines the loan rate i_l and also the dividend rate r in a positive way. The only thing in the production account that needs further explanation is given by the relationship $\delta K = \delta L \frac{K}{L} = \delta E \frac{K}{E}$ and $i_l(Y)(1-\delta)L$, which we by and large assume to work in the background of the model. We assume that capital depreciation occurs due to bankruptcy which makes this part of the capital stock just disappear and which also reduces the interest payments of firms and their loans by a corresponding amount.

As for the investment function, we assume that it depends positively on capacity utilization and thus the activity level and also positively on the state of confidence in the economy which we measure by the deviation of the share prices from their steady state value. There is in addition a negative leverage effect in the investment function. The investment function will be suitably extended later on. Investment is financed through retained earnings Π_f (to be determined residually), through new credit $\dot{L}$ and residually through the issue of new equities (depending on the amount of retained earnings that firms can realize). Concerning the income of firms we get the expression $Y_f = S_f = \Pi_f + \mathcal{I}$ which assumes that unintended inventory changes and output (not sales) are used in the income calculations made in this chapter. There is moreover the following transfer of income from firms to the household sector $Y_{hf} = wN(Y) + r(Y)(1-\delta)E_h$ based on the portion of dividends that go into this sector.

We stress again that the amount of investment that is financed by loans depends on what is supplied by commercial banks (so that there credit rationing occurring) and that the new equity issue is determined on this basis in a residual way in order to get investment demand realized.

5.2.2 Banking and Credit

The balance sheet of commercial banks is also a simple one: Banks can provide loans L out of checkable and time deposits D_1, D_2, but they can also invest these deposits or the contract based returned principal on loans into stock holdings $p_e E_b$. The interest rate on time deposits is i_d and considered as a given magnitude in this chapter, while the loan rate i_l was already assumed to depend positively on economic activity Y. There is no interest on checkable deposits which represent money endogenously generated by the commercial banking system.

Broad Commercial Banking (b, private ownership):

Balance Sheet:	
Assets	***Liabilities***
Reserves R $(= H_b = \rho_b D_1)$	Households' C-Deposits D_1
Loans L	Households' T-Deposits D_2
Equities (from firms) $p_e E_b$	Net Worth

We assume the simple textbook multiplier relationship between $M = H_h + D_1$, where H denotes the high powered money issued by the central bank. This multiplier formula is given as follows:

$$M = D_1 + H_h = \frac{1 + \rho_h}{\rho_b + \rho_h} H = \alpha_m H$$

based on the relationships $H_h = \rho_h D_1$, and $R = \rho_b D_1$ which represent the cash demand of households and the reserve requirements of commercial banks, respectively. This money multiplier is however assumed as inactive in the flow account of banks. We also ignore changes in time deposits in this account.

Flow Account:	
Uses	***Resources***
Interest Payments $i_d D_2$	Interest Payments $i_l(Y)(1-\delta)L$
Reserve Adjustment $\dot{R}=0$	Change in C-Deposits $\dot{D}_1 = 0,\ \rho_{b1}>0$
Defaults δL (retained profits)	Dividends $r(Y)(1-\delta)E_b$
Distributed Profit $\Pi_{bh} = i_l(Y)(1-\delta)L + r(Y)(1-\delta)E_b - i_d D_2 - \delta L$	
Net Loans $\dot{L} = [b_l(i_l(Y) - i_l(Y_o)) - b_e(r_e^e - r_{eo}^e)]L$	
Change in Equity Holdings $\dot{L} = -p_e \dot{E}_b^s,\ \dot{E}_b = \dot{E}_b^s - \delta E_b$	Change in T-Deposits $\dot{D}_2 = 0,\ \rho_{b2}=0$

The first part of the flow account is then largely self-explanatory. We stress however that it contains credit default (at rate δ) and the corresponding loss of interest on these loans. Moreover the amount of central bank money is considered a given magnitude here. We assume finally that there is a positive reserve requirement ratio $\rho_{b1}>0$ on C-Deposits, but none with respect to T-Deposits.

If commercial banks intend to provide additional loans $\dot{L}$ (or intend to reduce the number of outstanding debt) the following sequence of events is assumed to happen. They sell (purchase) equities of amount $-p_e\dot{E}_b = \dot{L}$. The means for the intended supply of loans therefore lead to a reduction in the asset holdings of banks. The opposite of course occurs when they find equities more interesting than loans from the perspective of profit maximization (under uncertainty).[31] We assume also as given a loan supply function $\dot{L}$ which depends on a comparison between the loan rate (in its deviation from the steady state) and the rate of return of equities (again in its deviation from the steady state). This later rate will be introduced when the dynamics of stock markets are considered in the next section. We assume finally that the profits (assumed to stay positive in this chapter) made by the banking systems are transferred to their owners, the sector of households.

In the flow account of banks we could allow in addition to the profit-oriented reallocation between their new loan supply (which can also be negative if they do not turn returned

[31] The role of equities to act as collateral or bank capital is neglected in this chapter.

principals back into the credit market) and their equity holdings for the loan generation sequence where commercial banks create new loans $\dot{L}$ which give rise to new deposits $\dot{D}_1$ or $\dot{D}_2$ through the circuit of money.

We summarize the above structure by pointing to its crucial elements again. The amount of credit is assumed to be determined by commercial banks by their comparing of the return on loans with the expected rate of return on their equities. Additional loans are here generated solely through the sale of some of the equities of firms owned by banks, i.e., there is not yet a supply of credit through the creation of commercial bank deposits, since the income circuit and money per se does not increase the stock of money. We here only discuss the possibility that there may be credit rationing by commercial banks, in the extreme simply because they find it more profitable from to invest in additional equities the principal they receive from those firms that have to repay their contracted debt.

5.2.3 Households and Consumption

The flow account mirrors what was already discussed in the previous flow account. It however adds now a consumption function to the investment function already provided which uses as main determinants the income of households and thus the activity level of the economy and the measure of the state of confidence we are using. The account moreover shows again how loans are financed through the creation of time deposits via the purchase of equities by commercial banks. Due to these operations we assume that the savings of households goes into new equity demand at first, subject to reallocations when financial markets are considered in the next section. The income of households consists of wage income, dividend income and loan rate income (which comprise time-deposit income, but is of reduced by the defaulting loans).

The balance sheet of households is on the basis of what has already been said and is self-explanatory.

Note that we simplify dividend distribution by assuming that all dividends are channeled back (one way or the other) into the household sector. Note also that the savings of

Households (h, bank owners and firm stock owners):

Balance Sheet:	
Assets	***Liabilities***
Cash H_h	
C-Deposits D_1	
T-Deposits D_2	
Equities $p_e E_h$	

Flow Account:	
Uses	***Resources***
Consumption Function $C = c_1 Y + c_2 p_e E + \bar{C}$	Wages $wN(Y)$
	Interest on T-Deposits $i_d D_2$
Reallocation of Equity Holdings $p_e \dot{E}_h^d = p_e \dot{E}_b^s$	Dividends $r(Y)(1-\delta)E_h$
Change in Cash Holdings $\dot{H}_h = 0$	
Change in C-Deposits $\dot{D}_1 = 0$	extra dividend payments $r(Y)(1-\delta)E_c$
Change in T-Deposits $\dot{D}_2 = -p_e \dot{E}_h^d$ $\dot{E}_h = \dot{E}_h^d - \delta E_h$	Distributed Profit $\Pi_{bh} = i_l(Y)(1-\delta)L + r(Y)(1-\delta)E_b - i_d D_2 - \delta L$
Households' Savings S_h	
income Y_h	$wN(Y) + r(Y)(1-\delta)E + i_l(Y)(1-\delta)L - \delta L$

households is directed towards the demand of new equities solely and that his portfolio is also modified by the loan – equity exchange of commercial banks. Note finally that dividends are paid per equity unit and not per value unit of the stocks and are thus independent of the occurrence of stock marked rallies.

5.2.4 The Monetary Authority

It is currently assumed that the monetary authority is completely inactive, but has accumulated equities in the past, through its open market operations, which in this model can only concern the equity market. All dividends that could accrue to the central bank are assumed to be paid to or transferred into the household sector (for reasons of simplicity), see their flow account.[32]

The Central Bank (c):

Balance Sheet:	
Assets	***Liabilities***
	High Powered Money $H = H_h + R$
Equities of Firms $p_e E_c$	CB: Net Worth

Monetary Policy (Flows):	
Uses	***Resources***
	Open Market Policies 0
Equity Demand 0 CB Surplus: $r(Y)(1-\delta)E_c \rightarrow HH$	Dividends $r(Y)(1-\delta)E_c \rightarrow HH$

The accumulation effects $\dot{E}^s_f, \dot{E}_h$ on the stocks of equities held and the reallocation of the existing stock will be ignored as accumulation equations in this first version of the model, just as the capacity effects on the capital stock through investment I and the capacity effect on inventories through unintended inventory investment $\mathcal{I}$.

[32] Total savings are $S_h + S_f + S_b \equiv (Y_h - C) + (\Pi_f + \mathcal{I}) + \delta L$ This gives after some restructuring of such expressions the consistency result that total savings equal total investment if and only if there is flow consistency on the equity market.

The assumed major determinants of consumption and investment imply as aggregate demand function the expression:

$$Y^d = a_y Y + a_e p_e E - a_l(l - l_o)E + \bar{A}, \quad L = lE, a_y < 1$$

with $a_y = c_1 + i_1, a_e = c_2 + i_2, \bar{A} = \bar{C} + \bar{I}$. The aggregate demand function is thus based on income and activity level effects (on households' consumption and firms' investment), state of confidence effects on firms and households, and self-discipline or enforced discipline of firms with respect to debt levels.

The laws of motions that flow from this section thus are:

$$\begin{aligned} \dot{Y} &= \beta_y(Y^d - Y) = \beta_y((a_y - 1)Y + a_e p_e E - a_l(L - L_o) + \bar{A}) \\ \dot{L} &= [b_l(i_l(Y) - i_l(Y_o)) - b_e(r_e^e - r_{eo}^e)]L \end{aligned}$$

with $r_e^e = r(Y)/p_e + \pi_e^e,\ r'(Y) > 0$ the expected rate of return on equities – to be considered in the next section – and $Y_o = [\bar{A} + a_e p_{eo} E_o]/(1 - a_y)$, L_o as the steady state levels of economic activity and debt. The matrix of partial derivatives of the Jacobian of this system at the steady state is given by:

$$\begin{aligned} J_o &= \begin{pmatrix} \beta_y(a_y - 1) & -\beta_y a_l \\ (b_l i_l' - b_e \frac{r'}{p_e})L_o & 0 \end{pmatrix} \\ &= \begin{pmatrix} - & - \\ \pm & 0 \end{pmatrix} \end{aligned}$$

We consider this subsystem of the full model as describing the credit channel of it. The matrix of partial derivatives in this respect shows that the credit channel (the interaction of firm's debt with economic activity) can be stable ($b_l i_l' > b_e \frac{r'}{p_e}$) or of unstable saddlepoint type ($b_l i_l' < b_e \frac{r'}{p_e}$). Increasing sensitivity of loan supply to rates of return on the financial markets thus destabilizes the credit channel on the real side of the economy. This may for example occur in the form of a Minsky (1982,1986) moment during periods of tranquil progress which may induce bank management to bear more speculative risk than is acceptable from a pure bankers point of view.

> *As we approach the last decade of the twentieth century, our economic world is in apparent disarray. After two secure decades of tranquil progress following World War II, in the late 1960s the order of the day became turbulence - both domestic and international. Bursts of accelerating inflation, higher chronic and higher cyclical unemployment, bankruptcies, crunching interest rates, and crises in energy, transportation, food supply, welfare, the cities, and banking were mixed with periods of troubled expansions. The economic and social policy synthesis that served us so well after World War II broke down in the mid-1960s. What is needed now is a new approach, a policy synthesis fundamentally different from the mix that results when today's accepted theory is applied to today's economic system.* Minsky (1982, p.3)

5.3 Portfolio choice and the dynamics of financial markets

We consider next the financial markets of the economy which in this chapter is simply described by the portfolio choice (desired portfolio readjustment) of households between money plus T-Deposits $M + D_2$ and equities E_h. We use a dynamic approach here in place of a Tobinian equilibrium determination of share prices,[33] by assuming that stock imbalances in households' gross portfolio:[34]

$$p_e E^d - p_e E = f_e(r_e^e) W_h^n - p_e E = -(M^d - M), \quad W_h^n = M + p_e E, r_e^e = \frac{r(Y)}{p_e} + \pi_e^e$$

[33]Significantly more elaborate versions of the dynamics of the financial sector (and also of the real sector) are provided in Asada et al. (2010, 2011a, 2011b), there however on the basis of Tobin's portfolio equilibrium approach in place of the delayed disequilibrium adjustment processes we consider in the present section.

[34]Since households are ultimately receiving – by assumption – all dividend payments, we use only an aggregate excess demand function as driving the price of stock and reserve a detailed treatment of the distribution of stocks and its implications for a later extensions of the model.

lead to a fractional flow demand for assets of amount $\alpha_e(E^d - E)$, $\alpha_e \in (0,1)$, which in turn leads to share price inflation or deflation of amount $\hat{p}_e = \beta_e \alpha_e \frac{p_e E^d - p_e E}{p_e E}$, β_e the adjustment speed of share prices whereby equilibrium in the stock market is reestablished ($E_h^d = E_h$).[35] Excess demand $\alpha_e(E^d - E)$ depends on the rate of return on equities r_e^e which is composed of the dividend rate of return $\frac{r(Y)}{p_e}$ and expected capital gains π_e^e. We assume that there holds $f_e(r_e^e) \in (0,1), f_e^{'} > 0, f_e(r_{eo}^e) = p_e E$, around the steady state value of the rate of return on equities.

Expected capital gains are based here on chartist behavior solely which is modeled on the theoretical level by a simple adaptive expectations formation mechanism. One could use nested adaptive expectations (humped shaped explorations of the past) or other backward looking mechanism as well, but this would increase the dimension of the considered dynamics, without leading really to an increase in insight. Adding fundamentalists' behavior on the other hand could be used to add stabilizing elements to the considered expectations formation, but again not to a real change in what we shall show below.

The laws of motion shown below thus represent our modeling of the dynamics of financial markets, primarily driven by the interaction between actual capital gains and expected ones.[36]

$$\begin{aligned} \dot{p}_e &= \beta_e \alpha_e \frac{p_e E_h^d - p_e E}{E} && (5.1) \\ &= \beta_e \alpha_e [f_e(\frac{r(Y)}{p_e} + \pi_e^e)(M + p_e E) - p_e E]/E && (5.2) \\ \dot{\pi}_e^e &= \beta_{\pi_e^e}(\hat{p}_e - \pi_e^e) && (5.3) \\ &= \beta_{\pi_e^e}(\beta_e \alpha_e [f_e(\frac{r(Y)}{p_e} + \pi_e^e)(M + p_e E) - p_e E]/E - \pi_e^e) && (5.4) \end{aligned}$$

[35] Note here that banks (including the central bank) are assumed in this chapter of only adjusting their equity stock by way of time derivatives, that is not instantaneously.

[36] An alternative formulation of the law of motion for stock prices is the following one (which would simplify the financial dynamics to a certain degree):

$$\hat{p}_e = \beta_e \alpha_e \frac{E_h^d - E}{E} = \beta_e \alpha_e f_e(\frac{r(Y)}{p_e} + \pi_e^e)$$

.

The Jacobian of these dynamics is given (at the steady state $p_{eo}(Y_o, H_h + D_1 + D_2), \pi^e_{eo} = 0$) by:

$$J_o = \begin{pmatrix} \beta_e\alpha_e[-f_e'(\cdot)\frac{r(\cdot)W_h^n}{p_e^2} + (f_e(\cdot)-1)E]/E & \beta_e\alpha_e f_e'(\cdot)W_h^n \\ \beta_{\pi_e^e}\beta_e\alpha_e[-f_e'(\cdot)\frac{r(\cdot)W_h^n}{p_e^2} + (f_e(\cdot)-1)E]/E & \beta_{\pi_e^e}[\beta_e\alpha_e f_e'(\cdot)W_h^n - 1] \end{pmatrix}$$
$$= \begin{pmatrix} - & + \\ - & \pm \end{pmatrix}$$

Stability analysis is simple in this case since the determinant of the matrix J is always positive and the trace of J gives rise to the critical stability condition

$$\beta^H_{\pi_e^e} = \frac{\beta_e\alpha_e[f_e'(\cdot)\frac{r(\cdot)W_h^n}{p_e^2} + (1 - f_e(\cdot))E]}{[\beta_e\alpha_e f_e'(\cdot)W_h^n - 1]E} > 0$$

if the entry J_{22} is positive and thus representing a danger for asymptotic stability. This asymptotic stability gets lost at the Hopf-bifurcation point $\beta^H_{\pi_e^e}$, where the system looses its stability in a cyclical fashion, in general through the disappearance of a stable corridor around the steady or the birth of an attracting limit cycle (persistent fluctuations in share prices) if the system is a non-linear one (where degenerate Hopf-bifurcations are of measure zero in the considered parameter space).

The considered Hopf-bifurcation represents in general however only a local phenomenon, around the considered bifurcation parameter. We expect therefore that the systems tends to become globally unstable when the adjustment speed of capital gain expectations $\beta^H_{\pi_e^e}$ becomes larger and larger.

This instability can be suppressed by introducing a Tobin type capital gain tax τ_e (not as he has proposed it: a transaction tax) with respect to the stock market. This modifies the second law of motion, for capital gain expectations, as follows:

$$\dot{\pi}_e^e = \beta_{\pi_e^e}((1-\tau_e)\beta_e\alpha_e[f_e(\frac{r(Y)}{p_e}+\pi_e^e)(M+p_eE)-p_eE]/E-\pi_e^e) \quad (5.5)$$

and leads to

$$\beta_{\pi_e^e}^H = \frac{\beta_e\alpha_e[f_e'(\cdot)\frac{r(\cdot)W_h^n}{p_e^2}+(1-f_e(\cdot))E]}{[(1-\tau_e)\beta_e\alpha_e f_e'(\cdot)W_h^n-1]E} > 0 \quad (5.6)$$

or

$$\tau_e^H = 1-\frac{\beta_e\alpha_e[f_e'(\cdot)\frac{r(\cdot)W_h^n}{p_e^2}+(1-f_e(\cdot))E]/E+\beta_{\pi_e^e}}{\beta_{\pi_e^e}\beta_e\alpha_e f_e'(\cdot)W_h^n} \quad (5.7)$$

$$= 1-\frac{[f_e'(\cdot)\frac{r(\cdot)W_h^n}{p_e^2}+(1-f_e(\cdot))E]/(E\beta_{\pi_e^e})+1/(\beta_e\alpha_e)}{f_e'(\cdot)W_h^n} < 1 \quad (5.8)$$

The destabilizing financial market accelerator can therefore always be tamed through the introduction of an appropriate level of a Tobin capital gain tax. We assume now in fact that this tax is operated as a stock tax, meaning that existing equities (on the secondary markets) are taxed in this way (but not the issue of new equities by firms on the primary markets). The change in taxation at time t is therefore given by $T=\tau_e\dot{p}_eE$ which in the case of capital losses represents a subsidy to equity holders. On this basis one can assume that the parameter c_2 is affected (lowered) by such a tax, but not the qualitative form of the consumption function.

Note here however that such a tax introduces a new type of income into the economy, administered by an independent fiscal authority, which is assumed to raise or deliver funds T according to the rule

$$T=\tau_e p_e E.$$

We assume that this fiscal authority has an initial endowment that is large enough such that this endowment remains positive during the business fluctuations that are implied by the model.[37]

5.4 The core real-financial market feedback interactions

We consider first the interaction of share prices with the credit channel of the economy by keeping capital gains expectation at their steady state value. The resulting feedback chains are mathematically determined through the products of the partial derivatives of the laws of motion that appear in the calculation of the principal minors of the 3D Jacobian of the dynamics at the steady state of the model. The 3 principal minors of order 2 represent in this way the credit channel (if the third law of motion is excluded), the financial accelerator (if the second is excluded) and a Tobin-type real-financial market interaction in the last case.

$$\dot{Y} = \beta_y((a_y - 1)Y + a_e p_e E - a_l(L - L_o) + \bar{A}) \tag{5.9}$$

$$\dot{L} = [b_l(i_l(Y) - i_{lo}) - b_e(\frac{r(Y)}{p_e} - r^e_{eo})]L \tag{5.10}$$

$$\dot{p}_e = \beta_e \alpha_e([f_e(\frac{r(Y)}{p_e})(M + p_e E)]/E - p_e) \tag{5.11}$$

Note that this steady state is uniquely determined and given by

$$Y_o = \frac{\bar{A} + p_{eo}E}{1 - a_y}, \quad L_o, \quad p_{eo} : f_e(r(Y_o)/p_{eo})(M + p_{eo}E) = p_{eo}E$$

with $E, M + D_2$ given magnitudes. Note also that we have to assume for the functions i_l, r that there holds

$$i_l(Y_o) = r(Y_o)/p_{eo}$$

in the steady state.

[37] We remark that capital gains are only realized when equities are moving between the three sectors of the economy.

The determinant of the Jacobian $= -a_3$ of this dynamical system is zero iff there holds:

$$b_l^{a_3} = \frac{r'}{i_l' p_e}[1 - \frac{f_e' W_h^n \frac{r}{p_e^2}}{[f_e' W_h^n \frac{r}{p_e^2} + 1 - f_e]}]b_e < \frac{r'}{i_l' p_e}$$

For values of b_l below this value we have a positive determinant and thus the instability of the steady state of the dynamics.

The Routh-Hurwitz coefficient $a_1 a_2 - a_3$ on the other hand is zero iff:

$$b_l^b = \frac{r'}{i_l' p_e} b_e + \frac{(J_{11} + J_{33})J_2 + \beta_y a_l L_o \beta_e \alpha_e b_e \frac{r}{p_e^2} \frac{r'}{p_e} f_e' W_h^n}{i_l' \beta_y (1 - a_y) \beta_y a_l} > \frac{r'}{i_l' p_e}$$

if β_e sufficiently large. The opposite holds true if this parameter is chosen sufficiently small. For values of b_l below this critical value we have a negative $a_1 a_2 - a_3$ expression and thus the instability of the steady state of the dynamics.

It is obvious that the conditions

$$a_3 > 0, a_1 a_2 - a_3 > 0 \text{ imply } a_2 > 0,$$

since $a_1 = -$ trace > 0 holds true, so that stability will be given for all

$$b_l > \max\{b_l^{a_3}, b_l^b\}$$

while there is instability below this maximum, which there represents the critical stability condition for these dynamics. The details of the proofs are provided in appendix I.[38]

There may be a Minsky (1982,1986) moment present in this type of an economy whereby the parameter b_e is increasing relative to b_l over time, since equity markets become more

[38] $a_2 = J_1 + J_2 + J_3$ the sum of the three principal minors of order 2 of the matrix J. The index in these minors shows the index of the excluded rows and columns.

and more the focus of interest of banks in relatively prosperous and tranquil phases of economic evolution. The economy may therefore become more and more fragile and volatile over time. Minsky type moments can be introduced into the dynamics of this section by the systematic change in some parameters of the model towards more volatile parameter constellations.

5.5 Open market policy

We now consider the possibilities for the central bank to steer the economy in the context of broad banking. Since the rate of interest on T-Deposits does not influence economic activity as well as financial markets there remains in the context of the model only the possibility to conduct open market operations through the purchase or selling of equities on the market for stocks (through trade with the household sector). This policy is assumed to react to the state of confidence in a negative way and is therefore characterized as being countercyclical in nature, and shown in the flow account of the central bank below.

The Central Bank (c):

Monetary Policy (Flows):	
Uses	***Resources***
	Open Market Policies $\dot{H} = c_m(p_{eo} - p_e)E$
Equity Demand $p_e\dot{E}_c^d = \dot{H}, \quad \dot{E}_c = \dot{E}_c^d - \delta E_c$ CB Surplus: $r(Y)(1-\delta)E_c \rightarrow HH$	Dividends $r(Y)(1-\delta)E_c \rightarrow HH$

Additional credit supply is now generated through the shown open market operations of the central bank, leading to the following sequence of events with respect to money and credit:

$$\begin{aligned} \dot{M} &= \dot{H}_h + \dot{D}_1 = \alpha_m \dot{H}, \quad \dot{R} = \dot{H}_b = \rho_b \dot{D}_1 \quad \rightarrow \\ \dot{D}_1 &= \alpha_m \dot{H}/(1+\rho_h), \quad \dot{H} = \dot{H}_b + \dot{H}_h \end{aligned}$$

since the changes in the reserves of commercial banks and the high powered money holdings of households are automatically adjusted by means of the money multiplier, creating deposits of amount $\dot{D}_1$ which can be totally transformed into loans by the commercial banks (but not into T-Deposits), since the reserves of the banks have already been adjusted.

Broad Commercial Banking (b, private ownership):

Flow Account:	
Uses	***Resources***
$i_d D_2$	$i_l(Y)(1-\delta)L$
$\dot{R} = \dot{H}_b = \rho_b \dot{D}_1$	$\dot{D}_1 = \alpha_m \dot{H}/(1+\rho_h)$
δL	$r(Y)(1-\delta)E_b$
Π_{bh}	
$\dot{L} = [b_l(i_l(Y) - i_l(Y_o)) - b_e(r_e^e - r_{eo}^e)]L$	
$\dot{L} = p_e \dot{E}_b^s + (\dot{D}_1 - \dot{R})$	$\dot{D}_2 = 0,\ \rho_{b2} = 0$

In the flow account of commercial banks we have now the presence of a money multiplier process. Note however that this is not yet a situation with truly endogenously generated credit, since the initiative for money creation comes from the central bank. The result is therefore of a conventional textbook multiplier type.

The changes implied in the household sector are shown in their flow account as follows:

Taken together the structure of the model is only modified in the equity demand function of commercial banks (which is based on their intended loan supply function). This does not change the laws of motion of the model and thus implies that monetary policy is completely ineffective in this case.

This however is not completely true since we have neglected here the effect of changes in H on the definition of private wealth W_h^n which is given by canceling balancing terms by: $W_h^n = (\alpha_m - 1)H + p_e E$. This implies that the monetary policy is feeding back into this term and thus into stock price dynamics such that the original 3D Jacobian is augmented as follows:

Households (h, bank owners and firm stock owners):

Flow Account:	
Uses	***Resources***
$C = c_1 Y + c_2 p_e E + \bar{C}$	$wN(Y)$
$p_e \dot{E}_h^s = p_e(\dot{E}_b^d + \dot{E}_c^d)$	$r(Y)(1-\delta)E_h$
$\dot{D}_1 = \alpha_m \dot{H}/(1+\rho_h)$	$r(Y)(1-\delta)E_b$
$\dot{H}_h = \rho_h \dot{D}_1$	$r(Y)(1-\delta)E_b$
$\dot{D}_2 = p_e \dot{E}_h^s - \dot{H}_h - \dot{D}_1$	$i_d D_2$
S_h	Π_{bh}
Y_h	$wN(Y)+r(Y)(1-\delta)E+i_l(Y)(1-\delta)L-\delta L$

$$J_o = \begin{pmatrix} J_{11} & J_{12} & J_{13} & 0 \\ J_{21} & J_{22} & J_{23} & 0 \\ J_{31} & J_{32} & J_{33} & + \\ 0 & 0 & - & 0 \end{pmatrix}$$

The determinant of this matrix is given by

$$|J_o| = \begin{vmatrix} J_{11} & J_{12} & 0 & 0 \\ J_{21} & J_{22} & 0 & 0 \\ 0 & 0 & 0 & + \\ 0 & 0 & - & 0 \end{vmatrix}$$

which is positive if and only if the shown 2D subsystem has a positive determinant. This shows that monetary policy and the implied endogenous money creation is adding stability to the considered 3D dynamics, at least for small values of c_m, since negative real parts of the three eigenvalues of the 3D system must then be augmented by a fourth eigenvalue which is negative.

If we allow in this extended setup that the expansionary monetary policy has a positive effect on economic activity as shown below:

$$\dot{Y} = \beta_y[(a_y - 1)Y + a_e p_e E - a_l(L - L_o) + \dot{L} + a_h \dot{H} + \bar{A}] \tag{5.12}$$

$$= \beta_y((a_y - 1)Y + a_e p_e E - a_l(L - L_o) + \dot{L} + a_h c_m(p_{eo} - p_e)E + \bar{A}) \tag{5.13}$$

we in addition get that the J_2 Tobin channel will be made weaker which improves the stability of the considered dynamics.

5.6 Credit demand and extended goods market dynamics

We are here reconsidering the supply schedule of bank loans by explicitly adding a demand side expression to it now: $\dot{l}_f^d(i_l)L, \dot{l}_f^{d'}(i_l) < 0$. This gives as equilibrium condition for the credit market the relationship:

$$0 = [b_l(i_l - i_{lo}) - b_e(r_e^e - r_{eo}^e)] + f_l(i_l - i_{lo})$$

if we specify loan demand by assuming $\dot{l}_f^d(i_l)L = -f_l(i_l - i_{lo})L$. Note that we no longer postulate a relationship between economic activity and the loan rate, since this relationship is to be derived now. The equilibrium condition for the credit market implies:

$$i_l = i_{lo} + \frac{b_e(r_e^e - r_{eo}^e)}{b_l + f_l}$$

The new law of motion for loans therefore now is

$$\dot{L} = -\frac{f_l}{b_l + f_l} b_e(r_e^e - r_{eo}^e)L \tag{5.14}$$

The Jacobian is in this case characterized by

$$J_o = \begin{pmatrix} \beta_y(a_y - 1) & -\beta_y a_l & \beta_y a_e E \\ -\frac{f_l}{b_l + f_l} b_e \frac{r'}{p_e} & 0 & \frac{f_l}{b_l + f_l} b_e \frac{r}{p_e^2} \\ \beta_e \alpha_e f_e' \frac{W_h^n r'}{p_e} & 0 & -\beta_e \alpha_e [f_e' \frac{W_h^n r}{p_e^2} + 1 - f_e] \end{pmatrix}$$
$$= \begin{pmatrix} - & - & + \\ - & 0 & + \\ + & 0 & - \end{pmatrix}$$

It is again possible to derive the type of maximum condition we have considered beforehand. Since $a_1 > 0$ holds true again, stability will be given for all $b_l > \max\{b_l^{a_3}, b_l^b\}$ while there is instability below this maximum. Yet, in the present situation, we observe that the system becomes unstable if the parameter b_e is chosen sufficiently large, since the parameter b_l is no longer available to compensate for this and since the credit channel is now always an instable one. This holds, since the coefficient a_2 from the Routh Hurwitz condition can now easily be made positive by increasing the parameter b_e, since there is no more much stability resistance present in the terms that make up the coefficient a_2 (while the determinant is still composed by opposing effects of the parameter b_e).

Assuming a Minsky bankers' carelessness increasing moment at work in the sizing of the parameter b_e may therefore lead to instability when the always destabilizing credit channel becomes sufficiently dominant.

Instead of going into the details of a stability analysis of the present case we extend it further by recognizing that the aggregate demand function Y^d did not allow for an explicit role of credit. However since part of the investment is credit financed it should be explicitly augmented by the credit volume currently provided, implying that the dynamic multiplier should – on this basis – in fact be formulated as follows:

$$\dot{Y} = \beta_y[Y^d - Y) = \beta_y((a_y - 1)Y + a_e p_e E - a_l(L - L_o) + \dot{L} + \bar{A}] \tag{5.15}$$

$$\dot{L} = -\frac{f_l}{b_l + f_l} b_e(r_e^e - r_{eo}^e) \tag{5.16}$$

It is obvious that the determinant of the Jacobian of these subdynamics is unchanged through this extension. This implies that the arguments of the preceding case remain intact, in particular the one concerning the Minsky moments in the credit channel.

5.7 Narrow banking and efficient credit supply

The return to the narrow banking idea, related to what Fisher (1935) proposed after the Great Depression in his book 100% Money, has recently been discussed again by de Grauwe (2008). In the mainstream textbook literature, however, see for example Freixas and Rochet (2008), this idea lives at best a shadowy existence, though of course the topic of bank runs is definitely of importance in this mainstream literature, see for example Rochet (2008) and Sinn (2009).

The Central Bank (c):

Monetary Policy (Flows):	
Uses	***Resources***
	Open Market Policies $\dot{H} = -c_{m1}(Y - Y_o) - c_{m2}(p_{eo} - p_e)E$
Equity Demand $p_e\dot{E}_c^d = \dot{H}$	
CB Surplus: $r(Y)(1-\delta)E_c \to HH$	Dividends $r(Y)(1-\delta)E_c \to HH$

We reconsider in this section Fisher's (1935) 100%-money proposal as modification of our modeling framework of a commercial banking system that acts on the credit market and the financial markets without any institutional barrier. We therefore now assume – to limit such a behavior from an ideal perspective of Fisher (1935) – that checkable deposits are backed up by a reserve requirement of 100 % ($\rho_b = 1$), so that commercial banks

Narrow Commercial Banking (b, private ownership):

Flow Account:	
Uses	***Resources***
$i_d D_2$	$i_l(Y)(1-\delta)L$
Reserve Adjustment $\dot{R} = \dot{D}_1$	New C-Deposits $\dot{D}_1 = (1-\rho_h)\dot{H}$
δL	
$\Pi_{bh} = i_l(Y)(1-\delta)L - i_d D_2 - \delta L$	
Net Loan Supply $\dot{L} = c_b(Y - Y_o)$	New T-Deposits $\dot{D}_2 = \dot{L}$

are reduced to purely depository institutions in this respect, while there are no reserve requirements on T-Deposits D_2, which are safeguarded by other means (including contract lengths, withdrawal penalties) against bank runs. Time deposits earn an interest rate that is interrelated with the loan rate received by firms and manipulated in order to initiate that granted loans are backed up by time deposits through the circuit of money when these loans reappear at first as checkable deposits in the money holdings of the household sector. We are thus now allowing (which can also be added to what we discussed beforehand) for the endogenous creation of commercial bank money, so to speak out of the blue, in addition to what we discussed when the textbook money multiplies was considered. By contrast there are now no equity holdings of commercial banks anymore (which can be introduced from the viewpoint of required bank capital or collateral later on).

But this money creation concerns the difference $M2 - M1$ of the conventional measures of money supply and thus does not allow banks to get interest income out of the money deposits for which they pay no interest. These money holdings are thus always checkable central bank money and can therefore not be subject to bank runs, since they are purely passive in the balance sheet of the banks and not at their disposal should they become insolvent.

The view thus is that commercial banks should not be allowed to endogenously create money out of the central bank money in their balance sheet and also not by purchasing equities through ink stroke money (which would return as in the form of T-Deposits to them through the circuit of money. The full control of the M1 money supply process –

Households (h, bank owners and firm stock owners):

Flow Account:	
Uses	***Resources***
$C = c_1 Y + c_2 p_e E + \bar{C}$	$wN(Y)$
	$i_d D_2$
Change in Equity Holdings $p_e \dot{E}_h^s = p_e \dot{E}_c^d = \dot{H}$	$r(Y)(1-\delta)E_h$
Change in Cash Holdings $\dot{H}_h = \rho_h \dot{H}$	$r(Y)(1-\delta)E_c$
C-Deposits Change $\dot{D}_1 = (1-\rho_h)\dot{H}$	
T-Deposit Change $\dot{D}_2 = \dot{L}$	$\Pi_{bh} = i_l(Y)(1-\delta)L - i_d D_2 - \delta L$
Y_h	$wN(Y)+r(Y)(1-\delta)E+i_l(Y)(1-\delta)L - \delta L$

in our view – should remain in the hands of the central bank which not only eliminates bank runs on checkable deposits. This also removes speculative behavior of the commercial banks from the model if equities cannot be pursued by money creation of type M1. The primary role of the commercial banking system then becomes to channel not only the interest bearing savings of households into the investment projects of firms – besides the creation of T-Deposits through their autonomous lending decisions through the circuit of money, supported in addition by the money supply or withdrawal rule of the central bank. Note that we now assume that the central bank knows the structure of the model and is realizing that it must use a procyclical money supply rule for the stabilization of the real-financial market interaction (see the results below).

The changes implied in the household sector are shown in their flow account and are as follows. Taken together the dynamics of the model we considered so far is then modified in the loan supply function $\dot{L}$ (plus the correction of the aggregate demand function discussed in the previous section) and in the aggregate expression for private wealth. This gives rise to

$$\dot{Y} = \beta_y((a_y - 1)Y + a_e p_e E - a_l(L - L_o) + \dot{L} + a_h \dot{H} + \bar{A}) \quad (5.17)$$

$$\dot{L} = c_b(Y - Y_o) \quad (5.18)$$

$$\dot{p}_e = \beta_e \alpha_e([f_e(\frac{r(Y)}{p_e})(L + p_e E) - p_e E]/E \quad (5.19)$$

This gives as Jacobian (if we assume that $a_y + c_b < 1$ holds true):

$$J_o = \begin{pmatrix} - & - & + \\ + & 0 & 0 \\ + & + & - \end{pmatrix}$$

Assuming again that the Tobinian real-financial market interaction is a stable one: $J_2 > 0$, in particular if monetary policy is made sufficiently active in this respect, then implies stability for the remaining feedback interactions, if the parameter a_h is chosen sufficiently large, since a_1, a_2, a_3 are then positive and since $a_1 a_2 - a_3$ can be made positive thereby too.

The assumed type of narrow banking therefore not only eliminates the discontinuities created by the occurrence of bank runs, but also makes the economy a stable one if the real financial market interaction (the product of the coefficients J_{13}, J_{31}) is not allowed to work in a too pronounced way by a proper choice of monetary policy). This shows that Narrow Banking is dynamically seen much more reliable and robust than the model of broad banking we have used beforehand.

But is it also as efficient in the supply of credit as the broad banking system (which as we know can be plagued by credit rationing if banks are too much focused on financial markets instead). This will indeed be the case – ignoring the financial market focus of broad banking already – if the interest rate on T-Deposits can be managed by commercial banks effectively such that their loans (supplied in view of the credit demand of creditworthy firms) are channeled into time deposits in place of checkable deposits. It is then a matter of the variables i_l, i_d to achieve such a result with however rationing occurring if there are limits to the interaction of these two interest rates. Note that we have here the change in time deposits generated by the households sector from his savings that are not created through loans and the circuit of money they imply.

In our view the considered institutional change outperforms possible efficiency gains of non-credit based risk taking broad banking. Loan supply does not depend negatively on the rate of return on the stock markets, but now positively on the level of economic activity. Moreover, a countercyclical monetary policy with respect to the state of confidence (and the level of economic activity) of the economy further improves the stability of the dynamics.

5.8 Implications for Financial Market Reform

Our model of narrow banking could be considered an extreme case, where there is no involvement of the commercial banks in security underwriting and security trading. This is just banking in the traditional sense with accepting time deposits and providing loans, and with a depository role solely as far as checkable deposits are concerned. These checkable deposits are safe due to the fact that they are – in the ideal case postulated by Irving fisher (1935)– fully covered by reserves. Bank runs are thereby prevented since the time deposits cannot be withdrawn without accepting a (significant) penalty. On the other hand our concept of broad banking, represented by investment banks, implies that equity purchase can substitute the supply of loans, and thus, under broad banking loans may be reduced by investment banks and capital assets purchased. Though in practice investment banks might borrow from capital markets to extend loans, for example from the money market or through carry trade, the emphasis being here on security trading. In other words, what we have basically stylized here in an extreme form through the two types of banking — narrow and broad banking — is commercial banks and investment banks.

In some way, this was the vision of the 1930 banking reform, inacted by the Glass-Steagall act of 1933, where commercial banks were not allowed to underwrite securities and to trade securities. The Glass-Steagall act was repealed under the Clinton administration in the US in 1999. This opened the door for commercial banks to engage in the security sector either in-house or through affiliations. From early on the conflict of interest was pointed out when regular banking and loan business are mixed with security issuing and trading, see Puri (1994) and later the evaluation by Gande (2008). This way, it was argued, commercial banks would become investment banks and they would have superior knowledge about firms to whom they lend. This would give them an unfair advantage that could result in monopolizing the market. On the other hand the strict separation of banking and security sectors never existed in its pure form under the Glass-Steagall act and many excessive practices with respect to risk taking, leveraging and bonus payments took place. It is thus not quite clear whether investment banking is the main cause for the financial meltdown of the years 2007-9, see Shin (2009).

