

FINANCIAL ASSETS, DEBT AND LIQUIDITY CRISES

A KEYNESIAN APPROACH

Matthieu Charpe, Carl Chiarella,
Peter Flaschel and Willi Semmler

Charpe, Chiarella,
Flaschel and Semmler
FINANCIAL ASSETS, DEBT
AND LIQUIDITY CRISES

'The global financial crisis has forcefully shown that financial factors – leverage, bankruptcies, bubbles – are major drivers of business fluctuations. By construction, mainstream macroeconomics does not account for them adequately. Charpe, Chiarella, Flaschel and Semmler, on the contrary, start from financial factors in building macroeconomic models. Whether you share their view or not, reading the book will be a most rewarding experience: the grand picture of macroeconomic developments they achieve is simply impressive.'

Domenico Delli Gatti, Professor of Economics, Catholic University of Milan

'The failure of mainstream economics in predicting and coping with the current crisis is under our eyes, and this has damaged the reputation of macroeconomics. The authors convincingly argue that their extended Keynesian approach might be more successful. This book is the answer to the often-heard accusation "You economists are useless." Hence all economists should read it.'

Giancarlo Gandolfo, Member of the Lincean Academy, Rome, and former Professor of International Economics at Sapienza University of Rome

'Mainstream macroeconomics has no good explanation for the booms and busts that are endemic in free-market economies. This book provides a convincing explanation. It stresses the interdependence of goods and credit markets and, in contrast to mainstream models, it puts the bounded rationality of agents at the center of macroeconomic dynamics. An eye opener.'

Paul De Grauwe, Professor of International Economics, University of Leuven

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Financial Assets, Debt and Liquidity Crises

The macroeconomic development of most major industrial economies is characterised by boom-bust cycles. Normally such boom-bust cycles are driven by specific sectors of the economy. In the financial meltdown of the years 2007–9 it was the credit sector and the real-estate sector that were the main driving forces. This book takes on the challenge of interpreting and modelling this meltdown. In doing so it revives the traditional Keynesian approach to the financial–real economy interaction and the business cycle, extending it in several important ways. In particular, it adopts the Keynesian view of a hierarchy of markets and introduces a detailed financial sector into the traditional Keynesian framework. The approach of the book goes beyond the currently dominant paradigm based on the representative agent, market clearing and rational economic agents. Instead it proposes an economy populated with heterogeneous, rationally bounded agents attempting to cope with disequilibria in various markets.

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A Keynesian Approach**

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$r_o, etc.$	Steady state values
$y = Y/K, etc.$	Real variables in intensive form
$m = M/(p_v K), etc.$	Nominal variables in intensive form
GBR	Government Budget Restraint

D. Commonly used abbreviations

AD	Aggregate Demand
ADF	Augmented Dickey-Fuller
AS	Aggregate Supply
BOJ	Bank of Japan
CAO	Central Application Office
CB	Central Bank
CDO	Collateralised Debt Obligation
CES	Constant Elasticity of Substitution
DSGE	Dynamic Stochastic General Equilibrium
ECB	European Central Bank
FED	Federal Reserve Board
GBR	Government Budget Restraint
GDP	Gross Domestic Product
GMM	Generalised Method of Moments
GNP	Gross National Product
IMF	International Monetary Fund
KMG	Keynes–Metzler–Goodwin
MBS	Mortgage Backed Security
METI	Ministry of Economy, Trade and Industry
MFT	Mundell–Fleming–Tobin
NAIRE	Non-Accelerating Inflation Rate of Employment
NAIRU	Non-Accelerating Inflation Rate of Unemployment
MOF	Ministry Of Finance
NDP	Net Domestic Product
NDP-F	Net Domestic Product at Factor costs
NNP	Net National Product
ODE	Ordinary Differential Equation
OECD	Organisation for Economic Co-operation and Development
OLG	OverLapping Generations
PC	Phillips Curve
PPP	Purchasing Power Parity
RBC	Real Business Cycle
RMBS	Residential Mortgage Backed Security
WB	World Bank

Preface

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.

(John Maynard Keynes, *The General Theory of Employment, Interest and Money*, 1936, p.159)

Deflation is also harder to fight than inflation. Over the past two decades central bankers have gained plenty of experience in how to conquer excessive price increases. Japan's ongoing inability to prevent prices falling suggests the opposite task is rather less well understood. Although it is true that heavily indebted governments might be tempted to erode their debts through higher inflation, there are few signs that political support for low inflation is waning.

(*The Economist*, 'The deflation dilemma', 3 June 2010)

The current macroeconomic development of the USA as well as of most major industrial economies is characterised by boom-bust cycles. Such boom-bust cycles start with overconfidence, expectations of high returns and overleveraging. Often an asset price boom goes hand in hand with a credit boom and rising prices. When a downturn is triggered, often initiated by a sudden bankruptcy or similar event, frequently entailing long-term protracted periods of low growth and low employment, prices may fall and periods of debt deflation are experienced. Normally such boom-bust cycles are driven by specific sectors in the economy. In the most recent boom-bust cycle, the credit sector and the real estate sector were the main driving forces.

To study such phenomena, this book takes a macroeconomic perspective. It uses a dynamic framework that builds on the theoretical tradition of non-clearing markets. The modelling philosophy behind most of the chapters of this book is of a Keynesian nature, representing an attempt to revive this theoretical approach on the working of the interaction of the financial market and macroeconomy from a fundamental perspective that also takes account of very recent developments. In its empirical application it refers to the various financial crisis episodes that the new century has already experienced.

The macroeconomic research approach that we employ differs in significant ways from the mainstream literature that uses the Dynamic Stochastic General Equilibrium (DSGE) approach as the basic modelling device. The key difference is that our approach represents an out-of-equilibrium approach which assumes that macrofoundations have to precede microfoundations. Most importantly, we dispense with the well-informed agents that are a key assumption of the rational expectations school. The main features

of the DSGE approach are – by contrast – the assumptions of intertemporally optimising agents, rational expectations, competitive markets and price mediated market clearing through sufficiently flexible prices and wages. Credit markets and financial markets have no particular role in this framework since all shocks are real shocks, coming from the real side of the economy. The New Keynesian approach to macroeconomics has, in the last decade or so, to a large extent, also adopted the DSGE framework, building on the intertemporally optimising agents and market clearing paradigm, but favouring more the concept of monopolistic competition, sticky wages and prices and nominal as well as real rigidities. An excellent description of this line of research is Eggertsson and Woodford (2003).

The focus of our approach in this book is to revive the Keynesian business cycle perspective on macrodynamics by giving a central role to the financial sector, as it was already formulated by Keynes (1936). It is well known that the intertemporal approach of smoothly optimising agents and fast adjustments in order to establish temporal or intertemporal marginal conditions in the product, labour and capital markets has not been very successful in matching certain stylised facts on those markets. A further deficiency of the intertemporal decision models is that macroeconomic feedback effects, in particular the ones that come from the financial sector – as well as their stabilising or destabilising impact on the macroeconomy – are rarely considered. Yet such feedback mechanisms, which are indeed relevant for the interaction of all three markets, have been central to the theoretical and empirical explorations by Keynesian authors since the 1930s. The emphasis of the topics here lies in the study of the relative strength and interaction of these feedback mechanisms as well as the transmission channels with respect to all three markets, those for labour, goods and financial assets. We are, in particular, interested in their impact on the stability of the economy once their working is considered in the context of a fully developed dynamical system approach.

We do not deny that forward-looking behaviour and (the attempt at) intertemporal optimisation by economic agents might be relevant for the dynamics of the economy, but in our view the exclusive focus on these issues in the present academic literature leaves completely to one side too many interesting, important and relevant issues. In particular, in the interaction of all three markets there may be non-linear feedback mechanisms at work which do not necessarily give rise to market clearing, nor necessarily to convergence towards a (unique) steady state growth path. Also, as recent research has shown, there is heterogeneity of agents and beliefs present in modern economies, as well as a large variety of informational, structural and financial frictions in the real world. We believe that this leaves many questions open so that the true understanding of the economy might better be pursued by a variety of frameworks. Often it is said with respect to the DSGE models that one needs to use an intertemporal optimising and rational expectations framework, otherwise one would leave ‘too much money on the sidewalk’. But one might also add, that by doing so, there is a danger that one might also leave too many problems in macroeconomics on the sidewalk.

Central points in our book on Keynesian macrodynamic theory, and its application to the study of the financial market and boom-bust cycles, are the mechanisms generating non-cleared markets and the phenomenon of disequilibrium recurrently present in certain markets such as the labour or goods markets. In contrast to the tradition that stresses the clearing of all markets at each instant of time,¹ in our modelling approach, as it will be stressed at several occasions throughout this book, disequilibrium situations are the main driving forces of wage and price inflation dynamics. Moreover, disequilibrium in financial markets is often generated by overleveraging in the real sector, the household sector as well as the financial sector of the economy. Some of the markets may act as either stabilising or destabilising forces through a variety of different macroeconomic channels such as the real wage feedback channel, product market, financial market as well as debt devaluation channels, showing that there are indeed different (and also valid) possibilities to specify and analyse the dynamics of the macroeconomy in a different way from that of the DSGE framework.

Due to the fact that in our modelling approach the stability of the analysed dynamical system is not imposed *ab initio* by the assumption of rational expectations (which requires that the economy always ‘jumps’ to some stable path and therefore always converges to the steady state after any type of shock), its stability properties (and its analysis) are based on the relative strength of the interacting macroeconomic and financial feedback channels. Such stability analysis, despite its importance for the understanding of the dynamics of an economy, does not seem to be relevant for the literature based on the rational expectations market clearing tradition and divergent paths (apart from anomalies) do not appear to be an issue there. However, the ongoing occurrence of ‘bubbles’ and ‘herding’ in financial markets worldwide, as well as the large macroeconomic imbalances present nowadays in the global economy through overleveraging indicate that such divergent paths can indeed take place in significant and sometimes long-lasting ways.

In our framework we finally dispense with another prominent assumption of mainstream economics, namely the assumption of a single representative household. In a capitalist economy there are – almost by definition – always at least two representative households to be considered, workers and asset holders. Of course, there exist more household types in actual economies and also hybrid configurations of them, but certainly not a single type as far as utility formation and budget constraints are concerned, as the current subprime and credit crises make obvious. Macroeconomic theory with only ‘Robinson Crusoe’, and not also ‘Man Friday’, not only ignores the conflict over income distribution and labour and employment issues, but also neglects the impact of financial and real boom-bust cycles on the labour market and job creation and destruction. The labour market will thus play an important part in our modelling strategy.

A number of professional colleagues, too numerous to name here, have contributed to the present project through stimulating discussions on various aspects of the subject

¹ This is really an heroic assumption in a continuous-time modelling framework.

matter of this book as well as on related research projects. We are also grateful for comments and criticisms we have received from numerous participants at presentations of aspects of the material of this book at numerous international conferences and research seminars. Of course, we alone are responsible for the remaining errors in this work. We are indebted to two anonymous referees who read the original version of the manuscript and offered many, even detailed, suggestions for its improvement. We also wish to thank Stephanie Ji-Won Ough of the University of Technology, Sydney 'UTS' for her excellent editorial work. Finally we would like to thank Chris Harrison of Cambridge University Press for all he has done to make the publication process go as smoothly as it has.

1 Financial crises and the macroeconomy

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 the 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?' Essays on Instability and Finance*, 1982, p. 213).

As the above citation from Hyman Minsky shows, one may think of modern macroeconomic development as a sequence of boom-bust cycles. Boom-bust cycles occur not only for specific sectors, but also for the entire macroeconomy. Macroeconomic boom periods are usually characterised by overvaluation of assets, overconfidence, expectations of high returns and undervaluation of risk, and by overleveraging. Bust periods reverse confidence and expectations. The current macroeconomic developments in the USA as well as in other regions of the world have features of a typical bust period that is characteristic of boom-bust cycles. In the boom period not only do prices increase but there is often also an asset price boom and credit boom. High asset prices serve as collateral for new borrowing. When a downturn starts, often initiated by a sudden bust, and frequently entailing long-term protracted periods of low growth and low employment, prices may fall and periods of debt deflation are often experienced. Normally such boom-bust cycles are driven by specific sectors in the economy. In the recent boom-bust cycle in the USA, the real estate and credit sectors were the main driving forces. Open economies may magnify those boom-bust scenarios.

Much theoretical and empirical work on the impact of the financial sector on the macroeconomy has been undertaken by different schools of economic thought. One currently prominent school builds on the theory of perfect capital markets, which are mostly assumed in intertemporal general equilibrium theory, which deals with stochastic growth and develops into Real Business Cycle (RBC) theory. Yet it is rare to find in the literature from this school explicit modelling of the interaction of credit, asset prices and real economic activity. In the context of that class of models it is in particular difficult to explain credit crunches and the rising default premia at the onset of the bust periods. Default or risk premia are explained on the basis of consumption-based asset pricing models, which have great difficulty in matching actual risk premia.

In contrast, many theoretical and empirical studies have applied the theory of imperfect capital markets. Moreover, there are other traditions, for instance, the Keynesian tradition as revived by Minsky (1975, 1986), Mishkin (1998), Kindleberger (2000) and Tobin (1975) that have been very influential in studying the interaction between financial markets and economic activity. This approach puts stress on how the instability of credit has a strongly magnifying effect on macroeconomic activity. Another important perspective on this interaction is that of Shiller (1991, 2001), which also explicitly deals with the overconfidence and overreaction in financial markets.

Our own thinking on these issues is heavily influenced by the Keynesian tradition. Yet one can also draw upon recent developments in information economics, as it has been developed by Stiglitz and others, wherein systematic attempts have been made to describe how actual financial markets operate. Many studies of financial markets, and this is Stiglitz's view, claim that a crucial impediment to the functioning of the financial system is asymmetric information. In this situation, one party to a financial contract has much less information than the other. Borrowers, for example, usually have much better information about the potential returns of their investment projects and the associated risks than do the potential lenders. Asymmetric information leads to two other basic problems: adverse selection and moral hazard. Adverse selection occurs when those borrowers with the greatest potential for default actively seek out loans. Moral hazard takes place after a transaction has taken place. Here, lenders are subject to hazards since the borrower has incentive to engage in activities that are undesirable from the lenders' point of view.

The Keynesian view as well as the information-based view of the financial markets explains why there is an important role for the government in the regulation and supervision of the financial marketplace. To be useful, proper financial architecture, regulation and supervisory mechanisms must aim towards the maximisation of access to information, while minimising overconfidence and underestimation of risk. This requires transparency and the creation of information through proper accounting, screening and monitoring. Firms and banks need to be required to adhere to standards of accounting and to make known publicly information about their sales, assets and earnings. Additionally, safety nets for institutions as well as for individuals are necessary to avoid the risks from a rapid liberalisation of financial markets. Before starting our formal analysis it is worthwhile for us to describe three types of typical financial crises that macroeconomies have experienced repeatedly over many decades.

1.1 Open economies, foreign debt and currency crises

The first type of crisis that we want to discuss is the financial crisis triggered by currency crises. In open economies the boom period is often accompanied by a consumption boom, huge consumption imports and current account deficits. Capital market liberalisation became popular during the 1980s and 1990s. Financial liberalisation has actively been advocated by such organisations as the International Monetary Fund (IMF) and the World Bank (WB) and has been pursued by many governments since the 1980s.

