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Philip Arestis and Gennaro Zezza

Advances in Monetary Policy and Macroeconomics

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1
Introduction

Philip Arestis and Gennaro Zezza

In September 2005 we organized a conference at the University of Cassino, Italy, the aim of which was to explore 'The Keynesian Legacy in Macroeconomic Modelling'. In the postwar period, macroeconomic modelling of developed economies was mainly rooted in Keynesian theory up to the 1970s, when the failure of applied models to deal with stagflation led to a shift in economic theory towards supply-side models, rational expectations, optimizing behaviour etc., and since that time attention to applied macroeconomic models as we knew it has diminished considerably among economists. However, existing empirical models based on Keynesian and Post Keynesian principles are sometimes more successful than models based on optimizing behaviour in tracking real economies. Moreover, theoretical macroeconomic models are still developed and discussed among economists of a Keynesian persuasion. The ultimate goal of the conference was to collect state-of-the-art results in what one may broadly label as Keynesian macroeconomic modelling, on both theoretical and empirical grounds.

The papers presented at the conference provided a rich collection on the main theme of the conference. We felt actually that there was enough material to warrant publication of a book on the theme of *Advances in Monetary Policy and Macroeconomics*. There are 14 such chapters and in what follows we try to provide a short summary of each one.

The first five chapters fall within the area of New Monetary Policy. In the opening chapter Giuliana Passamani and Roberto Tamborini deal with monetary policy, firms' bank dependence and default risk. Among Keynes's undeveloped, or underground, ideas that are being resurrected under new clothes are those of 'monetary theory of production' (1933) and firms' 'finance motive' in the demand for money (1937) in imperfect financial markets. The most important source of imperfection is now seen to be asymmetric information which generates agency problems between the firm and its external financial suppliers. This chapter presents a model that clarifies the *supply-side* responsiveness of the economy to these financial factors, and, therefore, to monetary policy to the extent that it drives inter-bank rates *vis-à-vis* default risk. Then the chapter moves to an empirical assessment of the model on the basis of Italian data. As expected theoretically, the inter-bank rate and the default risk premium are co-determinants of the equilibrium path of output and inflation.

Olivier Musy and Sébastien Pommier, in their contribution, attempt to analyse the performance of alternative expectational assumptions for the empirical evaluation of the New Keynesian Phillips Curve. They replace the standard Rational Expectations Hypothesis by several less restrictive assumptions on expectations formation. The difference between each of these hypotheses relies on the agents' information content in forming their forecasts. The authors find that assuming myopic forecasts gives support to the New Keynesian Phillips Curve, while the assumption of pure rational expectations performs badly. Naïve expectations do not produce a worse performance than any of the other alternatives considered. Their method also allows them to evaluate the relative performance of a variety of New Keynesian models.

The contribution by Chiara Oldani, 'The Taylor Rule and Financial Derivatives: The Case of Options', begins with the thesis that financial innovation is a variable that can be considered to be responsible for money demand instability and also for affecting the stability of financial markets. The aim of the monetary policy rule in New Keynesian models is not to control money supply, but to direct attention onto inflation and financial stability. Financial innovations should then be considered in the operation of monetary policy if it were able to alter the ability of the monetary authorities to reach the desired goal of price stability. Options are one of the most fastest-growing and attractive financial instruments in modern financial markets. Monetary policy rule (i.e. of the Taylor rule type) is based on the interest rate setting and, given that it is possible to verify that a positive relationship exists between the implied volatility of option contracts and the (risk-free) interest rate, it is meaningful to introduce the implied volatility into the Taylor rule, as an explanatory variable. This is precisely the aim of this contribution.

In chapter 5, entitled 'Credit Risk Management Rationing vs Credit Derivatives and Consequences for Financial Stability', Stefania Vanacore discusses the credit cycle in a theoretical context of inside money, which implies, of course, endogenous money supply, referring to a system reminiscent of the Keynesian finance motive. In a framework where the agents are distinguished by their capability to raise money (central bank money or commercial bank liabilities), the author analyses how credit supply changes when banks take advantage of the existence of a derivatives market for credit risk, and for hedging purposes. It is found that when credit derivatives exist, a rationing strategy is not always optimal for a bank. Hence, markets can positively influence credit quantity. At the same time, banks are less able to react to an increase of the systematic risk. Consequently, central banks must pay attention to market price volatility if they really mean to control financial instability.