What rather appeared to be major problems were the lack of leverage regulation, proprietary trading, excessive risk taking and bonus payments, unregulated derivative trading, and rise of unequal size of banking and investment firms, see Kaufman (2009).[39] In particular for the investment banks the leveraging, as measured as capital assets over equity, rose from 22.7 percent in 2001 to 30.4 percent in 2007, see Shin (2009).

Moreover, the issue of too big to fail came up with respect to the investment firms. According to Kaufman (2009), in the last 15 years the 8 biggest investment firms could increase their market share from 10 to 50 percent. So one might argue that a pure separation of commercial banking and investment banking will not generate a persistent solution for a stable banking sector.

The US administration under President Obama was aware of this and passed the Dodd-Frank Act in 2010 on a more comprehensive financial reform. A core part is the investment bank sector with the banning of proprietary trading. Narrow banking will however not be introduced, the reforms are far away from this. Solely to do this may not be so effective, but rather comprehensive reforms seem to be needed. The reforms are aiming at preventing again a meltdown of the sort that has occurred 2007-9. The banking system, mainly investment banking, but also commercial banking, had created excessive risk taking through

[39]For details of this and the subsequent points, see Semmler (2011)

proprietary trading, issuing of complex securities and excessive bonus payments.

Major points of the legislation were to avoid future bailouts and the cost that it has imposed on the tax payers through the establishment of a fund. A system risk council would be empowered to require that financial institutions that may pose risks to the financial system be regulated by the Federal Reserve, and it would also make recommendations to the Federal Reserve regarding capital, leverage, liquidity, and risk management requirements. Furthermore, what is planned is a regulation of over-the-counter derivatives and a tougher regulation of credit rating agencies, a regulation regarding corporate governance and executive compensation by shareholders, and a consumer protection agency which is a new agency that is supposed to monitor credit-card fees, credit agreements and mortgage offerings to make sure consumers are protected from predatory lending.

So there is a more comprehensive regulatory reform intention, but crucial in our context is the following: One important new provision is that the Act significantly restricts proprietary operations undertaken by commercial banks (provision known as the Volcker rule). Banks can place up to 3 percent of their Tier 1 capital in hedge fund and proprietary trading investments. The other aspect of the rule is that banks are prohibited from holding more than 3 percent of the total ownership interest of any private equity investment or hedge fund. This falls short of a complete disallowance of proprietary desks, which had been originally suggested and would have been equivalent to restoring the Glass-Steagall act. Further, there are some notable exceptions to the ban. There is a list of permitted activities, including investments in U.S. government securities, transactions made in connection with underwriting or market making related activities, transactions on behalf of customers, and "risk-mitigating hedging activities" in connection with individual or aggregated holdings of the banking entity. So overall, there is some move to avoid an extensive broad banking with excessive and uncontrolled security and derivative trading, but the financial reform seems conceptionally broader than this. Yet how much will finally be implemented remains to be seen.

5.9 Conclusions

We discussed in this chapter, monetary and fiscal policy measures aimed at preventing the financial market meltdown that started in the US subprime sector. This meltdown has spread worldwide and developed into a great recession. Although some slow recovery appears to be on the horizon, it is worthwhile exploring the fragility and potentially destabilizing feedbacks of the banking sector and the macroeconomy in the context of Keynesian macro models.

We have used a simple dynamic multiplier approach on the market for goods and also a simple rate of return driven adjustment rule for stock prices to study the role of commercial banks and credit when embedded into such an environment. We first considered the implications of a broad banking system where commercial banks are allowed to trade in capital assets (here equities) as a substitute for lending. We showed that such a scenario is likely to be an unstable one, even if an appropriate monetary policy of the central bank is added to the considered dynamics. Though in our simplified model of broad banking asset purchases and credit expansion are substitutes, as we have indicated, the model can be extended to accommodate more the empirical fact of comovements of asset purchases and credit expansion.

We then considered a situation of narrow banking which is defined by a Fisherian 100 % reserve ratio for checkable deposits and the exclusion of trade in stocks for commercial banks. This would imply a significant reduction of proprietary trading of the banking sector. It was shown that: a) in such a scenario stability is guaranteed by some weak assumptions on the behavior of economic agents, b) a sufficient loan supply to the entrepreneurs is guaranteed in such a framework, and c) disastrous bank runs are no longer possible, in contrast to what is possible under broad and also traditional banking.

Narrow banking thus not only provides systemic stability in place of systemic crises, but also dynamic stability as well as sufficient efficiency of the credit creation process. Though narrow banking appears a too extreme case to be implemented realistically, it shows the improved stability properties when broad banking is constrained.

In this chapter we have concentrated the consideration of broad commercial banking on the case where the supply of credit versus investment in financial assets are in the focus of interest of commercial banks. This is however only a partial view on their activities which moreover can include in particular the channeling of households savings in form of time or checkable deposits into credit for firms. Moreover, there also exists a channel – working in the opposite direction – that leads from firms' credit demand to the generation of household deposits that back up this demand. This mechanism of endogenous money creation has been introduced, contrasted with broad banking and investigated in the section on narrow banking, but can of course also be active under broad banking. In the interaction of savings and investment we therefore have from the viewpoint of the circuit of money causalities that run from saving to investment, but also a circuit that is working the other way round. In addition there is the interaction of credit supply with investment in financial markets under broad banking. Such an extension of the models of this chapter is needed if one wants to discuss the stylized fact of the comovement of credit and stock markets, an observation that must however be left here for future research.

5.10 References

Adrian, T., Moench, E. and Shin, S.S., 2010, Macro risk premium and intermediary balance sheet quantities, Federal Reserve Bank of New York Staff Reports, no. 428.

Asada, T., Chiarella, C., Flaschel, P., Mouakil, T., Proaño, C. and Semmler, W., 2010, Stabilizing an Unstable Economy: On the Choice of Proper Policy Measures. *Economics, The Open-Access, Open-Assessment E-journal,* 3, 2010-21, July 16, 2010: http://www.economics-ejournal.org/economics/ journalarticles/2010-21.

Asada, T., Chiarella, C., Flaschel, P., Mouakil, T., Proaño, C. and Semmler, W., 2011a, Stock Flow Interactions and Disequilibrium Macroeconomics: The Role of Economic Policy. Journal of Economic Surveys, 25(3), 569-599.

Asada, T., Flaschel, P. Mouakil, T. and Proaño, C., 2011b, Macroeconomic Activity, Asset Accumulation and Portfolio Choice: A Keynesian Perspective. Palgrave / Macmillan, Basingstoke, Hampshire.

Bernanke, B., Gertler, M. and Gilchrist, S., 1999, The financial accelerator in a quantitative business cycle framework, in J.B. Taylor and M. Woodford, Editors, Handbook of Macroeconomics vol. 15, North-Holland, Amsterdam, pp. 1341-1393.

Brunnermeier, M. and Sannikov, Y., 2010, A macroeconomic model with a financial sector, Working Paper , Princeton University

Chiarella, C., Flaschel, P., Proaño, C. and Semmler, W., 2010, Income Distribution, Portfolio Choice and Asset Accumulation. Tobin's Legacy Continued. Book Manuscript: New School University, New York.

De Grauwe, P., 2008, Returning to narrow banking, Center for European Policy Studies: CEPS Commentary (14.November, 2008).

Fisher,I., 1935, 100 % - Money. New York: Adelphi.

Freixas, X. and Rochet, J.-C., 2008, Microeconomics of Banking. Cambridge, MA: The MIT Press.

Gande, A., 2008, Commercial Banks in Investment Banking, in A. Thakor and A. Boot (eds.), Handbook of Financial Intermediation and Banking, Amsterdam, pp. 163-188.

Gorton, G.B., 2009, Slapped in the Face by the Invisible Hand: Banking and the Panic of 2007, New York: Oxford University Press.

Gorton, G.B., 2010, Questions and Answers About the Financial Crisis, NBER Working Paper No. w15787.

Kaufman, H., 2009, The Road to Financial Reform, New York: Wiley.

Kindleberger, C.P. and Aliber, R.Z., 2005, Manias, Panics, and Crashes: A History of Financial Crises, Hoboken, New Jersey: Jon Wiley & Sons.

Minsky, H., 1982, Can it Happen Again? Essays on Instability and Finance. New York: M.E. Sharpe.

Minsky,H., 1986, Stabilizing an Unstable economy.

Puri, M., 1996, Commercial Banks in Investment Banking: Conflict of Interest or Certification Role? Journal of Financial Economics, 40 (March) 373-401.

Reinhart, C.M. and Rogoff, K.S., 2009, This Time is Different: Eight Centuries of Financial Folly. Princeton University Press, New Jersey.

Rochet, J.-C., 2008, Why are there so many Banking Crises. The Politics and Policy of Bank Regulation. Princeton: Princeton University Press.

Semmler, W., 2011, Asset Prices, Booms and Recessions, 3rd edition, Springer Publishing House.

Shin, B., 2009, The Future of Investment Banking, Capital Market Weekly, Korea Capital Market Institute, 1(1).

Shleifer, A. and Vishny, R.W., 2010, Unstable Banking, Journal of Financial Economics, 97(3), 306-318.

Sinn, H.-W., 2009, Risk-Taking, Limited Liability and the Banking Crisis. Munich: CESifo.

5.11 Appendix

Proofs of propositions (section 5.4):

We consider first the interaction of share prices with the credit channel of the economy by keeping capital gains expectation at their steady state value.

$$\begin{aligned}
\dot{Y} &= \beta_y((a_y-1)Y + a_e p_e E - a_l(L-L_o) + \bar{A}) \\
\dot{L} &= [b_l(i_l(Y)-i_{lo}) - b_e(\frac{r(Y)}{p_e} - r^e_{eo})]L \\
\dot{p}_e &= \beta_e\alpha_e([f_e(\frac{r(Y)}{p_e})(M+D_2+p_eE) + p_eE_b + p_eE_c]/E - p_e)
\end{aligned}$$

The Jacobian is in this case characterized by

$$\begin{aligned}
J_o &= \begin{pmatrix} \beta_y(a_y-1) & -\beta_y a_l & \beta_y a_e E \\ (b_l i_l' - b_e\frac{r'}{p_e})L_o & 0 & b_e\frac{r}{p_e^2}L_o \\ \beta_e\alpha_e f_e'\frac{W_h^n r'}{p_e} & 0 & -\beta_e\alpha_e[f_e'\frac{W_h^n r}{p_e^2} + 1 - f_e] \end{pmatrix} \\
&= \begin{pmatrix} - & - & + \\ \pm & 0 & + \\ + & 0 & - \end{pmatrix}
\end{aligned}$$

This gives for the determinant of J_o

$$
\begin{aligned}
|J_o| &= \begin{vmatrix} \beta_y(a_y-1) & -\beta_y a_l & \beta_y a_e E \\ (b_l i_l' - b_e \frac{r'}{p_e})L_o & 0 & b_e \frac{r}{p_e^2} L_o \\ \beta_e \alpha_e f_e' \frac{W_h^n r'}{p_e} & 0 & -\beta_e \alpha_e [f_e' \frac{W_h^n r}{p_e^2} + 1 - f_e] \end{vmatrix} \\
&= \beta_y \beta_e \alpha_e L_o \begin{vmatrix} a_y - 1 & -a_l & a_e E \\ b_l i_l' - b_e \frac{r'}{p_e} & 0 & b_e \frac{r}{p_e^2} \\ \frac{r'}{p_e} f_e' W_h^n & 0 & -\frac{r}{p_e^2} f_e' W_h^n - 1 - f_e \end{vmatrix} \\
&= \beta_y \beta_e \alpha_e L_o a_l \begin{vmatrix} 0 & -1 & 0 \\ b_l i_l' - b_e \frac{r'}{p_e} & 0 & b_e \frac{r}{p_e^2} \\ \frac{r'}{p_e} f_e' W_h^n & 0 & -\frac{r}{p_e^2} f_e' W_h^n - (1 - f_e) \end{vmatrix} \\
&= -\beta_y \beta_e \alpha_e L_o a_l [[\frac{r}{p_e^2} f_e' W_h^n + 1 - f_e][b_l i_l' - b_e \frac{r'}{p_e}] + \frac{r'}{p_e} f_e' W_h^n b_e \frac{r}{p_e^2}]
\end{aligned}
$$

which gives for $|J_o| = 0$ the parameter relationship:

$$
b_l^{a_3} = \frac{r'}{i_l' p_e} [1 - \frac{f_e' W_h^n \frac{r}{p_e^2}}{[f_e' W_h^n \frac{r}{p_e^2} + 1 - f_e]}] b_e < \frac{r'}{i_l' p_e}
$$

For values of b_l below this value we have a positive determinant and thus the instability of the steady state of the dynamics. Note that this steady state is uniquely determined and given by

$$
Y_o = \frac{\bar{A} + p_{eo} E}{1 - a_y}, \quad L_o, \quad f_e(r(Y_o)/p_{eo})(M + D_2 + p_{eo} E) = p_{eo} E
$$

Note also that we have assumed for the functions i_l, r that there holds

$$
i_l(Y_o) = r(Y_o)/p_{eo}
$$

in the steady state.

The determinant of J_o is given by

$$|J_o| = -\beta_y\beta_e\alpha_e L_o a_l[[\frac{r}{p_e^2}f_e^{'}W_h^n + 1 - f_e][b_l i_l^{'} - b_e\frac{r'}{p_e}] + \frac{r'}{p_e}f_e^{'}W_h^n b_e\frac{r}{p_e^2}] = -a_3$$

and the trace by

$$\text{trace } J_o = \beta_y(a_y - 1) - \beta_e\alpha_e[f_e^{'}\frac{W_h^n r}{p_e^2} + 1 - f_e] = -a_1$$

For the sum of the minors of order two we get:

$$a_2 = \beta_y(1 - a_y)\beta_e\alpha_e[f_e^{'}\frac{W_h^n r}{p_e^2} + 1 - f_e] + \beta_y a_l L_o[b_l i_l^{'} - b_e\frac{r'}{p_e}] - \beta_y a_e E\beta_e\alpha_e f_e^{'}\frac{W_h^n r'}{p_e}$$

$$b = a_1a_2 - a_3 \quad = \quad \beta_y(1 - a_y)\beta_y a_l[b_l i_l^{'} - b_e\frac{r'}{p_e}] - (J_{11} + J_{33})J_2 - \beta_y a_l L_o\beta_e\alpha_e b_e\frac{r}{p_e^2}\frac{r'}{p_e}f'_e W_h^n$$

This gives, when solved under the critical stability condition $b = a_1a_2 - a_3 = 0$, the expression:

$$b_l^b \quad = \quad \frac{r'}{i_l^{'}p_e}b_e + \frac{(J_{11} + J_{33})J_2 + \beta_y a_l L_o\beta_e\alpha_e b_e\frac{r}{p_e^2}\frac{r'}{p_e}f_e^{'}W_h^n}{i_l^{'}\beta_y(1 - a_y)\beta_y a_l} > \frac{r'}{i_l^{'}p_e}$$

if β_e sufficiently large. The opposite holds true if this parameter is chosen sufficiently small. Compare to

$$b_l^{a_3} = \frac{r'}{i_l^{'}p_e}[1 - \frac{f_e^{'}W_h^n\frac{r}{p_e^2}}{[f_e^{'}W_h^n\frac{r}{p_e^2} + 1 - f_e]}]b_e$$

For values of b_l below this critical value we have a negative $a_1a_2 - a_3$ expression and thus the instability of the steady state of the dynamics.

It is obvious that the conditions

$$a_3 > 0, a_1a_2 - a_3 > 0 \text{ imply } a_2 > 0,$$

since $a_1 > 0$ holds true, so that stability will be given for all $b_l > \max\{b_l^{a_3}, b_l^b\}$ while there is instability below this maximum.

There may be a Minsky moment present in this type of an economy whereby the parameter b_e is increasing relative to b_l over time, since equity markets become more and more the focus of interest of banks in relatively prosperous and tranquil phases of economic evolution. The economy may therefore become more and more fragile and volatile over time.

6 Stock Market Booms and Busts, Credit Creation and the Implications of Broad and Narrow Banking for Macroeconomic Stability

6.1 Introduction

Over the last 25 years a great deal of research has demonstrated both theoretically and empirically how the financial markets, and especially the commercial banking sector amplify – through the financial accelerator mechanism put forward by Bernanke and Gertler (1989) – developments that originated in the real side of the economy. However, as pointed out by Bordo (2007), the prominent role of credit in the amplification of shocks has been acknowledged for a long time. According to Kindleberger and Aliber (2005), it is the instability of credit what leads to macrofinancial instability, while for Minsky (1982, 1986) it is the way financing becomes de-linked from collateral that contributes to a downward spiral once large real or financial shocks occur. In recent times, however, the role and extent of commercial banking itself and the issue of whether it adds to macroeconomic instability is currently the focus of a large body of literature, see Adrian and Shin (2010), Brunnermeier and Sannikov (2010), and Gorton (2009, 2010).

This chapter is based on Chiarella, Flaschel, Hartmann and Proaño (2012).

In this chapter we pursue a rather traditional root and model in the first instance a broad banking system characterized by the non-separation of commercial and investment banking. Such a system was put in place by the partial repeal of the Glass-Steagall Act of 1933 and the Bank Holding Company Act of 1956 through the Gramm-Leach-Bliley Act of 1999.[40] Thereafter we contrast such a system with a narrow banking system, characterized in turn by a Fisherian 100 percent reserve ratio for checkable deposits and the exclusion of trade in stocks and other assets for commercial banks. We use a minimal structure of financial assets to reconsider the issue of broad versus narrow banking: a risky asset (equities E) and two types of deposits, checkable and time (saving) deposits D_1 and D_2 respectively. In particular we focus on the destabilizing credit channel effect that comes into operation if commercial banks are strongly stock market oriented in their decision on new loan supplies.[41]

In contrast, we explore what it means for macroeconomic stability if the banking sector of the economy is simply a narrowly defined depository institution with respect to pure money holdings and is primarily concerned with channeling the flow of savings (time deposits) into investment flows where they act as credit creators, generating endogenous credit, but not endogenous money. As we will show, such an economy is characterized by strong stability features. In our view this situation is to be preferred that of broad or excessive banking, commercial bank money and credit creation that may sometimes be more flexible with respect to large upturns in investment booms, but that may be dangerous in opposite situations, where risk management has failed to work, and in cases where large bankruptcy scenarios (banks, firms and also governments) can have dramatic chain effects on the working of the national and the world economy.

The remainder of this chapter is organized as follows: In the next section the general

[40]The Glass-Steagall Act prohibited any one institution from acting as any combination of an investment bank, a commercial bank, and an insurance company. The Gramm-Leach-Bliley Act abolished this prohibition by allowing commercial banks, investment banks, securities firms, and insurance companies to consolidate.

[41]Note we will see in our model that as banks go into capital assets they reduce the loan supply. One might argue that empirically one observes a comovement of credit expansion and rising asset or equity prices. We will come back to this issue at the end of the chapter.

theoretical framework featuring a broad banking system is introduced by means of the discussion of the balance sheets and flow accounts of the different sectors of the economy. In section 5.3 the stability properties of a broad banking macrofinancial system are discussed. Thereafter, in section 5.4 the model is modified towards a narrow banking system and its stability properties are analyzed. Finally, section 5.6 concludes.

6.2 The Theoretical Framework

For the sake of expositional clarity we introduce the theoretical model by way of balance sheets and flow accounts for the four sectors of the economy considered here: firms, commercial banks, and the household sector. Commercial banks create loans – if this is sufficiently profitable – by selling equities on the stock market to the household sector (and v.v. with respect to credit reduction). Moreover they can create new deposits by providing loans through what we shall call 'ink stroke money', which they generate when loans reappear at first as checkable deposits in the household sector. This latter process of credit creation will however only concern us when the concept of a narrow banking system is introduced.

We denote in the following by $\dot{x}$ the time derivative of a variable x, by $\hat{x}$ the growth rate of x and by f' the first derivative of a function $f(\cdot)$. We do not consider goods price inflation and normalize the corresponding price level at 1. The only variable price of the model is the share price p_e.

6.2.1 The entrepreneurial sector

We assume that firms finance their investment in capital stock K through the issue of equities E and the additional use of loans L as external sources. In the analysis of this chapter, however, we will abstract from the feedback effects of the accumulation of assets $\dot{E}$ and $\dot{K} = I$ (investment) and therefore assume for notational simplicity in this case that $K = E$ holds (until E is considered explicitly via its law of motion). Further, since the

Metzlerian inventory adjustment process is not incorporated into the present framework, inventories V are adjusted passively to the difference between aggregate demand and supply $Y^d - Y = -\dot{V}$, the latter being in turn determined by a dynamic multiplier process to be discussed later. These variables are summarized in Table 6.1.

Table 6.1: Balance Sheet of the Firms (f)

Assets	***Liabilities***
capital stock pK $[p = 1]$	loans L
Inventories pV $[p = 1]$	Equities $p_e E$
	Net Worth

Let us now consider the firms' production and investment behavior in more detail. As usual, we assume that firms produce an output good using labor N and capital K (in form of loans L) as input factors. A specific formulation of such a production function is however not needed here: For our argument, it is sufficient to define the firms' profits (net of depreciation) as

$$\Pi_f = Y - wN - i_l L - r(Y)E - \delta K,$$

where w denotes the wage rate, N the level of employment (which is assumed to be a function of output with $N'(Y) > 0$), i_l the loan rate and δ the depreciation rate of capital, and assume that the dividend rate r per unit of equity is a positive function of the level of output Y, so that

$$r = r(Y) \quad \text{with } r'(Y) > 0. \tag{6.1}$$

Retained profits Π_f are thus determined residually.

The direct transfer of income from firms to the household sector consists of labor compensation and dividend payments, that is

$$Y_{fh} = wN + rE_h, \tag{6.2}$$

where E_h is the stock of equities held by the household sector. Retained profits are calculated on the basis of output (not demand) as is customarily done in the literature.

Table 6.2: Flow Account of the Entrepreneurial Sector

Uses	***Resources***
depreciation δK	
wage payments $wN > 0$	
loan payments $i_l L$	
dividends rE	
retained profits or losses Π_f	output $Y = Y^d + \dot{V}$
investment $I + \delta K$	investment financing $\dot{L} + \Pi_f + p_e \dot{E}_f^s + \delta K$

As for net investment I, we assume that it depends positively on capacity utilization and thus on Y and also positively on the state of confidence in the economy which we measure by the deviation of the share price p_e from its steady state value p_{eo}, and negatively on the firms' level of leverage, thus

$$I(Y, p_e, L) = \nu_y Y + \nu_e (p_e - p_{eo}) E + \nu_l (L_o - L) + \bar{I} \tag{6.3}$$

with $\nu_y > 0$, $\nu_e > 0$ and $\nu_l > 0$.

The three sources for the financing of new investment activities are retained profits Π_f (which are assumed to be determined residually), credit demand of firms $\dot{L}$ (where there is no credit rationing present) and the (residual) issue of new equities.

Concerning the demand of firms for loans, we assume that it is determined by[42]

$$\dot{L}(Y, i_l) \;=\; l_y (Y - Y_o) - l_i (i_l - i_{lo}) \qquad (l_y > 0,\, l_i > 0), \tag{6.4}$$

where i_l is the loan interest rate (the determinants of which will be discussed in Section 2.2 below) and that this demand is fully served by the commercial banking sector. Credit rationing is thus only indirectly present through increases in the loan rate of banks. Table

[42]Note here that this is a net demand function so that $\dot{L}$ can also be negative if the principal of the currently repaid contracted debt exceeds the new borrowing decisions of firms.

2 summarizes the flow account of the entrepreneurial sector.

6.2.2 The Banking Sector

As previously mentioned, the term "broad banking" characterizes a financial system where the activities of commercial banks are not restrained to their classical role of channeling the households' savings as sources of finance for real investment activities to be performed by the entrepreneurial sector, but where the commercial banks also engage (themselves) in financial investment activities. As it was already acknowledged through the creation of the second Glass-Steagall Act of 1933, if the same entity (in this case, the commercial banks) is engaged in both lending (the granting of credit) and investment (the use of credit) activities, a conflict of interest is quite likely to occur.[43]

In order to reflect such a broad banking system within our theoretical framework, we thus assume that commercial banks do not provide firms with new loans $\dot{L}$ out of checkable and time deposits D_1 and D_2 at a rate i_l (a rate which they set and control), but rather that they use their equities of the entrepreneurial sector $p_e E_b$, as illustrated in the balance sheet of the commercial banking sector, see Table 6.3. We thus consider primarily a process of asset substitution under broad banking and leave the generation of deposits that finance loans to later sections on narrow banking (which of course also apply to the situation where broad banking is considered).

Table 6.3: Balance Sheet of the Commercial Banking Sector (b)

Assets	***Liabilities***
reserves $R = \rho_{b1} D_1$	households' $c-$deposits D_1
loans L	households' $t-$deposits D_2
equities (from firms) $p_e E_b$	net worth

Apart from assuming that the loan interest rate set by commercial banks depends posi-

[43] As was previously mentioned, the Glass-Steagall Act of 1933 greatly restricted the ability of banks to conduct the activities associated with securities firms, insurance companies, merchant banks, and other financial companies. Such a separation between commercial and investment banking institutions was abolished by the Gramm-Leach-Bliley Act of 1999, see Barth et al. (2000).

tively on the state of the business cycle, we model the conflict of interest of the commercial banks arising from the non-separation between commercial and investment banking activities by assuming that as the prospective returns in the equity markets increase, banks demand a higher interest rate on loans from firms to equalize the profits of the two investment activities, so we write

$$i_l(Y, r_e^e) = i_{lo} + i_y\,(Y - Y_o) + \gamma_e(r_e^e - r_{eo}^e) \tag{6.5}$$

where $i_y(> 0)$ represents the reaction of the loan rate with respect to the relative level of economic activity (measured by the difference between actual and steady state output) and $\gamma_e(> 0)$ reflects the extent of stock-market orientation of the commercial banks and r_e^e is the expected rate of return on equities (to be defined below). The effect of such a specification of the loan rate is straightforward: if for example a stock market boom takes place, the commercial banks will increase the loan rate, which is likely to reduce the entrepreneurial sector demand for loans and thus the level of economic activity.[44]

To keep our model as parsimonious as possible we consider the interest rate on time deposits i_d as a given magnitude. Checkable deposits represent money endogenously generated by the commercial banking system through their loans (a process we will investigate later in the chapter).

As previously mentioned, commercial banks serve the loan demand of firms derived from their setting of the loan rate. This creates temporarily checkable deposits for firms which when the circuit on money is finished are checkable deposits of households. This money generation process is here assumed to happen instantaneously and for the time being we also assume that households instantaneously transfer this money into time deposits which allow us to keep the reserves of the commercial banks constant. This is done in order to concentrate on the money creation process in its simplest form.

[44]The modeling of the commercial banks' conflict of interest through the loan interest rate is a result of the assumption that the actual level of new loans is fully determined by the entrepreneurial sector. See Flaschel et al. (2010) for an alternative specification where banks directly control the amount of loans granted.

Table 6.4: Flow Account of the Commercial Banking Sector

Uses	***Resources***
interest rate payments $i_d D_2$	loan rate payments $i_l L$
reserve adjustment $\dot{R} = 0$	change in $c-$deposits $\dot{D}_1 = \dot{L}(\cdot) - p_e \dot{E}_b^s = 0,\ \rho_{b1} > 0$
distributed profits Π_{bh}	dividends rE_b
loans (credit demand of firms) $\dot{L} = p_e \dot{E}_b^s$	change in $t-$deposits $\dot{D}_2 = 0, \quad \rho_{b2} = 0$

Finally, we assume that the profits

$$\Pi_{bh} = i_l L + rE_b - i_d D_2 \tag{6.6}$$

made by the commercial banks remain positive in this chapter and are transferred to their owners, the household sector. The flow account of the commercial banking sector is shown in Table 4.

6.2.3 The Household Sector

The balance sheet of households is also self-explanatory and shown in Table 5.

Table 6.5: Balance Sheet of the Household Sector

Assets	***Liabilities***
$c-$deposits D_1	
$t-$deposits D_2	
Equities $p_e E_h$	

Furthermore, for simplicity we assume that private consumption is a function of the households' income and thus of the activity level of the economy, and as in the investment function, of the measure of the state of confidence $(p_e - p_{eo})E$. Thus we write

$$C = c_y Y + c_e(p_e - p_{eo})E + \bar{C} \qquad (c_y > 0, c_e > 0). \tag{6.7}$$

The flow account of the household sector (Table 6) mirrors these different activities and moreover shows again how loans are financed through the creation of time deposits. Due to these operations we assume that the savings of households go into the new equity supply of firms and the time deposits generated by the banking system. The aggregate income of households consists of wage income, dividend income and loan rate income (which comprise of time-deposit income, but is reduced by the defaulting loans).

Table 6.6: Flow Account of The Household Sector

Uses	***Resources***
Consumption C	wages wN
	interest on $t-$deposits $i_d D_2$
$c-$deposits change $\dot{D}_1 = 0$	dividends rE_h
$t-$deposit change $\dot{D}_2 = 0$	banks' profit $\Pi_{bh} = i_l L + rE_b - i_d D_2$
households equity demand $\dot{p}_e E_h^d$	
income Y_h	$wN + rE + i_l L$

We have simplify dividend distribution by assuming that dividends are channeled back into the household sector, and that the savings of households is directed towards the demand of new equities solely. Dividends are paid per unit of equity and not per unit of value of the stocks and are thus independent of the occurrence of stock market rallies.

Assuming no change in the deposit holdings of the household sector is based on the following implications of the budget equations of the firms and the households of the economy (banks have no income and do not save).[45]

$$\begin{aligned} I + \delta K + \dot{V} &\equiv \Pi_f + \dot{L} + p_e \dot{E}_f^s, \quad \Pi_f := Y - wN - i_l L - rE \\ C + \dot{D}_1^d + \dot{D}_2^d + p_e \dot{E}_h^d &\equiv wN + rE_h + i_d D_2 + \Pi_{bh}, \quad \Pi_{bh} := i_l L + rE_b - i_d D_2 \end{aligned}$$

Aggregating these two identities gives and adding banks' credit financing behavior then

[45] Note here that $\dot{V}, \dot{E}_f^s$ are determined residually

gives:[46]

$$\begin{aligned} C + I + \delta K + \dot{V} + \dot{D}_1^d + \dot{D}_2^d + p_e \dot{E}_h^d &\equiv Y + \dot{L} + p_e \dot{E}_f^s \\ \dot{L} &= p_e \dot{E}_b^s \end{aligned}$$

This gives rise to a Walras' Law of Flows of the following form:

$$Y + \dot{D}_1^d + \dot{D}_2^d + p_e \dot{E}_h^d + \dot{L} \equiv Y + \dot{L} + p_e \dot{E}_f^s + p_e \dot{E}_b^s$$

Assuming flow consistency on the equity market is thus compatible with the assumption $\dot{D}_1^d, \dot{D}_2^d = 0$ as it was assumed in the accounts of banks and the household sector. The described interaction between firms, banks and households is therefore an economically feasible one.

6.2.4 Stock Market Price Dynamics

Concerning the dynamics of equity prices we assume for simplicity that they are determined by the portfolio choice (desired portfolio readjustment) between money plus $t-$deposits $M + D_2$ and equities E at the aggregate level.[47] Here we use a dynamic approach in place of a Tobinian equilibrium determination of the share price by assuming that a stock imbalance in the economy's gross portfolio, $p_e E^d - p_e E$, leads to a fractional flow demand for equities $\alpha_e(p_e E^d - p_e E)$, $\alpha_e \in (0, 1)$,[48] which in turn generates a share price inflation (or deflation) according to

$$\hat{p}_e = \beta_e \alpha_e \left(\frac{p_e E^d - p_e E}{p_e E} \right), \tag{6.8}$$

[46]The term $\dot{V}$ describes involuntary inventory investment which formally seen clears the goods market.

[47]Significantly more elaborate versions of the dynamics of the financial sector (and also of the real sector) are provided e.g. in Asada, Flaschel, Mouakil and Proaño (2011), there however on the basis of Tobin's portfolio equilibrium approach in place of the delayed disequilibrium adjustment processes we consider in the present section.

[48]This specification implies that when the households observe a stock imbalance in their gross portfolio, they will adjust their equity holdings in a gradual manner, correcting in each (infinitesimal) period only a percentage α_e of the total imbalance $p_e E^d - p_e E$.

with β_e the adjustment speed of share prices whereby equilibrium in the stock market is reestablished.

In the following we assume that the nominal demand for equities E^d is a function of the expected rate of return on this asset type, defined as

$$r_e^e = \frac{r(Y)}{p_e E} + \pi_e^e \tag{6.9}$$

where $r(Y)/(p_e E)$ denotes the dividend rate of return and π_e^e the expected capital gains, that is

$$p_e E^d = f_e(r_e^e)E, \qquad f_e(r_{eo}^e)E = p_e E, \quad f_e^{'} > 0.$$

After inserting these expressions it can be easily seen that share price inflation (or deflation) is given by

$$\hat{p}_e = \beta_e \alpha_e \left(\frac{f_e(r_e^e)E - p_e E}{p_e E} \right)$$

or, on making use of (9) and the definition of $\hat{p}_e$, by

$$\dot{p}_e = \beta_e \alpha_e \left[f_e \left(\frac{r(Y)}{p_e E} + \pi_e^e \right) - p_e \right]. \tag{6.10}$$

In order to model the trend-chasing feature of expected capital gains observable in the real world on the theoretical level one could use the scheme of nested adaptive expectations

$$\dot{\pi}_e^e \quad = \quad \beta_{\pi_e^e}(\hat{p}_e - \pi_e^e) = \beta_{\pi_e^e} \left(\beta_e \alpha_e f_e \left(\frac{r(Y)}{p_e} + \pi_e^e \right) - \pi_e^e \right) \tag{6.11}$$

as is done for instance in Flaschel et al. (2010), or other backward looking mechanisms, but this would increase the dimension of the dynamics under consideration, without leading really to any increase in insight. On the other hand, adding fundamentalist behavior could be used to add stabilizing elements to the considered expectations formation, but again this would not lead to any real change in what we shall show below. Viewed in isolation, the two laws of motion given by eqs. (10) and (11) – which show the dynamics of financial markets as primarily driven by the interaction between actual capital gains and expected ones – give rise to a two-dimensional system with the following Jacobian matrix (evaluated at the steady state)

$$J_o = \begin{pmatrix} \beta_e\alpha_e[-f_e'(\cdot)\frac{r(\cdot)}{p_e^2}]p_e & \beta_e\alpha_e f_e'(\cdot)p_e \\ \beta_{\pi_e^e}\beta_e\alpha_e[-f_e'(\cdot)\frac{r(\cdot)}{p_e^2}] & \beta_{\pi_e^e}[\beta_e\alpha_e f_e'(\cdot) - 1] \end{pmatrix} = \begin{pmatrix} - & + \\ - & \pm \end{pmatrix}$$

Since the determinant of this matrix J is always positive, the local stability of this system depends solely on the trace of J. This gives rise to the critical stability condition

$$\beta^H_{\pi_e^e} = \frac{\beta_e\alpha_e f_e'(\cdot)\frac{r(\cdot)}{p_e}}{\beta_e\alpha_e f_e'(\cdot) - 1} > 0.$$

Asymptotic stability becomes lost at the Hopf-bifurcation point $\beta^H_{\pi_e^e}$, where the system looses its stability in a cyclical fashion, in general through the disappearance of a stable corridor around the steady state or the birth of an attracting limit cycle (persistent fluctuations in share prices) if the system is a non-linear one (where degenerate Hopf-bifurcations are of measure zero in the parameter space under consideration).

As discussed in Flaschel et al. (2010), by introducing a Tobin-like capital gains tax τ_e (not as these authors have proposed it: a transaction tax) with respect to the stock market, such instability features can however be suppressed. This modifies the second law of motion, for capital gains expectations, to

$$\dot{\pi}_e^e = \beta_{\pi_e^e}(\hat{p}_e - \pi_e^e) = \beta_{\pi_e^e}\left[(1-\tau_e)\beta_e\alpha_e f_e\left(\frac{r(Y)}{p_e} + \pi_e^e\right) - \pi_e^e\right]$$

and leads to

$$\beta^H_{\pi_e^e} = \frac{\beta_e\alpha_e f_e'(\cdot)\frac{r(\cdot)}{p_e}}{(1-\tau_e)\beta_e\alpha_e f_e'(\cdot) - 1} > 0$$

showing that the destabilizing financial market accelerator can therefore always be tamed through the introduction of an appropriate level of a capital gains tax.

In the next section we analyze the feedback mechanisms and the stability properties of the theoretical model discussed above.

6.3 Feedback Mechanisms and Stability Properties under Broad Banking

The assumed major determinants of consumption and investment imply for the aggregate demand function the expression

$$Y^d = a_y Y + a_e(p_e - p_{eo})E - a_l(L - L_o) + \bar{A} \quad (a_y < 1), \tag{6.12}$$

with $a_y = c_y + \nu_y$, $a_e = c_e + \nu_e$, $\bar{A} = \bar{C} + \bar{I} + \delta K$. The aggregate demand function is thus based on income effects (concerning both household consumption[49] and firm investment), state of confidence effects on firm and household goods demand, and self-discipline or enforced discipline of firms with respect to their level of debt. Further, we assume a gradual adjustment of the output level of the form

$$\begin{aligned} \dot{Y} &= \beta_y(Y^d - Y) \\ &= \beta_y(a_y Y + a_e(p_e - p_{eo})E - a_l(L - L_o) + \bar{A} - Y). \end{aligned}$$

For the dynamics of the loan rate, after inserting the expressions for i_l and r_e^e into equation (4) for new loans, we obtain

$$\begin{aligned} \dot{L}(Y, i_l(Y, p_e)) &= l_y\,(Y - Y_o) - l_i\,(i_{lo} + i_y\,(Y - Y_o) + \gamma_e(r_e^e - r_{eo}^e) - i_{lo}) \\ &= (l_y - l_i i_y)\,(Y - Y_o) - l_i\gamma_e\left(\frac{r(Y)}{p_e} + \pi_e^e - \frac{r(Y_o)}{p_{eo}} - \pi_{eo}^e\right) \end{aligned}$$

In the following we will consider the interaction of share prices with the credit channel of the economy by keeping capital gains expectations at their steady state value π_{eo}^e to

[49]Here output is used as a proxy for household income.

keep our analysis as straightforward as possible.[50] Under this assumption the system of differential equations describing the development of the economy is

$$\begin{aligned}
\dot{Y} &= \beta_y((a_y-1)Y + a_e(p_e - p_{eo}) - a_l(L - L_o) + \bar{A}),\\
\dot{L} &= (l_y - l_i i_y)(Y - Y_o) - l_i\gamma_e\left(\frac{r(Y)}{p_e} - \frac{r(Y_o)}{p_{eo}}\right),\\
\dot{p}_e &= \beta_e\alpha_e\left[f_e\left(\frac{r(Y)}{p_e} + \pi^e_{eo}\right) - p_e\right],
\end{aligned}$$

with $Y_o(=\bar{A}/(1-a_y))$, L_o and $p_{eo}(=r(Y_o)/i_{lo})$ as the steady state levels of the dynamic variables of the system.

Let us however focus first on the dynamic interaction of the real side of the economy by considering the subsystem given by the two laws of motions for Y and L keeping p_e at its steady state level p_{eo}. Thus we consider

$$\begin{aligned}
\dot{Y} &= \beta_y((a_y-1)Y + a_e(p_e - p_{eo})E - a_l(L - L_o) + \bar{A}),\\
\dot{L} &= (l_y - l_i i_y)(Y - Y_o) - l_i\gamma_e\left(\frac{r(Y)}{p_e} - \frac{r(Y_o)}{p_{eo}}\right).
\end{aligned}$$

The matrix of partial derivatives of the Jacobian of this system at the steady state is given by

$$\begin{aligned}
J &= \begin{pmatrix} \beta_y(a_y-1) & -\beta_y a_l \\ \left(l_y - l_i i_y - l_i\gamma_e\frac{r'(Y_o)}{p_{eo}}\right) & 0 \end{pmatrix}\\
&= \begin{pmatrix} - & - \\ \pm & 0 \end{pmatrix}
\end{aligned}$$

The matrix of partial derivatives shows that the credit channel describing the interaction of firm debt with economic activity determines whether the steady state of the system is

[50] This assumption can be justified by means of a Tobin tax on capital gains that is chosen sufficiently high, such that the stability of the 3D dynamics considered here is preserved (see the preceding section).

stable or of an unstable saddle-point type depending on whether

$$\gamma_e < \frac{p_{eo}}{l_i r'(Y_o)}(l_y - l_i i_y) \qquad \text{or} \qquad \gamma_e > \frac{p_{eo}}{l_i r'(Y_o)}(l_y - l_i i_y).$$

The economic rationale of this result is straightforward: because an increase in output leads on the one hand to a higher demand for loans, but on the other hand to an increase in the loan interest rate and in the dividends (due to $r'(Y) > 0$), and thus to an increase in r_e^e, the expected rate of return on equities, the final effect on the level of new loans $\dot{L}$ can be either positive or negative. If the effect is positive ($\partial\dot{L}/\partial Y > 0$), then the determinant of the Jacobian matrix will be positive and the steady state of the above subsystem will be locally stable. A higher output level will lead to new loans, and thus to a larger debt of the entrepreneurial sector which in turn will negatively affect the output dynamics, acting thus in a stabilizing manner. On the contrary, if the partial derivative fulfills $\partial\dot{L}/\partial Y < 0$, then an increase in output will lead to a lower level of new loans, which in turn will influence the output dynamics in a positive and thus destabilizing manner.