Liberalisation of capital markets was thought to generate a long period of expansion of the world economy due to the establishment of global markets for products and financial services.

Yet as others have warned the rapid liberalisation and enlargement of the financial markets may lead to more financial instability which, in turn, could be devastating, see for example Stiglitz *et al.* (2006). The Mexican (1994), Asian (1997/8) and Russian (1998) financial crises demonstrated the degree to which a too-rapid market liberalisation could lead to a currency crisis wherein a sudden reversal of capital flows is followed by financial instability and a consequent decline in economic activity. It is interesting to note that this very volatility and lack of trust, especially when combined with the increasing globalisation of markets, had also led to new financial products, spread across the world, and to heightened activity in these same markets. Usually the operations were undertaken with little or unchecked collateral on the borrowers' side.

In contrast to the foregoing view, the liberalisation of financial markets has been more positively evaluated by other schools of thought. An emphasis on the benefits of financial globalisation in general can be found within the American business and financial community, citing mainly the possible benefits of free capital mobility such as:

- reduced trading costs, and in particular low costs of financial transactions;
- an increase in investment returns;
- a lowering of the cost of capital when firms invest;
- an increase in liquidity in the financial market;
- an increase in economic growth and positive employment effects.

Certainly, capital market liberalisation has benefits. Yet, as mentioned earlier, there are also costs if it is done too quickly and imprudently, in particular with inappropriate sequencing.¹ Often the theory of perfect capital markets has been used in order to justify rapid and radical market liberalisation, in particular product and capital market liberalisation. Whereas some parts of the academic profession broadly continue to see the benefits of market liberalisation outweighing the costs, others see increasing problems, so that the strategy of rapid capital market liberalisation has recently come under scrutiny. Too rapidly liberalised capital markets, with a wrong sequencing, can trigger financial instability, contagion effects and strong negative external effects on the real side of the economy.

The negative externalities that can arise from rapid capital market liberalisation (CML) have been laid out in the recent book by Stiglitz *et al.* (2006). This book gives a fair account of the pros and cons of rapid CML. The major argument of the authors is that too rapid a CML leads to financial instability and to boom and bust cycles, hampering economic growth in the long run. Taking the view that capital markets are basically imperfect, they argue that free capital markets have significantly different

¹ Meaning for instance liberalisation occurs before appropriate regulations are put into place.

effects than free trade. CML might not produce the promised benefits but rather, as Stiglitz *et al.* (2006, Chs. 10 and 11) summarise:

- National fiscal and monetary policies become difficult to pursue, since national governments have to respond exclusively to the signals of the capital market, when pursuing policy objectives.
- Boom and bust cycles, rather than steady development, may come about. Booms in the housing sector, in land prices and equity prices as well as consumer purchases of imported goods lead to distortions of balanced growth, and are usually corrected by periods of bust.
- Financial instability and credit crises, leading to a general contraction of credit and higher risk premia for loans, can hamper economic development.
- There are strong contagion effects of financial busts, since capital movements – the inflow and outflow of capital – are fast in comparison with the changes in trade flows.
- The low income segment of the population as well as small businesses cannot insure and protect themselves against the risks that arise when bubbles burst and recessionary periods occur (or are prolonged). Indeed, those groups are very much affected.

Thus the proponents of (fast) CML frequently overlook the imperfect working of capital markets and attribute too much to their self-correcting mechanism. Frequently there is also mention of insufficient regulatory or supervisory institutions for the banking system, the stock market or the real estate market such that there are no stabilising forces or safety nets for certain countries – this in particular holds, as recent history of financial events has shown, for emerging markets and developing economies. Yet, even advanced countries with a long tradition of regulatory institutions such as for the banking sector and stock markets are also not protected from such events and the negative externalities of financial crashes and busts – as recent history, after the introduction of the new wave of financial innovations, has shown.

Already in the 1990s much critical work on the issue of open economy financial market liberalisation and currency and financial crises was published. Mishkin (1998), for example, posited an explanation of the Asian financial crisis of 1997/8 using the above information-theoretic ideas. A similar theory by Krugman (1999, 2000) pointed to the deteriorating balance sheets of banks and firms in the process of currency and capital market liberalisation. Miller and Stiglitz (1999) employed a multiple-equilibria model to explain financial crises in general.

Whereas these theories point to the perils of too rapid a liberalisation of financial markets and to the role of government bank supervision and guarantees, Burnside *et al.* (2001) view government guarantees as actual causes of financial crises. These authors argue that the lack of private hedging of exchange rate risk by firms and banks led to financial crises in Asia. Other authors, following the bank run model of Diamond and Dybvig (1983), argue that financial crises occur if there is a lack of short-term liquidity. Further modelling of financial crises triggered by exchange rate shocks can be found in Schneider and Tornell (2004), Edwards (1999) and Rogoff (1999), with Rogoff discussing the role of the IMF as the lender of last resort. A recent book elaborating on

the sequence of events in many types of financial crisis is that of Reinhart and Rogoff (2009).

Recent work on the roles of currency in financial crises can be found in Corsetti *et al.* (1998), Aghion *et al.* (2004), Kato and Semmler (2005), Flaschel and Semmler (2006), Proaño *et al.* (2007) and Röthig *et al.* (2007). Röthig *et al.* pursue a macroeconomic approach to model currency and financial crises and consider also the role of currency hedging in mitigating financial crises.² A further review of the stylised facts and literature on the interrelation of currency crisis, financial crisis and output loss is given in Chapter 2, where a proper modelling of this type of crisis is presented.

1.2 Household borrowing, debt default and banking crises

Another type of financial market instability and crisis arose from the interplay of household borrowing, a housing boom and new financial engineering tools developed and applied by the financial market. Although the financial market should play the essential role of channelling funds to households and firms that have potentially good buying or investment opportunities, and financial markets should permit economic agents to borrow against future income, this has not always been properly done.

Financial deepening is often accompanied by waves of financial innovations. Recent new financial innovations are hedge funds and all kinds of options and derivative instruments. Collateralised debt obligations (CDOs) and collateralised loan obligations (CLOs) are financial instruments where the loans of households and companies are turned into tradable securities (the so-called process of securitisation). These are relatively new financial instruments that have helped to diversify risk for the issuer of household mortgages or commercial credits. The number of such innovative financial products has grown rapidly, in fact credit derivatives in the form of credit default swaps, mortgage-backed securities or loan-backed securities have expanded exponentially, but so too have financial markets for them, which have also grown enormously. Yet in the USA as well as in many other countries, this interplay of new financial instruments and real estate boom has helped to build up an enormous bubble in real estate as well in the financial sector.

It is worth focusing more in detail on the housing and financial sector bubble. In the USA this triggered what has become known as the subprime crisis. How did it evolve, and why did it lead to a financial market meltdown, creating contagion effects and externalities not only to other sectors in the USA but had worldwide repercussions? Both the Federal Reserve Board (FED) and the European Central Bank (ECB) had few means to deal with this sudden meltdown and bust. Let us first survey briefly what led to the financial market meltdown from the middle of 2007.

As recent events have shown, reflected also in recent academic debates, there are large externalities and contagion effects arising from financial instabilities – either

² For further details on the early literature on currency and financial crises, see Reinhart and Rogoff (2009) and Semmler (2011).

arising from the stock market (as in the 1990s) or from the credit market, for example as now triggered by the subprime crisis. The evolution of the subprime crisis and its effect on the financial sector in the USA is described by the following trends:³

- the current financial market crisis is likely to have originated in low interest rates, rapidly rising household debt and a bubble in the housing market (high housing prices compared with fundamentals);
- the bubble phase has undergone an acceleration due to the outsourcing of risk because of the securitisation of mortgages (that were packaged and sliced into risky securities of different types, in particular CDOs);
- expectation of returns from investment in real estate and CDOs were rising, due to low interest rates, low default rates and high recovery rates;
- liquidity in the housing sector (and financial market) was pumped up by capital inflows, partly from abroad;
- the burst of the bubble was triggered by the failure of hedge funds (for example by the hedge funds of Bear Stearns), triggering a credit crunch in the banking sector;
- default risk and risk premia suddenly shooting up and a credit crunch occurring (as at the beginning of all downturns);
- the feedback to the real sector causing the growth rate of GDP to fall, with further feedback effects expected from the real to the financial side, that is, insolvency of financial institutions.

Indeed, as we have recently experienced, besides the open economy and currency crisis mechanism, an important financial market instability is likely to arise from the interplay of the real estate boom and the financial market boom. In the USA the financial market crisis of 2007/8 originated in the interaction of the housing market and the banking sector. Often one can also observe other scenarios; see Kindleberger (2000). For instance a stock market crash, together with the instability of credit, can trigger a downturn. Yet, this time in the USA it was not the stock market that triggered the bust. The stock market reaction came later. When the investors in subprime mortgages felt the first fallout, the holders of those securities experienced a massive credit crunch.

The real estate and banking crisis in the USA and UK has all the hallmarks of a boom-bust cycle. Although there was a regular business cycle from 2001 to 2007/8 the real estate boom-bust cycle had already started in the middle of the 1990s, during the information technology and stock market boom, the latter lasting from the beginning of the 1990s to 2000/1.

There are many views as to why the boom-bust cycle in real estate continued beyond the regular economic expansion, ending with the contraction of 2001. Some researchers attribute the boom-bust cycle in the real estate market and the run-up of the housing prices to the Greenspan low interest rate policy. In contrast, one might say that interest rates had already come down earlier (from the middle of the 1980s) with the decline of the inflation rate, but the housing boom started much later. There is also some truth

³ For details see Semmler and Bernard (2009).

in the view that Greenspan nowadays has expressed: the FED can lower the short-term interest rate, but it has no power over the long-term interest rate, and thus the yield curve. Indeed, the yield curve over a long time period, in fact until quite recently, was rather flat or even downward sloping. The USA had become a magnet of capital inflow and attracted savings from the rest of the world and this has kept the interest rate at the long end rather low.

A further explanation, proposed by Piazzesi and Schneider (2009) and Piazzesi *et al.* (2005), uses a portfolio approach and argues that the fraction of housing assets in household portfolios went down in the 1980s, whereas the fraction of equity held in the portfolios rose rapidly in the 1990s. Then, the trend reversed starting in 2000/1 with a rapid increase of housing assets in portfolios and a decline in the equity fraction. They attribute this to the shift in expected returns from three types of asset: from nominal assets (bonds), from equity and from real estate assets. Piazzesi *et al.* (2005) also argued that this large change in asset allocation has something to do with the inflation rate since the 1980s. Housing assets and equity assets show a negative co-movement which seems to arise from their different sensitivity to inflation rates. Yet, still the question remains as to why the equity prices and returns relatively declined as compared with housing prices and returns. Why did the housing asset boom take over from the equity boom starting at the end of the 1990s?

One could realistically attribute the housing price boom, as Shiller (2000) does, to some overshooting mechanism and excess volatility, namely first in the equity market and then in the real estate sector. Shiller also stresses the mechanism of over-valuation, overconfidence and overleveraging as causes of the housing and banking boom.

As above mentioned, another explanation refers to the recent development of new financial instruments, in particular credit derivatives, which have been rapidly and widely employed in the financial market. This has led, as many researchers have pointed out, to the outsourcing and diversification of risk. The main instruments in the real estate sector were mortgage-backed securities (MBS) and CDOs.

Yet, most of the literature seems to explain only the expansion period of the boom-bust cycle in the real estate market. The subsequent issue is thus how the bust was triggered. One might need a theory that explains both the excessive run-up in asset prices as well as the surprisingly fast decline and bust in the real estate sector.

For those asset pricing theories that adopt an intertemporal approach the occurrence of sudden busts is also a problem. According to the intertemporal view, the asset price represents the discounted expected future income stream, and these expectations drive the asset prices. Yet, usually it is hard to explain boom-bust cycles of the magnitude observed by an intertemporal model, since temporary blips or temporary strong deviations of pay-offs from the trend usually get smoothed out in intertemporal models, and boom-bust cycles are rarely observable in such models. Even strong technology shocks are not able to deliver such results.

The way, however, such boom-bust cycles have been constructed is to allow for expectation dynamics – for some time periods – that get revised after some time.

When agents realise that they have followed incorrect expectation dynamics this might then trigger at some point some sudden revision of expectations. Models of this type can be found in Beaudry and Portier (2004), Christiano *et al.* (2006, 2008) and also Lansing (2008), all of which work with the above mentioned mechanism of expectation dynamics.

Yet, in most literature based on the Dynamic Stochastic General Equilibrium (DSGE) model, the expectation dynamics concern technology shocks, which are capable of explaining only a small part of the boom-bust cycle in asset markets. Another source of expectation dynamics would be related to the expected pay-offs which themselves could be ill-founded, at least in the long run. In this approach we also can allow expected pay-offs to be discounted in order to arrive at some asset price dynamics. This looks like a realistic approach where one can assume that there is some expectation (as erroneous and ill-founded as it might be) that will be self-justifying. But then certain events may trigger the collapse of this self-justifying mechanism.⁴ Since the real estate sector has the feature of being mostly credit financed, an important component of this mechanism is the build-up of debt. Yet, the expansion and then the contraction of credit, has something to do with the instability of credit as mentioned in Kindleberger (2000) to be relevant for the Great Depression. We thus need to explain the rapid build-up and contraction of credit, and thus the triggering of a collapse in asset prices. A detailed modelling of some of these issues in the context of this type of financial crisis is undertaken in Chapter 3.

1.3 Overleveraging, debt and debt deflation

Overborrowing is not only typical for households but also for commercial banks, investment banks, firms, states and even entire countries. If there is general overleveraging and unsustainable debt, triggering a credit crisis there may not be only a downturn, but also a deflation, in commodity prices as well as in asset prices. In recent public debate on problems of the world economy, indeed 'deflation' or more specifically 'debt deflation,' has again become an important topic. The possible role of the credit crisis and debt deflation in triggering the Great Depression of the 1930s has come back into academic studies as well into the writings of economic and financial journalists. It has been observed that there are similarities between recent global trends and the 1930s, namely the joint occurrence of high levels of debt and falling prices. But with prices falling the real value of debt will rise. Debt deflation thus concerns the interaction of high nominal debt of banks, firms, households and countries and shrinking economic activity due to falling output prices and increasing real debt.

There is often another mechanism accompanying the one above, focusing on how a large amount of debt may exert an impact on macroeconomic activity by working through the asset market. Asset price inflation during economic expansions normally

⁴ For details of such a model, see Semmler and Bernard (2009).

gives rise to generous credit extension and lending booms. Assets with inflated prices serve as collateral for borrowing by firms, households or countries. On the other hand, when asset prices fall the borrowing capacity of economic agents shrinks, financial failures may set in, macroeconomic activity decreases and consequently large output losses may occur.

Countries that have gone through such booms and busts are some Asian countries (in particular Japan), Russia and Brazil in 1998 and 1999. In all of those countries as well as during the financial crisis in Mexico in 1994 asset price inflation and lending booms entailed subsequent debt crisis and asset price deflation. Thus, usually the mechanism of debt deflation due to falling output prices has been accompanied by the asset price deflation mechanism. Some academic commentators have recently also criticised the single-minded preoccupation of certain central banks and the IMF with inflation, and the word reflation has been coined in order to stress the fact that providing some room for inflation should be of help in preventing global financial crises. The viewpoint of the FED and of the government in the USA has of course received particular attention in this respect. When Alan Greenspan was chair of the FED, he was widely regarded as a person taking wise monetary policy decisions by lowering interest rates in 1998 and 1999 as a pre-emptive strike against a global debt deflation process.