In their contribution, Dominique Torre, Elise Tosi and Muriel Dal-Pont Legrand discuss the ways in which an independent Central Bank can operate monetary policy when it is committed to a medium-term achievement of a mixed set of objectives. Imperfect and asymmetric information between a bank responding *à la* Stackelberg and agents reacting to its initiatives is assumed. Agents are heterogeneous according to their inflationary expectations and their aversion to inflation. Monetary policy is not independent of the nature and the transformation of the opinions of agents. This policy can be of the type that suggests that the Central Bank, through its actions, has to convince agents that there is an inverse relationship between inflation and growth. Under such circumstances agents consider that, even in a world where time inconsistencies are not costless, an adequate level of inflation does not preclude growth.

The two chapters that follow fall squarely within the confines of the European Union (EU) experience. In the first of these, Philip Arestis, Georgios Chortareas and Theodore Pelagidis, in the chapter entitled 'Asymmetries as Sources of Conflict in a Monetary Union', turn their attention to the case of the Economic and Monetary Union (EMU) and some of the challenges that lie ahead. The authors attempt to identify the potential sources of economic conflict within the EMU. The greater the difference in the structure of production, the greater the incidence and magnitude of the demand shocks experienced by individual countries. The euro area mechanisms may be unable to face demand disturbances under a single currency regime, which could also debilitate production systems and, thus, diminish trade in regions that are lagging behind. Under the euro area institutional architecture, the erosion of fiscal policy and the inability to handle successfully asymmetric shocks may reflect negatively on the sociopolitical stability and legitimacy of the EMU regime.

In the second of these two chapters, entitled 'Alternative Fiscal Policy Rules and the Stabilization Problem in EMU: Theory and Simulations', Jorge Uxó and M. Jesús Arroyo deal with the EMU, which is supposed to have redefined the stabilization policy's main instruments for the European countries. A more active fiscal policy is propounded through a model of the European monetary union. In this model economies experience specific supply and demand shocks and have different instruments to carry out stabilization policies. The main objective of the exercise is to examine the conditions under which a larger stabilization capacity is put in place. This implies that economic policy should be able to offer some alternative mechanism that allows national authorities to recover their stabilization capacity. The formal analysis of the model is subjected to empirical investigation through simulating the proposed model with different sets of parameters. The main conclusion is that active fiscal policy improves stabilization, The fiscal policy rule proposed is based on both the output gap and on inflation.

The next two chapters can be thought of as sitting comfortably under the more general theme of 'Money, Credit and the Business Cycle'. The first of the two chapters, by Korkut Erturk, entitled 'On the Minskyan Business Cycle', attempts to link Keynes' *Treatise on Money* to the Minskyan financial fragility to show how a business cycle expansion comes to an end. The author suggests that Keynes' views on the sequence of the 'bull' and 'bear' sentiment and asset price speculation over the business cycle, can explain two of Minsky's central propositions in relation to business cycle turning points. These being that financial fragility increases gradually over the expansion, and that the eventual increase in the interest rate sets off a downward spiral, thereby bringing the expansion to an end. In both Minsky and Keynes's *Treatise*, the account of the expansion begins with optimistic expectations enabling firms to capitalize their expected earnings in financial markets and to finance their investment expenditures. Ultimately, though, the ability of the banking system to accommodate a rising level of economic activity falters.

Elisabetta De Antoni takes a different approach to that of Korkut Erturk, contrasting the Minskyan financial instability hypothesis with Keynes's General Theory, in the second of the two chapters, entitled 'Minsky's Vision and its Relationship with *The General Theory*'. The author's suggestion is that the former cannot be treated as an interpretation of the latter. Minsky deals with a vibrant economy with upward instability, naturally inclined to overinvestment and overindebtedness. The General Theory, by contrast, is concerned with a depressed economy, tending to chronic underinvestment and thus to high and long-lasting levels of unemployment. Despite these differences, the basic vision of the two cases is the same. The financial instability hypothesis and The General Theory may be considered as being two faces of the same coin; however, they are two faces that look in opposite directions. From this perspective, Minsky may be considered to have extended the economics of The General Theory to a vibrant and euphoric economy, making it even more general and modern.