It should be clear that the net effect of Y on $\dot{L}$ depends very much not only on $r'(Y)$, but also on γ_e, the parameter representing the stock market orientation of the commercial banking sector. The larger γ_e the more negative will be the influence of Y on $\dot{L}$.

Let us now consider the original model with the dynamic law of motion for the equity prices p_e, thus we consider

$$\begin{aligned}
\dot{Y} &= \beta_y((a_y - 1)Y + a_e(p_e - p_{eo}) - a_l(L - L_o) + \bar{A}), \\
\dot{L} &= (l_y - l_i i_y)(Y - Y_o) - l_i \gamma_e \left(\frac{r(Y)}{p_e} - \frac{r(Y_o)}{p_{eo}}\right), \\
\dot{p}_e &= \beta_e \alpha_e \left[f_e\left(\frac{r(Y)}{p_e} + \pi_{eo}^e\right) - p_e\right].
\end{aligned}$$

The corresponding Jacobian of this 3D subsystem evaluated at the steady state of the system is

$$J = \begin{bmatrix} J_{11} & J_{12} & J_{13} \\ J_{21} & J_{22} & J_{23} \\ J_{31} & J_{32} & J_{33} \end{bmatrix} = \begin{bmatrix} \partial\dot{Y}/\partial Y & \partial\dot{Y}/\partial L & \partial\dot{Y}/\partial p_e \\ \partial\dot{L}/\partial Y & \partial\dot{L}/\partial L & \partial\dot{L}/\partial p_e \\ \partial\dot{p}_e/\partial Y & \partial\dot{p}_e/\partial L & \partial\dot{p}_e/\partial p_e \end{bmatrix},$$

and it is a simple matter to calculate that

$$\begin{aligned} &J_{11} = \beta_y(a_y - 1), && J_{12} = -\beta_y a_l, && J_{13} = \beta_y a_e, \\ &J_{21} = l_y - l_i i_y - l_i \gamma_e \tfrac{r'(Y_o)}{p_{eo}}, && J_{22} = 0, && J_{23} = l_i \gamma_e \tfrac{r(Y_o)}{p_{eo}^2}, \\ &J_{31} = \beta_e \alpha_e f_e'(\,\cdot\,) \tfrac{r'(Y_o)}{p_{eo}}, && J_{32} = 0, && J_{33} = -\beta_e \alpha_e \left(f_e'(\,\cdot\,) \tfrac{r(Y_o)}{p_{eo}^2} - 1 \right). \end{aligned}$$

As can be clearly observed, this Jacobian matrix has the following sign structure

$$J = \begin{bmatrix} - & - & + \\ \pm & 0 & + \\ + & 0 & - \end{bmatrix},$$

under the assumption that $f_e'(\,\cdot\,)r(Y_o) > p_{eo}^2$.

According to the Routh-Hurwitz stability conditions for a 3D dynamical system, the steady state is asymptotic locally stable if

$$a_i > 0 \quad (i = 1, 2, 3) \quad \text{and} \quad a_1 a_2 - a_3 > 0,$$

where $a_1 = -\text{trace}(J)$, $a_2 = \sum_{k=1}^{3} J_k$ with

$$J_1 = \begin{vmatrix} J_{22} & J_{23} \\ J_{32} & J_{33} \end{vmatrix}, J_2 = \begin{vmatrix} J_{11} & J_{13} \\ J_{31} & J_{33} \end{vmatrix}, J_3 = \begin{vmatrix} J_{11} & J_{12} \\ J_{21} & J_{22} \end{vmatrix}.$$

and $a_3 = -\det(J)$.

For the Jacobian matrix the trace is given by

$$\text{trace } J = \beta_y(a_y - 1) - \beta_e\alpha_e\left(f_e^{'}(\,\cdot\,)\frac{r(Y_o)}{p_{eo}^2} - 1\right) = -a_1$$

and the determinant is given by

$$\begin{aligned}
|J| &= -\beta_y a_l l_i \gamma_e \frac{r(Y_o)}{p_{eo}^2}\beta_e\alpha_e f_e^{'}(\,\cdot\,)\frac{r'(Y_o)}{p_{eo}} \\
&\quad -\beta_y a_l \beta_e \alpha_e\left(f_e^{'}(\,\cdot\,)\frac{r(Y_o)}{p_{eo}^2} - 1\right)\left(l_y - l_i i_y - l_i\gamma_e\frac{r'(Y_o)}{p_{eo}}\right) \\
&= -\beta_y a_l\beta_e\alpha_e\left[\left(f_e^{'}(\,\cdot\,)\frac{r(Y_o)}{p_{eo}^2} - 1\right)(l_y - l_i i_y) - l_i\gamma_e\frac{r'(Y_o)}{p_{eo}}\right] = -a_3.
\end{aligned}$$

In order that $|J| = 0$ we have the parameter relationship

$$\left(\gamma_e^{a_3}\frac{l_i r'(Y_o)}{p_{eo}}\right) = \left(f_e^{'}(\,\cdot\,)\frac{r(Y_o)}{p_{eo}^2} - 1\right)(l_y - l_i i_y)$$

that is

$$\gamma_e^{a_3} = \left(\frac{f_e^{'}(\,\cdot\,)i_{lo} - r(Y_o)/i_{lo}}{l_i r'(Y_o)}\right)(l_y - l_i i_y)$$

For the sum of the three principal minors of order two $a_2 = J_1 + J_2 + J_3$ of the Jacobian matrix J we get

$$a_2 = \beta_y(1 - a_y)\beta_e\alpha_e\left(f_e^{'}(\,\cdot\,)\frac{r(Y_o)}{p_{eo}^2} - 1\right) - \beta_y a_e\beta_e\alpha_e f_e^{'}(\,\cdot\,)\frac{r'(Y_o)}{p_{eo}} + \beta_y a_l\left(l_y - l_i i_y - l_i\gamma_e\frac{r'(Y_o)}{p_{eo}}\right).$$

As with the previous stability condition, we calculate the threshold value for $a_2 = 0$ as

$$\gamma_e^{a_2} = \frac{(1 - a_y)\beta_e\alpha_e(f_e'(\,\cdot\,)i_{lo} - r(Y_o)/i_{lo})}{a_l l_i r'(Y_o)} + \frac{r(Y_o)(l_y - l_i i_y)}{i_{lo} l_i r'(Y_o)} - \frac{a_e\beta_e\alpha_e f_e'(\,\cdot\,)}{a_l l_i}.$$

It is obvious that the critical stability condition

$$a_1 a_2 - a_3 > 0$$

will be fulfilled and thus stability will be guaranteed for all $\gamma_e < \min\{\gamma_e^{a_2}, \gamma_e^{a_3}\}$ while there will be instability in the opposite case.

These stability conditions for the original system basically corroborate the results of the reduced two-dimensional system discussed above with respect to the financial market orientation parameter γ_e. It is however interesting to note that this three-dimensional system allows us for example to incorporate into our model additional effects or stylized facts such as the positive correlation between stock market booms (higher equity prices) and increases in new credit, represented by the entry J_{23} in the above Jacobian matrix.[51]

In the next section we reconsider the implications Fisher's (1935) 100%-money proposal as a modification of our modeling framework of a commercial banking system that acts on the credit market and the financial markets without any institutional barrier.

6.4 Macroeconomic Stability and Efficiency under Narrow Banking

6.4.1 Introduction

The return to the narrow banking idea, related to what Fisher (1935) proposed after the Great Depression in his book 100% Money, has recently been discussed again for example by De Grauwe (2008). In the mainstream textbook literature, however, see for example Freixas and Rochet (2008), this idea lives at best a shadowy existence, though of course the topic of bank runs is definitely of importance in the mainstream literature, see Rochet (2008) and Sinn (2009).

According to the narrow banking view, commercial banks should not be allowed to

[51] Within a similar framework the possibilities for the central bank to steer the economy in the context of broad banking were discussed in Flaschel et al. (2010). Since the rate of interest on $t-$deposits does not influence economic activity nor the financial markets in the context of the model there remains only the possibility to conduct open market operations through the purchase or sale of equities on the market for stocks (through trade with the household sector). However, as shown in Flaschel et al. (2010), the open market operations of the central bank do not really improve the stability properties of the dynamical system.

endogenously create (perfectly liquid) checkbook money out of the central bank money in their balance sheet, where they are therefore simply offering services in the form of depositary institutions, nor should they be allowed to purchase equities through ink stroke money (which would return to them in the form of checkable or time deposits through the circuit of money). If equities cannot be purchased by money creation of type M1 (or vice versa), commercial banks will not so easily engage in speculative behavior, because in such a system banks would no longer hold equities as bank capital. The rate of return on equities would no longer be of importance for the conduct of banks' businesses and would thus be removed from the loan rate setting policy (see section 6.2) of these narrowly defined banks.

Furthermore, if the process of checkable money supply remains fully in the hands of the central bank (since it can set the reserve ratio on checkable deposits equal to 100%), the rationale for bank runs on checkable deposits would disappear, as the public would know that all checkable deposits in the hands of the commercial banks is backed up by reserves at the central bank. The primary role of the commercial banks – besides being depositary institutions – would then be confined to the active creation of sufficient $t-$deposits through their loan rate and deposit rate setting via the circuit of money, possibly supported in addition by a money supply or withdrawal rule of the central bank in view of what happens in the interaction between the real and the financial markets (to be considered briefly later on).

We will show in the remainder of this chapter that such narrowly defined commercial banks (where all sorts of investment banking are excluded), are able to support macroeconomic stability and can be efficient in the satisfaction of the credit demand of firms, besides being safeguarded against banks runs.

6.4.2 Narrow banking

On the basis of what we have modeled and investigated in the case of broad banking, let us therefore begin with the discussion of narrow banking by means of the following modifications of the broad banking system previously discussed. We first of all assume that commercial banks are not allowed to trade in financial assets anymore, beyond the limits that are set by the rules regulating banking capital proper (which is assumed to be zero here). Moreover, we now assume – from the ideal perspective of Fisher (1935) – that checkable deposits D_1 have to be backed up by a reserve requirement of 100% ($\rho_{b1} = 1$) and are thus no longer at the disposal of commercial banks for the extension of loans, so reducing commercial banks to purely depository institutions in this respect. We assume instead (as a first example) that any inflow of checkable deposits to the household sector is reallocated by households into $t-$deposits. If commercial banks are willing to satisfy the loan demand of firms of amount $\dot{L}$, this implies the change in the flow account of the commercial banks indicated in Table 7 (in contrast to the flow table 4 of the broad banking case).

Table 6.7: Narrow Commercial Banking

Uses	***Resources***
$i_d D_2$	$i_l(Y)L,\ i_l' > 0$
$\Pi_{bh} = i_l(Y)L - i_d D_2$	
Firms' Loan Demand $\dot{L}(Y, i_l),\ \dot{L}_1 > 0, \dot{L}_2 < 0$	New $t-$Deposits $\dot{D}_2 = \dot{L}, \quad \rho_{b2} = 0$
Changes in Reserves $\dot{R} = \dot{D}_1 = 0$	New $c-$Deposits $\dot{D}_1 = 0, \quad \rho_{b1} = 1$

We have assumed again no reserve requirements on time-deposits D_2, which are safeguarded by other means against bank runs (including contract length and withdrawal penalties). For the composite function $\dot{L}(Y, i_l(Y))$ we assume that the loan rate setting policy of the banks is such that booms are not giving rise loan demand decreases, i.e., that this function can be approximated by $\dot{L} = l_b(Y - Y_o),\ l_b > 0$ in the neighborhood of the steady state value Y_o of economic activity.

Considering as in the case of broad banking the budget equations of firms and the household sector of the economy (banks still have no income and do not save) gives now rise to:

$$\begin{aligned} I + \delta K + \dot{V} &\equiv \Pi_f + \dot{L} + p_e \dot{E}_f^s, \quad \Pi_f := Y - wN - i_l L - rE \\ C + \dot{D}_1^d + \dot{D}_2^d + p_e \dot{E}_h^d &\equiv wN + rE_h + i_d D_2 + \Pi_{bh}, \quad \Pi_{bh} := i_l L - i_d D_2 \end{aligned}$$

Aggregating these two identities gives:

$$C + I + \delta K + \dot{V} + \dot{D}_1^d + \dot{D}_2^d + p_e \dot{E}_h^d \equiv Y + \dot{L} + p_e \dot{E}_f^s$$

This gives rise to a Walras' Law of Flows of the following form:

$$Y + \dot{D}_1^d + \dot{D}_2^d + p_e \dot{E}_h^d \equiv Y + \dot{L} + p_e \dot{E}_f^s$$

Assuming again flow consistency on the equity market is thus compatible with the assumption $\dot{D}_1^d = 0, \dot{D}_2^d = \dot{L}$ as it was assumed above. The described modification of the interaction between firms, banks and households is therefore an economically feasible one, if banks can manipulate the interest rate on time deposits such that the flow of checkable deposits from banks to firms and from there to the household sector can be redirected into time deposits.

6.4.3 Macroeconomic stability

In this scenario introduced in the preceding subsection, we get as laws of motion for the macroeconomy:

$$\begin{aligned} \dot{Y} &= \beta_y((a_y - 1)Y + a_e p_e E - a_l(L - L_o) + \dot{L} + \bar{A}), \\ \dot{L} &= l_b(Y - Y_o), \\ \hat{p}_e &= \beta_e \alpha_e \left(f_e(\frac{r(Y)}{p_e}) - 1 \right). \end{aligned}$$

The steady state of this dynamical system is of course the same as before and its Jacobian (if we assume that $a_y + l_b < 1$ holds true) has the sign structure

$$J_o = \begin{pmatrix} - & - & + \\ + & 0 & 0 \\ + & 0 & - \end{pmatrix}.$$

The sign structure implies stability of the steady state if the parameter a_e is such that $a_2 > 0$ holds true (since a_1 and a_3 are obviously positive) since in this case the positive interaction between the state of confidence in the goods market dynamics and the output effect on dividends in the stock market dynamics is the only effect that can be destabilizing. The term $a_1a_2 - a_3$ must then be positive, since the $-a_3$ term is matched by a component in the terms contained in a_1a_2.

The assumed type of narrow banking therefore not only *eliminates* the discontinuities created by the occurrence of *bank runs*, but also makes the economy *a stable one* if the real-financial market interaction between output dynamics and Tobin's q (the product of the coefficients J_{13}, J_{31}) is not allowed to work in such a pronounced way that it overcomes the plus sign of the term $-J_{12}J_{21}+J_{11}J_{33}$. This shows that Narrow Banking is dynamically seen more reliable and robust than the model of broad banking we have considered beforehand. Note that the stated condition is stronger than necessary, since it suffices that to choose a_e such that $a_1a_2 - a_3$ is positive, since a_2 must be positive in this case.

6.4.4 The Tobinan investment accelerator and counteracting monetary policy

We now add to the above first scenario of narrow banking a role for monetary policy and describe the flow account of the Central Bank as shown in Table 8.

The central bank is here assumed to pursue a countercyclical money supply rule for the stabilization of the real-financial market interaction. The central bank therefore expands

Table 6.8: Central Bank (Flows Account)

Uses	***Resources***
	Open Market Policies $\dot{H} = m_e(p_{eo} - p_e)E$
Equity Demand $p_e\dot{E}_c^d = \dot{H} = -p_e\dot{E}_c^s$	
CB Surplus: $r(Y)E_c \rightarrow$ H-sector	Dividends $r(Y)E_c$

money supply in a stock market boom by selling equities to the household sector (the only asset in which it can trade in this model) and by purchasing equities in the stock market bust. We assume moreover that it has inherited from the past a sufficient amount of equities E_c and that it transfers the dividends it receives on these equities to the household sector (as there is not yet a government sector in our model economy).

Note that the circuit of money induced by the money supply rule of the central bank "moves" in the opposite direction as compared to the circuit of money so far considered, since it affects the checkable deposit holdings of asset holders and the reserves of banks directly (by the assumed trade in equities) and – when a portion t_m of these $c-$deposits is transferred into time deposits by households – provides new opportunities for commercial banks to offer extra loans. We assume for the moment that the money supply rule of the central bank affects reserves solely and has therefore no impact on the credit channel of the model. The considered dynamics is thereby modified as follows:

$$\begin{aligned}
\dot{Y} &= \beta_y((a_y - 1)Y + a_e p_e E - a_l(L - L_o) + \dot{L} + \bar{A}), \\
\dot{L} &= l_b(Y - Y_o), \\
\hat{p}_e &= \beta_e \alpha_e \left(f_e(\frac{r(Y)}{p_e}) + m_e(p_{eo} - p_e) - 1 \right).
\end{aligned}$$

The steady state of this dynamical system is of course the same as before and its Jacobian is qualitatively unchanged in its the sign structure:

$$J_o \quad = \begin{pmatrix} - & - & + \\ + & 0 & 0 \\ + & 0 & - \end{pmatrix}.$$

but with a more negative entry J_{33} now however. All coefficients $a_i, i = 1, 2, 3$ of the Routh-Hurwitz polynomial are thus increased by the addition of this stock market policy of the central bank, and also the expression $a_1 a_2 - a_3$ as can be easily checked. The assumed monetary policy is therefore achieving its aim of stabilizing the interaction of the goods market with the stock market of the economy.

6.4.5 Efficiency of narrow banking and the occurrence of credit rationing

We consider in this subsection the more general case where the inflow of checkable deposits into the household sector through the loans $\dot{L}$ demanded by and granted to firms by the commercial banking sector are allocated by households into $\dot{D}_1 = t_m \dot{L}, t_m \in [0, 1]$ checkable deposits and $\dot{D}_2 = (1 - t_m)\dot{L}$ time deposits (in place of the $t_m = 1$ assumption we have made so far). As a whole the household sector has to hold $\dot{L}$ in one of these two forms,since we assume again an inactive central bank.

Since there are no reserve requirements on time deposits, the newly created deposits of this type can again be used as credit supply which creates further time deposits of amount $\dot{D}_2 = (1 - t_m)^2 \dot{L}$, etc.. In sum this gives rise to the increase in time deposits $\dot{D}_2 = \alpha_m \dot{L}$ where $\alpha = \frac{1-t_m}{t_m}$ holds true. This increase in time deposits is however accompanied by an increase in checkable deposits of amount

$$\sum_{n=1}^{\infty} t_m^n \dot{L} = \frac{t_m}{1 - t_m} = \frac{1}{\alpha_m}$$

which demand for additional reserves of this size in order to be feasible. We thus have that banks would create on the one hand hypothetical excess supply of credit if they initially grant the loans demanded by firms and then believe they can generate the considered multiplier sequence of time deposits from this. On the other hand banks would need additional reserves which they do not have as all profits are distributed.

This is however only a virtual supply scenario which cannot actually come into being. We have the given credit demand by firms and will now show how banks can provide loans that cover this demand and that meet the 100% reserve requirements of this ideal case of narrow banking. In order to achieve this we change the behavior of commercial banks as follows:

Table 6.9: Flow Account: Narrow Commercial Banking II

Uses	***Resources***
retained profits $\alpha_b(t_m)\Pi_b$	profits $\Pi_b = i_l(Y)L - i_d D_2$
distributed profits $(1-\alpha_b(t_m))\Pi_b$	
Reserve Change $\dot{R} = \dot{D}_1$	$\dot{D}_1 = \alpha_m(i_d)^{-1}\dot{L}^* = \alpha_b(t_m)\Pi_b$
Loan Demand of Firms $\dot{L}(Y, i_l)$	Potential Loan Supply $\dot{D}_2 = \alpha_m(i_d)\dot{L}^*$

In this table we assume that banks choose a baseline loan supply L^*, the implied reserve increases of which can be met out of the now assumed amount of retained profits of them. In addition they create the amount of time deposits $\dot{D}_2 = \alpha_m(i_d)\dot{L}^*$ through the initiated loan multiplier process which accompanies the considered creation of checkable deposits. We assume in this scenario that t_m depends negatively on the interest rate i_d on time deposits. The multiplier α_m therefore depends positively on this interest rate, i.e., the amount of time deposits generated by the assumed circuit of checkable loans of course increases with the interest rate paid on time deposits. Moreover the parameter α_b characterizing retained bank profits is assumed to increase with t_m in order in an attempt to meet the increase in reserve requirements the increase in the hoarding propensity t_m implies.

The task of the commercial banking system thus is to adjust the parameters α_b, i_d such that the potential loan supply $\dot{D}_2 = \alpha_m(i_d)\dot{L}^*(\alpha_b)$ exceeds the (screened) loan demand of firms $\dot{L}$. The consider deposit multiplier process may then not be fully needed in order to meet this loan demand. Moreover, in actual economies this multiplier process is not working instantaneously, but is evolving in time, accompanied by the time deposit generation of earlier loans of firms. In practice, the ideal demand equals supply condition

$$\dot{L}(Y, i_l) = \alpha_m(i_d)\dot{L}^*(\alpha_b), \quad \alpha_m^{'}(i_d) > 0, \dot{L}^{*'}(\alpha_b) > 0,$$

is therefore not easy to fulfill and needs the expertise of educated credit management in order to avoid (through some buffers in potential loan supply) the credit rationing of credit-worthy firms. However, the instruments our narrow commercial banking system has at its disposal should suffice to manage situations of normal checkable money demand though adjustments in retained profits and the interest rate on time deposits.

There may however occur situations where the hoarding parameter t_m increases significantly and cannot be mitigated any more through adjustments in retained profits or the interest rate on time deposits. Such situation may then lead to the rationing of the credit demand of firms. Such situations may come about when stock market bubbles burst or the real sector of the economy is in a bust and generating very low profits (or both). The quantitative easing strategy of the central bank considered in the preceding subsection may come to help in such a situation, by stabilizing stock prices and by supplying money for the credit channel. This may lead to a partial increase in loans which act positively on aggregate demand via the assumed dynamic multiplier process on the market for goods. Yet, depending on the extent of the real and financial crisis this may not always be sufficient, though any systemic effect of commercial banking is absent though the Fisherian 100% reserve requirement on checkable deposits. Bankruptcy of commercial banks are then only possible through significant increases in bad loans to firms, a situation that may need for bail-out policies of the central bank.

6.5 Conclusions

In this chapter we have considered the implications for macroeconomic stability of a broad banking system where commercial banks are allowed to trade in capital assets (here equities) as a substitute for traditional lending activities. Using a simple dynamic multiplier approach on the market for goods and a simple rate of return driven adjustment rule for stock prices we have shown that such a scenario is likely to be an unstable one, even if an appropriate monetary policy of the central bank is added to the considered dynamics. We then considered a narrow banking system defined by a Fisherian 100% reserve ratio for checkable deposits and the exclusion of stock trade for commercial banks. This would imply a significant reduction of proprietary trading of the banking sector. We showed in a narrow banking system that; a) the rationale for bank runs no longer exists as all checkable deposits are backed by high-powered central bank money; b) speculative behavior by commercial banks is excluded by law; while c) a sufficient loan supply to entrepreneurs can be guaranteed in such a framework.

Low and falling stock market prices, increasing liquidity preference and credit rationing are a big problem for any banking system, but in the narrow banking considered here at the very least the exclusion of bank runs (100% reserves) may lead to a more stable real-financial market interaction and presumably also a more efficient credit supply than in the case where the traditional function of commercial banks as credit institutions becomes mixed up with investment banking and the like. Narrow banking thus can not only provide a greater systemic stability, but also at least as much efficiency in the credit creation process as the present banking system. Furthermore while narrow banking appears a too extreme case to be implemented in reality, its features show the improvements in macrofinancial stability which can be attained if broad banking were to be constrained.

6.6 References

Adrian, T., Moench, E. and Shin, S.S., 2010, Macro risk premium and intermediary balance sheet quantities. Federal Reserve Bank of New York Staff Report 428.

Asada, T. Flaschel, P. Mouakil, T. and Proaño, C., 2011, Macroeconomic Activity, Asset Accumulation and Portfolio Choice: A Keynesian Perspective. Palgrave / Macmillan, Basingstoke, Hampshire.

Barth, J.R., Brumbaugh, R.D. Jr. and Wilcox, J.A., 2000, The Repeal of Glass-Steagall and the Advent of Broad Banking, Journal of Economic Perspectives, 14(2), 191-204.

Bernanke, B. and Gertler, M., 1989, Agency Costs, Net Worth, and Business Fluctuations, American Economic Review, 79(1), 14-31.

Bordo, M., 2007, The Crisis of 2007: The Same Old Story, Only the Players Have Changed. Remarks prepared for the Federal Reserve Bank of Chicago and International Monetary Fund conference; Globalization and Systemic Risk. Chicago, Illinois September 28, 2007.

Brunnermeier, M. and Sannikov, Y., 2010, A macroeconomic model with a financial sector, Working Paper, Princeton University.

De Grauwe, P., 2008, Returning to narrow banking. Center for European Policy Studies: CEPS Commentary (Nov. 14, 2008).

Fisher, I., 1935, 100 % - Money. New York: Adelphi.

Flaschel, P., Hartmann, F., Malikane, C. and Semmler, W., 2010, Broad Banking, Financial Markets and the Return of the Narrow Banking Idea, Journal of Economic Asymmetries, 7(2), 105-138.

Freixas, X. and Rochet, J.C., 2008, Microeconomics of Banking. Cambridge, MA: The MIT Press.

Gorton, G.B., 2009, Slapped in the Face by the Invisible Hand: Banking and the Panic of 2007, New York: Oxford University Press.

Gorton, G.B., 2010, Questions and Answers About the Financial Crisis, NBER Working Paper 15787.

Kindleberger, C. and Aliber, R., 2005, Manias, Panics and Crashes. A History of Financial Crises, 5th edition. New York: Wiley.

Minsky, H., 1982, Can it Happen Again? Essays on Instability and Finance. New York: M.E. Sharpe.

Minsky, H., 1986, Stabilizing an Unstable economy. - A Twentieth Century Fund Report, New Haven/London: Yale University Press.

Sinn, H.-W., 2009, Risk-Taking, Limited Liability and the Banking Crisis. Munich: CESifo.

7 A Basic Model of Real-Financial Market Interactions with Endogenous Opinion Dynamics

7.1 Introduction

> *So here's what I think economists have to do. First, they have to face up to the inconvenient reality that financial markets fall far short of perfection, that they are subject to extraordinary delusions and the madness of crowds. Second, they have to admit – and this will be very hard for the people who giggled and whispered over Keynes – that Keynesian economics remains the best framework we have for making sense of recessions and depressions. Third, they'll have to do their best to incorporate the realities of finance into macroeconomics. Many economists will find these changes deeply disturbing.*

Paul Krugman, New York Times, September 6, 2009

Financial crises are an important phenomenon in market economies: are recurrent, can be extremely disruptive and costly, and they raise important issues for theorists and policy makers alike. The ruling paradigm of Dynamic Stochastic General Equilibrium (henceforth, DSGE) in macroeconomics has done a rather unconvincing job with respect to the

This chapter is based on Hartmann, Charpe, Flaschel and Veneziani (2016).

explanation of financial crises and especially the recent global downturn, as admitted also by proponents of the DSGE approach, such as Charie et al. (2009). Arguably, this unsatisfactory performance has not been the result of a lack of mathematical sophistication. Rather, it derives from the adoption of an equilibrium approach coupled with the assumption of Rational Expectations, which seem methodologically and empirically questionable. Indeed, De Grauwe (2010) has attempted to build DSGE models without Rational Expectations by assuming agents to have limited cognitive abilities. Tovar (2009) among others has also argued that it is necessary to incorporate various transmission mechanisms that had been absent in the DSGE literature for quite a while, but are nonetheless crucial to understand monetary market economies. Improvements like Kumhoff et al. (2012) have been made to counter this line of critique, but cannot overcome the basic flaws which come with the imposition of RE. Even the incorporation of heterogeneous expectations, as it is done in Massaro (2012) or Branch and Evans (2011) only accomplishes partly a change in determinacy respectively policy implications, but sticks to imposed equilibrium considerations, which do not allow to map some of the essential dynamic feedbacks.

This chapter proposes a number of departures from DSGE methodology, which can be seen as the building blocks of a new approach in the Keynesian tradition, which we call Dynamic Stochastic General Disequilibrium (henceforth, DSGD). We construct an integrated macrodynamic model which incorporates some important feedback channels from the real to the financial sector (and vice versa), and in which markets are not assumed to jump to their equilibrium positions, but where dynamic adjustment processes take place. Further, unlike in much of the macrodynamic literature out of the DGSE approach, we analyze *behaviorally founded* (instead of standard micro-founded) expectation processes on the micro level in financial markets by incorporating an innovative concept of *animal spirits* developed by Franke (2012) instead of the standard rational expectation apparatus. In comparison, DSGD delivers a more general concept of which DSGE equilibria might be special cases, but cannot be considered the only economically relevant outcomes.

To be precise, we consider a one-good economy where output moves according to a dynamic multiplier approach which considerably simplifies the Metzlerian inventory accelerator mechanism of the Keynes-Metzler-Goodwin model of Chiarella and Flaschel (2000). Since our focus in this chapter is on financial markets and their specific sources of instability, the real side of the economy is kept as simple as possible. However, we assume that stock markets have real effects by influencing the agents' state of trust in the economy, and so their investment and consumption decisions.

The reader may question the label 'General' in the Dynamic Stochastic General Disequilibrium model we are considering in this chapter. However, if the approaches considered in Charpe et al. (2011a), Asada et al. (2011a) are added to the present model, its message remains essentially the same, though its real part is then of an advanced KMG type (as considered in detail in Charpe et al., 2011) and its financial part of an advanced Tobinian type of macroeconomic portfolio choice (as considered in detail in Asada et al., 2011a).

Three types of assets are traded on financial markets: first, a capital stock asset which is directly owned by households who supply the means of financing to firms. The second asset is a short-term, fix-price government bond, whose rate of interest is set by the Central Bank which issues the third asset, money M. A portfolio approach based on Tobin (1982) is employed to address disequilibrium adjustment processes on financial markets. Since the economy wide stocks of assets are given numbers in a set-up neglecting growth (for the purpose of analyzing business cycle issues), allocation is provided by the respective private asset demands. Households choose between risky capital and safe bonds, where the latter is just determined residually. Moreover, the central bank has to buy (sell) all the bonds left (needed) by private excess demand and finally adjust the money supply accordingly. It does not trade in the market for the capital stock. This allows us to identify the feedbacks between financial and real markets, via Tobin's q, here given by the market price of capital K. In particular, we consider the effects of real variables on capital gain expectations, which represent a key element of the expected rate of return on stocks.

Focusing only on one risky asset (though we have two additional ones present in the background) is appropriate in order to identify the key dynamic mechanisms and real / financial feedbacks. But it is important to stress that this is just a simplifying assumption and the model can be extended to include, for example, long-term bonds B^l or bank loans

Λ as in Charpe et al. (2011b), Chiarella et al. (2012) and in Asada et al. (2011b). In this chapter, however, we go even one step further in simplification to provide the core of the DSGD approach as clear as possible and, thus, redefine the wealth component, agents are focusing on, by the value of the capital stock (and thus ignore money and bond holdings in the stock demand function of asset holders[52]). This allows us to treat the stock market in isolation and to remove secondary wealth effects from the model, see Charpe et al. (2012) for a full Tobinian portfolio approach where such stock-flow consistency is restored.

One of the key contributions of the chapter, however, is the explicit incorporation of opinion dynamics in financial markets populated by heterogeneous agents, which allows us to examine the effects of herding and speculative behavior in combination with real-financial market interactions. More precisely, we adopt the distinction between *chartists* and *fundamentalists* originally proposed by Allen and Taylor (1990) and as Brunnermeier (2008) documents perceived as a main approach in explaining bubbles. Chartists behave like speculators and can be seen as technical traders who adopt a simple adaptive expectation mechanism. In contrast, fundamentalists focus on basic economic data and expect variables to return to steady state values with a certain adjustment speed. When regarded ceteris paribus, chartists tend to exert a destabilising influence on the economy, whereas the presence of fundamentalists is stabilising.

Albeit simple, this description of agent heterogeneity on financial markets is consistent with studies analyzing expectational heterogeneity (see, for example, Menkhoff et al., 2009), and agents' behavior on financial or foreign exchange markets (see, for example, De Grauwe and Grimaldi, 2005 and recently Proaño, 2011), and sufficient to examine some of the core propagation features of financial markets that have played a prominent role in the current crisis.[53] Overall *market* expectations are here a function of individual fundamentalist and chartist expectations, and of the relative weight of each group in the market.

When heterogeneity is introduced in macroeconomic models, the agents' type is normally

[52] based on Walras Law of Stocks and the assumed interest rate policy of the central bank.
[53] See Proaño (2011) for the incorporation of heterogeneous expectations in a two-country model along the lines of the disequilibrium approach presented here.

exogenously given and constant. In this chapter, we analyze a dynamic mechanism that endogenously determines agents' type and therefore the sizes of the different populations of traders. To be specific, we adopt the behaviorally-founded notion of *animal spirits* recently formalized by Franke (2012), in the context of his analysis of business sentiments. We assume that at every moment in time there is a positive probability of each agent changing their status, from chartist to fundamentalist, or vice versa. This probability depends on the key variables of the economy (output, expected capital gains, asset prices), but also on the composition of market traders itself, which allows us to capture herding processes. So it is an interplay between factors concerning the environment of the market and internal factors of the particular market.

The model economy thus constructed contains two potential sources of instability:
1) the feedbacks between real and financial markets via Tobin's q, and
2) the endogenous opinion dynamics produced by the interaction of heterogeneous agents on asset markets.
Thus, it allows us to investigate a key question emerging from the current financial crisis, namely whether unfettered, interconnected markets with heterogeneous agents are able to absorb external shocks, or rather tend to amplify them.

We prove that the resulting 4D dynamic system describing the evolution of the economy always has either a single steady state (with uniformly distributed agents) or three steady states (the one before, a chartist and a fundamentalist one), but even though various subdynamics of the model can be stable (at the uniform or the fundamentalist of the three steady states), the complete system may be repelling around all of its equilibria. Given the complexity of the 4D nonlinear system, though, it is difficult to draw more precise analytical conclusions on the overall dynamics (up to the consideration of two supplementing 2D cases). Therefore, we adopt numerical methods to explore the properties of the considered DSGD model further.

The numerical simulations show that the 4D system is indeed generally a bounded one: all trajectories remain in an economically meaningful subset of the state space. In this sense, the model shows the somewhat surprising result that unfettered markets with possibly accelerating real-financial feedback mechanisms have some in-built stabilising mechanism (based on opinion dynamics) that prevent the economy to move on an infeasible path. Moreover, despite the trivial dynamics of the 2D subsystems, the full 4D dynamics can exhibit somewhat irregular business fluctuations. Though the considered opinion dynamics is generally capable of ensuring upper and lower turning points in the real-financial market interactions, the generated persistent fluctuations may however still be too large to be acceptable from the societal and policy point of view.

We consider therefore various policies that may act as stabilizers of the private sector. Because markets are highly interconnected, we follow Minsky (1982) and consider multiple policy instruments: we in particular show that a Tobin-type tax on capital gains together with a capital market oriented monetary policy rule (the only 'risky asset' of the model) can indeed stabilize the economy, in the sense of reducing its volatility. The array of instruments proposed is similiar to those obtained by Farmer (2010) from a different modern 'animal spirits' approach.

7.2 Framework

The main purpose of this chapter is to analyze the specific sources of instability induced by financial markets participants and by feedback mechanisms between the financial and the real sector. Therefore, we simplify the real part of the Turnovsky (1995) benchmark model of dynamic macro portfolio adjustment[54] by ignoring inflation and growth, and by representing the quantity adjustment process by means of a dynamic multiplier approach. Specific instabilities arising from the real side of the economy are not taken into consideration. Giving the advantage that this simplifies the Metzlerian inventory accelerator mechanism of the real-side oriented Keynes-Metzler-Goodwin model of Chiarella and Flaschel (2000), thus suppressing it as a source of instability.[55] As a result, the real part of the economy is always stable (from this partial perspective), provided the propensity to

[54] This can be seen as a neoclassical reference point of our analysis, as it developes comparable feedback structures, but makes use of the Rational Expectations hypothesis.

[55] The instability induced in the KMG approach by the wage-price spiral is also ignored.

spend is less than one, which must be met in order to be sustainable on the micro level. However, we assume that stock markets have real effects on investment and consumption.

To be precise, we assume that output moves according to a standard dynamic multiplier process, except that the state of trust of the economy,[56] instead of the short-term rate of interest, influences investment and consumption decisions.[57] Formally, the law of motion of output (denoted by Y) is[58]

$$\dot{Y} = \beta_y(Y^d - Y) = \beta_y((a_y - 1)(Y - Y_o) + a_k(p_k - p_{ko})K) \tag{7.1}$$

$$Y_o = \frac{A}{1 - a_y - \frac{a_k b}{\rho_o^e K}}, \quad p_{ko} = \frac{bY_o}{\rho_{ko}^e K}$$

where A is autonomous expenditure, ρ_{ko}^e the given steady state value of the return on equity (see below for the general formulation of this rate), b the dividend rate, K total capital stock, a_y the propensity to spend, a_k the impact of Tobin's q on aggregate demand and β_y is the speed of adjustment concerning goods-market disequilibria.[59]

There is only one risky asset traded in the economy: K comprises the various forms of ownership claims on the physical capital stock (such as equities, corporate bonds, and credit) and can therefore be regarded as one representative capital asset. Its quantity is exogenously given. We assume that the market for K is imperfect, owing to information asymmetries, adjustment costs, or institutional restrictions, and therefore prices do not move instantaneously to clear markets. Let b denote the (given) profit share and let π_k^e

[56] measured by the price of the capital stock, p_k (equivalent to Tobin's q in this chapter).

[57] This linkage was established in formal terms by Blanchard (1981).

[58] For any dynamic variable x, $\dot{x}$ denotes its time derivative, $\widehat{x}$ denotes its rate of growth, and x_o denotes its steady state value.

[59] The flow-consistency background of such a Kaldorian dynamic multiplier process is considered in detail in ch. 5 of Chiarella and Flaschel (2000) and extended towards a Metzlerian treatment in their ch. 6. Note that firms (owned by households) hold inventories of goods and money in this framework which are here assumed to be passively changed through windfall profits or losses if goods demand exceeds (falls short of) output. It is assumed that investment decisions are made by the management of firms which are thus owned, but not directed by the household sector. Note finally that we do not yet consider explicitly capital depreciation, and neglect growth, inflation and government spending and taxes and thus the role of budget deficits in our model. The assumptions seem rather restrictive, but is adequate for the issues we wante to cope for the time being.

denote the expected change in stock prices.[60] Profits are entirely distributed as dividends. The expected rate of return on the capital stock ρ_k^e consists of these dividends $\frac{bY}{p_k K}$ and capital gains π_k^e.

$$\rho_k^e = \frac{bY}{p_k K} + \pi_k^e. \tag{7.2}$$

Following Asada et al. (2011a), we postulate a dynamic disequilibrium adjustment process for stock prices:[61]

$$\hat{p}_k = \beta_k \alpha_k [\sigma_k(\rho_k^e - \rho_{ko}^e)], \quad \alpha_k \in (0,1),\ \rho_{ko}^e = \frac{bY_o}{p_{ko}K}. \tag{7.3}$$

In words, only a fraction α_k of current aggregate excess demand for the capital *stock* $\sigma_k(\rho_k^e - \rho_{ko}^e)$ actually enters the asset market owing to the existence of adjustment costs. Thus, $1/\alpha_k$ represents the delay with which agents wish to clear any stock imbalance $\sigma_k(\rho_k^e - \rho_{ko}^e)$. As Asada et al. (2011a) have argued, this approach is necessary in an open economy where *flow* rather than stock imbalances enter the capital account of the balance of payments. But it is also plausible in closed economies, in a continuous time setup, to assume that adjustment processes on the financial markets are somewhat gradual. The flow processes on asset markets are then translated into asset price changes by the speed parameter β_k.