Moreover, global growth strategies, and the elements they should contain, continue to be discussed in academic and policy circles. The need for a fundamental restructuring of the IMF and World Bank and a new financial architecture is currently stressed in such discussions, based on the judgement that in 2007/8 the world faced its biggest financial challenge since the 1930s. Debt deflation and its destabilising potential therefore appears to be an important threat that the world economy is still facing.

Modern macroeconomic theory, as it has evolved since the Second World War, has paid scant attention to the above described mechanism of debt deflation. No doubt this is due to the fact that during that period the major economies in the world experienced a long period of growth followed by a long period of inflation from which we have only recently emerged. The classic study of debt deflation remains Fisher (1933), although Minsky (1975, 1982) in his writings on the financial instability hypothesis continued to warn of the dangers of another great depression. There is therefore an urgent need for economists to model the process of debt deflation in its interaction with monetary and fiscal policies that may stop the process of rising debt, falling output and asset prices and a collapse into depression.

In Chapter 4 we embed the process of debt accumulation and debt deflation via a sequence of partial models of debt accumulation and price deflation into fully integrated macroeconomic models of closed and open economies that are consistent with respect to budget constraints. At the core of the model will be firms that finance fixed investment as well as involuntary inventory investment not from retained earnings, but by loans from the credit market. In that chapter we neglect equity finance. Our model will thus focus mainly on the first mechanism of the debt deflation process, the destabilising role

of flexible wages and prices in economies with high nominal debt. The destabilising role of asset prices will be by and large neglected.⁵

Our macroeconomic model contains a sufficient number of agents and markets to capture the essential dynamic features of modern macroeconomies, and stresses the dynamic interaction between the main feedback loops of capital accumulation, debt accumulation, price and wage inflation/deflation, exchange rate appreciation/depreciation, inventory accumulation and government monetary and fiscal policies. Our modelling framework relies on previous work by the authors and contributions by other co-authors.⁶ The essential difference is that here we focus on debt-financed investment of firms in place of pure equity financing considered in the earlier works. We will thus add a further important feedback loop missing in our earlier approach to macro modelling, namely, from a partial point of view, the destabilising Fisher debt effect of deflationary (or inflationary) phases of capital accumulation arising from the creditor-debtor relationship between asset-owning households, banks and firms.

Keen (2000) has investigated the Fisher debt effect, between firms and financial intermediaries, in the context of an augmented classical growth cycle model of Goodwin (1967) type. He has found that it may imply local asymptotic stability for the overshooting mechanism of the growth cycle, but the overshooting can lead to instability, for high debt outside a corridor around the steady state of the model. In addition he provides an interesting discussion of Fisher's vision of the interaction of over-indebtedness and deflation and of Minsky's financial instability hypothesis. Keen extends the proposed model of the interaction of indebted firms and income distribution to also include a study of the role of government policies in such an environment. He focuses on nominal adjustment processes in the place of the real ones of the classical growth cycle model.

We will start our analysis in Chapter 4 from Keen's 3D model of the debt accumulation process, expand it by flexible prices (to obtain a 4D model), include inflationary expectations and an interest rate policy rule (so getting to an 8D model) and will finally provide general 16D dynamics with a complete representation of stock-flow interactions, adjusting prices and quantities, asset market behaviour, issues of open economies and fiscal and monetary policy rules. We discuss briefly subjects of importance in the development of market crises (and domestic or foreign policy intervention) on this general level. These issues have to be integrated and investigated, however, in much more detailed ways in order to allow a full treatment of the dangers of the joint occurrence of debt and deflation in certain areas of the world economy or on a worldwide scale.

1.4 Plan of the book

In Part I we provide an introduction to our modelling philosophy of financial and real interactions. We provide a basic model of the three types of financial crisis phenomena

⁵ For work on the credit market, economic activity and the destabilising role of asset price inflation and deflation, see Minsky (1975) and Mishkin (1998).

⁶ See Chiarella and Flaschel (2000), Chiarella *et al.* (2000) and Chiarella and Flaschel (1999b,c,d).

as discussed above and as observed in the last few decades. We model (1) the currency and financial crises in open economies with a large amount of foreign debt, (2) the US current mortgage and real estate crisis and its spillover as a credit crisis for the whole banking sector, and (3) we deal with the effect of general overleveraging and the consequent threat of the emergence of the process of debt deflation. All of these types of financial crises are fundamentally overleveraging crises that first appear as liquidity crises and then as solvency crises. The liquidity crises may be associated with what Keynes had called the liquidity trap.

In Part II we discuss a general framework for Keynesian macroeconomic model building from the out-of-equilibrium perspective, in the form of a structural macroeconomic model of the interaction of financial and real markets. It derives the intensive form of this type of model and thus (for econometric application) the stationary variables of the model, since the existence of a (uniquely determined) steady state in these variables can be shown for this matured type of Keynesian model. We use various techniques to discuss the feedback channels of this general approach to macrodynamics, first in isolation and then in their interaction.

In Part III finally we apply the framework developed to issues of the interaction of firms' investment decisions with the emergence of overleveraging and then debt deflation spirals. We here refer to the relationship of firms and commercial banks on the market for loans, on the one hand, and to the feedbacks between households' housing demand decisions and the mortgage supply by asset holders on the other hand. We also elaborate the processes of debt default and bankruptcies that may follow, if the liquidity problem turns into a solvency problem for households, banks or firms. In a further chapter we investigate the performance of the Japanese economy in the light of such a crisis scenario. In contrast to the related models of Part I we use more complete approaches here to study such phenomena.

Part I

The non-linear dynamics of credit and debt default

2 Currency crisis, credit crunches and large output loss

2.1 The emergence of currency crises

With the end of the Bretton Woods system in the 1970s and the financial market liberalisation in the 1980s and 1990s, the international economy has experienced several financial crises in certain countries or regions entailing, in most cases, declines in economic activity and large output losses. This has occurred regardless of whether the exchange rates were pegged or flexible. There appear to be destabilising mechanisms at work from which even a flexible exchange rate regime cannot escape. In this chapter we review some of the stylised facts that appear to be common to such financial crises and develop a Mundell–Fleming–Tobin (MFT) type model based on Rødseth (2000, Ch. 6). Our approach builds on Miller and Stiglitz (1999) and takes up Krugman's (1999a, 1999b, 1999c and 2001) suggestions in order to study the real and financial crises generated by large exchange rate swings.

With respect to exchange rate shocks due to currency runs triggering financial and real crises, there are three views, in fact three generations of models, that have been presented in the literature. The first view maintains that news on macroeconomic fundamentals (such as differences in economic growth rates, productivity differences and differences in price levels, in short-term interest rates as well as in monetary policy actions) may cause currency runs. The second view maintains that speculative forces drive exchange rates where there can be self-fulfilling expectations at work, destabilising exchange rates without deterioration of fundamentals. Third, following the theory of imperfect capital markets, it has recently been maintained that the dynamics of self-fulfilling expectations depend on some fundamentals, for example, the strength and weakness of the balance sheets of the economic units such as households, firms, banks and governments. From the third point of view we can properly study the connection between the deterioration of fundamentals, exchange rate volatility, financial instability and declining economic activity. Although recently diverse microeconomic as well as macroeconomic theories have been proposed to explain currency runs, financial crises and recessions, we think that particularly relevant are those types of models that show how currency crises may entail destabilising mechanisms, leading possibly through non-linearities and multiple equilibria, to large output losses.

Such a model type can be found in Miller and Stiglitz (1999), who base their model on the work by Kiyotaki and Moore (1995) and various papers by Krugman (1999, 2000). For a detailed survey of the literature on exchange rate volatility, financial crisis and large output loss, see Semmler (2011, Ch. 12). The work by Krugman is most closely related to this chapter. It, however, contains a different motivation as to how the destabilising mechanism, triggered through currency crises, actually takes its course. Our model is narrower than the framework discussed in Krugman and thus concentrates on a few but essential elements of the currency crises. This is due to the fact that many behavioural equations of the MFT type model that is employed remain stable despite large currency depreciation, implied large declines in investment and large output losses.

The remainder of the chapter is organised as follows.¹ Section 2.2 introduces some stylised facts. Section 2.3 presents the basic model. Section 2.4 then adds the budget restrictions and considers the accounting relationships that characterise the model in order to provide a clear picture of the scope of the model. Section 2.5 studies the dynamics under flexible exchange rates and Section 2.6 under the breakdown of a fixed exchange rate system. In Section 2.7, we significantly extend the model towards a treatment of international capital flows and show that this gives further momentum to the crises scenarios we have developed earlier, for the case of only domestic trade in foreign assets. Section 2.8 concludes the chapter.

2.2 Some stylised facts

In recent times there have been major episodes of international financial crises in certain regions or countries entailing a large output loss. The balance sheets of firms, households, banks and governments were central in this context. Weak balance sheets of these economic units mean that liabilities are not covered by assets. In particular heavy external debt denominated in foreign currency, for example dollars, can cause a sudden reversal of capital flows and a currency crisis. Credit risk and a sudden reversal of capital flows is often built up by a preceding increase in foreign debt. The deterioration of balance sheets of households, firms and banks has often come about by a preceding lending boom, increased risk taking and an asset price boom. Subsequently a currency crisis is likely to occur, entailing a rise in the interest rate, a stock market crash and a banking crisis and large output loss. Yet, financial and exchange rate volatility do not always lead to an interest rate increase and a stock market crash. It is thus not necessary that financial instability will be propagated. The major issue is in fact what the assets of the economic units represent. If economic units borrow against future income streams they may have to use net worth as collateral. The wealth of the economic units (or of a country) are the discounted future income streams. Sufficient net wealth makes

¹ This chapter is based on the MFT baseline exchange rate model of Krugman type outlined in Flaschel and Semmler (2006). It generalises their treatment of financially driven exchange rate crises towards an inclusion of international capital flows in the balance of payments of the domestic economy.

the agents solvent otherwise they are threatened by insolvency which is equivalent to saying that the liabilities outweigh the assets. The question is only what are good proxies to measure insolvency, that is what is sustainable debt. Of course, exchange rate volatility and currency crises are relevant factors as well and thus the question arises as to what are the causes for large exchange rate shocks.

There are typical stylised facts to be observed before and after the financial crises which have been studied in numerous papers (see for example Mishkin (1998), Milesi-Ferretti and Razin (1996, 1998), Kamin (1999)). The empirical literature on financial crisis episodes may be summarised in the following stylised facts:

- there is a deterioration of balance sheets of economic units (households, firms, banks, the government and the country);
- before the crisis the current account deficit to GDP ratio rises;
- preceding the currency crisis the external debt to reserve ratio rises, after the crisis the current account recovers;
- there is a sudden reversal of capital flows and unexpected depreciation of the currency;
- the foreign debt denominated in foreign currency of the economic agents suddenly rises due to a drastic depreciation of the currency;
- domestic interest rates jump up, partly initiated by CB policy;
- subsequently stock prices fall;
- a banking crisis occurs with large loan losses by banks and subsequent contraction of credit (sometimes moderated by a bailout of failing banks by the government);
- the financial crisis entails a large output loss due to large scale investment declines and bankruptcies of firms and financial institutions.

Recent financial crises, such as the Asian crisis 1997–8, were indeed triggered by a sudden reversal of capital flows and an unexpected strong depreciation of the currency. In the next section we will build up a model which attempts to explain some of the stylised facts, in which we will stress in particular the impact of large currency depreciations on the breakdown of investment decisions and the resulting large output loss. This can occur despite significant improvements in the trade balance. We will use a standard portfolio approach to describe the financial sector of the economy and concentrate on the balance sheets of firms, their investment behaviour and the multiplier dynamics that derive from it in order to show how ongoing reallocation of assets into foreign bonds can imply a currency crisis, a breakdown of investment and a large output loss.

2.3 The Krugman model: an MFT representation

Krugman (2000, p. 83) states that ‘a fully fledged model of balance-sheet driven crisis is necessarily fairly complex’. That paper, however, shows that Krugman’s ideas can indeed be represented in a coherent way even on the textbook level if his type of investment function is assumed and if imperfect substitution between financial assets is modelled as in Tobin. Here we build on a simplified and modified version of the MFT model developed by Rødseth (2000, Ch. 6.2). We aim at a fully fledged model

of a balance-sheet driven crisis considered in Krugman (1999, 2000). With respect to consumption and investment behaviour, the model only contains the necessary variables to make Krugman's point and thus does not use wealth and interest rate effects in consumption and investment behaviour. Instead, we make use of the following simple representation of consumption, investment and goods market equilibrium:

$$Y = C(Y - \delta\bar{K} - \bar{T}) + I(s) + \delta\bar{K} + \bar{G} + NX(Y, \bar{Y}^*, s). \quad (2.1)$$

Here s is the exchange rate measured in units of domestic currency per unit of foreign currency.² We assume behind equation (2.1) given price levels \bar{p} , \bar{p}^* at home and abroad, given foreign output \bar{Y}^* and a given world interest rate \bar{i}^* as is often done in Mundell–Fleming models of small open economies. We normalise the price levels to 'one' for reasons of simplicity which allows us to identify quantities and value terms in national accounts. We finally assume as usual $C' + NX_Y < 1$, $NX_s > 0$ and, as already stated, neglect the influence of the domestic rate of interest on consumption and investment. Since we presume that there is no inflation at home and abroad we also do not need to consider real interest and real exchange rates. The assumed type of investment behaviour is described in detail below. Note finally that the above equation implicitly assumes that all investment demand concerns domestic goods in order to get strong multiplier effects on the economy in the case of strong currency depreciation.

Private households consume and save out of their disposable income $Y - \delta\bar{K} - \bar{T}$. We assume that capital stock \bar{K} is given, as is the rate of depreciation δ , and \bar{T} is an assumed lump-sum tax.³ Feedbacks from the flow of savings into the asset holdings of households are still ignored, but could be added as in Rødseth (2000, Ch. 6.6) via the government budget constraint, which would however add further laws of motion to the model (see the next section for the discussion of the flow conditions that characterise asset markets as time evolves). Here, however, we only consider explicitly the stock constraint of private households and their portfolio demand functions as first proposed in Tobin (1969) and as modelled in Rødseth (2000) on various levels of generality:⁴

$$W_p = M_o + B_o + sF_{po} \quad (2.2)$$

$$M = m(Y, i) \quad (2.3)$$

$$sF_p = f(\varepsilon, W_p), \quad \varepsilon = \bar{i}^* + \hat{s}^e - i \quad (2.4)$$

$$B = W_p - m(Y, i) - f(\varepsilon, W_p). \quad (2.5)$$

² Since the domestic economy is assumed to be a small open economy it will be convenient to think of it as Norway (as in Rødseth (2000)) and so denote the domestic currency as Krona. The exchange rate s is measured on this basis in units of Krona per US dollar (simply denoted dollar hereafter).

³ Lump-sum taxes are here calculated net of interest, see Rødseth (2000, Ch. 6) for a similar assumption.

⁴ We present the portfolio model using the gross substitute assumption in the way that asset demands always depend positively on their own rate of return and negatively on the other ones. We therefore define the risk premium on foreign bonds as the negative of the one considered in Rødseth (2000) in order to get a positive dependence of the demand for foreign bonds on the risk premium in the place of the negative one in his book.