The rest of the book contains five chapters on the general theme of 'Issues for Spatial and Open Macroeconomies'. In the first of these, entitled 'Towards a Spatial Keynesian Macroeconomics', William Mitchell and James Juniper begin by providing a clarification of the goals of a Post Keynesian macroeconomic governance structure. The authors further develop the concept of a Spatial Keynesian approach to macroeconomics. Two approaches to Post Keynesian macroeconomic policy are considered and compared. One, which is characterized as generalized expansion and leverage on private multipliers, and the other, represented by a Job Guarantee. The importance of taking a spatial dimension to the principle of effective demand is emphasized. It is also argued that the first of the approaches is flawed in this respect. The role played by spatial networks in distributing macroeconomic activity across the regional surface is also highlighted.

Daniela Federici and Sergio Santoro in the chapter that follows, entitled 'Monetary Shocks and Real Exchange Rate Dynamics', investigate the real exchange rate dynamics in the context of a general equilibrium approach based on microfoundation principles. This is integrated with nominal rigidities and imperfect competition. It is true to suggest that few empirical studies have been carried out to test the consistency of this approach with the data. This contribution develops a theoretical model based on the assumptions referred to above, which is subsequently tested. A Full Information Maximum Likelihood procedure is adopted to estimate the structural parameters in order to analyze the reactions of the real exchange rate to monetary shocks. The overall conclusion of the empirical part of the chapter are very encouraging in terms of validating its theoretical premise.

Carolina Pagliacci and Elizabeth Ochoa, in the chapter entitled 'Macroeconomic Risk: Evaluation of International Reserves in Venezuela', present a methodology that allows decision makers to synthesize and analyse information related to the management of international reserves, in an environment of high uncertainty. In particular, four dynamic indicators (the forecasted path of both international reserves and inflation, the likelihood of a currency crisis, and an indicator of optimality of reserves) are proposed over which risk is measured. Probability distributions of these variables are obtained by stochastic simulations of shocks in a Venezuelan external sector model. The model describes the behaviour of the main components of the balance of payments and the path of the nominal exchange rate. The definition of the exchange market pressure is used throughout, along with an account of the presence of exchange rate controls. An application of the methodology illustrates the different types of risks and tradeoffs involved in reserve performance.

In the penultimate chapter, entitled 'World Bank Trade Models and the Doha Debate', Rudi von Arnim and Lance Taylor propose a 2-region SAM with trade and aid flows tied together in a social accounting matrix format suggested by Wynne Godley, and a model structure heavy on CES-aggregates, in order to construct a stylized replica of the World Bank's LINKAGE model. The authors' goal is to critique standard approaches to measuring 'welfare gains' from the Doha Development Agenda. The contribution finds that the World Bank's simulation results are not only lopsided, but also biased due to an interaction between the government's accounts and LINKAGE's 'Armington' specification of foreign trade under imperfect competition.

Finally, in chapter 15, Marcelo Curado, Gabriel Porcile and Ricardo Viana present a model that is based on a North–South technology gap, which shapes international competitiveness. The model comprises a demand curve for foreign exchange, based on the Keynesian balance-of-payments-constrained growth theory, and a supply curve of foreign capital based on the principle of increasing risk, formalized as a nonlinear function of the Southern interest rate. The dynamics of the model generates external fragility in economies in which a large technology gap reduces international competitiveness. External disequilibrium recurrently gives rise to a downward pressure on the rate of economic growth, and to the possibility of severe exchange rate crises in the Southern economy.

We would very much like to thank all of the contributors for being unselfishly prepared to revise their contributions time and time again in order to satisfy our demands and those of the publishers. We would also like to thank participants to the conference for their useful comments. We are indeed grateful to the Italian Central Bank, and in particular to Dr Salvatore Rossi at the Bank, for generous financial support. The Department of Economics, Faculty of Law, University of Cassino, were also extremely courteous in hosting the event and also for providing generous financial support. Amanda Hamilton from Palgrave Macmillan and her staff have been extremely supportive throughout the life of this project. We are extremely grateful to all these people and their institutions for making this book possible.