In addition to K (with market price p_k,) we have in the background of the model two other financial assets, namely, as is customary, money M and short-term fix-price bonds, B.[62] The CB fixes the interest rate on B at the level r. Since it does not trade in real capital it must then accept households' excess demand for bonds. Households must however hold the same amount of real capital at the 'end' of the trading period, i.e., they can only realise a new composition of money and bonds (not explicitly shown in this chapter) if the CB

[60] We assume a constant profit share throughout the chapter. This is consistent with our assumption of constant output prices, wages, and labour productivity.

[61] Note that the reference rate ρ_{ko}^e is a parameter of the model which will be equal to the steady state rate by the law of motion for share prices assumed below.

[62] See Charpe et al. (2011, sec.2) for their explicit representation and also for a critique of allowing government to issue a perfectly liquid asset B, with $p_b = 1$.

resets r. The allocation of wealth into 'aggregate money' $M + B$ and capital K will thus remain unchanged after each trading period, during which a reallocation of real capital is intended and alters the rate of change of the price of real capital according to the law of motion (8.2). For the sake of simplicity, we assume that households are focused on the market for real capital to such an extent that their nominal wealth $W = M + B + p_k K$ can be replaced (proxied) by $p_k K$ in their capital demand function, which allows to ignore total private wealth in the above law of motion of stock prices.

Equations (8.1)-(8.2) represent the baseline model. In this economy, Tobin's q is measured by p_k, and it plays a key role in breaking down the real/financial dichotomy. Real markets influence asset markets via the role of output as the main determinant of the rate of profit of firms, and thus of the rate of return on real capital. Financial markets feedback to the real side via the impact of Tobin's $q = p_k K/pK = p_k/p = p_k$, assuming $p = 1$, on aggregate demand (either via a consumption or an investment effect).

In order to focus on the stability characteristics of the Tobin feedback channel in isolation, assume for the time being that capital gain expectations are stationary, so that the corresponding 2D system describing the dynamics of Y, p_k is only subject to a Tobin-type accelerator mechanism. The Jacobian J of the real-financial market interaction is:

$$J = \begin{pmatrix} -\beta_y(1-\alpha_y) & \beta_y a_k \\ \beta_k \alpha_k \sigma_k b/(p_k K_o) & -\beta_y \alpha_k \sigma_k b Y_o/(K_o p_k^2) \end{pmatrix} = \begin{pmatrix} - & + \\ + & - \end{pmatrix}.$$

The trace of J, trJ, is unambiguously negative. Then, it is not difficult to prove that if a_y is sufficiently small (but of course still larger than zero as well as smaller than one) and a_k is sufficiently small, the determinant of J, $\det J$, is positive, and the system is locally asymptotically stable around the steady state. This case is illustrated in figure 1. If the above restrictions on a_y and a_k do not hold, then it is possible to have $\det J < 0$, and so the system might display saddle-point dynamics around the steady state. If one assumes that policy is able to reduce the parameters a_y (propensity to spend) and a_k (capital market effect on aggregate demand), at least far off the steady state, then figure 1 suggests that

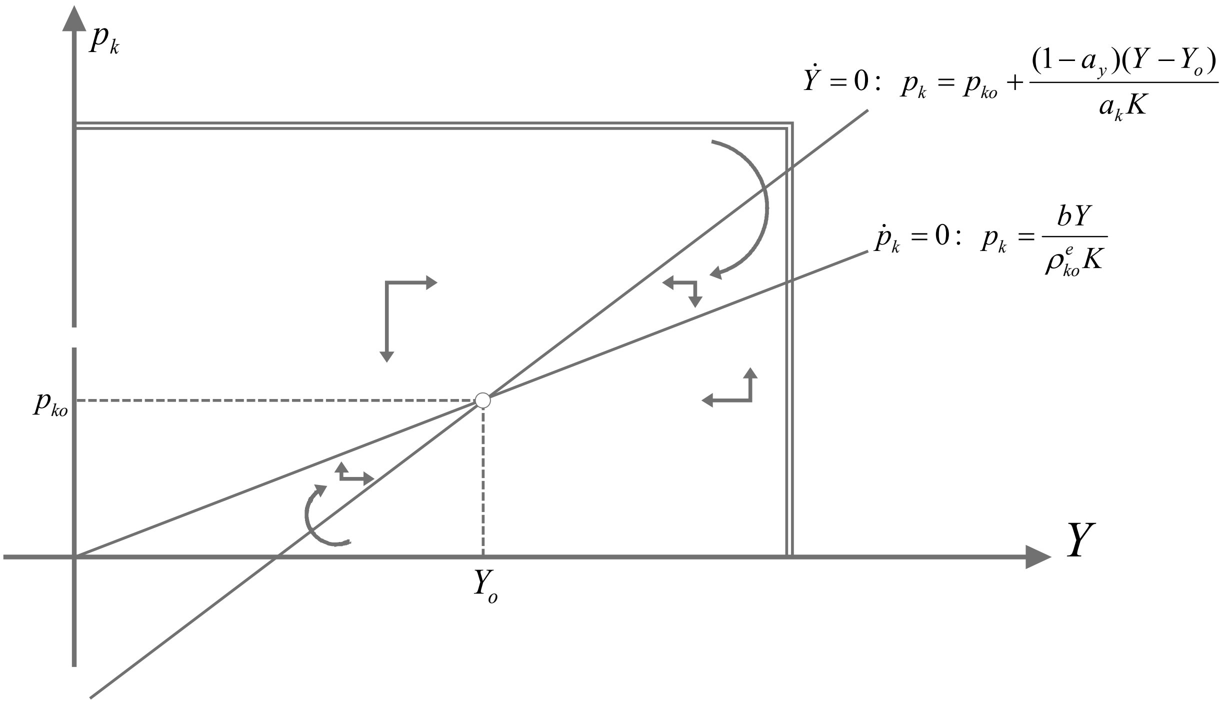

Figure 7.1: Asymptotically stable real-financial market interaction.

global stability may be obtained. These stabilising forces may however be absent in a neighbourhood of the equilibrium. In this case the steady state is a repeller and figure 1 suggests the existence of a limit cycle within the compact box depicted.

These conclusions only concern the interaction of real and financial adjustment processes and do not depend on the presence of behavioral traders on the financial markets, which are introduced in the next section.

7.3 Capital gain expectations

Extending the model to include behavioral traders now, we consider financial markets with heterogeneous expectation formation and, following Allen and Taylor (1990) or Frankel and Froot (1990), distinguish between *fundamentalists*, f, and *chartists*, c. Fundamentalists expect capital gains to converge back to their steady state position (zero in our model). Chartists instead adopt a simple adaptive mechanism to forecast the evolution of capital gains $\dot{\pi}_k^e$. Formally:

$$\begin{aligned}\dot{\pi}_{kf}^e &= \beta_{\pi_{kf}^e}(0 - \pi_{kf}^e),\\ \dot{\pi}_{kc}^e &= \beta_{\pi_{kc}^e}(\hat{p}_k - \pi_{kc}^e).\end{aligned}$$

Heterogeneous expectations are introduced here step by step, meaning that we start first with exogeneously given fractions of agent types and analyze dynamic implications of this step, before we finally allow for an endogeneous determination of populations.

To be sure, more complex expectation formation mechanisms can be adopted for each type of agent, including forward looking rules, in particular if numerical simulations are intended. Yet, our formulation has the virtue of analytical simplicity, and it allows us to draw a sharp distinction with respect to Rational Expectation models.

Given that agents have heterogeneous expectations, it is not obvious a priori what *market* expectations should be. In standard equilibrium models with efficient markets, heterogeneous information and beliefs are spontaneously aggregated and made uniform under the pressure of market forces. This is clearly not the case in our framework, as it seems rejectable on an empirical basis and is, thus, replaced here. As a first step before full endogeneous determination, suppose that the population shares of chartists and fundamentalists, $\nu_c, (1-\nu_c)$, respectively, are constant.[63] It may be tempting to argue that the market expectation is the weighted average of the expectations of chartists and fundamentalists:

$$\pi_k^e = \nu_c \pi_{kc}^e + (1-\nu_c)\pi_{kf}^e.$$

It is not clear, however, that this is the theoretically appropriate way of capturing the formation of market expectations. For market expectations π_k^e may actually reflect what both types of agents *think* will emerge from the process of aggregation of fundamentalist and chartist expectations. In other words, market expectations may reflect the agents' view about the 'average' opinion. And this need not be the exact, weighted average of the

[63]Population shares are endogenized in the next section.

individual expectations. In turn, the law of motion of market expectations may be the product of what on average agents think the average opinion and its rate of change will be. In the words of Keynes (1936, p.156):

> *It is not a case of choosing those which, to the best of one's judgment, are really the prettiest, nor even those which average opinion genuinely thinks the prettiest. We have reached the third degree where we devote our intelligences to anticipating what average opinion expects the average opinion to be. And there are some, I believe, who practise the fourth, fifth and higher degrees.*

In this chapter, we consider the following simple law of motion for aggregate capital gain expectations:

$$\dot{\pi}_k^e = \beta_{\pi_k^e}[\nu_c \hat{p}_k(Y, p_k, \pi_k^e) - \pi_k^e], \tag{7.4}$$

where $\beta_{\pi_k^e} > 0$ represents an adjustment speed parameter and where share price inflation only enters expectations with the weight ν_c of the chartists (since the change in their number is not foreseen). We thus assume that adaptive expectations formation drives the expectation of capital gains (to the extent they are present in the market), while fundamentalists are only adding stabilizing forces to it. To be sure, this is only one possible formalisation of the dynamics of aggregate expectations in markets with heterogeneous agents, and alternative approaches can be proposed (see, for example, the approach adopted by De Grauwe and Grimaldi, 2005, in their analysis of the behavior of agents on foreign exchange markets). Yet, we regard equation (8.4) as a very parsimonious way of capturing *both* the influence of aggregate observed variables *and* the role of heterogeneity and self-driving forces in expectation formation.

In order to analyze the dynamics of this economy, note that if the weight of chartists in average expectation is zero, the Jacobian of the 3D system (8.1), (8.2), (8.4) at the steady state becomes

$$J = \begin{pmatrix} -\beta_y(1-\alpha_y) & \beta_y a_k & 0 \\ \beta_k \alpha_k \sigma_k b/(p_k K_o) & -\beta_y \alpha_k \sigma_k b Y_o/(K_o p_k^2) & \beta_k \alpha_k \sigma_k \\ 0 & 0 & -\beta_{\pi_k^e} \end{pmatrix} = \begin{pmatrix} - & + & 0 \\ + & - & + \\ 0 & 0 & - \end{pmatrix}.$$

with $J_{33} = -\beta_{\pi_k^e}$, so that a negative eigenvalue is added to the system. Therefore if a_y is sufficiently small but larger than zero and a_k is sufficiently small, the steady state of the expectations-augmented real-financial interaction process is, again, locally stable. Hence, given the continuity properties of eigenvalues, if a_y is sufficiently close to (but smaller than) one and a_k is sufficiently small, then the steady state of the Tobin dynamics (8.1)-(8.2), augmented by the capital gain expectations rule (8.4), remains locally asymptotically stable even if the weight of chartists in average expectations formation is positive, but is sufficiently small. Intuitively, fundamentalists – if sufficiently dominant – may counteract any destabilising tendencies that chartists may create.

Instead, if the number of chartists, ν_c, the responsiveness of asset prices to disequilibria, β_k, and / or the responsiveness of the demand for capital stocks to expected returns, $f'(0)$, are sufficiently high, then one may obtain $J_{33} > 0$ and even $trJ > 0$. In this case, if the upper 2×2 minor satisfies the Routh-Hurwitz stability conditions (and the real-financial market interaction as such asymptotically stable), the system becomes unstable by way of Hopf-bifurcations, i.e., in general, by the death of a stable corridor around the steady state or by the birth of stable persistent fluctuations around it. The dynamic system (8.1), (8.2), (8.4) can thus provide a theory of business fluctuations caused by the interaction of real and financial markets.

To be sure, the previous argument and the existence of Hopf bifurcations is only based on a local analysis. Yet one may expect the presence of chartists to lead to explosive dynamics in general, if the speed of adjustment on financial markets or the responsiveness of the demand for capital stock are sufficiently high. This explosiveness may be tamed far off the steady state if nonlinear changes in behavior or policy reduce β_k and/or α_k enough to make the system globally stable, thus ensuring that all trajectories remain within an economically meaningful bounded domain. We do not analyze this conjecture further here. Rather, in the next section, we explore the possibility that endogenous changes in the agents' populations, ν_c, reduce the influence of chartists far off the steady state and thereby create turning points in the evolution of capital gain expectations.

7.4 Opinion dynamics

Even if one rejects the assumption of Rational Expectations, agents in financial markets do learn and they may change their behavior endogenously in response to changes in the key economic variables. In this section, we adopt a version of the herding and switching mechanism developed by Lux (1995) and Franke (2012), which provides behavioral foundations to the agents' attitudes in the financial market. Unlike in standard DSGE models, we do not start from individual optimization programs. The switching mechanism is arguably more realistic than DSGE and it is a very elegant way of capturing both rational behavior and purely speculative effects and herding. In fact, agents decide whether to take a chartist, or a fundamentalist, stance depending on the current status of the economy (captured by the key variables Y, p_k), on expectations on the evolution of financial gains (π_k^e), and also on the current composition of the market (captured by the variable x, defined below).

Formally, suppose that there are $2N$ agents in the economy. Of these, N_c are chartists and N_f are fundamentalists so that $N_c + N_f = 2N$. Let $n = \frac{N_c - N_f}{2}$. Following Franke (2012), we describe the distribution of chartists and fundamentalists in the population by focusing on the difference in the size of the two groups (normalised by N). To be precise, we define

$$x = \frac{n}{N} \in [-1, 1], \quad \text{and get} \quad 1 - x = \frac{N_f}{N}, 1 + x = \frac{N_c}{N}, \tag{7.5}$$

where, as in Franke (2012), N is assumed to be large enough that the intrinsic noise from different realisations when individual agents apply their random mechanism can be neglected. Formally, as in Franke (2012), given the continuous time setting, we in fact take the limit of x as N tends to infinity.

Let $p^{f \to c}$ be the transition probability that a fundamentalist becomes a chartist, and likewise for $p^{c \to f}$. The change in x depends on the relative size of each population multiplied by the relevant transition probability.

$$\dot{x} = (1-x)p^{f \to c} - (1+x)p^{c \to f}.$$

The key behavioral assumption concerns the determinants of transition probabilities: we suppose that they are determined by a *switching index* s, summarising the expectations of traders on market performance. The switching index depends positively on the agent composition of the market (capturing the idea of herding, as the fact that e.g. when chartist attitudes are prevailing the general mood even reenforces chartistic opions. See Franke and Westerhoff (2009, p.7).), and on economic activity, and negatively on the market value of the capital stock and on average capital gain expectations. Formally, assuming again a functional shape as simple as possible, in order to concentrate on the essential nonlinearities:[64]

$$s = s_x x + s_y(Y - Y_o) - s_{p_k}(p_k - p_{ko})^2 - s_{\pi_k^e}(\pi_k^e)^2. \tag{7.6}$$

This switching index assumes – besides the herding term and the role of economic activity as in Franke (2012) – that the deviations of share prices and capital gain expectations from their steady state values (in both directions) favour opinion making in the direction of the fundamentalists, because doubts concerning the macroeconomic situation become widespread. This change can be interpreted as a change in the state of confidence, whereby agents believe that increasing deviations from the steady state eventually become unsustainable. A similar approach concentrating on price p_k misalignment is used in Franke and

[64]The details of the approach are in Lux (1995) and Franke (2012).

Westerhoff (2009, eq.6).

An increase in s is assumed to increase the probability that a fundamentalist becomes a chartist, and to decrease the probability that a fundamentalist becomes a chartist. More precisely, assuming that the relative changes of $p^{c\to f}$ and $p^{f\to c}$ in response to changes in s are linear and symmetric:

$$
\begin{aligned}
p^{f\to c} &= \beta\exp(as), &\quad (7.7)\\
p^{c\to f} &= \beta\exp(-as). &\quad (7.8)
\end{aligned}
$$

Given the above assumptions, the complete 4D dynamic system becomes:

$$
\begin{aligned}
\dot{Y} &= \beta_y[(a_y-1)(Y-Y_o)+a_k(p_k-p_k^o)K] &\quad (7.9)\\
\hat{p}_k &= \beta_k\alpha_k\sigma_k(\rho_k^e-\rho_{ko}^e) &\quad (7.10)\\
\dot{\pi}_k^e &= \beta_{\pi_k^e}[\frac{1+x}{2}\hat{p}_k-\pi_k^e] &\quad (7.11)\\
\dot{x} &= \beta[(1-x)\exp(as)-(1+x)\exp(-as)] &\quad (7.12)
\end{aligned}
$$

where s is given by eq. 7.6. Equations (8.9)-(8.12) represent our baseline DSGD model. All variables are here dynamic in the sense that their evolution over time is described by more or less gradual adjustment processes, and no algebraic equilibrium condition is involved (only the definitional equation for s). Markets are essentially interconnected and there are various feedback mechanisms between them.

The key theoretical and policy question is, whether the unfettered market economies described by the DSGD model, where real/financial feedbacks play a prominent role and expectation formation may be affected by herding behavior, display explosive trajectories, or rather whether they contain some inherent stabilising mechanisms. As a first step, note

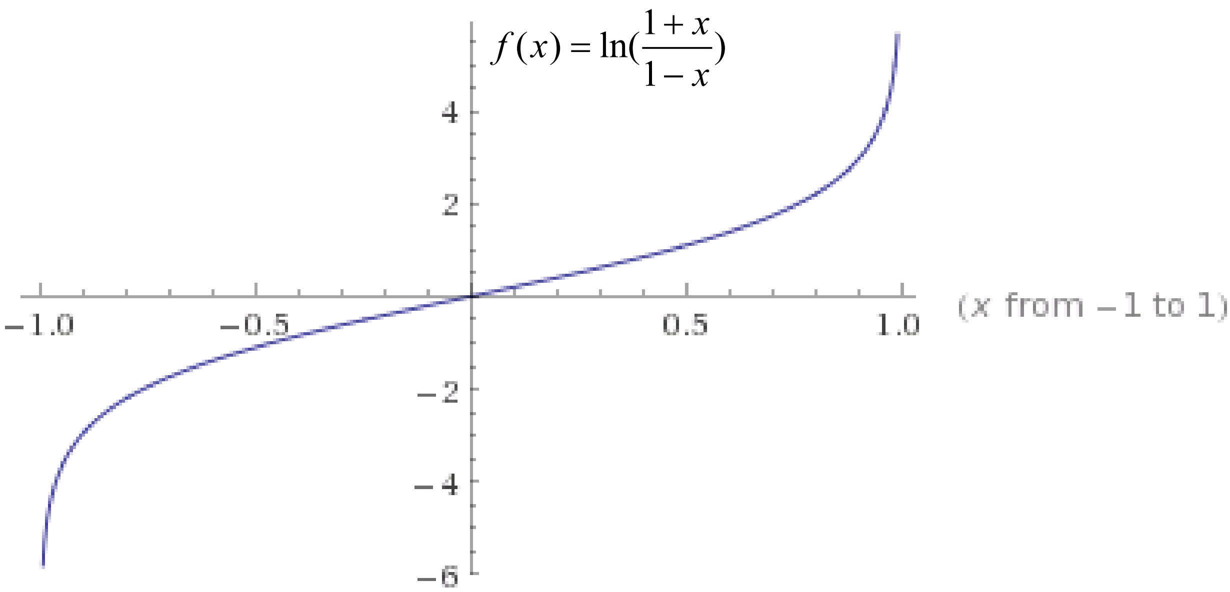

Figure 7.2: The core of the switching function $f(x) = \ln(\frac{1+x}{1-x})$, $f'(0) = 2$ (which when set equal to $2as_x x$ gives the steady state values for x).

that the dynamic system (8.9)-(8.12) always has the following steady state:

$$Y_0 = A/(1-a_y), \quad (7.13)$$

$$p_{ko} = bY_o/(\rho^e_{ko}K), \quad (7.14)$$

$$\pi^e_{ko} = 0, \quad (7.15)$$

$$x_o = 0. \quad (7.16)$$

If $s_x \leq 1/a$ then this steady state is unique (the first three values are always uniquely determined). If $s_x > 1/a$, then there are two additional steady state values for $x_o : e_f, e_c$, one where chartist are dominant and one where the opposite holds true (all other steady state values remain unchanged). This is suggested by the backward-bending shape of the $\dot{x} = 0$ - isocline in figure 3, but is to be obtained in fact by what is shown in figure 2 (which is based on the assumption of given unique steady state values $Y_o, p_{ko}, \pi^e_{ko} = 0$). The figure 2 – and the derivative of this function at 0 – shows that $as_x < 2$ must hold for the case of a uniquely determined steady state value $x_o = 0$.

Before analyzing the dynamics of the complete system, it is interesting to consider the properties of the opinion dynamics and the expectation part of the model in isolation. We thus assume that output and dividend payments are fixed at their steady state values. This yields the following 2D system:

$$\dot{\pi}_k^e = \beta_{\pi_k^e}[\frac{1+x}{2}\beta_k\alpha_k c - 1]\pi_k^e, \tag{7.17}$$

$$\dot{x} = \beta[(1-x)\exp(as(x,\pi_k^e)) - (1+x)\exp(-as(x,\pi_k^e))]. \tag{7.18}$$

First, note that x always points inwards at the border of the $x-$domain $[-1,1]$. Then, it can be conjectured that there must be an upper and a lower turning point for π_k^e in the economically relevant phase space $[-1,1] \times [-\infty,+\infty]$ and that, if the steady state $(0,0)$ is unstable, the generated cycle stays in a compact subset of this phase space. The expectation herding mechanism would thus be bounded, if taken by itself.

Franke (2012) shows this conjecture to be correct in the context of a formally similar 2D system. Here we simply note that $\dot{x}$ approaches infinity if there is an unlimited increase, or decrease, in the capital gains inflation rate π_k^e. However, as x approaches zero from above or from below, $\dot{x}$ would go to zero if it did not cross the vertical axis at $x = 0$. This is a contradiction and therefore there must always be an upper or lower turning point for capital gain inflation or deflation.

The phase space of the 2D system (8.13)-(8.14) is shown in figure 3. The diagram is drawn under the assumption that $s_x > 2/a$, and so there are three steady states (e_f, e_o, e_c). The horizontal axis is an invariant set of the dynamics which cannot be left (or entered) in finite time. Focusing on this part of the $\dot{\pi}_k^e = 0$ - isocline we see that both the fundamentalist and the chartist steady state (e_f, e_c) are attracting, but that this only holds for the fundamentalist equilibrium, when the economy is subject to non-zero capital gain expectations.

The $\dot{x} = 0$ - isocline is:

$$\pi_k^e = \pm\sqrt{\frac{s_x x - \ln\sqrt{(\frac{1+x}{1-x})}/a}{s_{\pi_k^e}}},$$

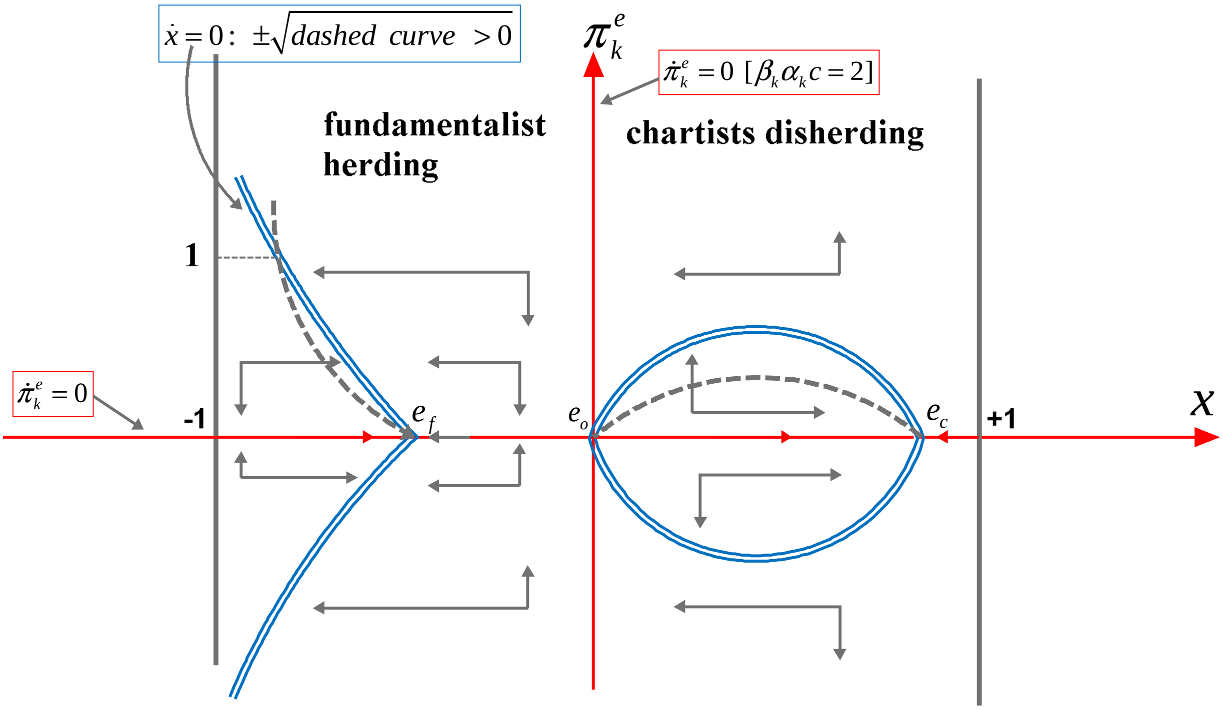

Figure 7.3: Bounded herding Behaviour.

and it is attracting with respect to x, since x falls whenever π_k^e is above the isocline and it rises if π_k^e is below it. Note that this isocline is not defined for values of x that make the numerator inside the square root negative. Figure 3 displays some innovative features, as compared to the 2D phase diagrams in the literature, though the outcome of the 2D subdynamics is a fairly trivial one, since only the equilibrium where fundamentalists dominate is by and large a stable one. The figure 3 also suggests that the economy remains in a bounded subset of the state space, if capital gains depart too much from their steady state value (which is zero), due to the strong effects this has on opinion dynamics.

However, because the law of motion of expected capital gains is not easily mapped onto figure 3, it is difficult to analyze the properties of the full 4D system. One should expect the local dynamics to be unstable without policy intervention, since the real-financial markets interaction, in connection with opinion dynamics, is likely to be of centrifugal nature. This raises the issue of the global viability of the unfettered market economy. For based on the analysis of the 2D systems, we cannot conclude that the trajectories of the full 4D dynamic

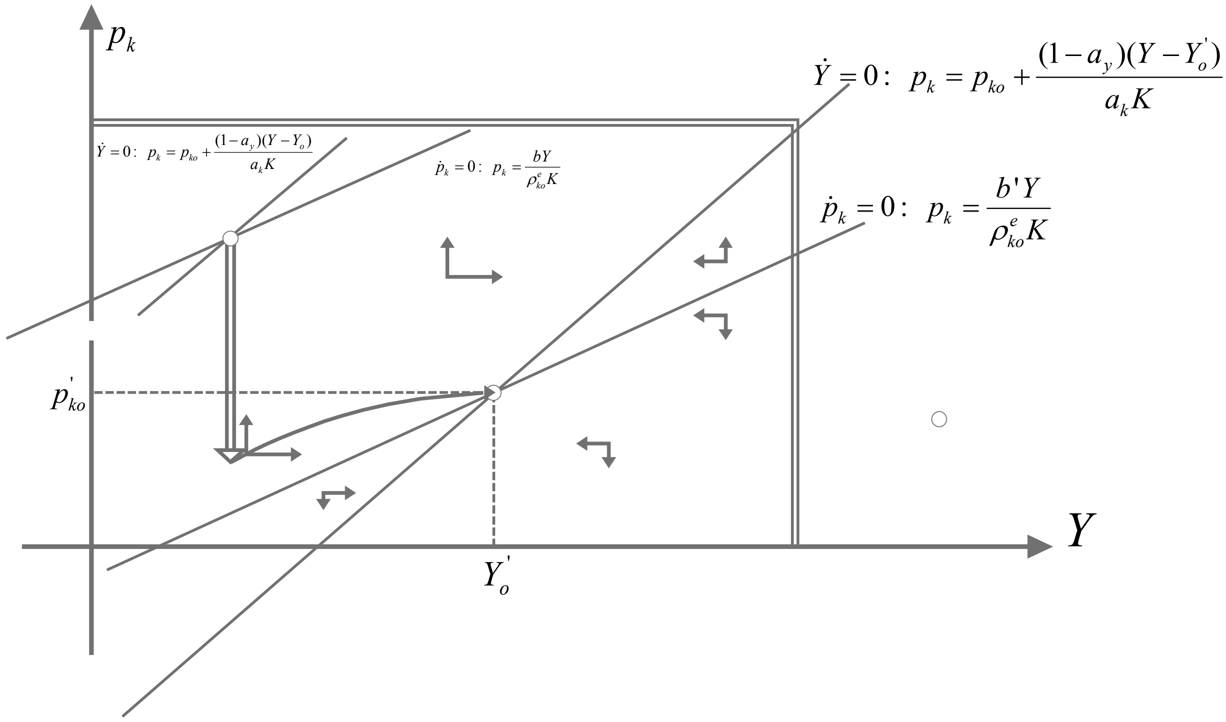

Figure 7.4: Rational expectations imply real-financial market interactions that – after a tailored jump in the share price p_k – converge to the steady state of the post-shock dynamics.

system will always remain in an economically significant subset of the state space.

Given the strong nonlinearity of the opinion part and also in the rate of return function of the 4D dynamics (despite the simple linear behavioral rules we have adopted), we shall address these questions by means of numerical simulations in the next section. They will show that interesting irregular and persistent fluctuations in the real and financial variables of the model can be generated, quite in contrast to what is possible in such a model type under the assumption of the homogeneous rational expectations of the mainstream literature.

In the latter case one assumes in the deterministic case, see Turnovsky (1995) for a variety of examples, that π_k^e is simply given by $\hat{p}_k$. The population dynamics and a separate law of motion for share price expectations is then redundant and we get for the law of motion of share prices in this case:

$$\begin{aligned}\hat{p}_k &= \beta_k\alpha_k\sigma_k(\frac{bY}{p_kK}+\hat{p}_k-\rho^e_{ko}) \\ &= \frac{\beta_k\alpha_k\sigma_k}{1-\beta_k\alpha_k\sigma_k}(\frac{bY}{p_kK}-\rho^e_{ko}) = \frac{1}{1-1/\beta_k\alpha_k\sigma_k}(\rho^e_{ko}-\frac{bY}{p_kK})\end{aligned}$$

We restrict our investigation of the rational expectations approach on the likely case where $\beta_k\alpha_k\sigma_k > 1$ holds true in which case the last fraction to the right is positive. Formally seen, the 2D dynamics of section 7.2 is now self-contained in this modification of its second law of motion. Moreover, the isoclines in figure 1 remain in their position and the dynamics are now pointing upwards above the $\dot{p}_k = 0$ - isocline and vice versa. This situation is shown in figure 4. In this figure we also consider a shock to the economy which moves both isoclines into a new position (for graphical reasons). Assuming the economy to have been in the steady state of the old dynamics then implies (by assumption) a jump of share prices p_k onto a unique position on the stable arm of the post-shock dynamics (if these dynamics are determinate) along which they and output then converge to the new steady state position. This is a very tranquil theoretical scenario for what is assumed to happen in the financial markets.

We have shown by means of figure 4 that the RE school basically trivializes the deterministic skeleton of the analysis of real-financial market interactions. Moreover, it also needs in the presently considered model the side condition that

$$a_y < a_k b/(\rho^e_{ko}K)$$

holds true in order to get the saddle-point dynamics shown in figure 4. What happens in the opposite case is therefore not explained by the RE-methodology of the DSGE approaches, but blocked out from consideration.

7.5 Numerical simulations

As for the investigation of the global features of the nonlinear 4D dynamics, we reformulate the model in discrete-time in order to simulate it for different parameter sets. We use a standard Euler discretization to re-write the model. It is done with a sufficiently small step-size (high-frequency) in order to reproduce qualtitatively the same results as the continous counterpart. [65]

In the following, different types of shocks to the economy are considered, based at first on a choice of parameters which is charcterised by the occurence of business cycles as will be shown: $\beta_{\pi_k^e} = 4$, $\beta_k = 2.723$, $\alpha_k = 0.5$, $c = 2$, $b = 0.28$, $s_{\pi_k^e} = 0.5$, $a = 1$, $\beta_y = 2$, $a_y = 0.6$, $a_k = 0.35$, $A = 1$, $K = 1$, $\rho_0^e = 0.25$, $s_y = 0.1$, $s_x = 0.8$ and $s_{p_k} = 0.04$.. On the basis of these parameter choices we get the following somewhat irregular and persistent, but not yet really complex[66] fluctuations in the state variables of the model. Other configurations may deliver more stable outcomes, but these constellation of values cannot be safely excluded from consideration on economic grounds. So it makes sense to test the stability properties of the model in the parameter regions that might exhibit non-convergence. These are then implying potential crises, which the economy easily runs into, as speed and other parameters vary over time and stability gets lost as non-convergence values are crossed eventually.

We observe relatively regular sequences of smaller and larger fluctuations in for example the opinion dynamics x which sometimes go close to the extreme -1 where no chartist would be present any more. We have chosen here however an extreme case, right at the border of the viability of the dynamics, so that further (significant) increases of the parameter $\beta_k = 2.723$ will lead to a breakdown of the system. There is therefore no hope in this case to get more complex dynamics by making β_k larger and larger.

Figure 5 shows on the left the (very) long-run attractor (its projection into the output /

[65] See Flaschel and Proaño (2009) for a detailed consideration of this procedure with respect to the period length employed. Moreover, the procedure of Euler-discretization is admissable here, as we show that no chaotic dynamics occur.

[66] when their Largest Liapunov Exponent is measured.

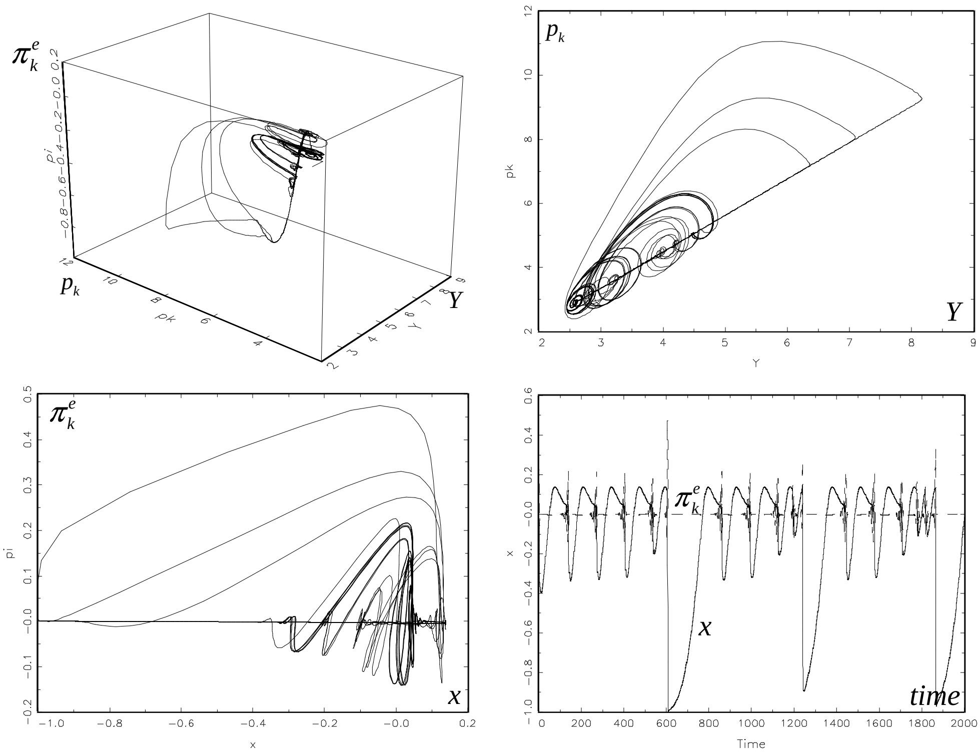

Figure 7.5: Irregular persistent business fluctuations.

stock price subspace) of what is shown in figure 5 as still transient behavior of the dynamics.

We repeat the phase sub-diagram of figure 5 top-right here in 5a in order to compare its deterministic outcome with the situation on the right, in figure 5b, where the attractor is shown with noise added to the system (in fact to output Y, uniformly with standard deviation 0.01, using the software package E&F Chaos with otherwise preset conditions). We can see that noise matters in this situation of already somewhat irregular business fluctuations quite a lot, however not to the extent that it destroys the qualitative features of the attractor of the consider example. This is our first example of what we consider an outcome of the DSGD type.

The third simulation example, in figure 6, the top four diagrams, show that if we set $s_{p_k} = 0.06$, $s_x = 1.6$ and if we assume $\beta_{\pi_k^e} = 0.4$, $\beta_k = 2$, $b = 0.26$ (slight variations of the starting values, which may easily come about), then persistent herding of chartists

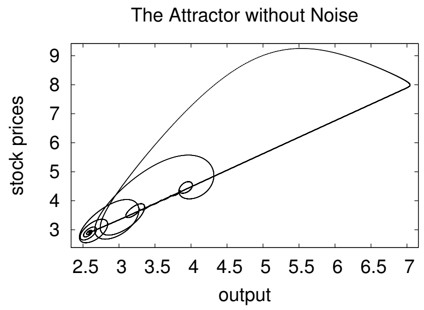

Figure 5a

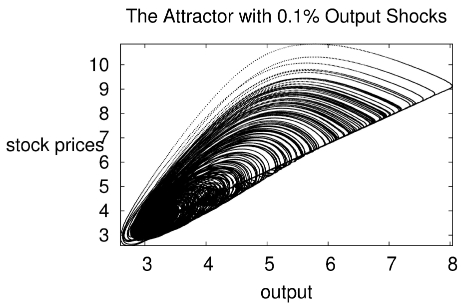

Figure 5b

can in fact emerge for quite a while in a seemingly tranquil environment, though it is also visible that the instability of the economy is slowly increasing in this situation. Therefore, this is only a 'temporary' illusionary impression of the working of the economy, since after a (considerable) time span, the dynamics become explosive to such a degree that the population share switches quickly into a case which is dominated by fundamentalist (a case significantly below $x = 0$). It there finally comes to rest at a fundamentalist-dominated equilibrium which also stabilizes the rest of the economy. The expectational part behavior is accompanied by a drop in output and share prices and an even bigger boom thereafter before the chartist prevalence is replaced. The real and financial sides then land softly at a new steady state position after a while. Again to be stated, other cases of parameter choice can be less problematic, but since parameter changes occur gradually these presented thresholds will be passed eventually and trigger the implied irregualar dynamics. Justification in detail will be provided by way of bifurcation analyses below.