Note again that we have normalised the price level to be equal to 1. In equation (2.2) we consider the reallocation of money holdings, M_o , fixed-price domestic bond holdings, B_o , and foreign fixed-price bond holdings of domestic households, F_{po} , between money M , dollar-dominated (private) foreign bonds F_p and domestic bonds B (the prices of these bonds are also assumed to be equal to one in terms of their currency, again for reasons of simplicity).

We do not yet consider any specific exchange rate regime of Mundell–Fleming type and thus do not yet state in detail which of the quantities M , B , F_p , F_c the foreign bond holdings of the CB are to be considered as exogenously determined. We should point out that, under the assumption that domestic bonds are not or cannot be traded internationally, a fixed exchange rate regime would imply that $F_p + F_c$ can be considered as fixed, while in a flexible exchange rate regime we would have that F_p can be considered as fixed, since the CB then need not intervene in the foreign exchange market. Equation (2.2) provides the definition of private wealth currently held in the household sector, when the nominal exchange rate is s . In equation (2.3) money demand equals money supply and we assume $m_y > 0$, $m_i < 0$ as in the usual LM Approach. In equation (2.4) demand for dollar-denominated bonds sF_p , expressed in domestic currency, is assumed to depend on private wealth W_p and the risk premium ε , which is defined by the difference of foreign and domestic interest rates augmented by expected capital gains or losses \hat{s}^e , with \hat{s}^e as the expected rate of depreciation or appreciation. We assume $f_\varepsilon > 0$ and $F_{W_p} \in (0, 1)$. Demand for domestic bonds B is then determined residually in equation (2.5) by Walras' Law of Stocks. With respect to expected depreciation \hat{s}^e we assume

$$\hat{s}^e = \hat{s}^e(s), \quad (\hat{s}^e)' \leq 0, \quad \hat{s}^e(s_o) = 0 \quad \text{at the given steady state value of } s. \quad (2.6)$$

Equation (2.6) is a general formulation of regressive expectations, see Rødseth (2000, Ch. 1.4) for details.⁵ Note here already, however, that we assume that economic agents have perfect knowledge of the relevant steady state value of s of the model (denoted by s_o) and that they are therefore forward looking in their behaviour. It is thus expected that the actual exchange rate adjusts with possibly varying speed to this steady state value. Such an expectational scheme may also be characterised as asymptotically rational behaviour and represents a very fundamental and tranquil type of expected exchange rate adjustment scheme. This assumption ensures that expectations are therefore not central in the explanation of the currency crises considered in this chapter.

As the above portfolio demand approach is formulated, we have substitution between money and domestic bonds on the one hand and between domestic and foreign bonds on the other hand. The first is determined in reference to the nominal rate of interest i and the second in reference to the risk premium ε between domestic and foreign bonds. Furthermore, all domestic money and bonds are held by domestic residents. There is thus no international trade in domestic bonds. There is nothing extraordinary

⁵ A specific formulation could be $\hat{s}^e = \beta_{\hat{s}^e}(s_o/s - 1)$, where s_o denotes the steady state value to which the economy is converging.

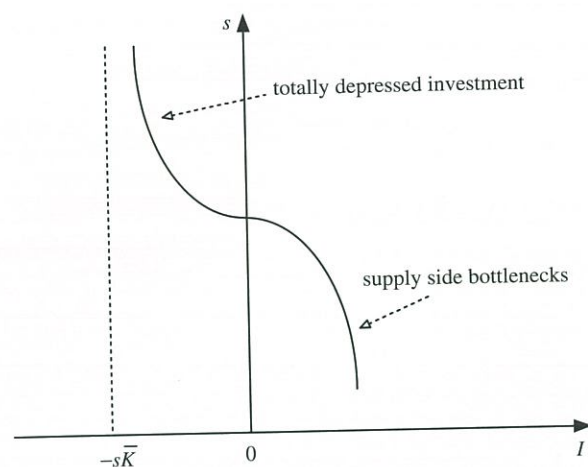


Figure 2.1 A Krugman (2000) type of investment function

involved in our description of the sector of private households which is characterised by a simple consumption and savings function and a standard portfolio approach to imperfect capital mobility.

The sector of firms, here so far only represented by its net investment function $I(s)$, is however quite different from what is usually used to characterise investment behaviour. Investment is here made dependent solely on the nominal exchange rate s , in the way shown in Figure 2.1.

We assume that investment depends negatively on the exchange rate s , and strongly so in an intermediate range of the exchange rate s . The story behind this assumption is that depreciation worsens the balance sheet of firms (see the next section), due to the fact that their past investment decisions were financed by foreign bonds (firm bonds denominated in foreign/dollar currency). Depreciation thus increases the debt of firms when measured in domestic currency and lowers the credit rating and the credit-worthiness of the firms and their ability to finance current investment. Investment is therefore reduced when depreciation of the domestic currency occurs and, by the assumption made below, in the considered middle range for the exchange rate is reduced to such a degree that dominates the positive (normal) reaction of net exports NX with respect to exchange rate changes, that is

$$-I'(s) > NX_s > 0.$$

In this range we therefore have for the aggregate demand function $Y^d(Y, s)$ that

$$Y_Y^d \in (0, 1) \text{ and } Y_s^d < 0.$$

The latter partial derivative represents a striking difference to the usual assumptions on aggregate demand in models of the Mundell–Fleming type.

For very high and very low exchange rates we however assume that investment is not very sensitive to further exchange rate changes for two reasons: on the one hand,

there are supply bottlenecks for very high investment demand and on the other hand, there are some investment projects that must and can be continued – despite severe credit rationing of firms – even for very high levels of the exchange rate. For extreme values of the exchange rate we therefore have the usual positive dependence of goods market equilibrium on the level of the exchange rate.

We have already stated that the implications of the government deficit with respect to changes in the supply of money and domestic bonds are still ignored in the current short-term analysis of a small open economy. With respect to the CB, we assume that it can change not only the supply of money and domestic bond holdings instantaneously through standard open market operations, but also the amount of the dollar-denominated bonds if it desires to do so. Following Rødseth (2000, Ch. 6) we however assume that the following constraint must hold true:

$$F_p + F_c = \bar{F}^*,$$

with F_c the foreign bond holdings of the CB and \bar{F}^* the total amount of dollar-denominated bonds held in the domestic economy (treated separately from the credit given to firms). This assumption can be justified by considering regimes where money can only be exchanged against foreign currency in the domestic economy (through the monetary authority) and by assuming that domestic bonds cannot be traded internationally which may be a realistic assumption for the type of economy considered here. This completes the short-run equilibrium description of the considered small open economy. We stress again that we even get a fixed F_p -value if the monetary authority need not intervene in the foreign exchange market.

Finally we note again that the above feature of investment behaviour has been chosen so that in its middle range the investment function is characterised as being very elastic with respect to the exchange rate s . For very high and very low exchange rates, however, investment becomes very inelastic in this regard. If the currency is strong (low s), investment runs into a bottleneck and is limited by supply side conditions, be they actual or only perceived ones. If the currency is very weak, net investment is reduced to its floor level (which may even be negative). In sum, we have an investment behaviour formally similar to the one considered in the Kaldor (1940) trade cycle model, but here based on net worth effects resulting from exchange rate changes, instead of an influence of economic activity Y on the net investment of firms.

As in Kaldor (1940) (see also Blanchard and Fischer (1989, p. 532)), we consider the following goods market adjustment process off the IS or goods market equilibrium curve:⁶

$$\begin{aligned} \dot{Y} &= \beta_y(Y^d - Y) \\ &= \beta_y(C(Y - \delta\bar{K} - \bar{T}) + I(s) + \delta\bar{K} + \bar{G} + NX(Y, \bar{Y}^*, s) - Y). \end{aligned} \quad (2.7)$$

This dynamic multiplier process is a stable one for any given level of s , since $Y_Y^d - 1 < 0$ is assumed to hold true.

⁶ Note that this is a simplification of a more general goods market adjustment process where also inventories are adjusted by firms.

Next, we derive two equilibrium curves, for the goods and asset market equilibria respectively, situated in the Y, s phase space and surrounded by the multiplier dynamics just introduced. First we consider the IS curve, defined by the equation (2.1), and get by the implicit function theorem for the slope of this curve, with Y the dependent and s the independent variable,

$$Y'(s) = -\frac{I' + NX_s}{C' + NX_Y - 1} \begin{matrix} \geq 0 \\ < 0 \end{matrix},$$

where the difference in signs is due to the ambiguity in the sign of the numerator, since the denominator is unambiguously negative. In the mid-range of s -values, discussed above, we have $Y'(s) < 0$ and so a backward bending IS curve, since I' dominates NX_s in this range, while we have a positive slope for this curve outside of this range, since $|I'|$ becomes close to zero there.

For the IS curve we thus get a scenario as shown in Figure 2.2, where we have also added the output adjustment of firms when economic activity departs from the IS curve. This shows that the IS curve is a global attractor with respect to output adjustment whenever the economy is displaced from it by a shock. Note also that the IS curve should become very steep for very large and very small values of the exchange rate s , since investment and net exports may be very insensitive to further exchange rate changes then. Note also that this curve should cut the horizontal axis at a positive value of output Y , since \dot{Y} is positive at $Y = 0$ by assumption.

Let us next consider the asset market equilibrium as described by equations (2.2)–(2.6). From equation (2.3) we have, for any given M , a positive dependence of i on Y and a negative one with respect to M as is generally the case in such simple LM

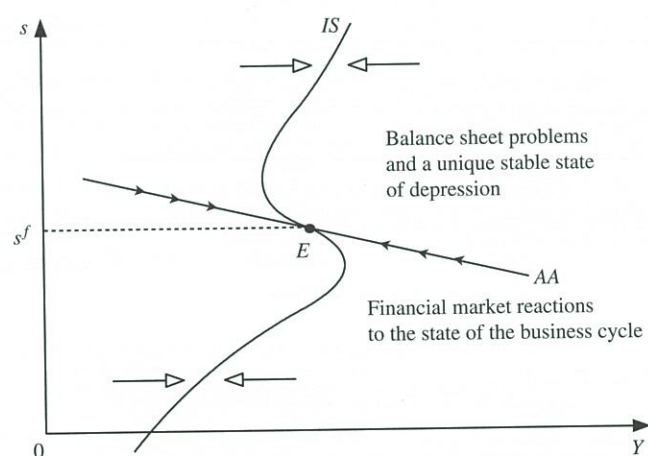


Figure 2.2 IS equilibrium and output adjustment along the AA curve in the case of an output and asset market determined exchange rate

approaches to the money market, thus we denote this dependence as $i(Y, M)$ and have

$$i_Y > 0, i_M < 0. \quad (2.8)$$

Inserting this reduced form equation and equation (2.6) into equation (2.4) gives rise to⁷

$$sF_p = f(\bar{i}^* + \hat{s}^e(s) - i(Y, M), M_o + B_o + sF_{po}), \quad M \text{ given.} \quad (2.9)$$

This condensed representation of full asset markets equilibrium will give rise (for flexible exchange rates and thus given F_p) to a strictly negatively sloped equilibrium curve AA (representing the influence of the business cycle on exchange rate determination). This curve cuts the vertical axis by assumption and for reasons of simplicity will be always drawn as a straight line in the following.⁸ Under Walras' Law of Stocks we thus have a well-defined single curve for the characterisation of equilibrium in the financial markets of the economy for any given level of money supply M .⁹ Summarising we thus have in the present modelling framework a new and extended type of IS–LM diagram, where LM equilibrium is combined with an FF-equilibrium for dollar-denominated¹⁰ bonds to provide a strictly decreasing function in the Y, s phase space in place of the usual output-interest rate phase space, the AA asset market equilibrium curve. Furthermore, the IS or goods market equilibrium curve is now situated in the same phase space where it usually assumed strictly positive slope is only valid for very high as well as very low values of the exchange rate s . We thus have to deal with new slopes of IS–LM curves in a newly defined economic phase space in the following analysis.

2.4 Sectoral budget equations and national accounts

In this section we consider explicitly the dynamic adjustment of foreign reserves (or bonds) in the domestic economy (as well as flows into domestic money and bond holdings) that occur due to the investment decision of firms, the saving decision of households, the decisions of the government and of the CB, also taking into account the net exports of our model economy. We want to show that all the foreign account flows balance each other in the balance of payments (under certain consistency assumptions on new domestic money and bond supply) so that there is no need – beyond what happens

⁷ Note that the use made of this equation and the restriction that F is fixed in this chapter assumes that domestic bonds are non-tradable, which implies that the tradable amount of foreign bonds is fixed to the domestic holdings of such bonds at each moment of time. In the case of a flexible exchange rate this simply reduces to a given F_p due to the non-intervention of the domestic CB in this case.

⁸ Although it may only approach the horizontal axis for exchange rates approaching zero.

⁹ This distinguishes our approach to the AA curve from the one suggested in Krugman (2000), where a leaning against the wind strategy seems to be part of the AA curve. Leaning against the wind in our model means shifting the AA curve to the left by means of restrictive monetary policy (reduced money supply). This is indeed also stated in Krugman and Obstfeld (2003) where, however, the interest rate parity condition is used for the derivation of the AA curve in the place of our explicit (imperfect substitute) portfolio representation of the asset markets.

¹⁰ Note that we assume in this chapter that dollar-denominated bonds held by domestic households can only be traded on the domestic financial markets; see Rødseth (2000) for more details.

in the stock markets – for the CB to intervene in order for the foreign exchange market to be in equilibrium. We will in particular describe here the changes in foreign bond holdings of households and the CB and the change in the foreign debt of firms.

First of all, we assume now explicitly that all income generated by firms is transferred into the household sector, however we formally deduct depreciation in order to arrive at net magnitudes. Since we allow for negative net investment, the amount representing depreciation need not be kept back by, and invested within, firms. We thus assume here that there is a positive floor to gross investment I^g and that enough foreign credit is available in order to finance at least a minimum amount of investment projects that are not scrapped during a currency crisis. This gives rise to the following budget equations of firms:¹¹

$$Y - \delta\bar{K} - s\bar{i}^*F_f = wL^d + \Pi_p, \quad I = s\dot{F}_f, \quad (2.10)$$

Equation (2.10) states that firms have to pay interest on their foreign debt and transfer all remaining proceeds into the households sector as wages wL^d and profits Π_p . Their investments I (if positive) thus have to be financed completely by new foreign debt, since we assume that investment goods are completely purchased on the international goods markets. They thus represent foreign goods, here however – in the investment demand function – already measured in terms of the domestic currency. This means that the quantity demanded on the world market must depend on the exchange rate with an elasticity that is smaller than -1 in order to give rise to an investment schedule in the domestic currency with the assumed property $I'(s) < 0$. This investment behaviour may be due to credit constraints, but also simply due to the fact that such investment is not profitable at the currently prevailing exchange rate.