2
Monetary Policy with Firms' Bank Dependence and Default Risk

Giuliana Passamani and Roberto Tamborini

2.1 Introduction

Among Keynes's undeveloped, or underground, ideas that are being resurrected in a new guise are those of the 'monetary theory of production' (1933) and firms' 'finance motive' in the demand for money (1937). With variable acknowledgement and faithfulness, these ideas are detectable in the modern macroeconomics of imperfect capital markets.

The most important source of imperfection is now seen to be asymmetric information generating agency problems between the firm and its external financial suppliers. As a consequence, and contrary to the Modigliani–Miller approach, firms are not indifferent among different financial resources. They rely primarily on internal funds so that their activity depends more on the availability of such funds than on external funds. For some classes of firms, most likely small firms with little capacity for internal accumulation and with limited access to open markets, investment capacity can mostly rely on one single source of external funds, namely bank credit. Research on the macroeconomics of imperfect capital markets is thus centred on the behaviour of firms that are financially constrained or bank dependent, and is evolving in three distinct ways: the determination of macroeconomic variables (output, employment, inflation, etc.), the transmission of monetary policy impulses through their effects on credit supply to bank-dependent firms ('bank lending channel') or on firms' self-financing capacity ('net worth channel'), the ensuing characteristics of business cycles in a dynamic setting.[1]

The work presented in this chapter contributes to the first and second ways, both theoretically and empirically. The basic consequence of capital market imperfections to be examined is firms' exposure to financial risk, or, better, firms' responsiveness to these risks (Greenwald and Stiglitz, 1990b). Risk is embedded in economic activity, yet the ideal-type productive unit of general-equilibrium competitive theory – a unit efficiently managed by well-diversified capital owners is as such free of risk, so that the standard assumption of risk-neutral expected profit or value maximization is justified.

When this ideal type is no longer applicable, the firm (its owners or its managers) either bears idiosyncratic risk directly or this risk is transferred onto the firm by its external financiers. This is most clearly the case when the firm is financed by debt, so that the firm's specific default risk on debt should be taken into account.

Greenwald and Stiglitz (1988a, 1988b, 1990a, 1993) have produced a reference class of macroeconomic models where firms need external finance to run production, this requirement is met by bank debt, and the default risk on debt is internalized by the firm owing to the pecuniary and non-pecuniary extra costs associated with default and bankruptcy procedures (often referred to as 'bankruptcy costs'). However, the inclusion of bankruptcy costs in these models has been questioned because it is not well founded theoretically and is controversial empirically (e.g. Altman, 1984; White, 1989). Alternatively, there has been growing interest in macro-models as well as industry-level models where bank-dependent firms' decisions include the interest rate on working capital (mainly the wage bill) with no specific bankruptcy costs (e.g. Blinder, 1987; Christiano and Eichenbaum, 1992; Christiano *et al.*, 1997; Barth and Ramey, 2001). In this study we have followed this latter route which can easily be extended to include the relevant risk premium into the interest rate charged to the firms by the banks. Either way, labour demand and aggregate supply functions result to be sensitive (with a negative sign) to (i) the real interest rate paid by the firm and (ii) the probability of default of the firm. The key consequence is that these financial factors directly affect the *supply side* of the economy.[2]

This theoretical finding has several interesting consequences for macroanalysis and monetary policy. First of all, if interest rates affect both demand *and supply*, this may provide a consistent explanation of the stylized facts of monetary policy (quick, large and *persistent* responses in quantities; small, slow and delayed responses in prices; procyclicality of real wages and profits: see, for example, Greenwald and Stiglitz 1987; Christiano *et al*. 1996, 1997; AEA 1997) with no particular assumptions concerning price rigidity. Secondly, if the presumption that firms' internalization of financial risks affects their output choices is confirmed, then this factor may represent an additional source of output variability to be taken into account. Finally, an additional relevant implication for monetary policy arises, namely that stabilization interventions on inter-bank rates may also be targeted to offsetting sharp changes in firms' financial risks.

Our chapter is organized as follows. In section 2.2 we do not present yet another macro-model with bank-dependent firms; rather, we fit existing building blocks in a consistent framework amenable to empirical analysis. This is presented in section 2.3 on the basis of Italian data. Our dataset includes monthly observations of real wage rates, average interest rates on bank loans, inter-bank rates as a proxy for the monetary policy stance, a proxy for firms' default risk, inflation and industrial production over the years 1986:1–1998:12. This time period ensures uniformity of data and the abandonment by the Bank of Italy of pervasive and recurrent administrative interventions that characterized the previous decades. The period ends up with Italy's entrance in the euro area which may represent a major regime shift in the data.