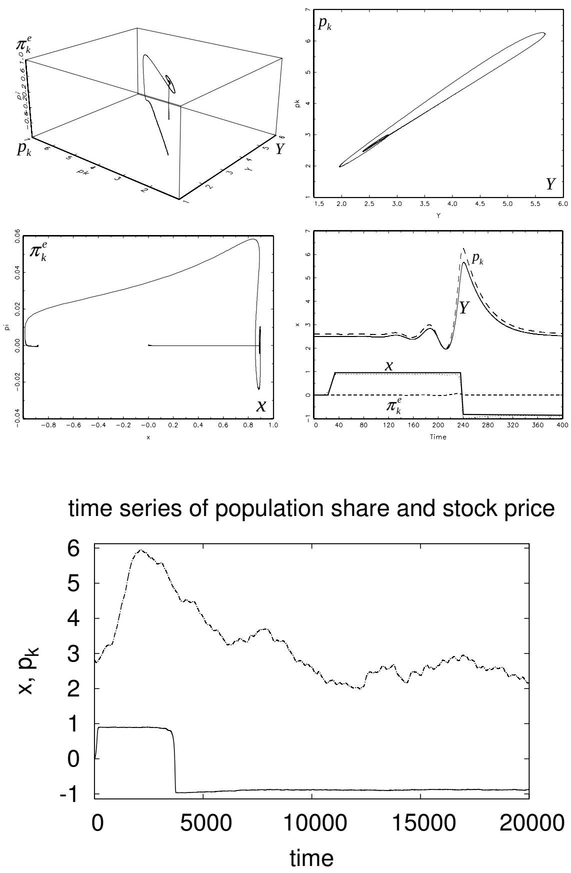

Figure 7.6: Multiple equilibria and temporary chartist herding: Without and with noise

Figure 6, at the bottom, again adds noise with variance 0.03 to the evolution of output Y which has a visible effect on both stock prices and populations shares which in the second case are however somewhat modest (even when the scale is chosen to be the interval $[-1, +1]$. The temporarily nearly fixed chartist position is shorter in the case where noise has been added. since the stock prices start rising nearly immediately now. while they moved only a little bit for quite a while in the deterministic case. In the deterministic case we moreover see that output and stock prices are strictly pro-cyclical in their evolution.

Next we provide a first robustness test for the considered dynamical system. The employed software and the program listing (including parameter values is described in the appendix of the chapter. Of crucial importance is the choice of the speedparameters β_i, as they constitute one of the distinguishing features of a disequilibrium approach, which are not needed in an equilibrium setting. We vary in this numerical simulations at first only the speed of adjustment of the expected stock price inflation and this between 0 and 10, i.e., over a very large range for this speed of adjustment. We test viability only over a horizon of 40 years and plot within this range only the last thirty years. The step size of the iteration is 0.01 so that the number of iterations has to be divided by 100 in order to get the time window expressed in years. In the figure 7, the first four plots show for this situation the behavior of the state variables where in fact – due to the chosen step size – only the minimum and maximum value of the state variable matter as information at each value of the parameter $\beta_p i$. The plots were generated using the bifurcation diagram routine in E&F Chaos which however does not supply in the nearly continuous case more information than was just stated. A next step – which allows for bifurcation diagrams in continuous time – would thus be to plot only the local minima and maxima of the four considered state variables which would allow to see period doubling routes into complex dynamics and more.

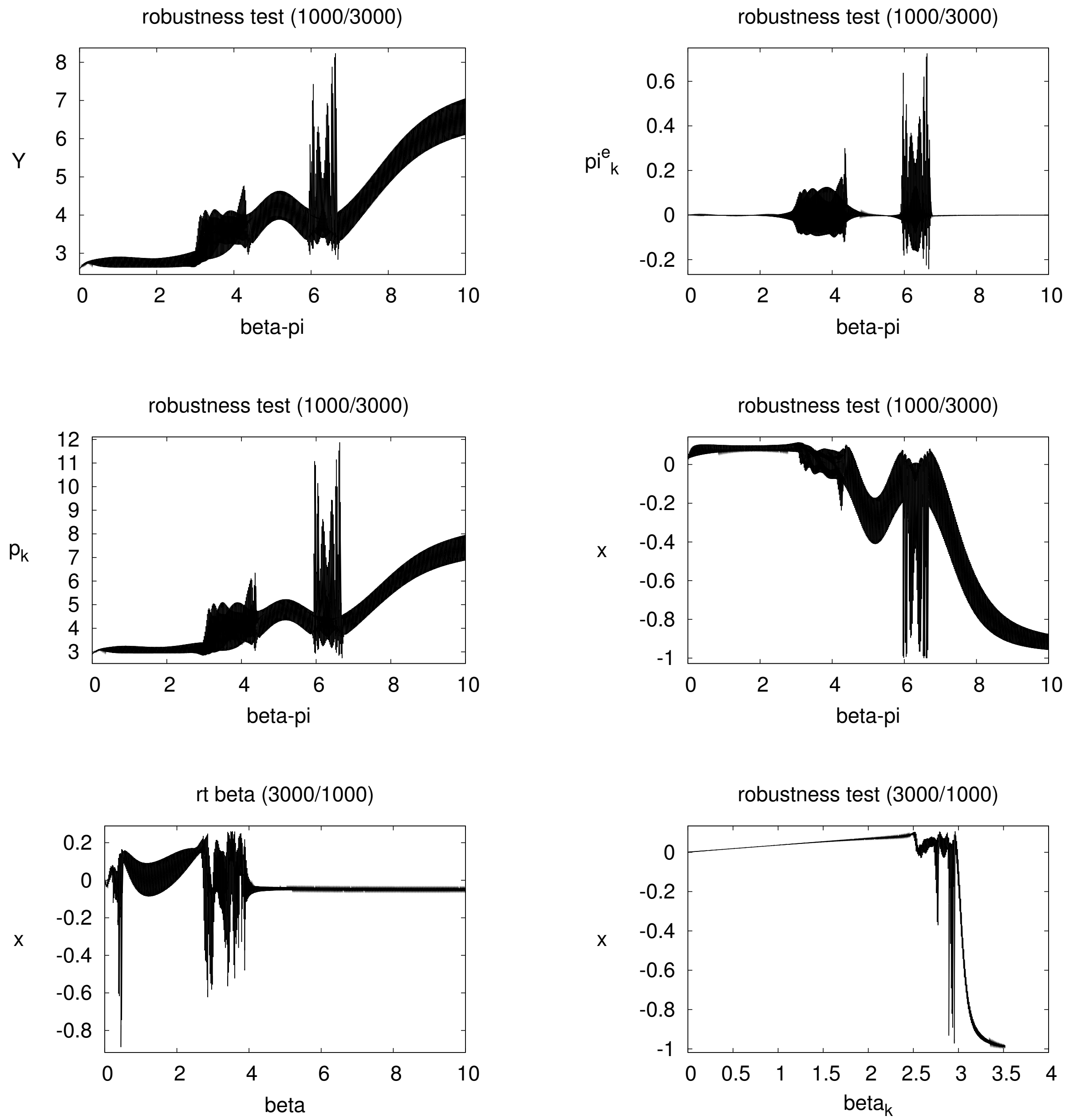

Figure 7.7: Varying speeds of adjustment and a testing of the viability of the model

It is interesting to compare the behavior of the state variables as the parameter β_π is varied. In particular the repeatedly occurring convergence to nearly a zero rate of expected stock price inflation is remarkable. This is correlated with relatively small fluctuations around positions where the proportion of chartists is low.On the left hand side of the first four figures we can see also that output and stock price dynamics is strongly correlated when viewed from this global perspective. The two figures at the bottom show left the variation of the speed in the population dynamics and right of the speed of stock price adjustment. We can see that increases in th former are stabilzing and thus allow for a huge variation again between zero and ten, while the latter is not (the dynamics breaks down before reaching the speed value four).

7.6 Some policy issues

Next we consider some policy experiments again by way of diagrams which check the robustness of the dynamics for a certain parameter range. Traditional anti-cyclical fiscal policy, i.e. here, a decrease in the marginal propensity to spend a_y can avoid problems in the behavior of the model which in the present example demands for a fairly low overall propensity to purchase in order to make the dynamics viable. It appears therefore that the present example needs a fairly low multiplier value for his to occur. The reasons for such a demand are not obvious from the chosen set of parameter values.

Unorthodox anti-cyclical fiscal policy, which reacts in view of what happens with stock prices, i.e., a lowering of the parameter a_k, is also stabilizing (as was to be expected), but not in a sense that can be perceived as monotonic as the parameter a_k is decreased. By contrast, increasing interest rates on short-term bonds, i.e. here , the assumption of a decreasing capital demand parameter c, since assets are allocated thereby away from the capital stock, clearly help to stabilize the economy, as always primarily from the viewpoint of its viability, but now also by reducing its volatility n a monotonic fashion.

This however is again not the case if taxes on dividends are introduced and increased which lowers the profitability parameter b in the expected rate of return function. There is

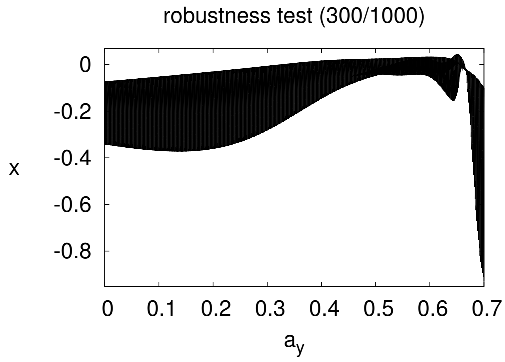

Figure 8a

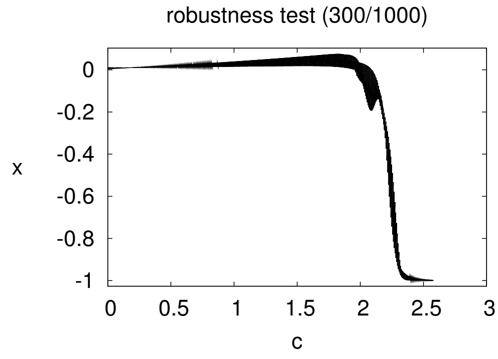

Figure 8b

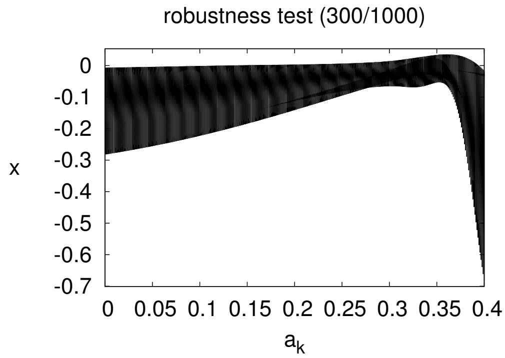

Figure 8c

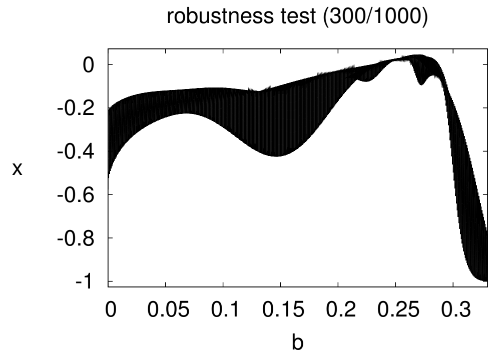

Figure 8d

finally the possibility to raise Tobin-type taxes on stock market transactions of the capital gains $\hat{p}_k$ there achieved. As many authors since Keynes (1936) and Minsky (1982, 1986) have stressed, the main function of stock markets should be to ensure the efficient allocation of savings, and gambling activities should be constrained. It is therefore appropriate to consider a *Tobin type tax (or subsidy)* on capital gains at rate τ_k, leading to a total tax revenue equal to $\tau_k \dot{p}_k K$. The law of motion for capital gain expectations (8.11) can then be re-written as:

$$\dot{\pi}_k^e = \beta_{\pi_k^e}[\frac{1+x}{2}(1-\tau_k)\hat{p}_k - \pi_k^e],$$

and Tobin taxes therefore indeed have a stabilizing effect by weakening the impact of chartists on the process of market expectation formation. The figure 8 summarizes the first four findings on these policy issues.

The source of instability in the real economy was the Tobin accelerator of section 7.2, and one way of stabilising the saddle point dynamics in the real-financial interaction subsystem might also be a sort of ‘Quantitative Easing’, whereby the Central Bank directly intervenes on asset markets in response to the state of the economy: it increases aggregate demand for capital during downturns and reduces it during booms, thus affecting the price of capital which in turns affects consumers’ and investors’ decisions.

Formally, we may assume that the Central Bank sets a policy parameter $m_k > 0$ that represents its responsiveness to the output gap. The real-financial subsystem (8.1) - (8.2) then becomes:

$$\begin{aligned}
\dot{Y} &= \beta_y[(a_y - 1)Y + a_k(p_k - p_k^o)K + A], \\
\hat{p}_k &= \beta_k\left[\alpha_k c\left(\frac{bY}{p_k K} - \rho_{ko}^e\right) - m_k\left(\frac{Y}{K} - \frac{Y_o}{K}\right)\right].
\end{aligned}$$

The Jacobian of this system has, again, the following structure:

$$J = \begin{pmatrix} -\beta_y(1-\alpha_y) & \beta_y a_k \\ \beta_k\alpha_k\sigma_k b/(p_k K_o) - m_k/K_o & -\beta_y\alpha_k\sigma_k bY_o/(K_o p_k^2) \end{pmatrix} = \begin{pmatrix} - & + \\ + & - \end{pmatrix},$$

but the determinant of J is now more likely to be positive, thanks to the policy m_k, which reduces J_{21} in magnitude and subsequently rises the probability of $J_{11}J_{22} - J_{21}J_{12} > 0$. Thus, this type ‘Quantitative Easing’ has indeed a stabilising effect by counteracting the unstable spiral of positive reinforcement in the process of the interaction of the real with the financial markets.

7.7 Hints on complex dynamics

In this section we briefly investigate the area around the chosen critical parameter value $\beta_k = 2.723$, see the appendix, and provide an example of bifurcation diagrams where only the local minima and maxima are plotted.

In figure 9 we show to the left a bifurcation diagram, obtained from E&F Chaos by eliminating the first 1000 years in the time series for each parameter value on the horizontal axis, and by plotting thereafter the next 100 years. The convergence to the intermediate

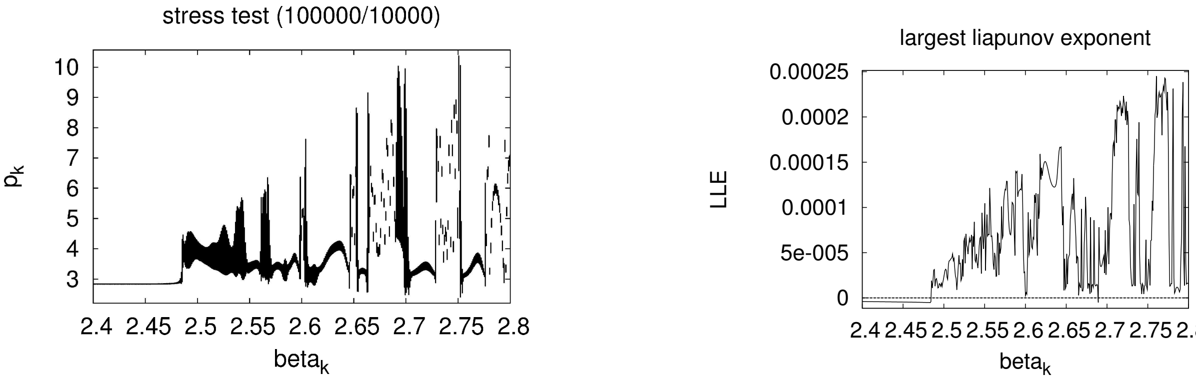

Figure 7.8: From convergence to stress: Bifurcation diagram and the corresponding Largest Liapunov Exponent.

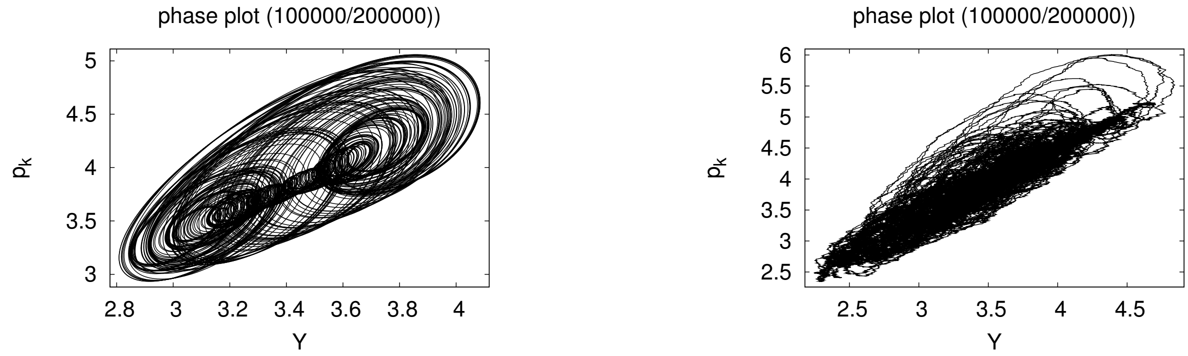

Figure 7.9: Complex dynamics with no noise ($\beta_k = 2.478$) and with noise (variance $0.01Y$).

steady state $x = 0$ gets abruptly lost around the parameter value $\beta_k = 2.477$ and the behavior becomes immediately of the type shown in the next figure 10. Thereafter the dynamics changes its erratic behavior in a sequence of locally similar outcomes, until it breaks down at around a value of $2,82$. Figure 9, on the right, shows the Largest Liapunov Exponent corresponding to this behavior, obtained from E&F Chaos by using 1000 years of initial iterations and then 1000 years of iterations as demanded in this submodule of the E&F Chaos software.

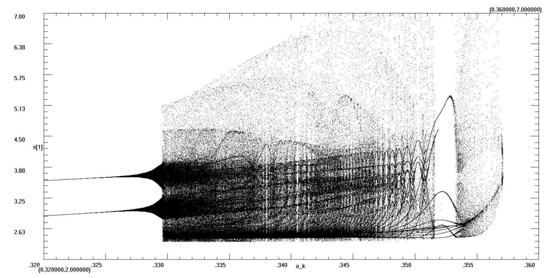

Figure 7.10: Bifurcation diagram showing local maxima and minima on the vertical axes for variations of the parameter a_k

In figure 11 we finally plot a bifurcation diagram where only the local minima and maxima of the state variable on the vertical axes are plotted against the parameter a_k. This suggests that the dynamics are becoming increasingly irregular as the impact of the stock market on aggregate goods demand is increased.

Summing up, we can state that the simulations demonstrate the global viability of the fully integrated 4D dynamics. The $\dot{x}$ mechanism is clearly pointing inside and presents a crucial part of the model which keeps the behavior of the system by and large bounded. Yet the steady states of the dynamics may be locally unstable, and the economy may face severe and fairly irregular booms and busts along its business fluctuations. The considered very simple DSGD-type interaction of the real with the financial markets therefore can become very complex once heterogeneous expectations and switching agent behavior is introduced into them. This stands in stark contrast to the global asymptotic stability which is characteristic for the DSGE models of the literature. It remains to be said that the simulations only provide examples of the manifold outcomes that this simple model of real-financial market interaction and opinion dynamics can generate.

The last figure indicates what happens if the period length is varied and, thus, gives an additional robustness check for the validity of our obtained results. We show that small values of h do not change very much, while larger ones of course matter and thus raise the question which period length is in fact the appropriate one. Fortunately, in macroeconomics we know the quite fundamental fact that the generation (not necessarily the observation)

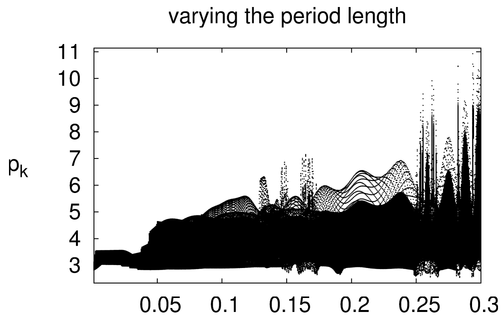

Figure 7.11: Varying the period length h of the model

of the macro-data is high frequency in nature, We thus need not even look for result on larger period length, but can right from the start rely on small values of the period length h in the Euler discretization and if still problematic with respect to accuracy on even still smaller ones.

However, the examples we have treat in this chapter are close to complex dynamics already. Therefore qualitative similar outcomes for slightly varied period lengths can only be expected over the short-run of say three yeas of so. For the longer run more refined methods have to used to evaluate the differences in the orbits generated by the dynamics within a range of daily down to hourly or even less long period lengths.

7.8 Conclusions

A Dynamic Stochastic General Disequilibrium model in the Keynesian tradition was presented as alternative to the perceived DSGE paradigm. In our model, the assumptions of market clearing and rational expectations are dropped. Instead a set of gradual, dynamic adjustment processes take place on highly interconnected real and financial markets. A Tobinian accelerator process drives the evolution of real macroeconomic activity. Financial markets, described by a risky representative capital stock asset, influence the state of trust of the economy, as measured by Tobin's q, and thus consumption and investment decisions. In turn, the performance of the real sector influences agents' decisions on financial markets via the profit rate. We showed that this interaction need not be stable. Further, we introduced heterogeneous expectations in financial markets populated by chartists and fundamentalists, and showed that chartist behavior is another potential source of instability in the economy.

The crucial theoretical, empirical, and policy question arising then is whether unregulated market economies contain some mechanisms ensuring the stability or global boundedness of the economy if centrifugal forces prevail, making the equilibrium locally unstable and, potentially, the system explosive.

Numerical simulations show that global stability can be ensured if, far off the steady state, opinion dynamics favors fundamentalist behavior during booms and busts which ensures that there are turning points in both of these situations. However, both the local analysis and the simulations suggest that such market economies can nevertheless be plagued by severe business fluctuations and recurrent crisis phenomena. Moreover, certain non-excludable parameter constellations imply complex and close to chaotic dynamics.[67]

We show among others that two policy measures often advocated in the Keynesian literature, namely Tobin taxes, here on capital gains, and quantitative easing, can mitigate these problems.

Closing this chapter with some remarks on our treatment of expectation formation, which suggest interesting lines for further research. First, one may argue that the theoretical expectation rules characterising chartists and fundamentalists, and the process of formation of market expectations should be replaced by more sophisticated backward- and forward-looking rules based on econometric estimation techniques. It would certainly be interesting to analyze the impact of different expectation rules on the system (which is numerically not a huge step). But we do not expect these changes to significantly affect the qualitative conclusions of our analysis.

Second, in our formalisation of market expectations, we suppose the agents' guessing process is stopped after one step: market expectations are what agents think they will be on average. We consider this as a first step into the analysis of more complex processes of aggregate expectation formation. Once one drops the assumption of Rational Expecta-

[67] For further general implications of possible chaotic behavior see e.g. Federici and Gandolfo (2014).

tions, other possibilities can be explored, including Keynes' (1936) celebrated 'third degree' process, where agents try to anticipate what *average opinion* expects average opinion to be. We leave this suggestion for further research.

7.9 References

Asada, T., Flaschel, P., Mouakil, T., Proaño, C.R., 2011a, Asset Markets, Portfolio Choice & Macroeconomic Activity , Basingstoke: Macmillan.

Asada, T., Charpe, M., Flaschel, P., Malikane, C., Mouakil, T. and Proaño, C., 2011b. Output, Stock Markets and Macro-Policy Measures in a Keynesian Portfolio Model. Intervention, European Journal of Economics and Economic Policies, 8(2), 341-360.

Blanchard, O. 1981. Output, the Stock Market, and Interest Rates. American Economic Review, 71(1), 132-143.

Branch, W. A. and Evans, G.W., 2011, Monetary Policy and Heterogeneous Expectations, Economic Theory, 47(2), 365-393.

Brunnermeier, M.K., 2008, Bubbles, in: Durlauf, S., Blume, L. (Eds.), The New Palgrave Dictionary of Economics, 2nd Edition, Palgrave Macmillan.

Chari, V., Kehoe, P.and McGrattan, E., 2009. New Keynesian Models: Not yet useful for policy analysis. American Economic Journal: Macroeconomics, 1, 242-266.

Charpe, M., Chiarella, C., Flaschel, P. and Semmler, W., 2011a, Financial assets, debt and liquidity crises: A Keynesian approach. Cambridge University Press, Cambridge.

Charpe, M., Flaschel, P., Hartmann, F. and Proaño, C.R., 2011b, Stabilizing an unstable economy: Fiscal and Monetary Policy, Stocks, and the Term Structure of Interest Rates. Economic Modelling, 28, 2129-2136.

Charpe, M., Flaschel, P., Proaño, C. and Semmler, W., 2012, Credit-Financed Investment, Dual Labor Markets and International Capital Markets in a Macrodynamic Two-Country Framework. ILO working paper

Chiarella, C. and Flaschel, P., 2000, The Dynamics of Keynesian Monetary Growth: Macrofoundations. Cambridge University Press, Cambridge.

Chiarella, C., Flaschel, P., Franke, R. and Semmler, W., 2009, Financial Markets and the Macroeconomy. A Keynesian Perspective. Routledge, New York.

Chiarella, C., Flaschel, P., Hartmann, F. and Proaño, C.R., 2012, Stock Market Booms and Credit Creation: Implications of Broad and Narrow Banking for Macroeconomic Stability, Journal of Economic Behavior and Organization, .

De Grauwe, P., 2010. The scientific foundation of dynamic stochastic general equilibrium (DSGE) models. Public Choice, 144, 413-443.

De Grauwe, P. and Grimaldi, M., 2005. Heterogeneity of agents and the exchange rate: A nonlinear approach. In: De Grauwe, P. (Ed.), Exchange Rate Economics: Where Do We Stand?. CESifo Seminar Series, MIT Press, Cambridge, pp. 125-168.

Diks, C., Hommes, C. Panchenko, V. and van der Weide, R., 2008, E&F Chaos: A user friendly software package for nonlinear economic dynamics. Computational Economics, 32, 221-244.

Farmer, R.E.A., 2010, How to reduce Unemployment: A new Policy Proposal, Journal of Monetary Economics, Carnegie Rochester Conference Series on Public Policy, 57(5), 557-572.

Federici, D. and Gandolfo, G., 2014, Chaos in Economics, Journal of Economics and Development Studies, 2(1), 51-79.

Flaschel, P. and C.R. Proaño, 2009. The J2 Status of "'Chaos"' in Period Macroeconomic Models. Studies in Nonlinear Dynamics & Econometrics, 13(2).

Franke, R., 2012, Microfounded animal spirits in the new macroeconomic consensus. Studies in Nonlinear Dynamics and Econometrics, 16:4, Article 4.

Franke, R. and Westerhoff, F., 2009. Estimation of a Structural Stochastic Volatility Model of Asset Pricing. Working paper: Kiel Univeristy.

Hommes, C. ,2006, Heterogeneous agent models in economics and finance, in: Handbook of computational economics, Vol.2: Agent-based computational economics, eds L. Tesfatsion and K. L. Judd, 1109-1186, Amsterdam, North-Holland

Keynes, J.M., 1936. The General Theory of Employment, Interest and Money. Macmillan, London.

Lux, T., 1995. Herd Behaviour, bubbles and crashes. Economic Journal, 105, 881 - 889.

Massaro, D., 2012, Heterogeneous expectations in monetary dsge models. CeNDEF Working paper 12-02.

Menkhoff, L., Rebitzky, R. and Schröder, M., 2009. Heterogeneity in Exchange Rate Expectations: Evidence on the Chartist-Fundamentalist Approach. Journal of Economic Behavior & Organization, 70(1-2), 241-252.

Minsky H., 1982. Can "It" Happen Again? M.E. Sharpe, New York.

Minsky H., 1986. Stabilizing an Unstable Economy. Yale University Press, New Haven, CT.

Proaño, C.R., 2011, Exchange Rate Determination, Macroeconomic Dynamics and Stability under Heterogeneous Behavioral FX Expectations. Journal of Economic Behavior and Organization, 77, 177-188.

Tobin, J., 1982. Money and the Macroeconomic Process. Journal of Money, Credit and Banking, 14, 171-204.

Tovar, C.E., 2009. DSGE Models and Central Banks. Economics: The Open-Access, Open Assessment E-Journal, Vol. 3, 2009 - 16.
`http://www.economics-ejournal.org/economics/journalarticles/2009-16`

Turnovsky, S., 1995. Methods of Macroeconomic Dynamics. MIT Press, Cambridge, MA.

7.10 Appendix

Regarding numerical simulations we have made use here of the (really user-friendly) software E&F Chaos which was developed at the Center for Nonlinear Dynamics and Finance (CeNDEF) at the Faculty of Economics and Business, Universiteit van Amsterdam. This tool for the numerical analysis of dynamic period models as well as continuous-time ODE systems can be downloaded from the webpage of the CeNDEF and is discussed in detail (from the viewpoint of period models primarily) in Diks, Hommes, Panchenko and van der Weide (2008). In this chapter we have used the following simple code (without comments and hard returns in long lines in the original program listing):

```
The model as written for E\&F Chaos (as an ordinary text-file):


Initial conditions:
Y=2.75, pk=2.8, pi=0, x=0


Parameter values:
bpi=4, bk=2.723, alk=0.5, c=2, b=0.28, beta=0.2, sx=0.8, spi=0.01, a=1,
by=2, ay=0.6, ak=0.35, barA=1, barK=1, rhoo=0.25, sy=0.1, spk=0.06,
h=0.01 (step size)


d(iscrete time)
Yo=barA/(1-ay) pko = b*Yo/(rhoo*barK)


Laws of motion:
Y1 = Y+h*by*((ay-1)*(Y-Yo)+ak*(pk-pko)*barK)
pk1 = pk+h*pk*bk*alk*c*(b*Y/(pk*barK)+pi-rhoo)
pi1= pi+h*bpi*((1+x)/2*bk*alk*c*(b*Y/(pk*barK)+pi-rhoo)-pi)
x1= x + h*beta*((1-x)*math.exp(a*(sy*(Y-Yo)-spk*(pk-pko)^2+sx*x-spi*pi^2))
   -(1+x)*math.exp(-a*(sy*(Y-Yo)-spk*(pk-pko)^2+sx*x-spi*pi^2)))
```

```
Iteration:

Y=Y1

pk=pk1

pi=pi1

x=x1
```

8 A Behavioral Macroeconomic Model of Exchange Rate Fluctuations with Complex Market Expectations Formation

8.1 Introduction

As discussed by Kindleberger and Aliber (2005), the evolution of the world economy has been characterized by recurrent financial and exchange rate crises which, due to their often devastating macroeconomic and social effects, have raised important issues for theorists and policy makers. In this context, the ruling paradigm in macroeconomics of Dynamic Stochastic General Equilibrium (henceforth, DSGE) modeling has done a rather non-convincing job in explaining the recurrent character of such financial phenomena and especially the recent global downturn as argued by Colander et al. (2009), and also admitted by some of its proponents such as Chari et al. (2009). Arguably, this unsatisfactory performance has not been the result of a lack of mathematical sophistication. Rather, it derives from the adoption of an equilibrium approach coupled with the assumption of Rational Expectations, which jointly seem questionable both from the methodological and the empirical perspective.

This chapter is based on Flaschel, Hartmann, Malikane and Proaño (2014).

In the behavioral finance literature – in contrast to the predominant macroeconomic literature – it is widely acknowledged that the rational expectations assumption is not able to explain basic stylized facts of financial markets – not only concerning crises –, see e.g. Hommes (2006) and De Grauwe and Grimaldi (2006), and alternative expectations formation schemes are widely used.

This chapter proposes a number of departures from the DSGE methodology, which can be seen as the building blocks of a new approach in the Keynesian tradition[68], by constructing a macrodynamic model along the lines of Dornbusch (1976), which incorporates basic important feedback channels between the real and the financial sector, and in which markets are not assumed to jump to their equilibrium positions, but where dynamic adjustment processes are taking place. Further, unlike in much of the macrodynamic literature existing besides the DGSE approach, we analyze *microfounded* expectation processes on financial markets by incorporating an innovative concept of *animal spirits* developed by Franke (2012) – see also Charpe et al. (2012a) – instead of the standard rational expectation apparatus.

To be precise, we consider a one-good economy where output moves according to a dynamic multiplier approach which considerably simplifies the Metzlerian inventory accelerator mechanism of the Keynes-Metzler-Goodwin model of Chiarella and Flaschel (2000). Since our focus in this chapter is on expectational induced dynamics in financial markets of a small open economy and their specific sources of instability, the real side of the economy is kept as simple as possible. However, we assume as is customary that foreign exchange markets have real effects. Two types of assets are traded on financial markets: first, a foreign government bond $B^*, p_b^* = 1$ which is internationally traded at a given rate of interest i^*, and secondly a short-term, fix-price government bond, whose rate of interest is set by the Central Bank. Against this background we assume that the nominal exchange rate (its rate of growth) is driven by the expected rate of return differential between foreign and domestic bonds (where the first rate depends on the expected depreciation of the domestic

[68] Further contributions to this line of research in behavioral macroeconomic modeling are e.g. Charpe et al. (2011, 2012a and 2012b) as well as Hartmann and Flaschel (2014).

currency in addition to the foreign rate of interest).

Focusing on two assets (and only one is a risky one) is appropriate in order to identify the key dynamic mechanisms and the real-financial feedbacks on which they are based. But it is important to stress that this is just a simplifying assumption and the model can be extended to include, for example, equities E, long-term bonds B^l and bank loans Λ as in Charpe et al. (2011), Chiarella et al. (2012). In this chapter, however, we concentrate the analysis on foreign bonds for the sake of clearness and simplification and redefine the wealth component, agents are focusing on, by the value of the foreign bond holdings (and thus ignore money and domestic bond holdings in the stock demand function of asset holders). This allows us to treat the FX market in isolation and to remove a secondary wealth effect from the model, see Charpe et al. (2012b) for a Tobinian portfolio approach where such stock-flow consistency is restored. One of the key contributions of the chapter is the explicit incorporation of market expectations or opinion dynamics in financial markets populated by heterogeneous agents. This allows us to examine the effects of herding and speculative behavior in a simple macrodynamic framework of a small open economy as proposed by Franke (2012). More precisely, we adopt the distinction between *chartists* and *fundamentalists* widely used in the literature on exchange rate dynamics, see e.g. De Grauwe and Grimaldi (2005), Proaño (2011) and Chiarella et al. (2011). Chartists behave like speculators and can be seen as technical traders who adopt a simple adaptive expectation mechanism. In contrast, fundamentalists focus on basic economic data and expect variables to return to steady state values with a certain adjustment speed. Chartists tend to exert a destabilizing influence on the economy, whereas the presence of fundamentalists is generally stabilizing.

Albeit simple, this description of agent heterogeneity on financial markets is consistent with empirical studies that analyze expectational heterogeneity, such as Frankel and Froot (1990) and Menkhoff et al. 2009). This description is also sufficient to examine some of the core features of financial markets that have played a prominent role in the recent global financial crisis. Overall *market* expectations are here a function of individual fundamentalist and chartist expectations, and depend on the relative weight of each group in the market. Hence, the model economy contains two potential sources of instability: the feedbacks between real and foreign exchange markets via the nominal exchange rate e, and the endogenous market expectations dynamics produced by the interaction of heterogeneous agents on asset markets. Thus, it allows us to investigate a key question emerging from the current financial crisis, namely whether unfettered, interconnected markets with heterogeneous agents are able to absorb external shocks, or rather tend to amplify them.

We prove that the resulting 4D dynamical system describing the evolution of the economy always has either a single steady state characterized by uniformly distributed agents, or three steady states (one with uniformly distributed agents, a chartist and a fundamentalist one). Even though various subdynamics of the model can be stable (at the uniform or fundamentalist steady state), the complete system may be repelling around all of its equilibria. Given the complexity of the 4D nonlinear system, it is difficult to draw more precise conclusions on the overall dynamics (up to the consideration of two supplementing 2D cases). Therefore we adopt numerical methods to further explore the dynamic properties of the model. The numerical simulations show that the 4D system is indeed *viable*: all trajectories remain in an economically meaningful subset of the state space. In this sense, the model shows the somewhat surprising result that unfettered markets with possibly accelerating real-financial feedback mechanisms have some in-built stabilising mechanism (based on opinion dynamics) that prevent the economy to move on an infeasible path. Moreover, despite the trivial dynamics of the 2D subsystems, the full 4D dynamics can exhibit irregular and even complex motions. Hence, if all of the steady states are repelling, the system can exhibit irregular, though persistent real-financial market fluctuations.[69] The considered opinion dynamics is therefore capable of ensuring upper and lower turning points in the real-financial market interactions, but the generated persistent fluctuations may still be too large to be acceptable from the societal point of view.

The remainder of the chapter is organized as follows. In the next section we briefly discuss the Dornbusch (1976) exchange rate dynamics in order to motivate the subsequent

[69] The term persistence must be understood throughout the chapter not as the stability of a trend, but as the occurrence of a steady dynamical pattern for at least a while.

framework as well as to highlight its main features. In section 8.3 we then extend the Dornbusch framework through the incorporation of heterogeneous behavioral expectations and endogenous market expectations formation. We analyze the resulting framework by means of numerical simulations in section 8.4, focusing on the stability of the system, and in section 8.5 possible policy measures to tame fluctuations are reviewed. Section 8.6 draws some concluding remarks.

8.2 The Dornbusch Exchange-Rate Dynamics under Rational Expectations

Since Dornbusch's (1976) approach to exchange rate dynamics serves as a point of departure of the model put forth in this chapter, we firstly recapitulate its basic properties. The Dornbusch (1976) exchange rate dynamics reads in the case of the Uncovered Interest Parity condition (UIP) with myopic perfect foresight on the exchange rate dynamic in their simplest form as follows (with e, p, y the logarithms of the exchange rate, the price and the output level, the foreign price level being normalized to 1):

$$\begin{aligned} \dot{p} &= \beta_p(y^d(e-p) - \bar{y}) \\ \dot{e} &= i(p) - \bar{\imath}^* \end{aligned}$$

We assume that the economy is at its full employment level $\bar{y}$, but that deviations of aggregate demand y^d (which only depend on the real exchange rate here) from this level determine with adjustment speed β_p the rate of inflation. The second law of motion is the UIP condition, under the assumption of myopic perfect foresight. The relationship $i(p)$ is a standard inverted LM curve, i.e., it describes a positive relationship between the price level and the domestic nominal rate of interest. Clearly the steady state is of saddle-point type (the determinant of the Jacobian is negative) and the implied phase diagram is shown in figure 1.

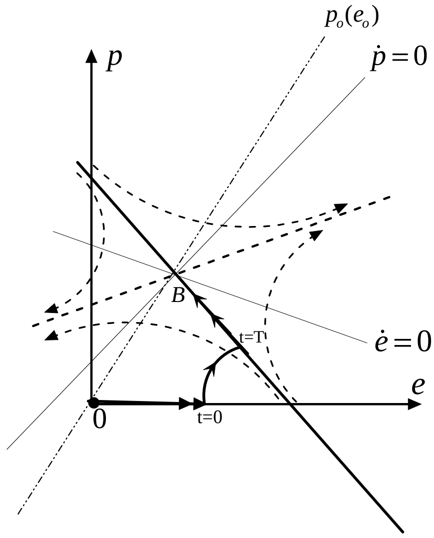

Figure 8.1: The Dornbusch exchange rate dynamics under myopic perfect foresight

The rational expectations school solves such a dynamical system in the following way. It assumes that the economy is (if no anticipated shocks are occurring) always on the stable manifold of the given saddle-point, horizontally to the right of the old steady state 0, in the intersection of the stable manifold (a straight line in this simple model) with the horizontal axis, if an unanticipated shock that moves the steady state to point B has occurred, since the price level can only adjust gradually in this model. We therefore get an overshooting exchange rate (with respect to its new steady state values) and thus an increase in goods demand, which increases the price level and the nominal interest rate gradually. This then appreciates the exchange rate from its excessively high level until all variables reach the new steady state.

In the case of anticipated shocks the situation that is assumed by the rational expectations school becomes more complicated, since at the time of the announcement of the policy we are still in the old phase diagram around the point 0. In this case, the exchange rate jumps at $t = 0$ to the right to a uniquely determined level. From there it uses the unstable saddle-point bubble in the old dynamics, which starts at this point. The exchange rate then reaches the stable manifold of the new dynamics exactly at the time T when the announced policy shock actually takes place. We thus have – depending on T – a jump in the exchange rate that may still overshoot its new steady state position and which then switches immediately towards a bubble of length T with both rising prices and exchange rates, from which it departs through a soft landing on the new stable manifold at time T.

This is – when appropriately extended – the rational expectations approach to exchange rate dynamics in the frame of a Dornbusch IS-LM model with a price Phillips curve. Its solution techniques looks attractive, since it provides – in addition to the usual treatments of shocks – also a well-defined answer in the case of anticipated events (within certain bounds, depending on the size of the anticipated shock). However, the rational expectations approach may also be viewed as a rather heroic solution to the treatment of (un)anticipated demand, supply and policy shocks from a descriptive point of view.