For the household sector we next obtain a flow budget constraint, in view of what has been stated for firms,

$$Y - \delta\bar{K} - s\bar{i}^*F_f + s\bar{i}^*F_p - \bar{T} - C = \dot{M} + \dot{B} + s\dot{F}_p. \quad (2.11)$$

Note that lump-sum taxes are here calculated net of domestic interest payments by the government, similar to the procedures applied in Rødseth (2000, Ch. 6). The government budget constraint here simply reads

$$\bar{G} - \bar{T} = \dot{M} + \dot{B}, \quad \bar{T} = T - iB.$$

We assume with respect to CB behaviour that all interest income on government bonds that are held by the CB (due to past open market operations) is transferred back to the government sector and thus does not appear in the government budget constraint as a separate item. We therefore represent explicitly only privately held government bonds, as is usually done in the literature. The budget equation (2.11) of households says that household savings on its left-hand side is spent on new money and new domestic bonds as they are supplied by the government; the remainder goes into new foreign bonds. This in fact represents a flow consistency assumption that guarantees that the balance

¹¹ In the case of negative net investment we thus get that firms are paying back part of their foreign debt.

of payments¹² will always be balanced in the present framework. Note again that all prices (goods and assets) – apart from the exchange rate – are set equal to one in the present form of the model.

With respect to CB behaviour we finally assume that its (remaining) income (equal to its savings) is spent on the acquisition of foreign reserves in the form of foreign bonds, so that we have

$$s\bar{i}^*F_c = s\dot{F}_c.$$

Aggregating all (dis-)savings of households, government and the CB gives the equation

$$Y - \delta\bar{K} - C - \bar{G} + s\bar{i}^*(F_p + F_c) - s\bar{i}^*F_f = s(\dot{F}_p + \dot{F}_c),$$

which in turn implies due to the assumed goods market equilibrium condition:¹³

$$CA + I = NX + s\bar{i}^*(F_p + F_c) - s\bar{i}^*F_f + I = s(\dot{F}_p + \dot{F}_c) = S = S_p + S_g + S_c.$$

Inserting the foreign bonds that finance firms' investment then gives rise to the equality between the current account deficit (or surplus) and the surplus (or deficit) in the capital account as shown in the equation

$$NX + s\bar{i}^*(F_p + F_c) - s\bar{i}^*F_f = s(\dot{F}_p + \dot{F}_c) - s\dot{F}_f.$$

We thus have that the balance of payments is always balanced, although we stress that this is under the assumption that households absorb the new money and the new domestic bonds shown in the government budget constraint. All flows that need foreign currency thus will obtain it and the stock markets are, as assumed, always in equilibrium. Net exports and net interest payments on foreign bonds are always equal in sum to net capital exports or net foreign bond imports, with households and the CB as creditors and firms as debtors in the interest and foreign bond flows. Note that although we have this balance in the balance of payments we have nevertheless included the possibility of credit rationing of firms, subsumed in the assumed shape of the investment function, that is, investment and its financing does not reflect demand side aspects solely. The investment function is therefore based to some extent on factual outcomes.

We note again that domestic money can only be exchanged against foreign currency in the domestic economy. Combined with the assumption that domestic bonds are not traded internationally, this is sufficient to provide the constraint $F_p = F_{p0}$ for asset reallocations in the case of a flexible exchange rate. In the case of a fixed exchange rate system, this gives an endogenous F_p determination, served by the domestic CB. These two alternatives will find application in the next two sections. Note that the case of an exchange rate that is fixed by the domestic CB will exhibit the inequality $F_p \leq F_{p0} + F_c$ as a feasibility constraint on the reallocation of foreign bonds between households and

¹² Note that we show planned magnitudes solely.

¹³ This condition states that the current account surplus (or deficit) CA plus net investment must be equal to aggregate savings.

Table 2.1. *The balance sheet of firms (current values)*

Tangible Assets	Liabilities
pK	sF_f Net worth (measuring credit-worthiness)

the CB. This therefore characterises the range within which the CB is capable of fixing the domestic exchange rate.

Note finally that the balance sheet effect for firms, here debts in foreign bonds solely, with no retained earnings and with no equity financing, reads simply as in Table 2.1.¹⁴

The actual change in this balance sheet, through investment/disinvestment, is here simply represented by the assumption

$$I(s) = s\dot{F}_f(s), \quad I'(s) < 0,$$

implying that there holds

$$\frac{d\dot{F}_f}{\dot{F}_f} \bigg/ \frac{ds}{s} < -1,$$

an assumption which is not explained in detail here as far as the credit rationing process or voluntary investment reduction underlying this investment schedule are concerned.

Firms, which are run by domestic households, thus combine labour L^d and capital K , financed solely by foreign financial capital, to produce the output Y and the accounting net worth $pK - sF_f$. Portfolio markets determine the interest rate i and the exchange rate s (if flexible) for any given output level. The goods market determines the output level Y of firms for any given exchange rate separately in a fixed exchange rate system (where asset markets determine i and F_p) and jointly with the asset markets in the case of a flexible exchange rate. Financial flows caused by the savings and investment decisions of the considered sectors of the economy do not matter in this interaction, but have been considered here in addition for consistency reasons. Financial crisis in the proper sense of the word is here only present in the assumed investment behaviour and its financing condition, up to the consideration of the capital flight parameter α later on, since consumption behaviour and asset demands remain stable otherwise (or are here not explicitly considered with respect to critical behavioural non-linearities). There is also no explicit consideration of bankruptcies.

In the remaining part of this section we finally summarise our model economy from the perspective of national accounts, based on the budget restrictions just discussed.

¹⁴ This balance sheet is thus based on the historical (current) value of the capital stock and does not take into account any discounted cash flows in the formulation of the net worth of firms (equities are also not yet present in the model; their value may be measured by such discounted cash flows). We thus ignore any interest rate effect on the measure of the net worth of firms, on the basis of which credit rationing will then be decided.

Due to these restrictions, and to the assumption that the type of financing of the government deficit (the inflow of new money and domestic bonds) is always accepted by the private sector of the economy, we will again find that the balance of payments, representing the real and financial flows planned by the various sectors, is always balanced and thus of no importance for the determination of the exchange rate. This rate is in fact determined by a stock or portfolio approach solely, on the basis of the stocks the economy inherited from the past (disregarding the given foreign debt or credit to firms).

We start by introducing some notation not used so far in this chapter:

- FD_f : Financial deficit of firms;
- FD_g : Financial deficit of the government;
- FD_p : Financial surplus of the private sector;
- FD_c : Financial surplus of the CB;
- I^g : Gross investment ($I^g = I + \delta\bar{K}$);
- J, X : Imports and exports of commodities.

We assume again that the given domestic as well as the foreign price level are both set equal to one by appropriate normalisation so that we can use just the nominal exchange rate only to express all quantities in terms of the domestic commodity. We have five sectors in the economy: households, firms, the government, the CB and the world economy or the foreign account. We distinguish four accounts for the first four sectors: production, income, wealth accumulation and financial account. Our model is based on the assumptions that households and the fiscal authority have no production account and firms no income account (all profits are transferred to the household sector). Of course all accounts only show items that exist in the model of this paper and thus exclude many factual items of the System of National Accounts.

Note, furthermore, that imports are explicitly represented in terms of the foreign commodity, while their consumption by households, firms and the government is left implicit and expressed in terms of the domestic commodity solely. We here follow the usual practice of summarising the role of imports in the net export function which therefore represents the influence of the exchange rate on domestic consumption and investment. We stress again that taxes in our model are calculated net of interest paid to the household sector, so that $\bar{T} = T - iB$, while the interest received by the CB on government bonds is transferred back into the government sector. Taxes are thus endogenous in the present model, but held constant after interest payments have been deducted. Interest on foreign bonds received by the CB is counted as income in this sector and used for the further accumulation of foreign bonds by the CB. Note also that money financing of the government deficit is assumed to take place via corresponding open market operations of the CB which are however not represented in this sector, but simply stated as a final outcome in the government sector.

Table 2.2 summarises production/income accounts, the change of wealth accounts and the flow of funds accounts of firms, households and the government. Table 2.3 gives the income, change of wealth and flow of funds accounts of the CB.

Table 2.2. *The production, change of wealth and flow of funds accounts of firms, households and the government*

Firms					
Production Account		Change of Wealth Account		Flow of Funds Account	
Debits	Credits	Debits	Credits	Debits	Credits
δK		I^g	δK	FD_f	$s\dot{F}_f$
$s\bar{i}^*F_f$	I^g		FD_f		
wL^d	G				
Π_p	C				
sJ	X				

Households					
Income Account		Change of Wealth Account		Flow of Funds Account	
Debits	Credits	Debits	Credits	Debits	Credits
T	wL^d	FS_p	S_p	\dot{M}	FS_p
C	iB			\dot{B}	
S_p	$s\bar{i}^*F_p$			$s\dot{F}_p$	
	Π_p				

The Government					
Income Account		Change of Wealth Account		Flow of Funds Account	
Debits	Credits	Debits	Credits	Debits	Credits
G	$\bar{T} = T - iB$		S_g	FD_g	\dot{M}
S_g			FD_g		\dot{B}

Table 2.3. *The income, change of wealth and flow of funds accounts of the CB*

The CB					
Income Account		Change of Wealth Account		Flow of Funds Account	
Debits	Credits	Debits	Credits	Debits	Credits
S_c	$s\bar{i}^*F_c$	FS_c	S_c	$s\dot{F}_c$	FS_c

There is finally the balance of payments, shown in Table 2.4, which records the items that concern the current and the capital account, the latter also including the reserve changes of the CB. As mentioned above, the balance of payments is always balanced due to our treatment of the budget equations of the four sectors of the economy and

Table 2.4. *The balance of payments account*

Balance of Payments (measured in domestic currency)	
Debits	Credits
Trade Account:	
Imports $s \cdot J$	Exports X
Interest Income Account:	
Interest payments of firms to the foreign economies $s\bar{i}^*F_f$	Interest payments from the foreign economies $s\bar{i}^*F_p + s\bar{i}^*F_c$
Capital Account:	
$s\dot{F}_p = 0$	$\dot{B}_p^{d*} = 0$
Official Reserve Transactions of the CB:	
$X - sJ + s\bar{i}^*F_p + s\dot{F}_c - s\bar{i}^*F_f$	

thus does not represent a further restriction (besides the stock portfolio equilibrium equations) to the working of the economy. Note that since domestic bonds have been assumed non-tradable internationally (an assumption that we will relax in a final section of this chapter) we must have $\dot{F}_p = 0$ in the capital account (if interest payments are made in the domestic currency).¹⁵ Table 2.4 displays the balance of payments account.

This concludes our presentation of the flow conditions that characterise the small open economy under consideration. We stress that in view of the above considerations, the situation considered here is still a fairly ordered one in the case of a crisis. Capital accumulation has been financed by foreign credit throughout and all interest payments are always met at the world rate of interest. However, new credit will become rationed as expressed by the investment function if the balance sheet of firms worsens through depreciation. This credit rationing being given, the crisis considered in this chapter is then a purely macroeconomic one: a Keynesian effective demand depression with large loss in domestic output and income due to a large reduction in investment demand, but still with flow consistency in particular in the balance of payments. The crisis scenario we investigate in this chapter is thus still a partial one with credit rationed firms and a capital flight parameter (to be introduced in the next section), but otherwise stable portfolio demand equations, a stable expectations scheme, stable behavioural equations on the goods market and given wages and prices.

2.5 Flexible exchange rates: output and exchange rate dynamics

We consider here exclusively the case of flexible exchange rates and thus the case where the CB in general does not need to intervene in the market for foreign exchange and

¹⁵ The term \dot{F}_c is neglected in the following treatment since $F_p + F_c = \bar{F}^*$ is assumed to hold.

conduct trade in foreign bonds. The equilibrium in the foreign exchange market can therefore be described by

$$F_{po} = F_p = \text{const} \quad \text{at all time,}$$

that is the amount of dollar-denominated (foreign) bonds that can be traded in this market is simply given by the amount of such bonds already held by private households. That is so because we continue to assume that domestic bonds cannot be traded internationally and that M (or i) is kept fixed by open market operations (concerning domestic bonds) by the monetary authority. The case of a flexible exchange rate will be used in Section 2.6 to describe the consequences of a breakdown of a fixed exchange rate regime.

Since there is no change in the supply of foreign currency by means of changes in the reserves F_c of the CB we can now determine an asset market equilibrium curve $s(Y)$ from the reduced form asset market representation provided by equation (2.9) at the end of Section 2.3. For any given output level, the equation (2.9) determines the exchange rate s that clears the asset markets, the interest rate i being determined by equation (2.8) that came from the LM curve of the model. According to the implicit function theorem the slope of the curves $s(Y)$ is given by

$$s'(Y) = -\frac{-f_\varepsilon i Y}{-F_{po} + f_\varepsilon (\hat{s}^e)' + f_{W_p} F_{po}}. \quad (2.12)$$

We have $(f_{W_p} - 1)F_{po} < 0$ and $f_\varepsilon (\hat{s}^e)' \leq 0$, since $f_{W_p} < 1$ and $(\hat{s}^e)' \leq 0$ has been assumed. Furthermore, the numerator of equation (2.12) is always positive, so we can assert that $s'(Y) < 0$ holds. Hence the asset markets equilibrium curve AA is always negatively sloped, as shown in Figure 2.2 (there as a straight line). We note that the AA curve becomes steeper as the capital mobility (as measured by f_ε) becomes higher, the interest rate elasticity of money demand becomes lower, the more dominant is the demand for dollar bonds in the portfolio of asset holders and the more sluggishly regressive expectations adjust.

Next, we investigate the implications of a steep AA curve that under otherwise normal conditions gives rise to a situation as shown in Figure 2.3, which now exhibits three IS- AA equilibria. As Figure 2.3 immediately reveals, however, only two of the equilibria are stable when exchange rates are flexible and when output adjusts sluggishly through the dynamic multiplier process.

Below E_2 , at a point on the AA curve (which is always binding if the exchange rate is perfectly flexible) we have expanding output according to the IS curve and thus convergence to E_1 , while the opposite holds true for points above E_2 on the AA curve. We stress that the AA -equilibrium must here prevail by assumption (when s is treated as a statically endogenous variable), while the economy may temporarily be off the IS curve. As shown, this implies that E_1 and E_3 are attractors, while E_2 is a repeller.

Assume now that – for some reason – the AA curve shifts to the right to AA' (see again Figure 2.3) so that only the upper stationary equilibrium remains in existence.

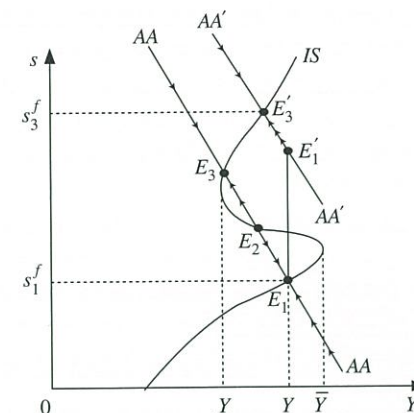


Figure 2.3 Dynamic multiplier analysis under perfectly flexible exchange rates. Here the dynamics undergo a fold catastrophe

Assume further that the economy was initially at E_1 . Since output Y cannot react instantaneously, the economy must jump to the new asset market equilibrium E_1' and will thus undergo an instantaneous process of strong currency depreciation.¹⁶ Yet, despite such strong depreciation, the economy will not expand its activity level thereafter via the exchange rate effect on net exports, but will instead start to contract until the new stationary equilibrium E_3' has been reached, a process which is accompanied by further depreciation of the currency as Figure 2.3 shows.

The effects of the considered shift in the asset market equilibrium curve are therefore a sudden first and then a continuous further depreciation of the currency, a radical first and then a continuous improvement in the trade balance (due to rising s and falling Y), a strong first and then a continuous decrease in domestic investment near to its floor and as a result of this dominant change in aggregate demand, declining economic activity and declining domestic interest rates.