8.3 A Macrodynamic Framework Applying Franke's (2012) Endogenous Market Expectations Formation

8.3.1 The Dornbusch model with somewhat sluggish exchange rate adjustments

As previously mentioned the main purpose of this chapter is to analyze the specific sources of macroeconomic instability induced by FX markets characterized by an endogenous market expectations formation. That is the reason why we focus on the Dornbusch and opinion dynamics part and neglect other sources of instability. Following this modeling strategy, we simplify the real part by ignoring inflation and growth, and by representing the quantity adjustment process by means of a dynamic multiplier approach. This simplifies the Metzlerian inventory accelerator mechanism of the real-side oriented Keynes-Metzler-Goodwin model of Chiarella and Flaschel (2000), thus suppressing it as a source of instability.[70] As a result, the real part of the economy is always stable (from this partial perspective), provided the propensity to spend is less than one. However, we assume that FX markets

[70]The instability induced in the KMG approach by the wage-price spiral as discussed e.g. by Flaschel and Krolzig (2006) is also ignored.

have real effects on investment and consumption.

To be precise, we assume that output moves according to a standard dynamic multiplier process.[71]

$$\dot{Y} = \beta_y(Y^d - Y) = \beta_y((a_y - 1)(Y - Y_o) - a_i(i - i^*) + a_e(e - e_o), \tag{8.1}$$

where Y_o is the given steady state level of output, a_y the propensity to spend, a_e the impact of the exchange rate e on aggregate demand, a_i the impact of the interest rate i on aggregate demand and where β_y is the speed of adjustment concerning goods-market disequilibria. For the sake of concreteness we measure e by AUD/USD with Australia as the domestic economy.

There is only one risky asset traded by the agents of the domestic economy, foreign bonds: B^*, which are subject to exchange rate risk. Following Chiarella et al. (2009), we postulate a dynamic disequilibrium adjustment process for the nominal exchange rate e :

$$\hat{e} = \beta_e \alpha_e \sigma_e (i^* + \pi_e^e - i), \quad \alpha_e \in (0, 1). \tag{8.2}$$

In words, only a fraction α_e of current aggregate excess demand for the foreign bonds *stock* $\sigma_e(\cdot)$ actually enters the foreign exchange market owing to the existence of adjustment costs. Thus, $1/\alpha_e$ represents the delay with which agents wish to clear any stock imbalance $\sigma_e(\cdot)$. As Chiarella et al. (2009) have argued, this approach is necessary in an open economy in a continuous time framework where *flow* rather than stock imbalances must enter the capital account of the balance of payments. The flow processes on asset markets are then translated into asset price changes by the speed of adjustment parameter β_e.

In addition to B^* (with USD price 1) we have in the Australian economy domestic short-term fix-price bonds, B with AUD price 1. The central bank is assumed to fix at

[71] For any dynamic variable x, $\dot{x}$ denotes its time derivative, $\widehat{x}$ denotes its rate of growth, and x_o denotes its steady state value.

each moment of time the interest rate on B at the level i according to the rule

$$i = i^* + i_y(Y - Y_o) + i_e(e - e_o), \quad i_y, i_e > 0, \tag{8.3}$$

with i^* the given foreign rate of interest. Equations (8.1)-(8.2) represent our baseline model of the real financial interaction in a small open economy which is kept as simple as possible since we want to highlight the interaction of this part with the dynamics of expectations formation.

In order to investigate the stability characteristics of the real-financial interaction, assume for the time being that capital gain expectations π_e^e, occurring when there is currency depreciation and switching back into domestic bonds, are given and zero. We then simply have for the matrix of partial derivatives evaluated at the steady state, the Jacobian J of the real-financial market interaction, when the Taylor rule is inserted into the output and the Dornbusch exchange rate dynamics:

$$J = \begin{pmatrix} J_{11} & J_{12} \\ J_{21} & J_{22} \end{pmatrix} = \begin{pmatrix} - & + \\ - & - \end{pmatrix}$$

if the parameter i_e is chosen sufficiently small. i_e is a policy parameter chosen by the domestic central bank and, therefore, can be expected to be carefully adjusted due to exchange rate targeting purposes. The sign structure resulting on this prerequisite gives for the Jacobian matrix trace $trJ < 0$ and determinant $detJ > 0$ and, hence, implies according to Routh-Hurwitz conditions for two-dimensional continuous-time dynamic systems two eigenvalues with negative real parts.

The real-financial interaction with stationary expectations is thus asymptotically stable around the steady state. This case is illustrated in Figure 2.

These conclusions only concern the interaction of real and financial adjustment processes and do not depend on the presence of behavioral traders on the financial markets, which are introduced in the next section.

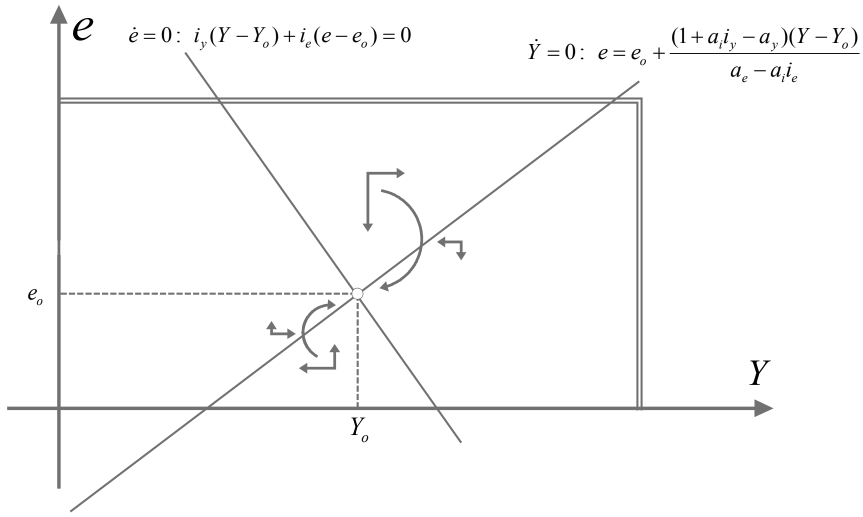

Figure 8.2: Asymptotically stable real-financial market interaction.

8.3.2 Behavioral expectations

We consider financial markets with heterogeneous agents and follow the behavioral approach to macroeconomic dynamics, employed e.g. by Chiarella et al. (2008) and mentioned by Brunnermeier (2008). Traders of foreign bonds are distinguished as *fundamentalists*, f, and *chartists*, c. Fundamentalists expect capital gains in the foreign exchange market to converge back to their steady state position (zero in our model) with speed $\beta_{\pi^e_{ef}}$. Chartists instead adopt a simple adaptive mechanism to forecast the evolution of capital gains in FX markets $\dot{\pi}^e_e$. The adoption is transmitted with speed $\beta_{\pi^e_{ec}}$ to the chartists' expectation formation. Formally:

$$\begin{aligned}\dot{\pi}^e_{ef} &= \beta_{\pi^e_{ef}}(0 - \pi^e_{ef}),\\ \dot{\pi}^e_{ec} &= \beta_{\pi^e_{ec}}(\hat{e} - \pi^e_{ec}).\end{aligned}$$

To be sure, more complex expectation formation mechanisms can be adopted for each type of agent, including forward looking rules, in particular if numerical simulations are intended.[72] Yet, our formulation has the virtue of analytical simplicity, and it allows us to

[72]E.g., Assenza et al. (2012) investigate systematically dynamic implications of various sets of expectation formation schemes for a macroeconomic equilibrium model. A similar procedure to analyze rigorously

draw a sharp distinction with respect to Rational Expectation models.

Given that agents have heterogeneous expectations, it is not obvious a priori what the *market* expectations should be. In standard equilibrium models with efficient markets, heterogeneous information and beliefs are spontaneously aggregated and made uniform under the pressure of market forces. This is clearly not the case in our framework. As a first step, suppose that the population shares of chartists and fundamentalists, ν_c and $(1-\nu_c)$, respectively, are constant.[73] It may be tempting to argue that market expectation is the weighted average of the expectations of chartists and fundamentalists:

$$\pi_e^e = \nu_c \pi_{ec}^e + (1-\nu_c)\pi_{ef}^e.$$

It is not clear, however, that this is a theoretically appropriate way of capturing the formation of market expectations. For market expectations π_e^e may actually reflect what both types of agents *think* will emerge from the process of aggregation of fundamentalist and chartist expectations. In other words, market expectations may reflect the agents' view about the "average" opinion. And this need not be the exact, weighted average of the individual expectations. In turn, the law of motion of market expectations may be the product of what on average agents think the average opinion and its rate of change will be. In the words of Keynes (1936, p.156):

> *It is not a case of choosing those which, to the best of one's judgment, are really the prettiest, nor even those which average opinion genuinely thinks the prettiest. We have reached the third degree where we devote our intelligences to anticipating what average opinion expects the average opinion to be. And there are some, I believe, who practise the fourth, fifth and higher degrees.*

In this chapter, we consider the following simple law of motion for aggregate capital gain expectations:

$$\dot{\pi}_e^e = \beta_{\pi_e^e}[\nu_c \hat{e}(\cdot) - \pi_e^e], \tag{8.4}$$

consequences of different expectational mechanisms could be applied to our model.

[73]Population shares are endogenised in the next section.

where $\beta_{\pi_e^e} > 0$ represents an adjustment speed parameter and where the nominal exchange rate depreciation only enters expectations with the weight ν_c of the chartists (since the change in their number is not foreseen). We thus assume that adaptive expectations formation drives the expectation of capital gains (to the extent chartists are present in the market), while fundamentalists are only adding stabilizing forces to it. To be sure, this is only one possible formalization of the dynamics of aggregate expectations in markets with heterogeneous agents, and alternative approaches can be proposed (see, for example, the approach adopted by De Grauwe and Grimaldi (2005) in their analysis of the behavior of agents on foreign exchange markets). Yet, we regard equation (8.4) as a very parsimonious way of capturing *both* the influence of aggregate observed variables *and* the role of heterogeneity and self-driving forces in expectation formation.

In order to analyze the dynamics of this economy, note that if the weight of chartists in average expectation is zero, the Jacobian of the 3D system (8.1), (8.2), (8.4) at the steady state becomes

$$J = \begin{pmatrix} - & + & 0 \\ - & - & + \\ 0 & 0 & - \end{pmatrix}.$$

with $J_{33} = -\beta_{\pi_e^e}$, so that a negative eigenvalue is added to already stable 2-D subsystem. Therefore the steady state of the expectations-augmented real-financial interaction process is, again, locally stable. Hence, given the continuity properties of eigenvalues, the steady state of the dynamics (8.1)-(8.2), augmented by the capital gain expectations rule (8.4), remains locally asymptotically stable even if the weight of chartists in average expectations formation is positive, but is sufficiently small. Intuitively, fundamentalists – if sufficiently dominant – may counteract any destabilizing tendencies that chartists may create.

Instead, if the number of chartists, ν_c, the responsiveness of the nominal exchange rate to disequilibria, β_e, and / or the responsiveness of the demand for capital stocks to expected returns, $f'(0)$, are sufficiently high, then one may obtain $J_{33} > 0$ and even $trJ > 0$. In this case, the system becomes unstable by way of Hopf-bifurcations, i.e., in general, by the death of a stable corridor around the steady state or by the birth of stable persistent fluctuations around it. The dynamic system (8.1), (8.2), (8.4) can thus provide a theory of business fluctuations caused by the interaction of real and financial markets.

Note that the previous argument and the existence of Hopf bifurcations is only based on a local analysis. Yet one may expect the presence of chartists to lead to explosive dynamics in general, if the speed of adjustment on financial markets or the responsiveness of the demand for capital stock are sufficiently high. This explosiveness may be tamed far off the steady state if nonlinear changes in behavior or policy reduce β_e and/or α_k enough to make the system globally stable, thus ensuring that all trajectories remain within an economically meaningful bounded domain. We do not analyze this conjecture further here. Rather, in the next section, we explore the possibility that endogenous changes in the agents' populations, ν_c, reduce the influence of chartists far off the steady state and thereby create turning points in the evolution of capital gain expectations.

8.3.3 Market expectations dynamics

Even if one rejects the assumption of Rational Expectations, agents in financial markets do learn and they may change their behavior endogenously in response to changes in the key economic variables. In this section, we adopt a version of the herding and switching mechanism developed by Lux (1995) and Franke (2012), which provides behavioral foundations to the agents' attitudes in the financial market. Unlike in standard DSGE models, we do not start from individual optimization programmes. The switching mechanism is arguably more realistic than DSGE and it is a very elegant way of capturing *both* rational behavior *and* purely speculative effects, as well as the phenomenon of herding. In fact, agents decide whether to take a chartist, or a fundamentalist, stance depending on the current status of the economy (captured by the key variables Y, e), on expectations on the evolution of financial gains (π_e^e), and also on the current composition of types of traders in the market (captured by the variable x, defined below).

Formally, suppose that there are $2N$ agents in the economy. Of these, N_c are chartists and N_f are fundamentalists so that $N_c + N_f = 2N$. Let $n = \frac{N_c - N_f}{2}$. Following in particular Franke (2012), we describe the distribution of chartists and fundamentalists in the population by focusing on the difference in the size of the two groups (normalised by N). To be precise, we define

$$x = \frac{n}{N} \in [-1, 1], \quad 1 - x = \frac{N_f}{N}, 1 + x = \frac{N_c}{N}, \tag{8.5}$$

where, as in Franke (2012), N is assumed to be large enough that the intrinsic noise from different realizations when individual agents apply their random mechanism can be neglected. Formally, given the continuous time setting, the limit of x is taken as N tends to infinity.

Let $p^{f \to c}$ be the transition probability that a fundamentalist becomes a chartist, and likewise for $p^{c \to f}$. The change in x depends on the relative size of each population multiplied by the relevant transition probability.

$$\dot{x} = (1 - x)p^{f \to c} - (1 + x)p^{c \to f}.$$

The key behavioral assumption concerns the determinants of transition probabilities: we suppose that they are determined by a *switching index s*, summarizing the expectations of traders on market performance. The switching index depends positively on itself (capturing the idea of herding, see Franke and Westerhoff (2009, p.7), and on economic activity, and negatively on the exchange rate and on average capital gain expectations. Formally, assuming again a functional shape as simple as possible, in order to concentrate on the essential nonlinearities:[74]

$$s = s_x x + s_y(Y - Y_o) - s_e(e - e_o)^2 - s_{\pi_e^e}(\pi_e^e)^2. \tag{8.6}$$

This switching index assumes – besides the herding term and the role of economic activ-

[74]The details of the approach are to be found in Lux (1995) and Franke (2012).

ity as in Franke (2012) – that the deviations of share prices and capital gain expectations from their steady state values (in both directions) favour opinion making in the direction of the fundamentalists, because doubts concerning the macroeconomic situation become widespread. This change can be interpreted as a change in the state of confidence, whereby agents believe that increasing deviations from the steady state eventually become unsustainable. A similar approach concentrating on price p_k misalignment is used in Franke and Westerhoff (2009, eq.6).

An increase in s is assumed to increase the probability that a fundamentalist becomes a chartist, and to decrease the probability that a fundamentalist becomes a chartist. More precisely, assuming that the relative changes of $p^{c\to f}$ and $p^{f\to c}$ in response to changes in s are linear and symmetric:

$$p^{f\to c} = \beta \exp(as), \tag{8.7}$$

$$p^{c\to f} = \beta \exp(-as). \tag{8.8}$$

Given the above assumptions, the complete dynamic system becomes:

$$\dot{Y} = \beta_y((a_y - 1 - a_i i_y)(Y - Y_o) + (a_e - a_i i_e)(e - e_o)) \tag{8.9}$$

$$\hat{e} = \beta_e \alpha_e \sigma_e (i^* + \pi_e^e - [i^* + i_y(Y - Y_o) + i_e(e - e_o)]) \tag{8.10}$$

$$\dot{\pi}_e^e = \beta_{\pi_e^e}[\frac{1+x}{2}\hat{e} - \pi_e^e] \tag{8.11}$$

$$\dot{x} = \beta[(1-x)\exp(as) - (1+x)\exp(-as)] \tag{8.12}$$

As a first step, note that the dynamic system (8.9)-(8.12) always has the following steady state: $Y_o, e_o, \pi_{eo}^e = 0, x_o = 0$, where the first three values are uniquely determined (up to flukes), but not x, see below. The asserted uniqueness follows from $\hat{e} = 0$, since we get from this $\pi_{eo}^e = 0$ and on this basis then two equations in the unknowns Y, e which can be solved as intended if policy coefficients are slightly perturbed (if needed).

Equations (8.9) - (8.12) represent our baseline model of a small open economy. All state variables are here dynamic in the sense that their evolution over time is described by more or less gradual adjustment processes, and no algebraic equilibrium condition is involved. Algebraic equations are only used for the equation of the switching index s and the Taylor rule equation of the Central Bank, where the short-term interest rate can be set instantaneously. Both equations do not represent equilibrium conditions. Markets are essentially interconnected and there are various feedback mechanisms present between them.

The key theoretical and policy question is, whether the unfettered market economies described by the model, where real/financial feedbacks play a prominent role and expectation formation may be affected by herding behavior, display explosive trajectories, or rather whether they contain some inherent stabilizing mechanisms.

If $s_x \leq 1/a$ then this steady state is unique (the first three values are always uniquely determined). If $s_x > 1/a$, then there are two additional steady state values for x_o : the equilibria e_f, e_c, one where chartist are dominant and one where the opposite holds true (all other steady state values remain unchanged). This is suggested by the backward-bending shape of the $\dot{x} = 0$-isocline in figure 4, but is to be obtained in fact by what is shown in figure 3 (which is based on the assumption of given unique steady state values $Y_o, e_o, \pi^e_{eo} = 0$). The figure 3 – and the derivative of this function at 0 – shows that $as_x < 2$ must hold for the case of a uniquely determined steady state value $x_o = 0$.

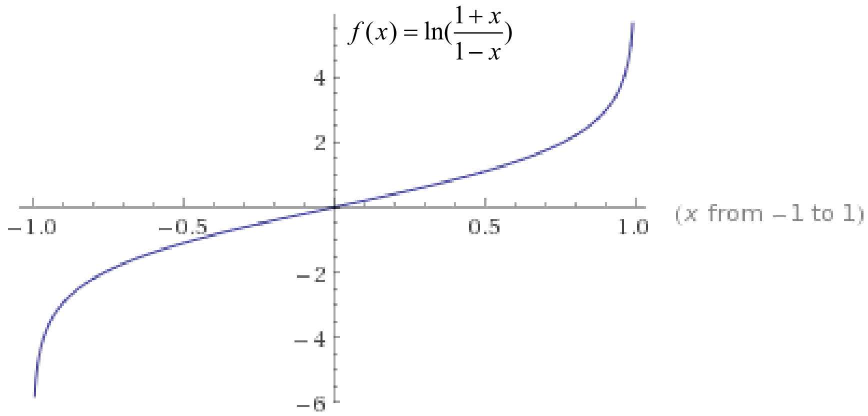

Figure 8.3: The core of the switching function $f(x) = \ln(\frac{1+x}{1-x})$, $f'(0) = 2$ (for a steady real-financial market configuration).

Before analyzing the dynamics of the complete system, it is interesting to consider the properties of the opinion dynamics and the expectational part of the model in isolation. We thus assume that output and dividend payments are fixed at their steady state values. This yields the following 2D system:

$$\dot{\pi}_e^e = \beta_{\pi_e^e}[\frac{1+x}{2}\hat{e} - \pi_e^e], \tag{8.13}$$

$$\dot{x} = \beta[(1-x)\exp(as(x,\pi_e^e)) - (1+x)\exp(-as(x,\pi_e^e))]. \tag{8.14}$$

First, note that x always points inwards at the border of the $x-$domain $[-1,1]$. Then, it can be conjectured that there must be an upper and a lower turning point for π_e^e in the economically relevant phase space $[-1,1]\times[-\infty,+\infty]$ and that, if the steady state $(0,0)$ is unstable, the generated cycle stays in a compact subset of this phase space. The expectational herding mechanism would thus be bounded, if taken by itself.

Franke (2012) shows this conjecture to be correct in the context of a formally similar 2D system. Here we simply note that $\dot{x}$ approaches infinity if there is an unlimited increase, or decrease, in the capital gains inflation rate π_e^e. However, as x approaches zero from above or from below, $\dot{x}$ would go to zero if it did not cross the vertical axis at $x=0$. This is a contradiction and therefore there must always be an upper or lower turning point for capital gain inflation or deflation.

The phase space of the 2D system (8.13)-(8.14) is shown in figure 4. The diagram is drawn under the assumption that $s_x > 2/a$, and so there are three steady states (e_f, e_o, e_c). The horizontal axis is an invariant set of the dynamics which cannot be left (or entered) in finite time. Focusing on this part of the $\dot{\pi}_e^e = 0$-isocline we see that both the fundamentalist and the chartist steady state (e_f, e_c) are attracting, but that this only holds for the fundamentalist equilibrium, when the economy is subject to non-zero capital gain expectations.

The $\dot{x}=0$ isocline is:

$$\pi_e^e = \pm\sqrt{\frac{s_x x - \ln\sqrt{(\frac{1+x}{1-x})}/a}{s_{\pi_e^e}}},$$

and it is attracting with respect to x, since x falls whenever π_e^e is above the isocline

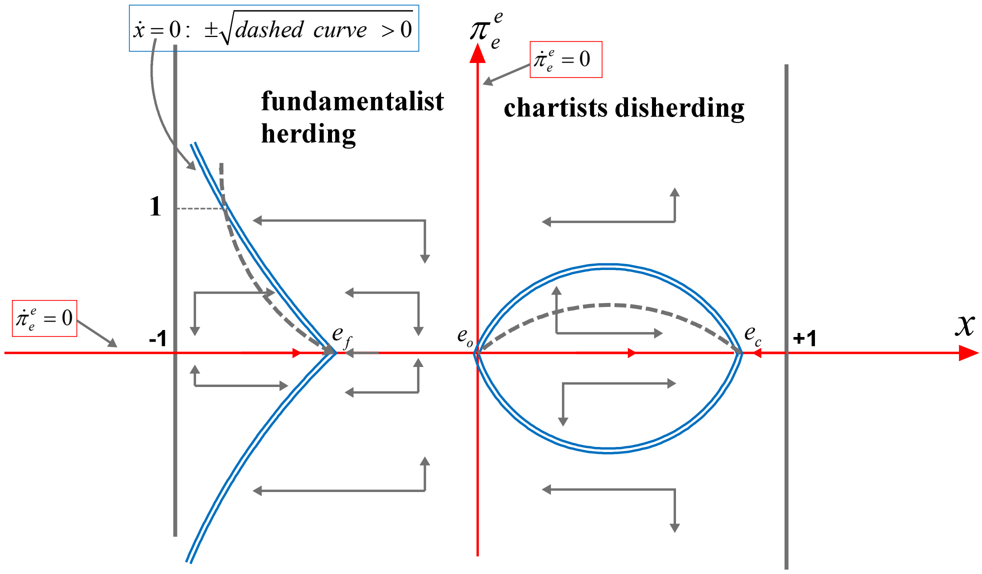

Figure 8.4: Bounded herding behaviour.

and it rises if π_e^e is below it. Note that this isocline is not defined for values of x that make the numerator inside the square root negative. Figure 4 displays some innovative features, as compared to the 2D phase diagrams in the literature, though the outcome of the 2D subdynamics is a fairly trivial one, since only the equilibrium where fundamentalists dominate is by and large a stable one. Figure 4 also suggests that the economy remains in a bounded subset of the state space, if capital gains depart too much from their steady state value (which is zero), due to the strong effects this has on opinion dynamics.

However, because the law of motion of expected capital gains is not easily mapped onto figure 4, it is difficult to analyze the properties of the full 4D system. One should expect the local dynamics to be unstable without policy intervention, since the real-financial markets interaction, in connection with opinion dynamics, is likely to be of centrifugal nature. This raises the issue of the global viability of the unfettered market economy. Based on the analysis of the 2D systems, we cannot conclude that the trajectories of the full 4D dynamic system will always remain in an economically significant subset of the state space.

Given the strong nonlinearity of the opinion part and also in the rate of return function of the 4D dynamics (despite the simple linear behavioral rules we have adopted), we shall address these questions by means of numerical simulations in section 8.4. They will show that interesting irregular and persistent fluctuations in the real and financial variables of the model can be generated, quite in contrast to what is possible in such a model type under the assumption of the homogeneous rational expectations of the mainstream literature.

8.3.4 Rational expectations and imperfect exchange rate adjustments

In the case of Rational Expectations one assumes in the deterministic situation, see Turnvosky (1995) for a variety of examples, that π_e^e is simply given by $\hat{e}$. The population dynamics and a separate law of motion for exchange rate expectations is then redundant and we get for the law of motion of the exchange rate in this case:

$$\begin{aligned} \hat{e} &= \beta_e \alpha_e \sigma_k (i^* + \hat{e} - i(\cdot)) \\ &= \frac{\beta_e \alpha_e \sigma_k}{\beta_e \alpha_e \sigma_k - 1}(i_y(Y - Y_o) + i_e(e - e_o)) \end{aligned}$$

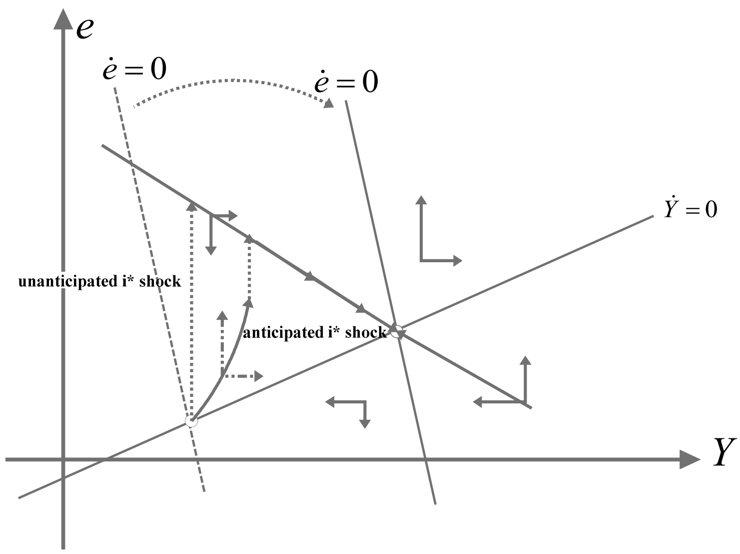

Figure 8.5: Rational expectations imply real-financial market interactions that – after a tailored jump in the exchange rate e – converge to the steady state of the post-shock dynamics.

We restrict our investigation of the rational expectations approach on the likely case where $\beta_e \alpha_e \sigma_k > 1$ holds true, in which case the fraction to the right is positive (the opposite case is indeterminate in the language of the rational expectations school). Formally seen, the 2D dynamics of section 8.2 is now self-contained in this modification of its second law of motion. Moreover, the isoclines in figure 1 remain in their position and the dynamics are now pointing upwards above the $\dot{e} = 0-$isocline and vice versa. This situation is shown in figure 5. In this figure we also consider a shock to the economy which moves both isoclines into a new position (for graphical reasons). Assuming the economy to have been in the steady state of the old dynamics then implies (by assumption) a jump of the exchange rate share prices e onto a unique position on the stable arm of the post-shock dynamics (if these dynamics are determinate) along which they and output then converge to the new steady state position. This is a very tranquil theoretical scenario for what is assumed to happen in the FX markets, as illustrated by Fig. 5.

8.4 Numerical simulations

Turning to the whole $4D$ system with an endogenously determined amount of behavioral traders again, we use numerical means now to gain more detailed insights to its dynamical behavior. In order to run the numerical simulations the software package $E\&FChaos$ by Diks et al. (2008a) has been applied.[75] It allows for the implementation of dynamic economic models in a very user-friendly plain text file and offers routines for many tasks required for performing analyses of dynamical systems. The code for the model at hand looks as follows:

[75] The software can be downloaded from http://www1.fee.uva.nl/cendef/whoiswho/makeHP/page.asp?iID=19

```
Y=1.02, e=2, pie=0, x=0
bpi=1, be=2.5, alpe=0.25, sige=4, beta=1.4, sx=1.2, spie=0.5, a=1, by=2, ay=0.6,
ai=0.1, ae=0.35, iy=0.1, ie=0.1, sy=0.2, se=0.5, Yo=1, eo=2, stari=0.05

c 0.01
i=stari+iy*(Y-Yo)+ie*(e-eo)
Y1=by*((ay-1)*(Y-Yo)-ai*(i-stari)+ae*(e-eo))
e1=e*be*alpe*sige*(stari+pie-i)
pie1=bpi*((1+x)/2*be*alpe*sige*(stari+pie-i)-pie)
x1=beta*((1-x)*math.exp(a*(sx*x+sy*(Y-Yo)-se*(e-eo)^2-spie*pie^2))
               -(1+x)*math.exp(-a*(sx*x+sy*(Y-Yo)-se*(e-eo)^2-spie*pie^2)))

Y=Y1
e=e1
pie=pie1
x=x1
```

The line c 0.01 declares that the Runge-Kutta procedure is used to run the model as a continuous-time model with step size 1/100. The preceding lines provide the initial conditions and the parameter values for the simulation (each without hard return). Next, there is the definition of the employed Taylor rule. The next four equations provide the four laws of motion of the model and the subsequent equations provide the updating procedure for the state variables of the model. As a starting configuration of the model, reasonable values have been assigned to the parameters and initial conditions. For the time being they are neither calibrated, nor estimated, since the expectational part is not observable as such and empirical validation is beyond the scope of the thesis, but remains a challenging task for future research.

In the first simulation, we indicate where the 3D subdynamics – resulting when population shares are held constant ($\dot{x} = 0$) – loses their stability (at around $\beta_\pi = 1.5$) in figure

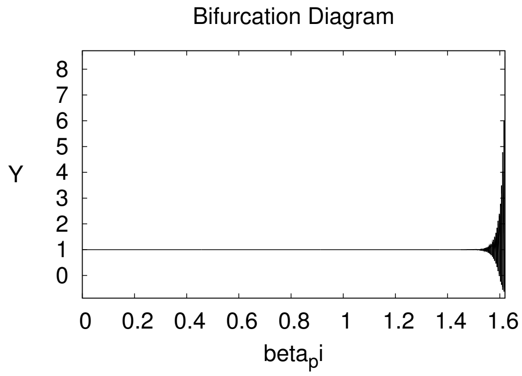

Figure 8.6: A Hopf bifurcation which leads into explosive instability

6 by way of a Hopf bifurcation. The bifurcation seems to be of a degenerate type, i.e., no limit cycle is born or lost at this bifurcation point. The figure primarily provides the point of departure for the study of the opinion dynamics that follows.

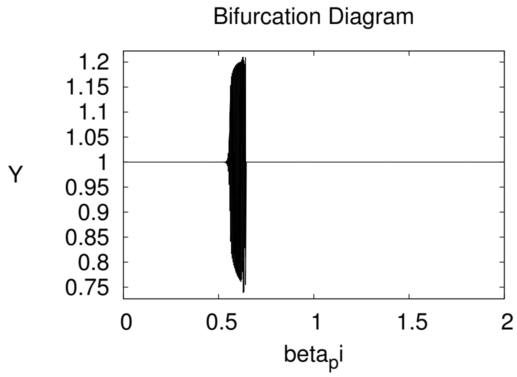

Figure 8.7: Stabilizing opinion dynamics

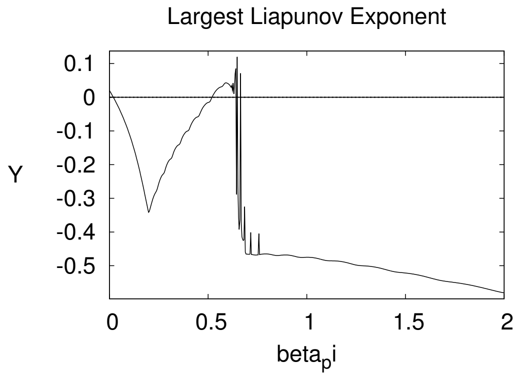

Figure 8.8: Are there 'chaotic' trajectories?

The opinion dynamics switched on again in figure 7 as indicated by the parameter values shown above. It reveals the surprising result that it is relatively complex around $\beta_\pi = 0.64$, but converges before and after this area, beyond the original bifurcation point.[76] This is by and large confirmed by the Largest Liapunov Exponent (LLE) shown in figure 8 for the same parameter range.[77] The range for irregular orbits is around 0.64 while we have

[76] We show ten years of iteration after transient period of 300 years.

[77] Note that the Largest Liapunov Exponent is positive for values of β_π slightly larger than zero, too. Since the LLE is no exact measure for complexity, the indicator only gives a hint for complexity. But we cannot confirm complex dynamics by the bifurcation diagram here. This might be due to the particularly brief remaining of the LLE in the positive area.

a simple limit cycle shortly before it (figure 9, $\beta_\pi = 0.62$). Such limit cycles can become irregular too when noise is added to them (here the noise is added uniformly, with a variance of 0.5% of output levels). After a while, the astonishing thing is that the deterministic part is reduced in its extent through the addition of noise (figure 10).

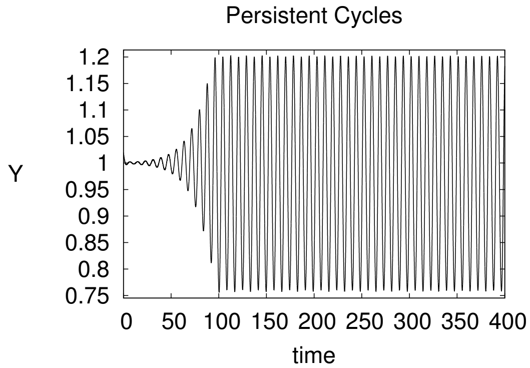

Figure 8.9: A limit cycle result

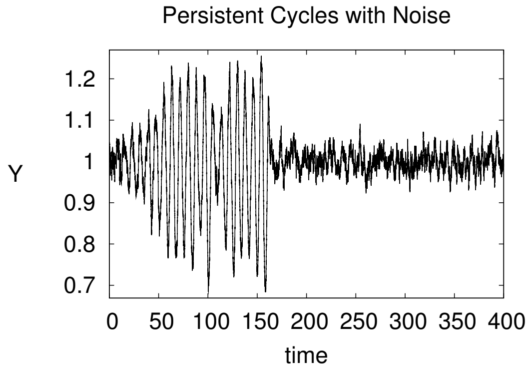

Figure 8.10: Adding noise to the limit cycle

Figure 11 demonstrates – in correspondence to figures 9 and 10 – that the time series can become irregular in the purely deterministic core of the model which is based on a continuous ODE system of dimension 4. This is only possible with at least three laws of motion, as we know from the famous Rössler dynamics (see the manual which is accompanying the software we are using (Diks et al. 2008b)). The deterministic dynamics can be coined smooth here in the sense that a recurrent and bounded pattern of smaller irregular cycles is observable. Adding again noise to the deterministic part of the model provides the same outcome as we have observed in the simple limit cycle case (figure 12). A threshold is passed beyond which the larger range of volatility collapses to a much narrower defined one with respect to the amplitude of the times series. The noise component starts to dominate the until then still recognizable deterministic structure.

Independent of policy to be discussed in the next section, the considered dynamics is very robust (viable) over large ranges of parameter values. We show this in the next two bifurcation diagrams (figures 13 and 14) with respect to the parameters β_x and β_e and for the share of chartists in the population of risk traders.

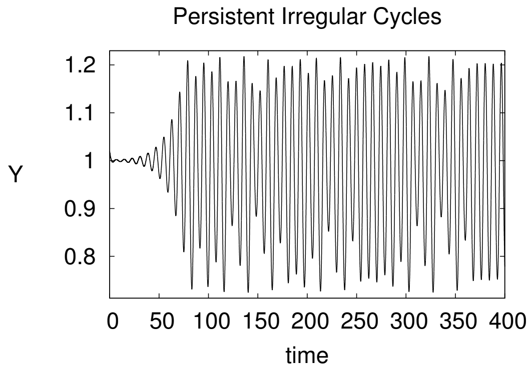

Figure 8.11: Smooth dynamics with irregular business fluctuations

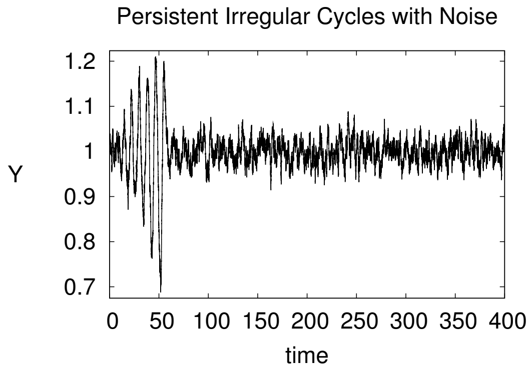

Figure 8.12: Adding noise to the already irregular output dynamics

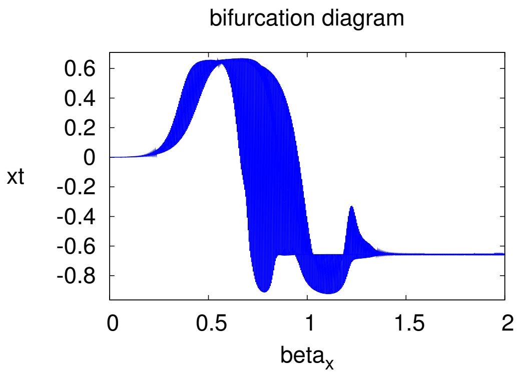

Figure 8.13: Robustness test of the dynamics for the adjustment speed of the chartists; population

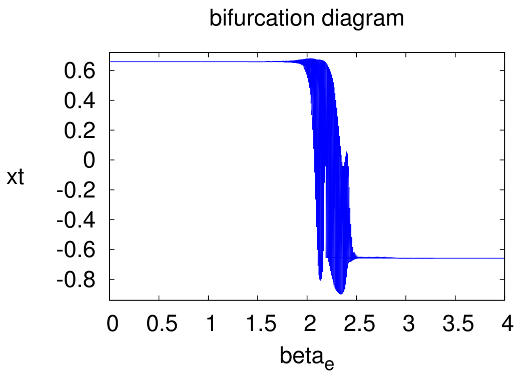

Figure 8.14: Robustness test of the dynamics for the adjustment speed of the exchange rate

In the first case (figure 13), the asymptotic stability of the centre equilibrium $x = 0$ gets lost after a while and gives rise to larger fluctuations in population shares which are tamed at a higher speed of adjustment of the population of chartists by the asymptotic stability of a population equilibrium where fundamentalists outweigh chartists. In the second bifurcation figure, we start from a stable chartist equilibrium which in the middle of the parameter range loses its stability through large fluctuations in population dynamics and falls into a fundamentalists equilibrium of nearly equal size (viewed from its absolute value). The astonishing thing again is – though both parameters can be expected to destabilize the economy – that it returns to asymptotic stability after a parameter range which is characterized by significant turbulence.

We close our simulation runs with two studies (figures 15 and 16) which show that the generally unstable chartist equilibrium can be persistent for quite a while (with and without noise), but will eventually be surrounded by explosive motion and then collapse to a stable equilibrium of fundamentalist type. This may also happen in the preceding figures when the time period for the simulation is made considerably longer.

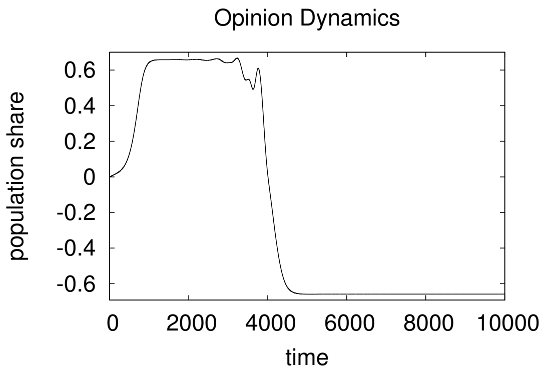

Figure 8.15: Prolonged, though only temporary dominance of chartists' positions

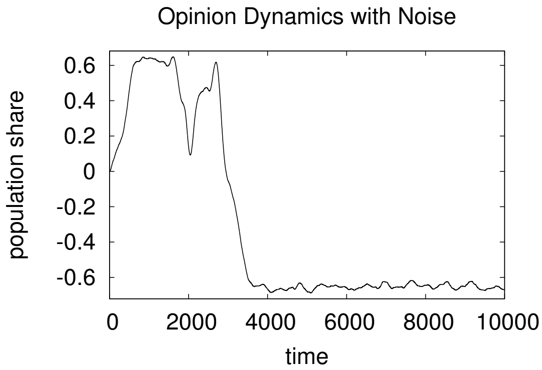

Figure 8.16: Adding noise to the situation shown in figure 15

8.5 Policy Options

The key theoretical, empirical, and policy question is whether unregulated market economies contain some mechanisms which ensure the stability of equilibria, or rather centrifugal forces prevail, making the equilibrium unstable and, potentially, the system non-viable. Numerical simulations show that global stability can be ensured if, far off the steady state, opinion dynamics induces fundamentalist behavior during booms and busts which ensures that there are turning points in both of these situations. However, both the local analysis and the simulations suggest that market economies can be plagued by fluctuations and recurrent crisis phenomena. That is the reason why at least a quick review of possible policy measures is indispensable.

We show that policy measures often advocated in the Keynesian literature, namely Tobin taxes, here on capital gains in the FX market, and countercyclical fiscal policy can mitigate those problems. Moreover, monetary policy which follows a FX market-oriented Taylor rule or is strongly output-oriented can enforce stability.

The model highlights *two* sources of instability in the economy: the interconnection between real and (foreign) financial markets, and the destabilizing role of chartists in asset markets.

First of all, as many authors since Keynes (1936) and Minsky (1982, 1986) have stressed, the main function of financial markets should be to ensure the efficient allocation of savings, and gambling activities should be constrained. It is therefore appropriate to consider a *Tobin type tax (or subsidy)* on capital gains in the FX market at rate τ_e, such that total tax revenue is equal to[78]:

$$\tau_e \alpha_e \sigma_e(\cdot)$$

Therefore the law of motion for capital gain expectations (8.11) can be re-written as:

$$\dot{\pi}_e^e = \beta_{\pi_e^e}[\frac{1+x}{2}(1-\tau_e)\hat{e}_e - \pi_e^e],$$

and Tobin taxes indeed have a stabilizing effect by weakening the impact of chartists on the process of market expectation formation.

Additional numerical analysis shows that capital gains taxation might ensure stability if conducted with sufficiently high rates. The bifurcation diagram in figure 17 points to a rate starting with not less than 20 percent for the parameter configuration chosen before.

Conventional counter-cyclical fiscal policy could also reduce fluctuations if it acts on the propensity to spend parameter a_y in the equation of the dynamic multiplier.(To be seen in figure 18.) But the prerequisite here is rather demanding as values up to 0.75 are associated with increasing explosiveness. Only after passing this threshold value is convergence achieved.

[78]Tobin (1978, 1996) proposed a currency transaction tax, which might work as a stabilizing device for international financial markets and generate revenues to be used by an international authority to finance economic development.

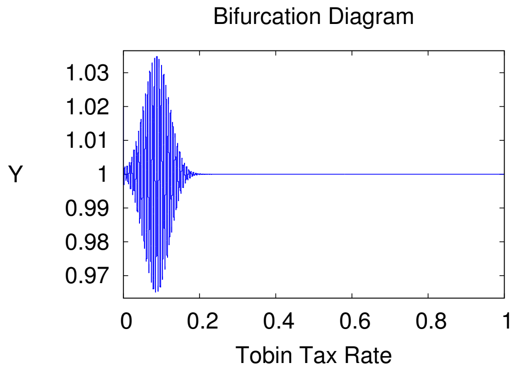

Figure 8.17: Capital gains taxation

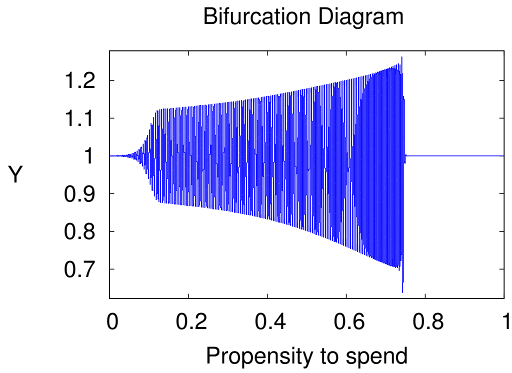

Figure 8.18: Countercyclical Fiscal Policy

Turning to monetary policy, the Taylor rule $i = i^* + i_y(Y - Y_o) + i_e(e - e_o)$ works as a built-in stabilizer, which eliminates an accelerating feedback structure between e and Y and, as already seen, makes the interaction of real and foreign bond markets in isolation a stable one. In order to assess the effects in combination with opinion dynamics, we have to rely on numerical means again. The figure 19 shows the bifurcation diagram for the policy parameter i_e, the positive reaction of the interest rate with respect to currency devaluations (and its decrease in the case of appreciations). Up to the critical area already studied, this policy reaction always provides convergent dynamics and is therefore supportive (also in areas where there are limit cycle fluctuations). An orientation towards output targeting can work successfully as well, but it needs to be conducted with sufficient strength. As it is clear from figure 20, convergent dynamics can only be achieved for rather high values of the output reaction parameter i_y in relation to FX-targeting.

8.6 Concluding Remarks

In this chapter a stylized model of a small-open economy with endogenous market expectations formation based on heterogeneous behavioral FX expectations has been presented. The assumptions of market clearing and rational expectations were dropped, and instead, a set of gradual, dynamic adjustment processes taking place on highly interconnected real and financial markets was assumed. The resulting framework – where foreign exchange

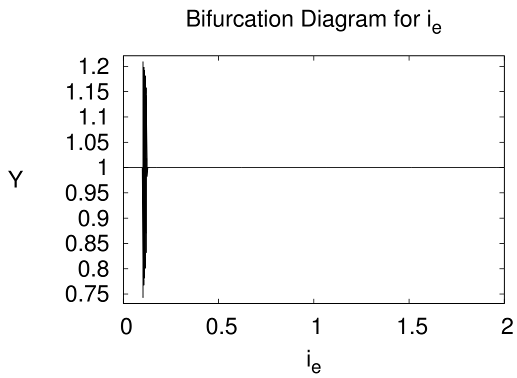

Figure 8.19: The impact of FX-oriented interest rate policy over the range $i_e \in [0, 2]$

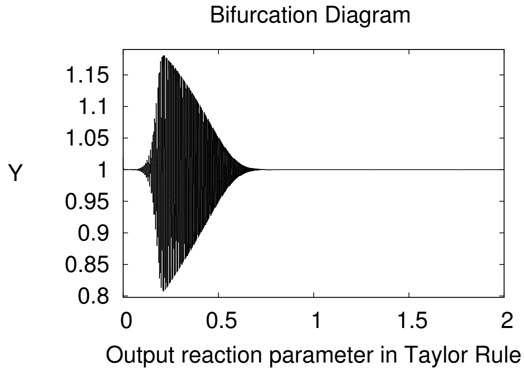

Figure 8.20: Output-oriented interest rate policy over the range $i_e \in [0, 2]$

markets influence the state of confidence of the economy and thus consumption and investment decisions, which in turn influences the performance of the real sector – has been shown to be tractable enough to be – at least partially – investigated by means of analytical tools on the one hand, but on the other hand elaborate enough to generate complex dynamics.

A central element of the analyzed theoretical framework was the assumption of FX markets populated by chartists and fundamentalists. One may argue that the theoretical expectation formation rules that characterise chartists and fundamentalists, should be replaced by more sophisticated backward- and forward-looking rules based on econometric estimation techniques. It would certainly be interesting to analyze the impact of different expectation formation rules on the system. We do not, however, expect these changes to significantly affect the key conclusions of our analysis. Secondly, in our formalization of market expectations, we supposed that the agents' guessing process is stopped after one step: market expectations are what agents think they will be on average. We considered this as a first step into the analysis of more complex processes of aggregate expectation formation. Once one drops the assumption of Rational Expectations, many further possibilities can be explored, including Keynes' (1936) celebrated "third degree" process, where agents try to anticipate what *average opinion* expects average opinion to be. We leave this suggestion for further research.

8.7 References

Assenza, T., Brock, W.A. and Hommes, C.H., 2012, Animal spirits, heterogeneous expectations and the amplification and duration of crises. Working Paper, CeDEF, University of Amsterdam

Brunnermeier, M.K., 2008, Bubbles. In: Durlauf, S., Blume, L. (Eds.), The New Palgrave Dictionary of Economics, 2nd Edition, Palgrave Macmillan.

Chari, V., Kehoe, P. and McGrattan, E., 2009, New Keynesian Models: Not yet useful for policy analysis. American Economic Journal: Macroeconomics, 1, 242-266.

Charpe, M., Flaschel, P., Hartmann, F. and Proaño, C.R., 2011, Stabilizing an unstable economy: Fiscal and Monetary Policy, Stocks, and the Term Structure of Interest Rates. Economic Modelling, 28, 2129-2136.

Charpe, M., Flaschel, P. Hartmann, F. and R. Veneziani, 2012a, Towards Keynesian DSGD-(isequilibrium) Modelling: Real-Financial Market Interactions with Heterogeneous Expectations Dynamics. IMK Working Paper 93/2012. Macroeconomic Policy Institute.

Charpe, M., Flaschel, P., Proaño, C. and Semmler, W., 2012b, Credit-Financed Investment, Dual Labor Markets and International Capital Markets in a Macrodynamic Two-Country Framework. ILO working paper

Chiarella, C., Flaschel, P., 2000, The Dynamics of Keynesian Monetary Growth: Macrofoundations. Cambridge University Press, Cambridge.

Chiarella, C., Flaschel, P., Franke, R. and Semmler, W., 2009, Financial Markets and the Macroeconomy. A Keynesian Perspective. Routledge, New York.

Chiarella, C., Dieci, R., Gardini, L. and Sbragia, L., 2008, A model of financial market dynamics with heterogeneous beliefs and state-dependent confidence, Computational Economics, 32, 55-72.

Chiarella, C., He, X.-Z. and Zheng, M., 2011, Heterogeneous expectations and exchange rate dynamics, The European Journal of Finance, 1-28.

Colander, D., Föllmer, H., Haas, A., Goldberg, M., Juselius, K., Kirman, A., Lux, T. and Sloth, B., 2009, The Financial Crisis and the Systemic Failure of Academic Economics," Discussion Papers 09-03, University of Copenhagen. Department of Economics.

De Grauwe, P. and Grimaldi, M., 2005, Heterogeneity of agents and the exchange rate: A nonlinear approach. In: De Grauwe, P. (Ed.), Exchange Rate Economics: Where Do We Stand?. CESifo Seminar Series, MIT Press, Cambridge, pp. 125-168.

De Grauwe, P. and Grimaldi, M., 2006, The Exchange Rate in a Behavioral Finance Framework, Princeton University Press.

Diks, C., Hommes, C. Panchenko, V. and van der Weide, R., 2008a, E&F Chaos: A user friendly software package for nonlinear economic dynamics. Computational Economics, 32, 221-244.

Diks, C., Hommes, C. Panchenko, V. and Tyszler, M., 2008b, Manual E&F Chaos Program, CeNDEF, University of Amsterdam.

Dornbusch, R., 1976, Expectations and exchange rate dynamics. Journal of Political Economy, 84, 6, 1161-1176.

Flaschel, P. and Krolzig, H.-M., 2006, Wage-price Phillips curves and macroeconomic stability. Basic structural form, estimation and analysis. In: Chiarella, C., Flaschel, P., Franke, R. and Semmler, W. (Eds.), Quantitative and Empirical Analysis of Nonlinear Dynamic Macromodels. Elsevier, Amsterdam.

Franke, R., 2012, Microfounded animal spirits in the new macroeconomic consensus. Studies in Nonlinear Dynamics and Econometrics, 16:4, Article 4.

Franke, R. and Westerhoff, F., 2009, Estimation of a Structural Stochastic Volatility Model of Asset Pricing. Working paper: Kiel University.

Frankel, J.A. and Froot. K.A., 1990, Chartists, fundamentalists, and trading in the foreign exchange market, The American Economic Review 80(2), 181–185. Papers and Proceedings of the Hundred and Second Annual Meeting of the American Economic Asociation.

Hartmann, F. and Flaschel, P., 2014, Financial markets, banking and the design of monetary policy.: A stable baseline scenario. Economies, 2(1), 1-19.

Hommes, C., 2006, Heterogeneous agent models in economics and finance, in: Handbook of computational economics, Vol.2: Agent-based computational economics, eds L. Tesfatsion and K. L. Judd, 1109-1186, Amsterdam, North-Holland.

Keynes, J.M., 1936, The General Theory of Employment, Interest and Money. Macmillan, London.

Kindleberger, C. and Aliber, R., 2005, Manias, Panics and Crashes. A History of Financial Crises, 5th edition. New York: Wiley.

Lux, T., 1995, Herd Behaviour, bubbles and crashes. Economic Journal, 105, 881 - 889

Menkhoff, L., Rebitzky, R. and Schröder, M., 2009, Heterogeneity in Exchange Rate Expectations: Evidence on the Chartist-Fundamentalist Approach. Journal of Economic Behavior and Organization, 70(1-2), 241-252.

Minsky H., 1982, Can ”It” Happen Again? M.E. Sharpe, New York.

Minsky H., 1986, Stabilising an Unstable Economy. Yale University Press, New Haven, CT.

Proaño, C.R., 2011, Exchange Rate Determination, Macroeconomic Dynamics and Stability under Heterogeneous Behavioral FX Expectations. Journal of Economic Behavior and Organization, 77, 177-188.

Tobin, J., 1978, A proposal for international monetary reform, Eastern Economic Journal, 105, 162-172.

Tobin, J., 1996, A currency transactions tax, why and how, Open Economies Review, 7, 493-499.

9 Segmented Labor Markets and the Distributive Cycle

9.1 Introduction

9.1.1 The theory of segmented labor markets and the case of Germany as a contemporaneous example

In this chapter we reconsider the trichotomy of floating, latent and stagnant segments of the labor market in the framework of the Goodwin (1967) model of the distributive cycle and discuss this concept of segmented labor markets both from the theoretical and the empirical perspective. The significance and relevance of this trichotomy can be easily observed with regard to the situation of labor markets in both advanced as well as developing countries. Marx (1954) introduced this theory of specifically segmented labor markets in conjunction with his discussion of the general law of capitalist accumulation in Capital, Volume I. Reconsidering the trichotomy of floating (fluid), latent and stagnant segments of the labor market, where the last segment – the stagnant one – can also be described as a dead segment, we can easily discover similarities on the level of well-being (not in absolute income of course) to the situation of the employees in the German economy of the 21st century. We have normal occupations, the floating segment, atypical employment in the low income sector (part-time workers, temporary work organized by special leasing firms and low paid, so-called mini jobs, in the latent segment, and unemployed persons receiving

This chapter is based on Charpe, Flaschel, Hartmann and Malikane (2014).

unemployment benefits (for one year, elderly people for 18–24 months) and long-term unemployed persons, with only marginal chances of a return to proper work, in the dead segment of the labor market.

Germany had a regulation for unemployed persons until 2005 which consisted of two forms of unemployment support, a maximum of two years unemployment benefits, and thereafter 'Sozialhilfe' (social help) with a smaller sum of money. In general, the length of payment and some other decisions were dependent on the length of working time before becoming unemployed and thus on the amount of payment into the unemployment insurance which was – and is – obligatory in Germany.[79]

In 2005, a radical labor market 'reform' took place against which protests have never stopped. It is named 'Hartz IV' because one of the main persons involved in the creation was Peter Hartz, a former German CEO, among others at the Volkswagen enterprise. A reason for the new regulation was the high increase of unemployed persons at the end of the 20th and beginning of the 21st century so that a commission was founded, the Hartz Commission, which intended to reduce the number of more than four million unemployed persons to less than half of it within four years, which however never happened. The new regulations have reduced the payment of unemployment benefits to one year, and put together 'Sozialhilfe' (social help) and a new unemployment benefit system II, better known in Germany under the name Hartz IV. The number IV can be explained by the following development from 2002 on:[80]

- Hartz I (implemented 2003) made reforms of the restrictive legislation on temporary work and work leasing, both of which were eased. Stricter rules with regard to registering as unemployed and accepting offered work were made

- Hartz II (also implemented 2003) has renewed the possibilities of founding a one-person business (Ich-AG) and made a reform of the mini-jobs (income up to 400

[79] See Blien, Walwei and Werner (2002) for an overview of the situation of unemployed persons and German regulations before the so-called Hartz 'reforms'.
[80] See Tompson (2009), 229ff.

Euro) which do only demand (small) social securities payment from the employer, but not from the employee

- Hartz III (implemented 2004) includes a reorganisation of the employment agency and special rules of cutting benefits if an offered work is not accepted without understandable reasons
- Hartz IV (implemented 2005) has merged Sozialhilfe (social help) and unemployment benefit to unemployment benefit II which is at present fixed on Euro 364 per month (plus payment of rents etc). For children there exist further standard rates.

While the – in 2004 renewed – Federal Institute for Employment has to deal with unemployed persons, try to find jobs for them and to organize the Hartz IV-payment, the underlying laws are to be found in the German Social Security Codes II and III which regulate the work of the Federal Institute for Employment. Both codes have been updated in recent years. While the main topics in Social Security Code II deal with basic social care as well as employment promotion, the dominant aspects in Social Security Code III refer to job-creating-measures and job training. Hartz IV recipients are mainly part of Security Code II, while unemployed persons who receive unemployment benefits for one year (about 60% of their former income), are dealt with in Security Code III though some tasks are mixed. Persons who earn only little in a job cani receive an additional support within the Hartz IV regulations. A basic principle in both codes is the orientation towards work-fare in contrast to welfare, which means that unemployed persons are supposed to engage themselves in skill enhancement and intensive job finding (Eurofound, 2009).

In 2009, there were 43 million persons in the active part of the German labor force, but nearly five million persons had only a so-called minijob (Federal Statistical Office 2011). Since the 1990s the number of low wage jobs has significantly increased by up to 20% of all employees.[81] Additionally, the German government refused a general minimum wage for years. But this has changed since the federal elections in late 2013. The introduction

[81] See Bosch and Kalina (2008, 19ff.) for the development in the last twenty years.

of a minimum wage is currently on the way. Solow (2008, 12ff.) discusses several possible reasons for the German downward development in labor market regulations, among which the growth of the service sector (in contrast to the manufacturing sector), gradual weakening of union power, intensified competition through incoming workers, for example from Eastern Europe, and relics of the Bismarckian organisation of the German welfare state (especially the 'male breadwinner household') are underlined as possible negative influences. He – as well as Bosch and Weinkopf (2008) and Bosch and Kalina (2008) – argues that the introduction of minimum wages might be a first step away from this downward development.

In 2010, there were 3 244 000 unemployed persons, following the information of the Federal Institute for Employment, which is a significant fall compared to 2009. Altogether, around 6 million employable persons received in 2010 benefits due to the Social Security Codes II and III, which means a reduction of 2% with regard to the preceding year, mainly with regard to those who received unemployment benefits. There were on the other hand one and a half million persons involved in a measure of labor market policy, mainly a form of skill training, which was nearly 15% less than in 2009, which means reduced support in finding a new job.

The data of long-term unemployed persons (Hartz IV receivers) show more than 20% of more than 24 months unemployed in total unemployment (Bundesagentur für Arbeit, 2010), but many Hartz IV receivers are in this system for more than five years, and more than 10 years even. This problem is related to the question of sufficient qualifications which are often missing. Therefore, so-called Hartz IV people are often linked to so-called problem-groups, which include migrants without any professional or even educational qualifications, single parent households, unskilled persons in general and early school leavers.

While the data from the Federal Statistical Office seem to suggest not only lots of different supports for unemployed persons, but also a decreasing number of unemployed persons (of both types) the situation of these parts of the society is far from being satisfactory (Bundesagentur für Arbeit, 2010).

The situation of Hartz IV receivers is not only close to poverty, a fact which is especially difficult for children and juveniles, but it also contains many degrading situations since persons who apply for Hartz IV have not only to reveal the details of their financial situation (savings, properties etc) and their living conditions (family, friends etc.), but they are forced to change their living place when they have too many rooms or pay a high rent (which will be overtaken by the agency). Furthermore they have to apply for all extra expenses, including clothing, birthday presents, traveling to a sick relative and so on.

Another degrading aspect is the often low support in finding a new job or even getting new qualifications which gives a feeling of being no longer part of the workforce. Furthermore, the public opinion on idle workforce members who are viewed as refusing work, can be, and is, also degrading. It has also to be taken into consideration that many long-term unemployed persons who live from Hartz IV will get into a difficult situation when they are old, because their retirement pension can be very low so that they will depend on the paid basic social help for aged persons.

Therefore, it is correct to compare Hartz IV with the stagnant (dead) segment as described above. Of course, their situation is not comparable to the situation of the dead segment on the labor market at his times, but in a cross-sectional comparison they are nevertheless in a comparable position concerning life perspectives, neighborhood problems, tendencies to drug consumption and inclination towards violence.

Moreover, there are certainly many difficult atypical working conditions in Germany that can be related to the latent segment though these workers have a chance to move up into the floating segment like skilled and well trained unemployed persons who may find a new job after some months. On the other hand, there are many persons in this segment who can also easily drop into the stagnant segment when, for example, part-time occupied workers lose their job, or temporary work organized by special leasing firms is so low paid that the comparison with regular workers is discriminating. These types of workers are indeed also supported through the Hartz IV program to a significant degree (around 3/4 of the Hartz IV receivers).

Unemployment is, of course, the root of all these problems. In this chapter we will therefore – among other questions – also deal with proposed solutions to solve this problem such as Basic Income Guarantees (BIG)[82] or an Employer of Last Resort (ELR). The importance of such programs cannot be underestimated, since the increase in child poverty that is accompanying mass unemployment is indeed of the type of a ticking time bomb (in Germany social help supplied to children increased from 130000 children in 1965 to 1.7 million children in 2010. To have approximately 10% of workers in the new classification system 'Hartz IV families' who are by and large chronically unemployed with no hope for improvement of their lot, represents a situation in a democracy that can only be considered as fatal. This chapter will provide against such a background a model of segmented labor market analysis and a reform proposal, that tries to cure such a situation.

9.1.2 Modeling Strategy

Goodwin's (1967) growth cycle model is one of the truly baseline models of macroeconomic theory, comparable to the orthodox Solow (1956) model in its simplicity, but totally different in its implications from the latter type of growth theory.[83] This has indeed also been acknowledged by Solow himself, see Solow (1990), and has led to numerous publications on modifications and extensions of this approach to a distributive cycle.

Barbosa-Filho and Taylor (2006) have characterized this cycle mechanism, see also Taylor (2004, ch.9) in this regard. Recently, in 2006, there has been a special issue in the Journal *Structural Change and Economic Dynamics* on Goodwin's legacy and its continuation as well as an edited volume on this subject, see Flaschel and Landesmann (2008). There has also been recent empirical work on this distributive cycle by Harvie (2000), Mohun and Veneziani (2006, 2008), Franke et al. (2006), Fiorio et al. (2013) and others. This indicates that the model of the reserve army mechanism designed by Goodwin (1967, 1972) is still attracting numerous studies of its further development and its empirical evaluation.

The chapter shows that Goodwin's model, which is characterized by the unrestricted operation of the 'law of capitalist accumulation', can be reformulated in such a way as to produce socio-economic outcomes that are socially and politically acceptable. Our main

[82] The Hartz IV contributions of the state currently amount to roughly 500 Euro per head.
[83] See Flaschel (2009) for a detailed study of this type of approach.

focus is to integrate the three segments of the labor market under the assumption of a given capital intensity (constant labor productivity) and to show, on this basis, that active labor market policy can generate an outcome that eliminates the stagnant portion of unemployment.

From this perspective, this chapter reconsiders the growth cycle of Goodwin (1967) to incorporate the various forms of unemployment pointed out by Marx (1954): the floating, latent and stagnant segments of the labor market. In Goodwin's model, only the floating type of unemployment was considered. We reformulate Goodwin's model by postulating an interaction between the three labor market segments. We then investigate its steady state positions and their stability in this extended framework. We then show that, in the presence of a benefit system that is undertaken by government as "employer-of-last-resort", the stagnant segment of the labor market can be assumed as eliminated, which improves the stability of the economy.[84] This approach thus shows that Goodwin's model, which is in a way characterized by the unrestricted operation of the "law of capitalist accumulation", can be reformulated in such a way as to produce socio-economic outcomes that are socially and politically acceptable.

The rest of the chapter is structured as follows. Section 9.2 adds to the Goodwin model a segmented labor market structure, in which the different types of unemployment interact on the basis of rates of employment and unemployment. Section 9.3 provides a steady state analysis of the model, and shows that the steady state rates of employment in the latent and stagnant segments depend on the speeds with which workers are pushed into or out of these segments. It also investigates the stability properties of the extended model, both from the theoretical and the numerical perspective. We find that adding the latent and stagnant portions of the labor market in this model generates potentially destabilizing forces , though there is a stabilizing inflation barrier term in our Phillips curve formulation. Section 9.4 introduces an active labor market policy where government acts as employer-of-last-resort thereby eliminating the stagnant portion of the labor market, whilst erecting a

[84] To our knowledge, the first study of an unemployment benefit system in the context of the Goodwin growth cycle model was provided by Glombowski and Krüger (1984).

benefit system that sustains the incomes of workers that leave the floating labor market into the latent one. We show that this policy guarantees the macro-stability of the economy's growth path. Section 9.5 briefly considers the historical origins of social legislation in Germany and presents possible future policies that intend to replace the Hartz IV system in a stepwise fashion by civic work. Section 9.6 concludes.

9.2 The model: Segmented labor and the distributive cycle

The model of the distributive cycle of Flaschel and Greiner (2009) can serve as a major reference point to the approach put forth in this chapter. Their model describes by its construction a viable situation for a capitalist economy. In that model, it is shown that the introduction of a benefit system and minimum and maximum real wage rules obtained through a social pact between labor and capital significantly improves the economic performance of Goodwin's (1967) reserve army economy. However, there is one serious neglect in such a scenario. Mass unemployment occurs without any social consequences for the household structure of the working class. In Marx's description of the reserve army mechanism this is taken note of and it is even claimed there that the distributive cycle necessarily implies a hierarchy of three segments in the labor market, the fluid[85], the latent and the stagnant[86] one. The existence of such hierarchy is unavoidable under an unrestricted evolution of the capitalist mode of production. In this chapter, as distinct from Flaschel and Greiner (2009), we provide a model in which these labor market and unemployment hierarchies are present and interacting.

Before starting the discussion of the model let us briefly state that Goodwin type models are pure supply side models[87] where Says's law holds since all wages are consumed and all

[85]Note that the terms fluid and floating will be used synonymously throughout the chapter.
[86]The terms stagnant and dead are interchangeable with respect to the lowest segment of the labor market.
[87]This fact might be no serious restriction for the policy conclusions we will derive from the model. Though demand issues are for sure of importance as well, any arguments made in favor of the wage side would only be strengthened by the incorporation of aggregate demand aspects. Thus, we consider to use a

profits are invested. The Goodwin type models also assume free hiring and firing, since no delays concerning employment adjustment processes are normally present in them. We moreover exclude government activities from consideration and are thus assuming with respect to the unemployed or even those members of the workforce in the stagnant ('dead') segment of the labor market that they are supported by other family members, by the church, by casual work and from beggary. All these flows between worker households are not modeled explicitly, but only represented through the total wage payment to workers of type 1 or 2. For interpretational simplicity we consider workers of type 1 as living in the town centers, type 2 as living in the outskirts of town and the ones of the dead segment as living in the slums.

We consider the growth cycle model as it was formulated by Goodwin (1967), without any consideration of social security yet, but add a consideration of the evolution of latent and stagnant portions of the labor markets. The growth cycle dynamics for the floating labor market can then be formulated (if the other segments of the labor market are still ignored):

$$\hat{\omega} = \beta_w(\frac{\bar{y}/\bar{z}}{l^s} - \bar{e}), \quad l^s = \frac{L^s}{K} \tag{9.1}$$

$$\hat{l}^s = n - \bar{y}(1 - \omega/\bar{z}), \quad \omega = w/p \tag{9.2}$$

where $\overline{z}$ is a constant output-labor ratio, $\overline{y}$ a constant output capital ratio, ω the real wage, β_w the adjustment speed of the real wage in reaction to the state of the labor market, $\overline{e}$ the steady state employment rate, $L^s$the labor supply, n the growth rate of the labor force, w the nominal wage and p the price level. Equation (1) says that real wage growth is a function of the deviation of the employment rate from its steady state rate. Equation (2) is an accounting identity describing the growth rate of the labour-capital ratio. Adding the other two segments of the labor market we assume now for the floating part of it (indexed

supply side approach to be ideally adequate to challenge orthodox supply-side oriented models' policy implications.

by 1) as law of motion for their real wage:

$$\hat{\omega}_1 = \beta_{we_1}(\frac{\bar{y}/\bar{z}_1}{l_1^s} - \bar{e}_1) + \beta_{we_2}e_2 - \beta_{wd}\frac{D}{L^s} + \beta_{w\omega_1}(\omega_1^o - \omega_1) \quad (9.3)$$

$$\hat{l}^s = n - \bar{y}(1 - \omega_1/\bar{z}_1 - \bar{\omega}_2/\bar{z}_2), \quad \omega_1/\bar{z}_1 + \bar{\omega}_2/\bar{z} < 1. \quad (9.4)$$

The real wage Phillips curve in the first labor market remains based on demand pressure term in the first labor market $\frac{\bar{y}/\bar{z}_1}{l_1^s} - \bar{e}_1$, and is now augmented by the positive influence of the second labor market through an increasing rate of employment $e_2 = \frac{\bar{y}/\bar{z}_2}{l_2^s}, l_2^s = L_2^s/K$ in the atypical (second) labor market and by a negative influence from the third (stagnant) segment of the labor market where there is no employment at all. The extent of this stagnant segment is measured by $D/L^s = d/l^s$. The last term is an error-correction term for the real wage and can be viewed as way to capture the influence of the rate of profit on the steady state real wage. The law of motion for labor intensity is the same as before, but now refers to the whole of labor supply per unit of capital. This is driven by the rate of profit, where the given real wage per unit of capital has now to be deducted. We assume throughout this chapter that the real wage in the latent segment of the labor market is a given subsistence wage, while there are no wages paid at all in the sphere of pauperism. Note that the given magnitudes $\bar{z}_1, \bar{z}_2$ of output per unit of employed labor have now to be interpreted in inverted form as employment coefficients since they are used here to calculate employment on the two active labor markets on the basis of a given output-capital ratio $\bar{y}$.

Note also that we have, by definition, the identity $L^s = L_1^s + L_2^s + D$ where total labor supply (as well as its households components, see below) grows at the natural rate n. The split of this labor supply into a floating, a latent and a stagnant segment must now be formulated in detail in order to complete the model. We thus assume here further that there are upward (inward) and downward (outward) movements between the floating and the latent segments of the labor market. We denote the floating and latent segments as type 1 and type 2 employment respectively, as indexed above. The unemployment rate in the floating segment is an indicator of the percentage of type 1 workers that are compelled to move into the latent segment and the employment rate of the latent segment is an indicator of the percentage of people who get the chance to move back into the first labor market. This gives rise to the following laws of motion:[88]

$$\hat{L}_1^s = -\gamma_1^d(1-e_1) + \gamma_1^u e_1 + n \quad (9.5)$$

$$\hat{D} = \gamma_2^d(1-e_2) - \gamma_2^u e_2 + n \quad (9.6)$$

We have already added here a similar law of motion for the movement in and out of the stagnant segment of the labor market which therefore assumes that there are ways to leave the sphere of pauperism. Yet the downward leading coefficients γ_1^d, γ_2^d will be significantly larger than the upward leading ones γ_1^u, γ_2^u. In the steady state we will have

$$\gamma_1^d(1-e_1) - \gamma_1^u e_1 = 0, \gamma_2^d(1-e_2) - \gamma_2^u e_2 = 0, \quad i.e.,$$
$$e_1 = \frac{\gamma_1^d}{\gamma_1^d + \gamma_1^u} = \frac{1}{1+\gamma_1^u/\gamma_1^d}, e_2 = \frac{\gamma_2^d}{\gamma_2^d + \gamma_2^u} = \frac{1}{1+\gamma_2^u/\gamma_2^d}$$

This suggests that for plausible values of e_1, say values greater than 50%, the parameter γ_1^u must be significantly less than γ_2^d.

Taken together we have as laws of motion for this economy with three labor market segments the differential equations (where everything is expressed per unit of capital and denoted in lowercase letters):

$$\hat{\omega}_1 = \beta_{we}(\frac{\bar{y}/\bar{z}_1}{l_1^s} - \bar{e}_1) + \beta_{we_2}\frac{\bar{y}/\bar{z}_2}{l_2^s} - \beta_{wd}d/l^s + \beta_{w\omega_1}(\omega_1^o - \omega_1) \quad (9.7)$$

$$\hat{l}^s = n - \bar{y}(1 - \omega_1/\bar{z}_1 - \bar{\omega}_2/\bar{z}_2) \quad (9.8)$$

$$\hat{l}_1^s = -\gamma_1^d + (\gamma_1^d + \gamma_1^u)\frac{\bar{y}/\bar{z}_1}{l_1^s} + n - \bar{y}(1 - \omega_1/\bar{z}_1 - \bar{\omega}_2/\bar{z}_2) \quad (9.9)$$

$$\hat{d} = \gamma_2^d - (\gamma_2^d + \gamma_2^u)\frac{\bar{y}/\bar{z}_2}{l_2^s} + n - \bar{y}(1 - \omega_1/\bar{z}_1 - \bar{\omega}_2/\bar{z}_2) \quad (9.10)$$

where the statically endogenous variable l_2^s is given by $l_2^s = l^s - l_1^s - d$. This represents a

[88]Note that law of motion for $\hat{L}_2^s$ is more complex, since there are more flows in and out of this market. The value of l_2^s can however be determined residually in the following presentation of the model.

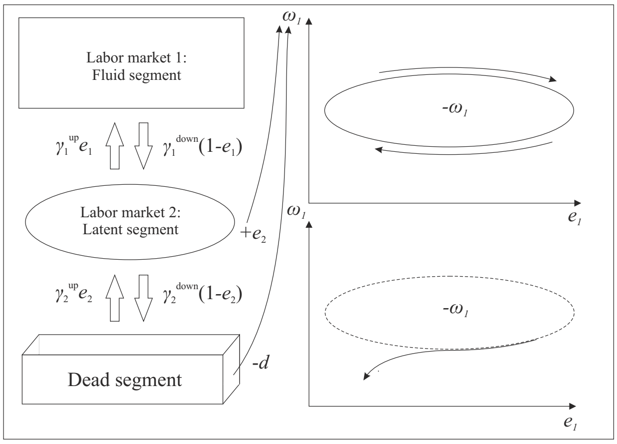

Figure 9.1: The flow of workers between the segments of the labor market.

description of the reserve army mechanism with the three segments of the labor market he assumed as typical for its working under the capitalism of his time.

We summarize the structure of the considered economy by way of figure 1. Figure 1 shows on its left hand side the flows occurring between the segments of the labor market which are therefore not completely separated from each other, but segmented to a degree that is mirrored through the size γ parameters. The figure top right shows an example of a Goodwin type distributive cycle which will be modified to a convergent dynamics if the real wage barrier term is added to it, here simply visualized by the $-\omega_1$ -expression in the center of it, the real wage of the workers in the fluid part of the labor market. The arrows in the middle indicate the forces that impact the fluid labor market because of the presence of the other two labor markets, namely the state of employment in the latent part of the labor market as measures by the employment rate e_1 and the size of the stagnant segment of the labor market, d, here measured relative to the size of the capital stock. The size of the first variable has a positive impact on the wage claims made in the fluid labor market while the size of the second one has a negative effect on the wage negotiations. The analysis of the model in subsequent section will show that these feedbacks arising from the lower labor markets onto the dynamics in the first one will add destabilizing forces to the distributive cycle generated in the fluid part of the labor market, as indicated in the figure bottom right.

9.3 Steady state and stability analysis

Since we have constructed the dynamics around given parameter values, the steady state, where time derivatives are zero, can easily be determined:

$$\omega_1^o = \frac{1 - n/\bar{y}}{1/\bar{z}_1 + \alpha/\bar{z}_2} \tag{9.11}$$

$$e_1^o = \frac{\gamma_1^d}{\gamma_1^d + \gamma_1^u}, l_1^{so} = \frac{y/\bar{z}_1}{e_1^o}, \quad e_2^o = \frac{\gamma_2^d}{\gamma_2^d + \gamma_2^u}, l_2^{so} = \frac{y/\bar{z}_2}{e_2^o} \tag{9.12}$$

$$l^{so} = l_1^{so} + l_2^{so} + d^o, \ \overline{d/l} = d^o/l^{so} \tag{9.13}$$

where the two latter equations are easily solved for the steady state values of l^s, d. For the stability of the 4D dynamical system around this steady state it is first of all important that the determinant of the Jacobian J^o at the steady state is positive. This determinant in the case where d/l is unimportant in the wage Phillips curve ($\beta_{wd} = 0$) is given by:

$$|J_o| = \begin{vmatrix} - & - & + & + \\ + & 0 & 0 & 0 \\ + & 0 & - & 0 \\ + & + & - & - \end{vmatrix}$$

Exploiting the linear dependencies between the various rows of this Jacobian quickly allows to calculate the determinant of J^o. The fact that it is positive implies that a loss of stability can only occur by way of so-ca;ed Hopf-bifurcation through the death or the birth of an attracting limit cycle (called sub- or supercritical Hopf-bifurcations, respectively).

Feedback chains that may create instability in this way are the two +...+ chains shown in the following substructure of J^o :

$$J_o = \begin{pmatrix} & - & + & + \\ + & & & \\ + & & & \\ + & & & \end{pmatrix}$$

In this particular case we face however no difficulty with respect to the sum of principal minors of order 2, J_2, of the shown Jacobian, since the entries $-J_{21}J_{12} > 0$ dominate the sign of J_2 since they have the weight l^{so}, while the negative off-diagonal products in the last matrix only have weights l_1^{so}, d^o with respect to otherwise equal products. The principal minors of order 2 therefore do not create stability problems through the positive feedback chains they contain. Similar arguments can be made with respect to the minors of order 3, while the ones of order 2 are obviously zero or positive. According to the Routh-Hurwitz Theorem this indicates that an increase of the parameter β_{we_2} need not endanger the stability of the steady state of the model. This is astonishing, since the terms $J_{14}J_{41}, J_{13}J_{31}$ seem to suggest the opposite.

In figure 2 we start by showing two phase plots, a projection into the Goodwin cycle on the first labor market (2a) and a projection of the interactions between the fluid and the dead segment of the labor market (2b). We can see that the Goodwin cycle is now convergent (due to the error correction term in the wage Phillips curve as in Blanchard and Katz (1999) in particular), but otherwise of the same kind as the original Goodwin cycle. The dead and the fluid segment in the labor market appear to be largely negatively correlated, as one would expect, so that the dead segment is reduced in extent when the first labor, and with it the second one, is showing higher utilization rates. [89]

[89]The simulations serve mainly illustrative purposes of the theoretical model and do not depend sensitively on specific choices from the economically meaningful parameter space.

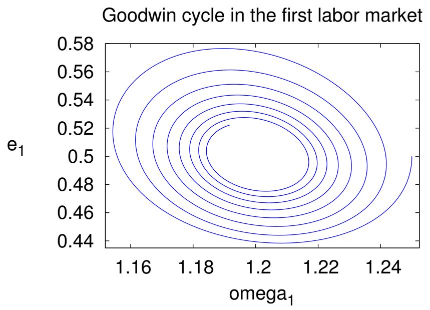

Figure 2a

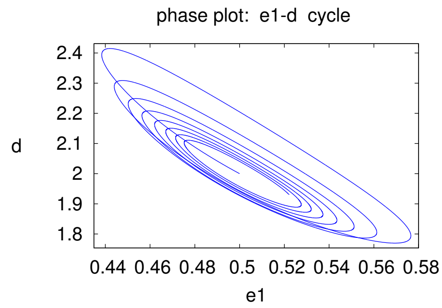

Figure 2b

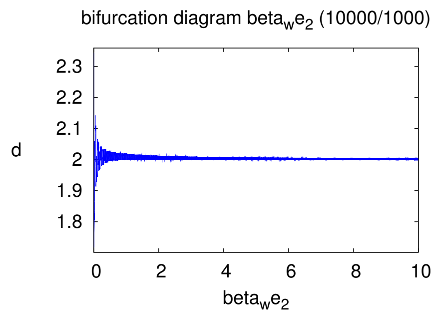

Figure 2c

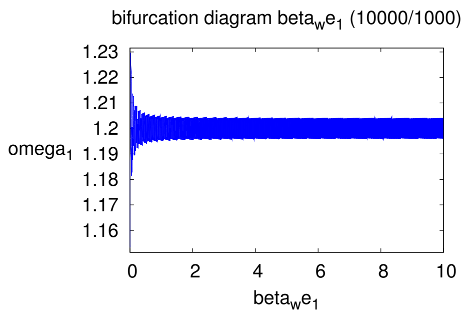

Figure 2d

In figures 2 c and d we show two bifurcation diagrams [90] which suggest that increases in the parameter β_{we_2} are indeed stabilizing as we have already suggested above. [91] Despite the existence of positive feedback loops the interaction of the three labor market segments is therefore not becoming more problematic if the first labor market becomes more sensitive to what happens on the second labor market, where low income work is performed. The same however does not hold true when the impact of the dead segment of the labor market on the wage formation process in the first labor market is increased (by an increasing parameter β_d). The positive feedback loop now sits in the first principal minor of order 2, top-left in the matrix J^o, and thus in the part where multiplication with l^{so} takes place when the sum of the principal minors is formed.