The question now is what the reasons for such a rightward shift in the AA curve (to AA') could be. To provide the grounds for one possible explanation we expand the functional dependence of the asset demand curve f so that it reads:

$$s F_p = f(\bar{i}^* + \hat{s}^e(s) - i(Y, M), W_p, \alpha), \quad f_\alpha > 0. \quad (2.13)$$

In equation (2.13) we use the new parameter α to express the risk of investing in domestic bonds, from the international perspective of domestic asset holders. Since a devaluation of the domestic currency deteriorates the international position of asset holders, we assume here that dollars represent the preferred currency and that *dollar-denominated bonds* are thus the preferred assets in the household sector. If there is a potential threat of depreciation of the domestic currency, asset holders may gradually

¹⁶ In the language of the theory of dynamical systems this type of sudden change is known as a fold catastrophe. See Rosser (2000).

decide (as expressed by an increase of the parameter α) to reallocate their asset holdings into dollar-denominated bonds. This process may be considered as capital flight from the domestic currency into the foreign one. An increasing parameter α , expressing increasing dollar-liquidity preference,¹⁷ therefore induces an attempt as reallocation into foreign bonds. Even though these reallocations cannot take place here since $F_{po} = F_p$ is fixed in a regime of flexible exchange rates, these attempts nevertheless move E_1 since an increasing parameter α shifts the AA curve to the right. This may even be the case to the extent that this lower equilibrium completely disappears and gives way to the sole equilibrium E'_3 shown in Figure 2.3. An increasing parameter α thus indeed produces currency depreciations (but also output expansions as long as the lower equilibrium E_1 remains in existence) and may thus induce further increases in the shift parameter.

What can be done by the CB to stop this tendency towards small and (if E_1 disappears) even large depreciations of the domestic currency? One such possibility is to increase the domestic rate of interest to counteract such capital flight, by way of a contractionary monetary policy. Reducing money balances through internal open market operations shifts the AA curve to the left and thus may prevent the AA curve – under the assumed capital flight conditions – shifting so much to the right that the lower equilibrium E_1 disappears. There is then only some depreciation (if E_1 remains in existence), which still expands output (if α is strong enough to overcome the contractionary impact of the restrictive monetary policy), yet which nevertheless moves the economy closer to the output level where the strong currency equilibrium E_1 (the normal equilibrium in Krugman's (2000) words) may disappear. This leaning against the wind strategy thus may be of help if α increases, at least to some extent or for some time.

Note again that output expands if α dominates the monetary strategy, but not to such an extent that the lower equilibrium E_1 disappears.

If, however, the economy gets trapped in E'_3 , the monetary authority can nevertheless attempt to bring the economy back to the lower stable part of the IS curve. Contractionary monetary policy moves the economy towards E_3 , and if continued, eventually to a situation where the upper equilibrium disappears. Exchange rate appreciation will then lead the economy vertically down until the asset market equilibrium curve is reached again. From there on we have a continuously rising exchange rate and rising output until a new stationary point of type E_1 is reached. It is however a questionable assumption that the capital flight parameter α would stay in place¹⁸ in the early phase of such economic contraction (caused by restrictive monetary policy), even though this policy tends to increase the domestic nominal rate of interest (which in turn is counteracted, but not fully offset, by the output contraction to which it leads).

¹⁷ This is to be contrasted with f_e which measures capital mobility for a given state of dollar-liquidity preference.

¹⁸ In particular, if the rapid depreciation (accompanied by restrictive monetary policy) leads to a significant degree of bankruptcy of firms.

Note that monetary policy can be made more direct if the interest rate is directly set by the monetary authority, while M is then adjusted to money demand $M(Y, i)$ through appropriate technical instruments of the CB. The expression $i(Y, M)$ in the asset market equilibrium equation is then replaced by an exogenously given i , which is called an interest rate peg. This obviously changes the qualitative results so far discussed considerably, since the AA curve then becomes horizontal with only one unique intersection with the IS curve under all circumstances.¹⁹ Note also that an extended investment function of type

$$\dot{K} = I = I(s(Y), K), \quad I_K < 0$$

would now introduce the Kaldor (1940) trade cycle analysis into the present framework. Note finally that, for given α and an equilibrium position E_1 , expansionary monetary policy may lead to a contraction if the economy, via the AA curve, is shifted so much to the right that the equilibrium E_1 disappears. As long as the economy is on the lower branch, lowering i leads to mild depreciation and to goods market improvements, since the net export effect dominates the investment effect. Yet, beyond \bar{Y} we reach the region where depreciation accelerates and output contracts (since investment then dominates net export effect) until stationarity is reached again in a situation where output and investment are at very low levels, in a stable state of depression.

In order to investigate exchange rate dynamics in more detail and in less perfect situations, we consider the excess demand function on the market for foreign bonds, which we denote by the function $X(s)$ that is given by²⁰

$$X(s) = f(\bar{i}^* + \hat{s}^e(s) - i(Y, M), M_o + B_o + sF_{po}) - sF_{po}. \quad (2.14)$$

The slope of this function is given by

$$X'(s) = f_e(\hat{s}^e)'(s) + f_{W_p}F_{po} - F_{po} < 0,$$

the sign following from our earlier assumptions that $(\hat{s}^e)'(s) < 0$ ($f_{W_p} < 1$). Excess demand for foreign bonds basically means excess supply of domestic bonds and thus domestic demand for foreign currency. It is therefore natural to assume that

$$\hat{s} = \beta_s X(s)/(sF_{po}), \quad \beta_s > 0 \quad (2.15)$$

Equation (2.15) describes (here in a linear fashion) the reaction of the exchange rate with respect to the excess demand function (2.14). This implies a stable adjustment process for the exchange rate to its equilibrium value s_o ²¹ so far only considered – as shown in Figure 2.4.

¹⁹ The AA curve is again negatively sloped in the case of a Taylor rule which uses the output gap on its right-hand side where therefore the interest rate responds again to the state of the business cycle. This implies that it may be wise in certain situations to avoid automatic interest rate movements and thus the possibility of multiple and in particular bad equilibrium selections.

²⁰ Here we assume that $i(Y, M)$ given or that the CB simply sets $i = \bar{i}$.

²¹ The equilibrium exchange rate is defined by $X(s_o) = 0$.

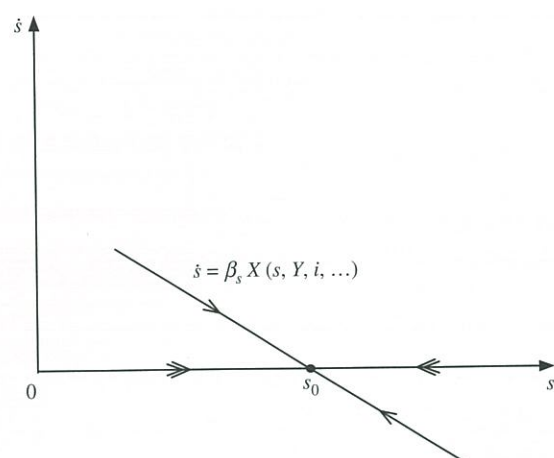


Figure 2.4 The market for foreign bonds and exchange rate adjustments

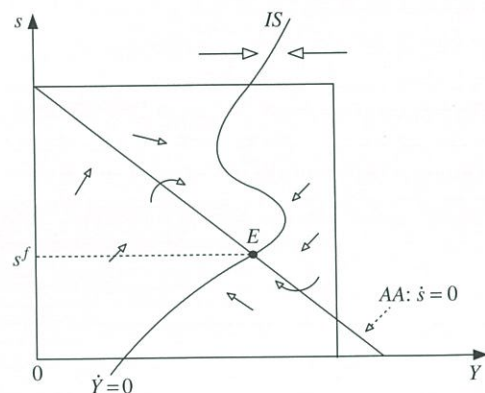


Figure 2.5 The Krugman dynamics extended to the whole Y, s phase space

Using the additional law of motion (2.15) together with those for Y given by equation (2.7), the dynamics along the asset market equilibrium curve AA can in fact now be extended to the whole (Y, s) phase space, as shown in Figure 2.5 (where we have returned for the moment to the consideration of a single stationary point E_1 , but we remind the reader of the possibility of multiple equilibria as shown in Figure 2.3). Note that the AA line is now crossed horizontally by the (Y, s) trajectories and the dynamics not characterised by the motion shown along the AA -line as in Figure 2.3 since now s does not adjust instantaneously.

The situation depicted in Figure 2.3 in fact characterises the limit case of infinitely fast exchange rate dynamics, $\beta_s = \infty$, which instantaneously places the exchange s on the AA curve, along which output still has to adjust. It thus represents a different dynamical system, as compared with the somewhat sluggish adjustment of the exchange rate that is now considered (the case $\beta_s = \infty$ is approached in a continuous fashion as β_s

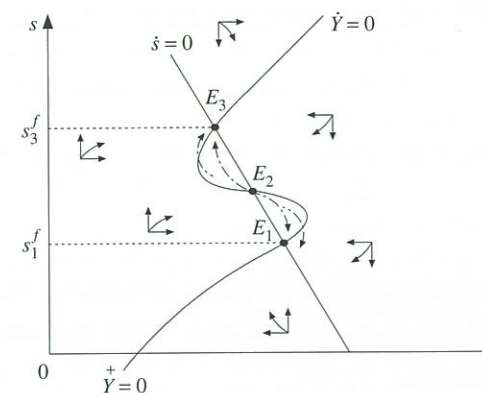


Figure 2.6 The extended dynamics in the Y, s phase space with three equilibria. The equilibria E_1 and E_3 are stable while E_2 is a saddle point

approaches ∞ , as indicated by the thick double arrows in Figure 2.5). Note furthermore that the positive orthant is an invariant set of the dynamics, it cannot be left since the change in output (in the exchange rate) is always positive sufficiently close to the axis $Y = 0$ ($s = 0$).²²

We conjecture with respect to Figure 2.5 that the sole equilibrium, shown there, is globally asymptotically stable in the positive orthant of \mathbb{R}^2 , but do not prove this here (via an appropriate application of Olech's theorem on global asymptotic stability, see Flaschel (1984) for similar applications). Since the dynamics cannot leave the box shown in Figure 2.5, the occurrence of *semi-stable* or *stable* limit cycles cannot be excluded, unless the adjustment speed of the exchange rate is close to ∞ where the dynamics are then close to those of the limit case we considered in Figures 2.2 and 2.3.

We return to the situation of Figure 2.3 with its multiple equilibria, but now embedded into the dynamics for Y and s given by equations (2.7) and (2.15). This situation is illustrated in Figure 2.6 where we again see two locally asymptotically stable equilibria and one unstable. These stability results can easily be shown by calculating the trace and determinant of the corresponding Jacobians. The process thus exhibits the equilibria E_1 and E_3 as (sole) stable equilibria under the now interacting dynamics of output Y and the exchange rate s .

Note also that Figure 2.6 suggests, and analysis of the corresponding Jacobians reveals, that the dynamics around E_2 are of saddle point type, with unstable arms leading to E_1 and E_3 respectively. It is more difficult to determine analytically the basins of attractions of the two attracting equilibria (indeed this may not be possible) and so determine what may happen elsewhere in the phase space. Numerical investigations need to be used to determine these basins explicitly. Here we shall simply assume that the dynamics are generally convergent to one of the two equilibria E_1 and E_3 after

²² The latter always holds if the non-linearity of the AA curve for small values of the exchange rate s is taken into account, since excess demand on the foreign exchange market must become positive then.

any shocks or disturbances. We justify this with the limit case $\beta_s = \infty$ where global convergence along the AA curve to either one or the other equilibrium is obvious (with the exception of the situation where the economy sits exactly in the unstable equilibrium E_2 between the two other ones).

We observe finally that, in the case of flexible exchange rates, the assumption of regressive expectations has to be interpreted and applied with care. If the economy converges to either E_1 or E_3 we know that the exchange rate will again become stationary, while the assumed type of regressive expectations $\hat{s}^e = \hat{s}^e(s)$, in particular with $(\hat{s}^e)'(s) < 0$, would imply that the expected rate of depreciation \hat{s}^e can only be zero in at most one of the three considered equilibria. This behaviour however is implausible in an environment where exchange rates can settle down at multiple stationary values. This situation can be remedied as follows.

Assume that the shock shown in Figure 2.3 has hit the economy, eventually leading it to the point E'_3 . Imbedded into the new AA curve shown here is a second shock, namely a revision of the long-run reference value s_o , to which regressive expectations are implicitly referring. This long-run reference value is here supposed to be always determined from the AA-situation, where in the defining equation we have set \hat{s}^e identically equal to zero. It is therefore the value of the exchange rate at which stationarity can be assured. Thus we assume here that expectations formation immediately switches to this new long-run value once the α -shock has occurred, for example by way of the explicit formula

$$\hat{s}^e(s) = \beta_{\hat{s}^e}(s_o/s - 1),$$

with s_o now the relevant long-run value of the exchange rate s . Regressive expectations are therefore always forward looking with respect to the long-run situation and thus change their schedule when an α -shock occurs. This means that the AA curve is subject to changes, the first caused by the parameter α (from which s_o can then be determined) and the second due to the shift in the \hat{s}^e schedule by means of s_o , which makes the AA curve steeper and guarantees that at E'_3 we arrive at s_o with $\hat{s}^e = 0$.

2.6 Fixed exchange rates and the emergence of currency crises

In this section we consider the case of a fixed exchange rate system, where $\hat{s}^e(s)$ can be assumed to be zero and where the amount of depreciation that takes place in the event of a currency crisis is not foreseen by the economic agents. The discussed dynamics of s therefore can then even be considered with $\hat{s}^e(s) \equiv 0$ and be viewed as being only implicitly present until the currency crisis in fact occurs (and modifies the expectations mechanism as discussed at the end of the previous section).

Flexible exchange rates do not represent the only exchange rate regime to which this model of large exchange rate swings and real crisis can be applied. We now turn to the fixed exchange rate case in order to see, for a normal situation of a seemingly fairly strong currency and high economic activity, how the discussed tendency to capital flight may gradually give rise to situations where the economy becomes trapped in

a depressed stationary equilibrium of type E_3 in Figure 2.3. It exhibits there a weak currency and low economic activity, but a significant reversal of net exports from a trade deficit to a trade surplus, despite the crisis state to which the economy has jumped and then continually made more severe in the direction of large output loss after the initial depreciation shock. In the fixed exchange rate regime we consider again the cases of fixed money supply. Now however the quantity F_p (foreign bonds demand realised by households) can depart from the level households already own and indeed rise beyond this level until the foreign reserves F_c of the CB become exhausted.

In order to investigate the possibility of an exchange rate crisis for the fixed exchange rate regime by means of the modelling framework of this paper, let us first introduce as reference curve a balanced trade line in its relationship to the IS or goods market equilibrium curve of Figure 2.3. Obviously, the equation

$$0 = NX(Y, s), \quad NX_Y < 0, \quad NX_s > 0$$

defines an upward sloping curve, representing balanced trade in the Y, s phase space. We have positive net exports on the upper part of the IS curve and negative net exports on its lower part. We assume for this curve that the situations depicted in Figure 2.7 hold true.