[90] The bifurcation analyses have been made with the E&F Chaos software of Diks et al. (2008). The program code and the exact parametrizations, which are not crucial for the qualitative implications as long as staying in an economically meaningful range, can be obtained by the authors upon request. The program applies the Runge-Kutta algorithm to run our continuous-time model with a step-size of 1/100.

[91] Noting that here transient periods of 30 and respectively 100 years and a plot of a state variable for 10 years were used. Convergence is however slow, see the vertical scale on the figure 2d, where 300 years of transient behavior have been omitted.

$$|J_o| = \begin{vmatrix} - & + & 0 & - \\ + & 0 & 0 & 0 \\ + & 0 & - & 0 \\ + & + & - & - \end{vmatrix}$$

It therefore dominates the other terms that contain the parameter β_d, see the entries in the matrix shown below, which implies that choosing this parameter sufficiently large will make the considered sum negative and thus violate one of the stability conditions of the Routh-Hurwitz theorem. The dynamics will therefore become an unstable one by way of a sub- or supercritical Hopf-bifurcation in general.

$$J_o = \begin{pmatrix} & + & & - \\ + & & & \\ & & & \\ + & & & \end{pmatrix}$$

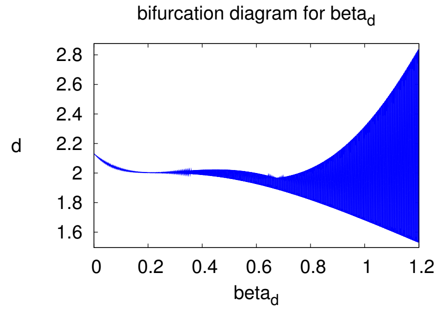

Figure 3a

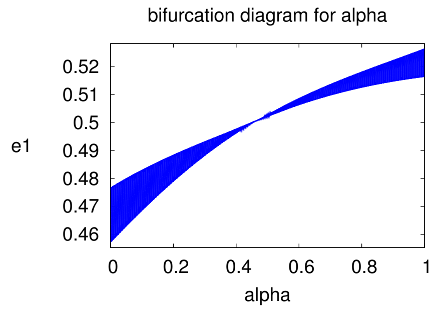

Figure 3b

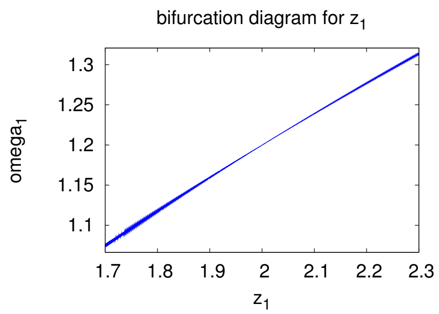

Figure 3c

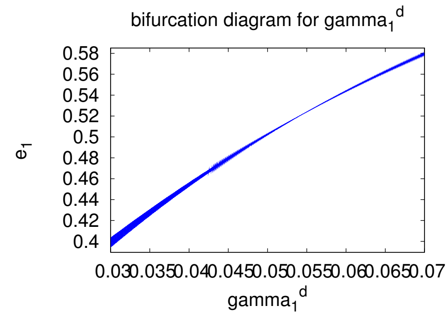

Figure 3d

Figure 3a shows what we have just discussed in analytical terms. It exemplifies that volatility is increasing by way of a ten year time window after transient phase of 30 years. With respect to the same time window we also consider such robustness test also for the parameters α, z_1, γ_1^d. The results for the parameter z_2 are nearly identical to the ones for the parameter z_1 and show that labor-saving technical change increases the employment rate in the first labor market. The same holds true for the parameter α which means that improvements in the income of low wage workers do not deteriorate the economic position of the economy. However, increasing the speed with which workers are transmitted from the first into the second labor market does the same thing and provides therefore an example where downward flexibility improves the economy from this partial perspective.

Instability with respect to an increasing role of the dead segment of the labor market on the wage bargain in the fluid labor market is however only one problematic feature of the existence of a dead weight in the labor market. As is well-known there are many further social consequences of a large D in the total labor supply L^s, such as increasing crime, drug consumption, prostitution and the like. Moreover, political instability may arise from such a segment as Chancellor Bismarck of Germany was one of the first to notice and to pay attention to (as a political leader of his time and from a conservative point of view). From a current German point of view there is however a lack of consciousness among current political leaders of what the long-run consequences of the persistent generation of so-called Hartz IV families with very low and insecure wage income and very low payments to retired people will be.

9.4 Active labor market policy and an employer of last resort

We have so far considered an economic system with three labor markets, a fluid one (the center economy), a latent one (coming from the periphery) and a stagnant one (where labor supply lives in the slums, where people primarily live on charity through the other members of the workforce whereby part of the latter's consumption demand is simply redistributed).[92] This segment of the labor market is however not totally a 'stagnant' one, since the parameter γ_2^u provides the extent by which its members can return to the latent segment of the labor market, depending on the rate of employment in this market. Workers employed in this second, latent portion of the labor market receive a given (minimum) real wage, while the fluid labor market works in the way it is assumed to work in the context of models of the distributive cycle. We have abstracted in this extension of the Goodwin model finally from any social legislation, and thus have assumed that the unemployed in the two active labor markets are living on the basis of the income of the families they are belonging to, as it is for example often the case in Spain and its larger family structures.

In the present section we now not only introduce an unemployment benefit system (augmented by a civic work below) for the two active labor markets of the model and we also

[92] We view the third segment of the labor market – when increasing – as being on the way to such a social structure, related to alcoholism, drug dealing and consuming, youth gang formation and racism.

assume that the system can be made watertight in the downward direction, i.e., the massive generations of a totally degraded workforce is no longer possible in it. Of course, there may exist disabled people of various kinds, but this is not a problem a macro-model has to deal with, so that we can simply assume that $\gamma_2^d = 0$ is established through a social network for the unemployed, performing now civic work for the society, civic work which supervised by the public sector, but organized on a private level.

We now consider this second labor market more of the type of a lower income sector, providing the base income corresponding to a basic consumption basket of an advanced capitalist economy but representing 'atypical employment', a seemingly necessity in current capitalism where such additions to the permanent staff are demanded by firms (here in the amount $Y/\bar{z}_2$. Moreover, we postulate that the public sector can demand services (called civic work which may be organized by modern communication techniques through social networks) from the unemployed (who are all receiving unemployment benefits at the base income level just discussed). The organization of these (social) services of course demands microeconomic coordination, with appropriate incentive as well as sanction schemes, and with an organizational structure based on electronic networking and the like.

We thus assume now the existence of a public Employer of 'Last Resort' who organizes with the help of (electronic) self-organization of the members of the civic work segment the employment (including processes of life-long-learning) of those workers who are not employed by capitalist firms in the first and second labor market. The public sector thus tries to improve the living conditions in the second labor market as much as possible and administers the funds (received from the workers employed in the first labor market) for the privately unemployed and also conducts a system of social services (in a broad sense of this word) supplied by the 'unemployed' (including skill preservation, processes of life long learning and the like).

We are therefore assuming for the Goodwin model with segmented labor markets $\gamma_2^d = 0$, the existence of sufficient unemployment funds B, which are depleted by the current base wage payments $\bar{\omega}_2$ to civic work (a historical subsistence wage which is nevertheless significantly 'better' than what currently happens in the Hartz IV sector of the German economy) and refunded by taxation of the income of workers ar the rate τ_b in the first labor market, and the adequate microeconomic organization of civic work which is neutral in its effects with respect to the work done in the private sector of the economy. We are also assuming on this basis that the homogeneity of the universal skills of the total workforce is preserved in this way. Due to this homogeneity of the workforce we can therefore now measure all employment rates in reference to L^s solely and thus can express the rate of employment in the civic work sector in residual form by $e_s = S/L^s = 1 - e_1 - e_2$. As the model is formulated we have however no 'ALG1' payments (unemployment benefits to workers in the first labor market for a limited time period $> \bar{\omega}_2$), since this would introduce a time structure in unemployment benefits which would increase mathematical complexity, without enriching the considered macro-structure very much. Moreover, since there is no delay in the adjustment of the workforce of firms, an activating labor market policy is not yet a meaningful topic here.

In order to apply this, we start again from the 4D model of unrestricted capitalism:

$$\begin{aligned}
\hat{\omega}_1 &= \beta_{we_1}(L_1^d/L_1^s - \bar{e}_1) + \beta_{we_2}L_2^d/L_2^s - \beta_{wd}D/L^s + \beta_{w\omega_1}(\omega_1^o - \omega_1) && (9.14)\\
\hat{l}^s &= n - \bar{y}(1 - \omega_1/\bar{z}_1 - \bar{\omega}_2/\bar{z}_2) && (9.15)\\
\hat{l}_1^s &= -\gamma_1^d + (\gamma_1^d + \gamma_1^u)L_1^d/L_1^s + n - \bar{y}(1 - \omega_1/\bar{z}_1 - \bar{\omega}_2/\bar{z}_2) && (9.16)\\
\hat{d} &= \gamma_2^d - (\gamma_2^d + \gamma_2^u)L_2^d/L_2^s + n - \bar{y}(1 - \omega_1/\bar{z}_1 - \bar{\omega}_2/\bar{z}_2) && (9.17)
\end{aligned}$$

With the introduction of civic work the stagnant segment of the labor market has been eliminated by assumption. This implies that $d/l^s = 0$ has to be replaced by $s/l^s, s = S/L^s$ with S the current number of civic workers. Based on this, we get as laws of motion for real wages and the labor markets of the economy the following ones (β_{wd} replaced by β_{ws} now).

$$\begin{aligned}
\hat{\omega}_1 &= (\beta_{we_1} + \beta_{ws})(e_1 - \bar{e}_1) + (\beta_{we_2} + \beta_{ws})(e_2 - \bar{e}_2) + \beta_{w\omega_1}(\omega_1^o - \omega_1) && (9.18)\\
\hat{l}^s &= n - \bar{y}(1 - \omega_1/\bar{z}_1 - \bar{\omega}_2/\bar{z}_2) \text{ or } \quad \hat{e}_1 = \bar{y}(1 - \omega_1/\bar{z}_1 - \bar{\omega}_2/\bar{z}_2) - n && (9.19)
\end{aligned}$$

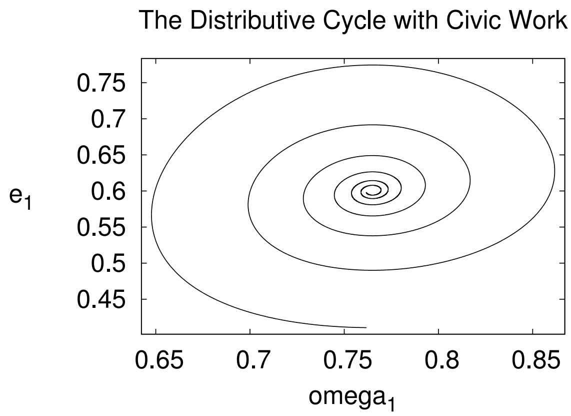

Figure 4: A damped reserve army mechanism in the first labor market

with

$$\begin{aligned} e_1 &= \frac{\bar{y}/\bar{z}_1}{l^s}, \quad e_2 = \frac{\bar{y}/\bar{z}_2}{l^s} = \frac{\bar{z}_1}{\bar{z}_2}e_1, \quad \bar{e}_2 = \frac{\bar{z}_1}{\bar{z}_2}\bar{e}_1, \quad \bar{e}_1 \text{ exogenously given} \\ \omega_1^o &= \bar{z}_1(1 - \frac{\bar{\omega}_2}{\bar{z}_2}) - n\frac{\bar{z}_1}{\bar{y}}, \quad l^{so} = \frac{\bar{y}}{\bar{z}_1\bar{e}_1} \end{aligned}$$

where l^{so} is the steady state solution of equation (18) and where the steady state value for the real wage is obtained from equation (19). The fact that $\bar{e}_1$ is exogenously given corresponds to the respective negotiation power of the labor and the capital side. As $\bar{e}_1$ is a kind of NAIRU that is not inflationary, it can only be achieved by a balance of power between the two production factors. By the choice of the benchmark levels of the employment rates we have adjusted the steady state of the model in principle to the one of the model of unrestricted capitalism (as far as their common features are concerned). Moreover, our modification of the model has brought us back to the basic format of the Goodwin model, with the stabilizing real wage barrier term in addition now. The model of this section is therefore obviously globally asymptotically stable as exemplified in the simulation of the model shown in figure 4.

The elimination of the stagnant segment is achieved by a policy that erects an unemployment benefit system embedded into a civic work structure with reserves B as follows:

$$\dot{B} = \tau_b\omega_1 L_1^d - \bar{\omega}_2(1 - (e_1 + e_2)L^s) \tag{9.20}$$

Workers employed in the first labor market are now taxed with rate τ_b in order to create inflows into the reserves of an unemployment benefit system. The outflow goes to unemployed workers of type 1 and 2 who receive the wage of the employed workers of type 2 as unemployment benefits and have to provide civic work in return (besides their skill preservation activities). This policy at least guarantees skill preservation for workers of type 1 and 2, by employing the $(1-e_1)L_1^s + (1-e_2)L_2^s$ workers as an 'Employer of Last Resort' in public institutions, which provide social services and more, yet work that is not in competition with the activities occurring in the private sector of the economy. The normal skils of the potentially unemployed people are therefore kept intact at least as suppliers of work of type 2. A labor market reform along these lines thus eliminates the existence of a stagnant segment on the labor market. Nevertheless, we still consider this as very basic reforms of the labor market institutions, yet one that is significantly superior to the Hartz IV system of Germany.

We have for the variable $b = B/K$, the benefit funds per unit of capital, the law of motion

$$\dot{b} = \frac{\dot{B}}{K} - b\hat{K} \tag{9.21}$$

$$= \tau_b \omega_1 \bar{y}/z_1 - \bar{\omega}_2(1 - e_1 - e_2)l^s - \bar{y}(1 - \omega_1/\bar{z}_1 - \bar{\omega}_2/\bar{z}_2)b \tag{9.22}$$

$$= (\tau_b \omega_1 e_1 - \bar{\omega}_2(1 - e_1 - e_2))l^s - \bar{y}(1 - \omega_1/\bar{z}_1 - \bar{\omega}_2/\bar{z}_2)b \tag{9.23}$$

with $e_1 = \frac{\bar{y}/\bar{z}_1}{l^s}$, $\quad e_2 = \frac{\bar{y}/\bar{z}_2}{l^s}$. In the steady state this gives

$$b^o = \frac{(\tau_b \omega_1^o \bar{e}_1 - \bar{\omega}_2(1 - \bar{e}_1 - \bar{e}_2))l^{so}}{n}$$

This expression shows that the parameters of the model have to be determined with care such that the wage income after taxes of households of type 1 is of an appropriate size. Moreover, the law of motion for b is a stable one as long as the prerequisite of a converging core model (equations (18)- (19)) is met.

The case of Germany in recent decades provides an example where things went wrong eventually after a long post-war prosperity phase due to a lack of cooperating corporatism between capital and labor primarily in the question of income distribution. It is shown in Flaschel and Greiner (2009) that adding minimum real wages as well as maximum ones to the distributive cycle can reduce its amplitude significantly both in the prosperity phase and the depressed phase. The reserve army of unemployed thus thereby is reduced in the depression, and the social degradation of part of the workforce avoided. But in the prosperity phase, unions in Germany did not think in terms of the reserve army mechanism and did not consider ceilings to their real wage claims. Chancellor Willy Brandt supported indirectly this behavior when he proclaimed that full employment would now be maintained forever. But the overshooting income claims mechanism worked in this context (leading first to stagflation and later on to stagnation without inflation). By contrast, minimum real wage legislation was not taken seriously after the Iron Curtain came down, neither by the social democrats who under Chancellor Schröder implemented the Hartz I – IV reforms, nor under Chancellor Merkel where the discussion about minimum wages was only conducted from a very microeconomic perspective. The result of such policies was the establishment of a progressively increasing low-income or part-time labor market segment and from there the flow of workers into Hartz VI which can by and large be considered a stagnant segment from the perspective of the social standards of the fluid segment of the labor markets in Germany.

These policies opened watergates on the labor market into a downward direction and contributed significantly to a return of a labor market structure as modeled in this thesis. Lacking insights into the reserve army mechanism on both sides of the conflict about income distribution (concerning agreements on both maximum and minimum real wages) as well as on both sides of the political spectrum in Germany (concerning resistance to processes of social degradation within the workforce) have now led in Germany to a situation where processes of social segmentation are difficult to overcome (even if policy would be willing to act accordingly).

The 1960's and early 1970's (where the insight into the working of capitalism and the reserve army mechanism was totally neglected) can thus be considered as a time of lost chances, since maximum and minimum real wages are easier to negotiate and implement by law in prosperity phases. To a certain degree the consequences of this failure was the disintegration of the concepts that constituted the German way to a 'Social Market Economy' into the direction of low income work and widespread poverty and its social consequences.

9.5 Historical origins and political perspectives

9.5.1 Social Legislation under Bismarck

The unrestricted working of the distributive cycle is not a viable way an advanced capitalist economy can reproduce itself in the long-run. We conclude that from what is shown in Figures 3a–3d and in the analysis accompanying it. The first person who became fully aware of this fundamental problem of capitalism on the side of the ruling classes was definitely Otto von Bismarck, Prime Minister in Prussia (appointed in 1862), and later on Chancellor in the German Empire which was founded in 1871 with Wilhelm I as first German emperor (and king of Prussia). When the last German emperor – Wilhelm II – came into power in 1888, the time of Bismarck as politically influential German chancellor was soon over, since Wilhelm II intended to make his own type of in fact internationally and nationally unbalanced policy. Bismarck thus resigned from his chancellorship in 1890.

The social legislation initiated by Bismarck was by no means an act of humanism, but a reflected strategic reaction to the social movements which the conflict between capital and labor in the sphere of production and about income distribution had created. A similar observation may hold for the Cold War period after World War II, while the opposite happened after the fall of the Iron Curtain in the 1990s, which was preceded however by Reaganomics and Thatcherism in the 1980s in the Anglo–Saxon world as a reaction to the stagflation of the 1970s. These latter deregulation policies did not at all pay attention to the social consequences they caused (compared to the prosperity phase after WWII).

Otto von Bismarck was born as a member of the Prussian landed aristocracy and after his education soon became part of the Prussian Parliament as a Conservative. As chancellor of the new Empire, Bismarck soon started to deal with social legislation though his first domestic measures were aimed at the role of the Catholic Church and its influence. These actions are known as 'Kulturkampf' and can be regarded as part of secularization though this was not the aim. A main success was the introduction of 'civil marriage' but the results of the 'Kulturkampf' were not generally successful with regard to the influence of political parties. One of Bismarck's aims had been to reduce the influence of the Catholic-oriented parties, such as the German Centre party. Therefore he even cooperated with the liberal parties in spite of significant areas of disagreement.

The failed revolution of 1848 as well as the social situation of the working class had raised the interest in the population of the German states in social issues, although the 1848 revolution was mainly part of a civil movement with the aim of a German unification. But after 1848, the first worker unions were established and socialist parties were founded. Thus, an important working class movement could develop with socialist parties, unions, and other working class organizations with the intention to improve the economic and social situation of the workers. Bismarck succeeded in 1878 to implement an 'antisocialist law' with the help of conservative and national-liberal parties, but the socialist movement nevertheless grew stronger so that the law was not renewed in 1890. Bismarck's best known and certainly most important decisions were the implementation of the world's first social legislations. Those are supposed to have been established not only due to the insight in the necessity for the state to improve the burdensome lot of workers, but also due to the fact of the increasing influence of the social-democratic party. Bismarck hoped to reduce this influence by introducing several social laws. These were mainly insurance bills so that the workers of the economy were not left unprotected.[93] Bismarck was aware of the bad working conditions and willing to improve them, but wanted at the same time to avoid regulations that could harm the economy.

Three areas of risk were regulated starting with the Health Insurance for part of the

[93] See Eurofound (2009) and van Meerhaeghe (2006)

workers in 1883 which was transferred into Health Insurance Act for most of the workers. This is the starting point of Medical Care in Germany. The Health Insurance was financed by contributions of employees (two-thirds of the sum) and employers (one-third of the sum). In 1884, The Accident Insurance Act followed which was of high relevance especially for workers in particulary dangerous establishments. This insurance was paid by employers who otherwise had to pay for workers who suffered an accident. The Law of Invalidity and Old Age Insurance for workers, journeymen and apprentices was the third social law in 1889 which was the starting point of a general old age pension insurance. Employers and employees had to pay each half of the costs which was also subsidized by the state.[94] Thus, the social security legislation which was implemented by Bismarck can without doubt be regarded as a first step towards a welfare state though the situation of working families remained difficult in the 19th century.

It was criticized as 'Staatssozialismus' especially by the liberals but in 1881 Bismarck even made a prediction:

> *It is possible that our policy may be reversed at some future time when I am dead; but State Socialism will make its way.* (Busch 1898)

There are also reasons for the remaining bad situation of workers to be found in Bismarck's social laws themselves, since, for example, not all workers were included in the three laws and not all possible cases were considered, at least not at the beginning. Other critical points are related to the fact that the Old Age Program allowed only payment after 30 years of work and not before the age of 70 though the average age expectation was below 50 at that time. As David Khoudour-Casteras (2008) shows, there was a notable positive effect of the social legislation with regard to the German emigration (mainly to the United States) since many Germans now decided to abandon their migration plans.

[94] See Holborn (1969)

9.5.2 Civic Work as a key factor of future labor market policy

Social legislation (based on democratic principles) may be the prerequisite to put workers, who were lost and deprived of their skills in the dead segment under unregulated capitalism, back to a meaningful occupation with adequate living conditions. We will deal with the question of what such a social legislation can look like to guarantee (re-)integration into work-life and the society and to create a positive perception for those people employed through an active labor market policy.

Active labor market policy must be conducted complementarily to the presence of free market hiring and firing in the fluid segment of the labor market. It is not meant to crowd-out skilled workers of the first segment, but to provide a safety net for those kicked-out due to the business cycle component in macroeconomic development. Besides the social benefits arising from an appropriate social legislation, skill-preservation is the second major function of the civic work system to be established. If a worker becomes unemployed in the competitive first labor market, she should be immediately supported by a governmental labor market agency to secure her income by unemployment benefits. Unemployment benefits could be paid out of a kind of insurance scheme as it is done today in Germany. When she is no longer entitled to receive them after a while and has not found a new job, she might enter the civic work program offered to everybody by the state. It can be tax-financed by the workers occupied in the fluid segment who will likely have a rather high-income on average. Of course, this is only one possible financing scheme, actually the one used in our formal model. This way of financing is chosen for the sake of keeping the model simple and to avoid unnecessary complications. But from societal point of view it might also be opportune to tax firms' profits as well.

Payments in the civic work program might no longer depend on previous income, but are equal for everyone, though they should take into account family backgrounds. Summarizing, one can briefly outline the principles and objectives of civic work as follows: Civic work has to be conducted in a tit-for-tat manner, which means that support by the state is granted in exchange for an obligation to work. This principle must be applied to the extent the participants of the program are actually able to work. The term workfare has been discredited in recent times, but might capture the principle quite well as long as it is understood in a technical way.

One of the main advantages of a civic work system is that it stops stigmatizing unemployed people. Under civic work the formerly unemployed people would contribute their part to the community. Lifelong learning being a major ingredient of the civic work proposal to preserve and even enhance the skills of individual workers. This can be achieved by employing those skills in a meaningful way to the benefit of the community and give all participants the opportunity to adjust their set of skills to the demand of potential employers in order to raise the probability of matching on the competitive labor markets.

The matching problem has not only to be solved in the first labor market, but in the area of civic work too. The society is in need of several services not provided by the market. Civic workers who are willing and capable of delivering those services must be assigned to the respective ”jobs”. As it turns out, this is also a matching problem which does not have to be solved top-down by a governmental authority, but in an intelligent bottom-up way. Means brought up by the information society might be of not underestimated help here.

This brings us naturally to the question of how to organize civic work. As already mentioned a guiding iron principle in contrast to former concepts of ”workfare” must be to organize civic work as a bottom-up approach and not top-down in an authoritarian way. The government could introduce and use e.g. e-civic-work online platforms to support the matching process of skills due to a demand and supply principle. Government might provide some of the resources for this allocation device but should allow for self-organization of the virtual marketplaces. The platform should be run on a non-profit basis (this is something different than commercial social platforms like Facebook and the like). It can be programmed and maintained (as well as improved) by civic workers with appropriate qualifications.

Also voluntary input is possible: that means it is open to contributions from everyone and thus remains in the public domain. There are existing successful examples for open source (public domain) projects like the LaTex-community, which has provided a high-standard software tool for academic paper type setting for years with permanent improvements.

Possible civic work services include for instance: the schooling of adults as part of lifelong learning and skill preservation and enhancement, care for the elderly or children with respect to additional services which are not provided under competitive market conditions, community projects of all kinds (which could not be financed otherwise), which demand a wide range contributions from construction work to service in libraries, engagement in community politics, support of local sports clubs and many more.

However, a crucial point which is not to be neglected is the question of the transition to such a system of civic work. If a government should decide to implement civic work as we have put it forth, no masterplan would be needed. Some rules at the beginning would provide for an "organic" generation of a robust and efficient civic work system. The government would have to give organizational principles when pursuing the goal of establishing civic work as we understand it. Guidelines and basic rules are needed, but no planning in detail from top. Self-organizing and learning by doing are from an evolutionary point of view superior principles to design any kind of such a admittedly complex system.

9.6 Conclusions

In this chapter, we started from a baseline version of the Goodwin (1967) model of the distributive cycle which describes the implications of the reserve army mechanism of capitalist economies. We have added to this model segmented labor markets. The models exhibited a unique steady state solution which depends on the speeds with which workers are pushed into or out of the labor market segments. We investigated the stability properties of this model and found that, though there was a stabilizing inflation barrier term in our wage Phillips curve, the interaction between the latent and the stagnant portions of the labor market generated potentially destabilizing forces.

We then introduced an active labor market policy where government acts as employer-of-last-resort thereby eliminating the stagnant portion of the labor market, whilst erecting an unemployment benefit system that sustains the incomes of workers that leave the floating labor market into the latent one. We showed that this policy guarantees the macro-stability of the economy's growth path. However, the affordability of such a structure needs a certain level of real wages and thus should be embedded into a model where there is growth of labor productivity. In such a system, where full employment is guaranteed, concerns about inflationary pressures should however be taken into account, see Desai (1973) for its initial treatment in the Goodwin model. We have therefore proposed a wage Phillips curve where elements of cautiousness are incorporated in a simple way, suggesting that more reflection is needed in order to design a wage management system that avoids strong inflationary pressure in the boom and that eschews the danger of deflation during recessions.

In the model of this chapter, we have assumed Say's Law and considered mainly the supply-side dynamics of the economy. It would be interesting, as an area of future research, to consider demand-side implications of introducing civic work through an "Employer of Last Resort". We postulate that the introduction of the demand-side channel, together with the appropriate policy refinement, will further add some stabilizing force that will minimize the amplitude of the business cycle. Furthermore, the consideration of the demand-side will provide a proper framework through which to compare the effects of various interventions on economic performance, e.g. civic work versus the Basic Income Grant.

Finally, we conclude that a reformed type of capitalism may be working much better compared to the unrestricted one, normally justified by international competitiveness pressures, where labor market segmentation can give rise to enormous economic and social problems. These problems can range from loss of social cohesion to social conflict and political instability.

9.7 References

Barbosa-Filho, N. and Taylor L., 2006. Distributive and demand cycles in the US economy - A structuralist Goodwin model. Metroeconomica 57, 389-411.

Blanchard, O. and L. Katz, 1999, 'Wage dynamics: Reconciling theory and evidence', American Economic Review, Papers and Proceedings, 89, pp. 69–74.

Blien, U., U. Walwei and Werner, H., 2002, 'Labour market policy in Germany. Job placement, unemployment insurance and active labour market policy in Germany', in: K.- S. Yoo and J. Chang (ed.), *Active labor market policies and unemployment insurance in selected countries*, Seoul, pp. 225–285.

Bosch, G. and Kalina, T., 2008, 'Low-wage work in Germany: An overview', in: Bosch, G. and Weinkopf, C. (eds), Low-Wage Work in Germany, New York: Russel Sage Foundation, pp. 19-112.

Bosch, G. and Weinkopf, C., 2008, Low-Wage Work in Germany, New York: Russel Sage Foundation

Bundesagentur für Arbeit, 2010: Monatsbericht Dezember und Jahr 2010. http://statistik.arbeitsagentur.de/cae/servlet/ contentblob/240798/publicationFile/115650/ Monatsbericht-201012.pdf

Desai, M., 1973, Growth Cycles and Inflation in a Model of the Class Struggle. Journal of Economic Theory 6, 572-545.

Diks, C., Hommes, C. Panchenko, V. and van der Weide, R., 2008, E&F Chaos: A user friendly software package for nonlinear economic dynamics. Computational Economics, 32, 221-244.

Eurofound, 2009, *Bismarck's Social Security Legislation* http://www.eurofound.europa.eu/emire/germany/bismarckssocialsecuritylegislation-de.htm)

Federal Statistical Office, 2011, Eckzahlen zum Arbeitsmarkt, Wiesbaden, Germany.

Fiorio, C., Mohun, S. and Veneziani, R., 2013, Social Democracy and Distributive Conflict in the UK, 1950-2010, Working Paper, No. 705, School of Economics and Finance, Queen Mary University of London.

Flaschel, P., 2009, Macrodynamics. Elements for a Synthesis of Marx, Keynes and Schumpeter. Heidelberg: Springer.

Flaschel, P. and Greiner A., 2009. Employment Cycles and Minimum Wages. A Macro View. Structural Change and Economic Dynamics, 20, 4, 279-287.

Flaschel, P. and Landesmann, M., 2008, Mathematical Economics and the Dynamics of Capitalism. The Legacy of Richard Goodwin Continued. London: Routledge Frontiers of Political Economy.

Franke, R., Flaschel, P. and Proaño, C., 2006, Wage-price dynamics and income distribution in a semi-structural Keynes-Goodwin model. Structural Change and Economic Dynamics 17, 452 – 465.

Glombowski, J., Krüger, M., 1984, Unemployment insurance and cyclical growth, in: R. Goodwin, M. Krüger, and A. Vercelli (eds.): Nonlinear Models of Fluctuating Growth. Heidelberg: Springer, 25 - 46.

Goodwin, R.M., 1967, A growth cycle, in: C.H. Feinstein (ed.): Socialism, Capitalism and Economic Growth. Cambridge, UK: Cambridge University Press, 54 – 58.

Goodwin, R. M., 1972, A Growth Cycle, in: E.K. Hunt and J.G. Schwartz (eds.): A Critique of Economic Theory. Harmondsworth: Penguin Books, 442–449.

Harvie, D., 2000, Testing Goodwin: growth cycles in ten OECD countries. Cambridge Journal of Economics 24, 349–376.

Holborn, H., 1969, A History of Modern Germany, Volume III, Princeton, NJ: Princeton University Press.

Khoudour-Casteras, D., 2008, 'Welfare state and labor mobility: The impact of Bismarck's social legislation on German emigration before World War I', Journal of Economic History, 68, pp. 211–243.

Marx, K., 1954, Capital, Volume I. London: Lawrence and Wishart.

van Meerhaeghe, M., 2006, 'Bismarck and the social question', Journal of Economic Studies, 33, pp. 284–301.

Mohun, S. and Veneziani, R., 2008, Goodwin cycles and the US economy, 1948 – 2004, in: P. Flaschel and M. Landesmann (2008): Mathematical Economics and the Dynamics of Capitalism. The Legacy of Richard Goodwin Continued. London: Routledge Frontiers of Political Economy.

Solow, R., 1956. A contribution to the theory of economic growth. Quarterly Journal of Economics 70, 65–94.

Solow, R., 1990, 'Goodwin's growth cycle: Reminiscence and rumination', in: K. Velupillai (ed.), Nonlinear and Multisectoral Macrodynamics,London: Macmillan, pp. 31–41.

Solow, R., 2008, 'The German Story (Introduction)', in: Bosch, G. and C. Weinkopf (eds), Low-Wage Work in Germany, New York: Russel Sage Foundation, pp. 1–18.

Taylor, L., 2004, Reconstructing Macroeconomics. Structuralist Proposals and Critique of the Mainstream. Cambridge, MA: Harvard University Press.

Tompson, W., 2009, 'The political economy of reform: Lessons from pensions, product markets and labour markets in ten OECD countries', OECD Publishing.

Veneziani, R., Mohun, S., 2006, Structural stability and Goodwin's growth cycle. Structural Change and Economic Dynamics 17, 437–451.

9.8 Appendix: Stability of balanced growth

In this section we investigate the stability properties of the Goodwin growth cycle model with the segmented labor markets which we have formulated above. We thus reconsider again the 4D autonomous system given by:

$$\hat{\omega}_1 = \beta_{we_1}(\frac{\bar{y}/\bar{z}_1}{l_1^s} - \bar{e}_1) + \beta_{we_2}\frac{\bar{y}/\bar{z}_2}{l^s - l_1^s - d} - \beta_{wd}d/l^s + \beta_{w\omega_1}(\omega_1^o - \omega_1) \tag{9.24}$$

$$\hat{l}^s = n - \bar{y}(1 - \omega_1/\bar{z}_1 - \bar{\omega}_2/\bar{z}_2) \tag{9.25}$$

$$\hat{l}_1^s = -\gamma_1^d + (\gamma_1^d + \gamma_1^u)\frac{\bar{y}/\bar{z}_1}{l_1^s} + n - \bar{y}(1 - \omega_1/\bar{z}_1 - \bar{\omega}_2/\bar{z}_2) \tag{9.26}$$

$$\hat{d} = \gamma_2^d - (\gamma_2^d + \gamma_2^u)\frac{\bar{y}/\bar{z}_2}{l^s - l_1^s - d} + n - \bar{y}(1 - \omega_1/\bar{z}_1 - \bar{\omega}_2/\bar{z}_2) \tag{9.27}$$

Since linear dependent expressions cancel in the calculation of the determinant of the Jacobian of this system at the steady position, we can simplify the right hand side of these equations as follows, without changing the sign of the determinant of this Jacobian:

$$\hat{\omega}_1 = \beta_{we_1}(\frac{\bar{y}/\bar{z}_1}{l_1^s} - \bar{e}_1) + \beta_{we_2}\frac{\bar{y}/\bar{z}_2}{l^s - l_1^s - d} - \beta_{wd}d/l^s \tag{9.28}$$

$$\hat{l}^s = \omega_1 \tag{9.29}$$

$$\hat{l}_1^s = (\gamma_1^d + \gamma_1^u)\frac{\bar{y}/\bar{z}_1}{l_1^s} \tag{9.30}$$

$$\hat{d} = -(\gamma_2^d + \gamma_2^u)\frac{\bar{y}/\bar{z}_2}{l^s - l_1^s - d} \tag{9.31}$$

After further reductions we arrive at the following form of aa truncated Jacobian of this dynamical system:

$$J_o = \begin{pmatrix} 0 & d/(l^s)^2 & 0 & -1/l^s \\ 1 & 0 & 0 & 0 \\ 0 & 1/(l^s - d)^2 & 0 & -1/(l^s - d)^2 \\ 0 & 0 & 1/(l^s)^2 & 0 \end{pmatrix}$$

This gives for the determinant of this Jacobian the expression:

$$J_o = (-d/l^s + 1)/[(l^s)^3(l^s - d)^2] = (1 - d/l^s)/[(l^s)^3(l^s - d)^2] > 0$$

since $d < l^s$ holds at the steady state.

With respect to the other stability conditions we have to consider the sign distribution within the Jacobian of the dynamical system:

$$\hat{\omega}_1 = \beta_{we_1}(\frac{\bar{y}/\bar{z}_1}{l_1^s} - \bar{e}_1) + \beta_{we_2}\frac{\bar{y}/\bar{z}_2}{l^s - l_1^s - d} - \beta_{wd}d/l^s + \beta_{w\omega_1}(\omega_1^o - \omega_1) \quad (9.32)$$

$$\hat{l}^s = n - \bar{y}(1 - \omega_1/\bar{z}_1 - \bar{\omega}_2/\bar{z}_2) \quad (9.33)$$

$$\hat{l}_1^s = -\gamma_1^d + (\gamma_1^d + \gamma_1^u)\frac{\bar{y}/\bar{z}_1}{l_1^s} + n - \bar{y}(1 - \omega_1/\bar{z}_1 - \bar{\omega}_2/\bar{z}_2) \quad (9.34)$$

$$\hat{d} = \gamma_2^d - (\gamma_2^d + \gamma_2^u)\frac{\bar{y}/\bar{z}_2}{l^s - l_1^s - d} + n - \bar{y}(1 - \omega_1/\bar{z}_1 - \bar{\omega}_2/\bar{z}_2) \quad (9.35)$$

which is given by

$$J_o = \begin{pmatrix} - & ? & ? & ? \\ + & 0 & 0 & 0 \\ + & 0 & - & 0 \\ + & + & - & - \end{pmatrix}$$

If the first term in the Phillips curve is dominating the second and the third one with respect to the state variable l^s, l_2^s, dso that the floating part dynamics of the model is in particular of the type of a Goodwin cycle $J_{12} < 0$ (with damped oscillations however) we in particular get[95]

$$J_o = \begin{pmatrix} - & - & + & + \\ + & 0 & 0 & 0 \\ + & 0 & - & 0 \\ + & + & - & - \end{pmatrix}$$

In addition to the stability result obtained above we see further stabilizing feedback channels at work. In the Goodwin subdynamics, i.e., the interaction of the state variables ω_1, l^s, we have again the result of section 2.3 of the distributive cycle without segmented labor markets. There are however also destabilizing feedback chains at work now. There is first the cumulative interaction of d, ω_1 in the laws of motion of real wages and of the stagnant segment of the labor market. And secondly, there is the cumulative interaction between the state variables l_1^s, ω_1 in the laws of motion for real wages and the latent segment of the labor market. Of course all these statements are made from a partial perspective concerning the principal minors of order 2 of the Jacobian J solely. There are no destabilizing adjustment processes in the trace of J. We however conclude from these observations that the stable Goodwin growth cycle within the floating element of the labor market is plagued by some positive feedback chains caused by the existence of the latent and the stagnant part of the labor market and their interaction with the real wage dynamics in particular. Should these feedback chains make the overall dynamics unstable this will occur by way of a Hopf bifurcation, through the death or birth of unstable or stable limit cycles, respectively, since the determinant of the system cannot change its sign, i.e., the roots of the Jacobian can only enter the positive part of the complex plane of complex numbers by becoming complex

[95] In order to get this result the conditions

$$\beta_{we_1}\frac{\bar{z}_2}{\bar{z}_1}(\frac{l_2^s}{l_1^s})^2 > \beta_{we_2}, \quad \beta_{we_1}\frac{\bar{y}}{z_1}(\frac{l^s}{l_1^s})^2, \beta_{we_1}\frac{\bar{y}}{z_1 l^s}(\frac{l^s}{l_1^s})^2 > \beta_{wd}$$

must hold. However, other cases with other stability properties are possible and thus make the outcome of this model of unrestricted capitalism somewhat ambiguous.

at the bifurcation point. The loss of stability therefore necessarily occurs in the presence of business fluctuations.