Figure 2.7 shows that output is completely fixed by the exchange rate in our model when a given exchange rate (say \bar{s}) is assumed. In the depicted situation we have a high level of economic activity, a trade deficit due to a strong currency and based on this high level of activity a capital market curve AA that would imply slight currency depreciation and even higher economic activity (with a lower trade deficit in addition) in the case of perfect exchange rate flexibility. Note here that the AA curve is however only implicitly present; it determines in the background of Figure 2.7 the stock of foreign bonds demanded by the public (excess demand being met out of the stocks held by

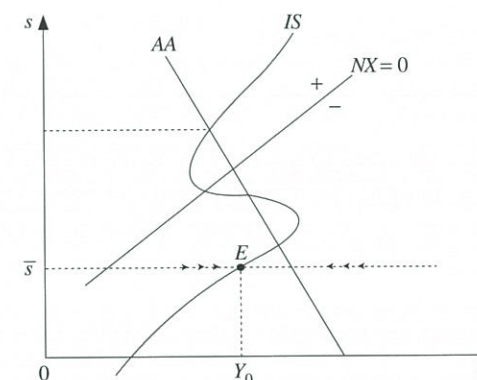


Figure 2.7 Balanced trade line and a normal equilibrium in a fixed exchange rate regime, with 'excess demand' for the foreign asset

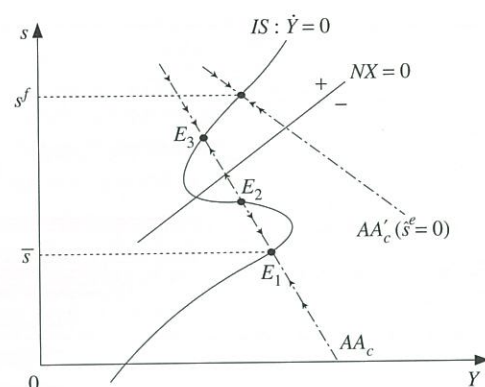


Figure 2.8 The normal real equilibrium, limited intervention range and the shadow dynamics in a fixed exchange rate regime

the CB) and that this curve is based on the assumption of $\hat{s}^e = 0$ in the fixed exchange rate case. The equilibrium Y may be called a normal equilibrium as in Krugman (2000).

The dynamics shown in Figure 2.8 (for the case $\beta_s = \infty$ in equation (2.15)) are therefore only shadow dynamics that would come into existence if the fixed exchange rate regime were to be abandoned by the CB. As long as this is not the case we always have that excess demand for foreign bonds $F_p - F_{p0}$ of the private sector, determined by

$$\bar{s}F_p = f(\bar{i}^* - i(Y, M), M_o + B_o + \bar{s}F_{p0}, \alpha),$$

is always serviced by the CB out of its foreign bond reserves F_c . Current foreign bond reserves are assumed to be sufficiently large to allow for this balancing of the market for foreign currency. This indeed then allows for the fixed exchange rate regime and implies that in the course of time (when the capital flight parameter α starts to increase in a continuous fashion) that private households hold more and more foreign bonds in their portfolio without a change in the total value of this portfolio, W_p , and thus their nominal wealth position, since the exchange rate is fixed.

We thus assume now that the expression F_p is slowly increasing through the influence (and solely through the influence) of the parameter α , since output is fixed by the given exchange rate. However only the IS curve matters for the domestic equilibrium on the real markets, while the AA curve only determines the position F_p of the stock of foreign bonds currently held in the private sector. Note here again that the expectations mechanism $\hat{s}^e(s)$ is not present in a fixed exchange rate regime, as long as people do not speculate about an exchange rate crisis in terms of exchange rates, which may nevertheless be approaching because of increases in the capital flight parameter α .

Besides the $NX = 0$ curve we also show in Figure 2.8 the critical line AA_c where $\alpha = \alpha_c$ has become so large that $\bar{F}^* = F_p$ (and so $F_c = 0$) holds, a situation in which the CB no longer has any reserves of the foreign currency. At this critical value of α , or indeed even before this value has been reached, the fixed exchange rate system will

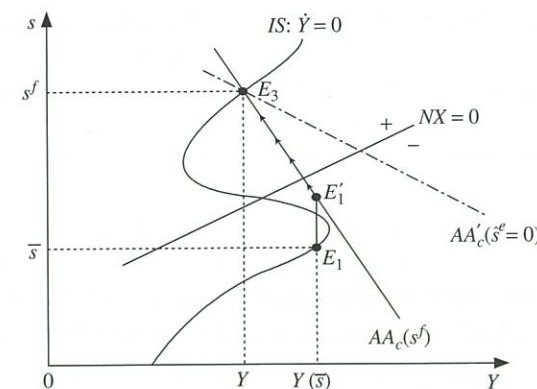


Figure 2.9 The breakdown of the fixed exchange rate regime: currency crisis, investment collapse and large output loss

break down and by assumption be replaced by the regime of perfectly flexible exchange rates considered in the preceding section. We thus assume now that the ongoing process of a financial capital restructuring of private households, via further increases in the capital flight parameter α , has progressed to such a point that the foreign exchange reserves of the CB are basically exhausted as represented by the line AA_c (where $\hat{s}^e = 0$ still holds). We have already indicated in Figure 2.8 the dynamics that would then come about if the exchange rate were to become flexible and be determined by the asset markets. This would however then also re-establish the regressive expectations mechanism, based on the now sole equilibrium E_3 and would thus in addition rotate the line AA_c in a clockwise fashion around this equilibrium to the position AA'_c , as explained in the preceding section and shown in Figure 2.9. In Figure 2.9 we go from the potential situation shown in Figure 2.8 to what would actually happen if the exchange rate were again subject to market forces with an adjustment speed $\beta_s = \infty$ in equation (2.15).

When this situation is reached, the exchange rate – by assumption – becomes completely flexible and the shadow dynamics of Figure 2.8 switch on, leading the economy in the way described in the preceding section to the bad equilibrium E_3 along the AA'_c curve. The latter is steeper than the intervention limit curve AA_c shown, but also runs through the single equilibrium point E_3 . In addition, the regressive expectations mechanism for the exchange rate dynamics becomes active with a long-run reference value for the exchange rate that is determined through E_3 .²³

The result of such a currency crisis will be (if Figure 2.9 applies) a large initial devaluation of the domestic currency, and based on this a larger and larger loss in output

²³ We thus in fact consider here some sort of asymptotically rational expectations which always know the long-run value of the exchange rate to which the economy will converge. This presumes knowledge of the IS curve and the AA curve for $\hat{s}^e = 0$ at least for the ranges where investment is very unresponsive to the exchange rate. Under this assumption along with the assumption that exchange rate dynamics must again come to a rest, the intersection of these two curves provides the agents with the long-run values of s that enter into their regressive expectations scheme.

as the currency continues to depreciate towards the value s_o (due to the dominance of the investment crisis). In the course of this process there will be a radical improvement in the trade balance (but this will still be too weak to overcome the loss of investment demand). Against this background recall that the domestic CB has lost (nearly) all of its currency reserves due to the flight from domestic bonds into foreign bonds. The economy thus tumbles into a real crisis with large output loss, based on a breakdown of investment, only partly counteracted by net exports due to the strong currency depreciation, with a CB that has become powerless with respect to any further intervention in the foreign exchange market.

Next we consider in addition to the above (again for the case of a fixed exchange rate \bar{s}) a law of motion for the capital flight parameter α that by assumption shifts the AA curve to the right if it increases. In the case of fixed exchange rates we again have Figure 2.8 in place of Figure 2.9. It shows the AA curve as the dotted line, an attracting curve that could lead the economy to either E_1 or E_3 if exchange rates were completely flexible (still for $\hat{s}^e = 0$). Note that there is excess demand for foreign bonds below the AA curve and excess supply above it. We have assumed that flexible exchange rates will come about when AA_c - and immediately thereafter AA_c applies in a situation where there is no longer a normal equilibrium point of type E_1 .

We have assumed that the demand function f for foreign bonds depends positively on the capital flight parameter α , since an increasing tendency to capital flight means that residents attempt to substitute domestic bonds by foreign bonds. Excess demand (calculated before CB intervention) increasing with α may in fact give rise to a law of motion for α of the following type (presented in discrete time here solely),

$$\alpha_{t+h} = \alpha_t + \beta_\alpha (f(\bar{i}^* - i(Y, M), W_p, \alpha_t) - f(\bar{i}^* - i(Y, M), W_p, \alpha_{t-h})),$$

where \bar{i}^* , $i(Y, M)$, $W_p = M_o + B_{o,t} + \bar{s}F_{p0,t}$ are all taken as given magnitudes despite the change in the composition of the bond holdings of the public. Note that we have inserted here $\bar{s}F_{p0,t} = f(\bar{i}^* - i(Y, M), W_p, \alpha_{t-h})$ as the result of the past foreign market intervention of the CB at each point in time, in order to express excess demand by the change in demand that has happened from $t-h$ to t . Demand for foreign bonds and their actual holdings are changing in this manner through time (without any change in total private wealth). An initial increase in this demand may therefore set in motion a continuous increase in the parameter α , by way of contagion, for instance. This may lead to an explosive movement of α if \bar{s} and $\alpha(0)$ are such that there is a positive excess demand at these initial values.

Again assume that some shock (for example coming from a neighbouring country) shifts the AA curve to the right to another curve AA' . At E_1 we now have excess demand for foreign bonds and thus an increasing α that continues to shift the AA curve to the right until AA_c is again reached. The normal equilibrium of the economy with flexible exchange rate shifts during this process towards higher output and exchange rate levels, until it finally disappears. During this process excess demand for foreign bonds may be increasing in an accelerating fashion, so far always met by the central

bank. When α continues to increase there may again arise the situation that the reserves of the CB become exhausted, so that $F_c = \bar{F}^* - F_p \approx 0$.

The fixed exchange rate regime by the CB will then break down and give rise to the exchange rate adjustments already discussed, leading the economy through a sudden depreciation to point E'_1 . Here output will start to decrease and the exchange rate will continue to increase until the new stationary point E_3 is reached. The economy is now trapped in a bad equilibrium E_3 as discussed in Krugman (1999, 2000), but with a significant reversal from trade deficits to a trade surplus.

We stress that this outcome may depend to some extent on the way Figure 2.9 has been drawn and therefore only represents the one typical situation when the reserves of the CB are so large and its intervention lasts so long that the AA_c curve, where it ceases its intervention, exhibits only the upper bad equilibrium for the economy with a flexible exchange rate. An alternative situation that may arise in the case of shorter intervention is illustrated in Figure 2.10, which shows an overshooting exchange rate depreciation and in fact an increase in economic activity as the currency starts to appreciate after the initial devaluation shock.

Still another possibility is indicated in Figure 2.11, where there is again no loss in output, since the induced devaluation of the exchange rate is such that its subsequent appreciation leads to increasing output levels via the net export channel. Whichever situation prevails the likelihood of exchange rate crisis coupled with a major collapse in investment behaviour and thus large output loss will lead to a return to flexible exchange rates, due to the lack of reserves to persevere with the fixed exchange rate regime, and re-establish the importance of the AA_c curve as a global attractor and the output movement along it (not always to the left if the bad equilibrium applies) until a new stationary point has been reached. Since AA_c again restricts the positions of the economy we return to $X = 0$ and thus possibly also to a stationary value for the capital flight parameter α .

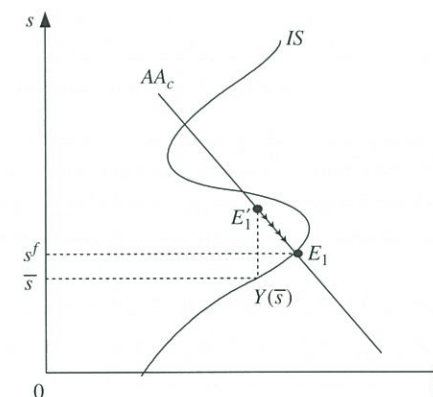


Figure 2.10 No currency crisis and output expansion in the case of a quick return to a flexible exchange rate regime

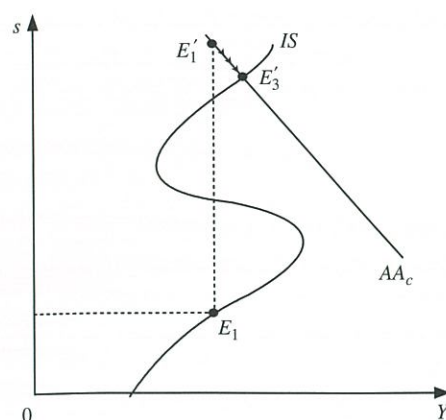


Figure 2.11 Overshooting exchange rate crisis and output improvements due to net export dominance

To sum up, the final consequence of the increasing propensity for capital flight is, if the situations Figure 2.10 and Figure 2.11 do not apply, that the exchange rate depreciates radically and that a severe economic depression will be induced, resulting from the balance sheet effect on investment, coupled with a pronounced reversal from a trade deficit to a trade surplus.

A leaning against the wind strategy of the CB, that is an increase in domestic interest rates in order to stem the capital flight, may, due to the consequent shift of the AA curves to the left, prevent the breakdown of the exchange rate system for some time, but will eventually fail due to the continuous increase in the parameter α as discussed above. This will then make the subsequent recession even more severe, since sooner or later the AA curve will apply, at the point where $\bar{F}^* = F_p$ (and so $F_c = 0$) has been reached.

2.7 International capital flows: adding capital account dynamics

We now extend the model, which has so far followed the assumptions made in Rødseth (2000, Ch. 6), by allowing for international trade in domestic bonds. In order to motivate this we again consider first the balance of payments of the domestic economy.

We now have two new entries (in the capital account) and in the following analysis will consider only equilibrium positions on the international market for domestic bonds so that the remaining part is to be interpreted as in the earlier sections of this chapter. As further simplification we assume that the impact of official reserve transactions on the domestic supply of money can be ignored in the goods market dynamics for the time being. We stress here that the current extension of the MFT model is an important one (though not from the purely mathematical perspective), since the financial markets of the economy are now no longer closed with respect to foreign capital movements,

Table 2.5. Balance of Payments (in foreign currency)

Debits		Credits	
Trade Account:			
Imports sJ		Exports X	
Interest Income Account:			
Interest payments of firms to the foreign economies $s\bar{i}^*F_f$		Interest payments from the foreign economies $s\bar{i}^*F_p + s\bar{i}^*F_c$	
Capital Account:			
$s\dot{F}_p^d$		\dot{B}^{d*}	
Official Reserve Transactions of the CB:			
$X - sJ + s\bar{i}^*F_p + s\dot{F}_c - s\bar{i}^*F_f$			

but are subject to foreign asset demands and thus now also vulnerable to speculative attacks from abroad.

There is however one further change to be made to the model which is suggested by our continuous-time model as well as the need to input flows $\dot{F}_p^d (= \dot{B}^{d*}/s)$ and not desired stock changes $f(\varepsilon, W_p)/s - F_p$ into the (flow) balance of payments. From the continuous-time perspective it is not very plausible to have full stock equilibrium at all moments in time. Moreover, since agents are facing some adjustment costs, it is therefore plausible to assume that only a portion γ of their desired stock changes $f(\varepsilon, W_p) - sF_p$ appears at the current moment of time as flow demand, here for foreign bonds, $f^d = \gamma(f(\varepsilon, W_p)/s - F_p)$, where γ as in the related (less fast) capital stock adjustment principle has a time dimension (not yet present in the excess stock demand function).

The behaviour of domestic agents on the international capital markets for domestic and foreign bonds assumed above is, as shown, closely related to the stock portfolio approach of this chapter. We assume that money market equilibrium is already ensured and consider the demand function

$$s\dot{F}_p^d = \gamma(f(\varepsilon, W_p) - sF_p)$$

as derived above from the stock demand for foreign bonds $f(\cdot, \cdot)$. The domestic flow demand for domestic bonds is then characterised residually by

$$\begin{aligned} \dot{B}_p^d &= \gamma[(M + B + sF_p) - M - f(\varepsilon, W_p)] - B \\ &= \gamma[sF_p - f(\varepsilon, W_p)] = -s\dot{F}_p^d = s\dot{F}_p^s. \end{aligned}$$

and thus need not be considered explicitly in the following if it matches with the foreign demand for domestic goods as is assumed below. It is thus obvious that these induced

flows add up to zero and thus transform the initial form of a Walras' Law of Stocks into a Walras' Law of Flows on the asset markets.

We thus have to consider in the following only the two flow demand functions (which have to be interpreted as supply functions in their negative domain):

$$s\dot{F}_p^d = \gamma[f(\bar{i}^* + \hat{s}^e(s) - i(Y, M), M + B + sF_p) - sF_p] = f(s, \cdot), \quad f_s < 0 \quad (2.16)$$

$$\begin{aligned} \dot{F}^{d*} &= -\frac{\dot{B}^{d*}}{s} = \gamma^*[f^*(\bar{i}^* + \hat{s}^{e*}(s) - i(Y, M), M^* + F^* + \frac{B^*}{s}) - F^*] \\ &= f^*(s, \cdot), \quad f_s^* < 0 \end{aligned} \quad (2.17)$$

As in earlier sections of the chapter we have again that f is a strictly decreasing function of the exchange rate s and get now in addition that this also holds true for the demand for foreign bonds by foreigners. The supply of foreign bonds by foreigners $s\dot{F}_p^{s*} = \dot{B}^{d*}$ is therefore an increasing function of the exchange rate. The market for foreign bonds concerning the domestic economy clears if $s\dot{F}_p^d = s\dot{F}_p^{s*}$ holds true, which holds if and only if the market for domestic bonds is cleared. We thus get a situation on the international capital market for domestic bonds as shown in Figure 2.12, describing through the intersection of the two curves shown the equilibrium in the trade between international and domestic bonds and the level of the exchange rate that achieves this result.

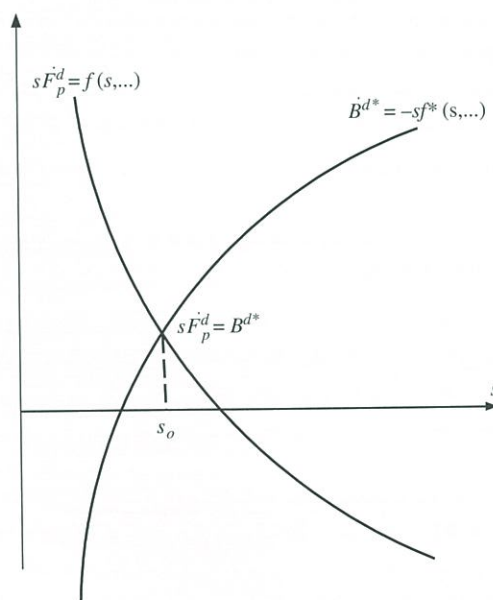


Figure 2.12 Equilibrium on the international market for domestic bonds

Summarising the above MFT extension towards the integration of international capital flows, we can state that the model assumes that cash management comes first and is always characterised by stock money market equilibrium $M/p = m^d(Y, i)$. Against this background domestic agents then plan to reallocate their interest-bearing assets according to the behavioural relationship $f(\varepsilon, W_p)$.

Figure 2.12 shows the level of the exchange rate s_o where the domestic demand curve for foreign bonds (the supply curve for domestic bonds) and the foreign demand curve for domestic bonds (the supply curve for foreign bonds) intersect and where therefore capital flow equilibrium is established. The equilibrium exchange rate now also depends on foreign characteristics in contrast to the case considered earlier in this chapter, where domestic bonds were considered as non-traded goods and where therefore the supply of such bonds (in the case of a flexible exchange rate regime) was just given by F_p . In this case the equilibrium in the domestic market for foreign bonds would be determined by the intersection of the f curve with the horizontal axis and would thus be independent of foreign asset demand. This is definitely a situation that is too simple to characterise today's international financial system. Note that the $-sf^*$ curve is a supply curve of foreign bonds, while in the form sf^* it would represent a demand curve for foreign bonds. In the case where the latter is identical to the f curve shown, the intersection of the $f, -sf^*$ must lie on the horizontal axis, so that the equilibrium exchange rate implies in this special case that there is no international capital flow.

We consider now the alternative situation of a fixed exchange rate regime ($s = \bar{s}$), where $\hat{s}^e = 0$ holds under normal conditions. Figure 2.13 depicts such a situation and shows that the CB is forced, in the depicted case of a domestic excess demand for foreign bonds, to supply the amount \dot{F}_c to the market for foreign bonds in order to defend its particular choice of exchange rate level. Such a situation can be very vulnerable however in a small open economy, since the reserves of the country may have become small in the course of time and thus provoke a currency crisis.

Foreigners (and also domestic residents) might for example correctly regard a situation in the considered economy, where $\dot{F}_p^d = \dot{F}_p^{s*} + \dot{F}_c^s$, $\dot{F}_c^s > 0$ holds as not being sustainable and expect that the domestic CB must give in sooner or later and allow the exchange to float freely due to a lack of reserves. In the given excess demand situation they therefore expect a devaluation of the domestic currency and thus start to move out of domestic bonds into foreign bonds or, as Figure 2.14 in fact shows, reduce their demand for domestic bonds. If such a move is sufficiently strong, this may quickly undermine the possibility of the CB of defending the fixed exchange rate system and thus indeed produce the result of a flexible exchange rate regime s_o that was already expected.

Another possibility for the occurrence of such a situation may be given by a speculative borrowing of domestic currency (bonds). These funds are then used to buy foreign bonds on the international capital market. If this move into foreign currency is again sufficiently strong this can also cause the CB to switch towards a flexible exchange rate regime and allow thereby for a devaluation of the domestic currency. The initial

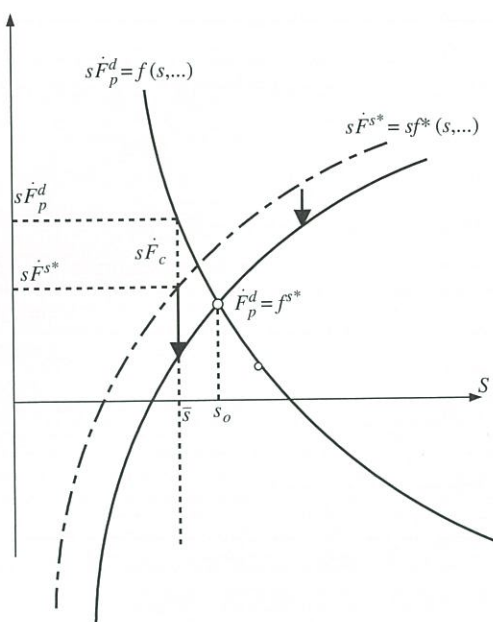


Figure 2.13 Fixed exchange rate regime and a speculative attack on the domestic currency

borrowers of the domestic currency can then make significant profits by going back into domestic bonds and paying back the credit with which they started their initial financial transactions.

Fixed exchange rate systems thus appear as vulnerable institutional configurations in countries where firms have high foreign debt, since an exchange rate crisis and a subsequent devaluation of the domestic currency can significantly affect the net worth of firms, their credit-worthiness and their investment financing. The resulting investment credit crunch then leads, via the Keynesian multiplier process, to large output losses. This was already demonstrated for the financially closed economy. The emergence of such credit crunch situations however becomes much more likely if there is international trade in domestic and foreign bonds, since capital movements can become much more pronounced in such a case.

We therefore now consider again a flexible exchange rate system in order to see what problems may arise in such a context. As flow demand functions on the international bond markets we have the equilibrium expression which determines now the equilibrium exchange rate at each moment in time. This may be written

$$s\dot{F}_p^d = \gamma[f(\bar{i}^* + \hat{s}^e(s) - i, M + B + sF_p) - sF_p], \quad \text{or equivalently} \quad (2.18)$$

$$\dot{B}^{d*}/s = -\gamma*[f^*(\bar{i}^* + \hat{s}^{e*}(s) - i, M^* + F^* + B^*/s) - F^*] \quad (2.19)$$

Solving one of these equations for the equilibrium exchange rate by means of the implicit function theorem gives the general expression

$$s = s(i(Y, \bar{M}), \bar{i}^*, \bar{M}, \bar{M}^*, B, B^*, F_p, F^*). \quad (2.20)$$

This function generalises the original Dornbusch (1976) approach which assumed the uncovered interest rate parity condition $i = i^* + \hat{s}^e(s)$ and it implies (as in Dornbusch) that s depends positively on i^* and negatively on i , but here also with explicit influences from the stocks of financial assets that now impact the determination of the exchange rate s . On this basis we can write the laws of motion in the domestic economy as

$$\dot{Y} = \beta_y(C(Y - \delta\bar{K} - \bar{T}) + I(s) + \delta\bar{K} + \bar{G} + NX(Y, \bar{Y}^*, s) - Y) \quad (2.21)$$

$$\dot{F}_p = \gamma[f(\bar{i}^* + \hat{s}^e(s) - i(Y, M), M + B + sF_p)/s - F_p]. \quad (2.22)$$

In the background of the model we have now however also changes in the stocks of domestic and foreign bonds, due to the firms' and the government's budget constraints which implies that the above laws of motion do not constitute an autonomous system of differential equations.

We have however as in the case of a closed domestic capital market that the dependence of the exchange rate s on output Y is a negative one (with all stocks of financial assets considered as given magnitudes for the time being) and thus in this case again we have the AA curve depicted earlier. But this curve (and the resulting equilibrium exchange rate), shown in Figure 2.14, is now moving in time in ways not easy to

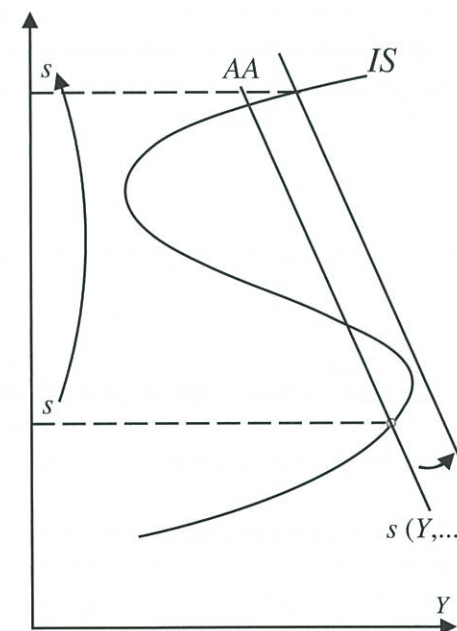


Figure 2.14 Flexible exchange rate and the endogenous change from booms to busts

determine and thus may in particular lead to situations where the boom equilibrium shown in Figure 2.14, exhibiting high investment, high output levels and a strong domestic currency, gets lost. This will then lead again to a radical depreciation of the domestic currency, and from there to severely depressed levels of investment and thus high output losses. The economy therefore remains vulnerable also in the case of a flexible exchange rate regime, due to its high dependence on foreign credit in the financing decision of domestic firms.

Economic policy should therefore aim to steer the economy away from the (not really known) right-hand output maximum of the IS curve in order to not allow for a situation that is easily vulnerable in the way just discussed. This means that investment should not be pushed up to its supply rationed level where such a regime switch to a currency crisis becomes likely. Finally, in a flexible exchange rate regime, the domestic economy is heavily dependent on foreign investment strategies and therefore of course not at all as safe as in the case with no international capital flows that we considered earlier.

2.8 Conclusions

We have introduced in this chapter an open economy portfolio model that has allowed us to study the channels that cause, and the feedback effects that arise from, large currency swings. We have demonstrated that large currency swings under flexible exchange rates as well as slowly progressing and then sudden capital flights under fixed exchange rates may lead to strong repercussions on the financial market when a large fraction of the domestic debt of firms is denominated in foreign currency. There are also strong repercussions under fixed exchange rates when there are capital flights that develop slowly at first and then become abrupt. These repercussions may in turn entail a low level equilibria and large output losses for the economy. Following a model suggested by Krugman (1999, 2000) we showed rigorously in a dynamic model with multiple equilibria that there are mechanisms at work that can indeed give rise to such phenomena. Our results point to the dangers that may be brought about for a country if financial and capital market liberalisation without safety nets and sufficient financial market regulations are pursued too quickly, and we have shown that a flexible exchange rate does not exclude such dangers.

We have considered the small and sometimes very large effects of increasing dollar-liquidity preference in a set-up where the exchange rate, if flexible, was moving counter-cyclically and where leaning against the wind policies were present via restrictive monetary policy. These policies attempt to shift the financial markets equilibrium curve to the left where there is reduced output but stronger currency values that partially neutralise the increasing dollar-oriented liquidity preference. Such policies may also be supported by the IMF as a lender of last resort. Those efforts may prevent the outbreak of the considered crisis and may be a more appropriate way to cope with the increased vulnerability of small open economies exhibiting a high level of foreign debt.

The model was completely explicit with respect to budget conditions, the accounts of the four sectors of the economy and the balance of payments, showing clearly

however the narrow foundations on which this type of crisis model still rests. We have flow consistency and the fulfilment of all plans of the agents of the economy – up to firms which may be credit or supply rationed in their pursuit of new investment goods. We still have fixed-price bonds. Expectations thus solely concern changes in the exchange rate, depreciation or appreciation, and were assumed to be of the asymptotically rational (regressive) type. Assuming fixed-price bonds means that asset holders can indeed enforce a currency crisis (in a fixed exchange rate system) if they initially hold enough domestic bonds compared with the dollar-denominated bonds held by the CB. Speculation on the degree of success of currency attacks is thus quite possible in this framework.

Concerning expectations one might ask why we did not assume rational expectations (based on myopic perfect foresight) in this chapter. However, this would turn the two equilibria that were stable under regressive expectations into saddlepoint dynamics. Furthermore, the unstable equilibrium in the middle would then become a stable equilibrium, if the dynamic multiplier process is supposed to work with sufficient speed. We would therefore obtain a situation that is not easily handled by means of the conventional jump variable technique.

Rather than pursuing this type of extension one might approach goods market behaviour with more advanced behavioural functions as in Rødseth (2000, Ch. 6) or extend the asset market approach towards flex-price bonds and also add equity issuance of firms. A stock-flow interaction may then be added to the model.

Finally, in the place of a fixed money supply or its discretionary changes, we could consider interest rate policy rules (Taylor type rules) and also Phillips curve (PC) driven price dynamics. The latter could in particular help to elaborate the issue of debt deflation, since firms are already formulated here as being highly indebted and thus also very vulnerable with respect to output price deflation, in particular if wages and foreign interest rates remain given magnitudes; see Chapter 4 for a treatment of debt deflation in the context of a closed economy.