We have chosen Italy because there are strong reasons to believe that firms' bank dependency is prominent in this country. A long-standing empirical literature is available, and more recently several studies taking stock of the new theories of imperfect capital markets testify to the sensitivity of firms' activity to credit supply conditions.[3] Our study adds further evidence to this view, but our approach can offer three distinctive contributions of general interest. First, to our knowledge, empirical research on the Italian case, as for many other country studies, has been limited to the idea of the bank lending channel as an amplifier of the traditional demand-side effects of monetary policy popularized by the Bernanke–Blinder (1988) approach, with no consideration of possible supply-side effects.[4] Secondly, the demand-side approach has stumbled over an empirical identification problem. Plenty of evidence already exists that in many industrialized countries output is correlated with various measures of credit conditions (interest rates, total loans, etc.), but this is as such insufficient to infer which is the causal direction (see e.g. Eichenbaum, 1994), and it is even compatible with a passive role of endogenous monetary aggregates over the real business cycle (King–Plosser, 1984). As we shall see, introducing the supply side of the economy, in particular the joint estimation of the output market and labour market equations, can solve the identification problem while preserving the benefits of the aggregate level of analysis. Finally, our model allows us to test whether the interest rate and the default risk premium have distinguishable effects on output. This is a rather new perspective in the applied macroeconomic models with bank–firm relationships, which may lead to a better design of monetary policy interventions.

As far as statistical methodology is concerned, we have followed Johansen's structural cointegration analysis approach (Johansen, 1995). We have found this particularly well suited to our purpose which was to investigate the long-run relationships between financial factors and real variables within a structural model. In fact, this technique allows to decompose the long-run relationships into those which are stationary, the cointegrating relations, and those which are non-stationary, the common trends. Then a distinction can be drawn between forces that move of variables along their long-run paths and those which produce gravitations around them, while the whole system of forces can be analyzed in a single integrated statistical procedure.

Section 2.4 summarizes and concludes.

2.2 Modelling a macro-economy with bank-dependent firms and default risk

As a general framework, it is convenient to consider a model economy with the following structure:

- the economy operates sequentially along discrete time periods indexed by t, $t+1$, ..., where production takes 1 period of time regardless of the scale of production; firms produce a homogenous output and the only input is labour with decreasing marginal returns and constant input–output elasticity;
- firms can start a new production round only after 'closing accounts' (i.e. the whole output has been sold out and all various claimants paid); hence they should raise working capital (the wage bill) in advance;
- yet as firms plan production at the beginning of period t, they face uncertainty about revenue from output sales at $t+1$; as a consequence, they are 'equity rationed', that is, they are unable to raise working capital in the open market and can only resort to bank debt;[5]
- households supply labour inelastically in a competitive labour market, and consume out of savings with 1 period lag.

2.2.1 Firms

The basic element in all models of bank-dependent firms is that the expected $t+1$ profit Z^e of firm j as of time t is given by[6]

$$Z^e_{jt+1} = P^e_{jt+1}Q(t)_{jt+1} - W_t N_{jt} R_t \tag{2.1}$$

where P^e_{jt+1} is the firm's forecast of the market price, $Q(t)_{jt+1} = Q(N_{jt})$ is output for sale at $t+1$ as determined by the labour input N_{jt} at t, W_t is the nominal wage rate, and $R_t \equiv (1+r_t)$ is the gross interest rate.

Owing to the debt liability, the firm faces a constrained optimization problem, i.e. to maximize Z^e_{jt+1} under the solvency constraint

$$P_{t+1}Q(t)_{jt+1} \geq W_t N_{jt} R_t \tag{2.2}$$

It will be convenient to restate the problem in terms of expected inflation. To this effect, let $\Pi_{t+1} \equiv P_{t+1}/P_t \equiv (1+\pi_{t+1})$ denote the one-period price growth factor (inflation for short). Accordingly, $\Pi^e_{jt+1} \equiv P^e_{jt+1}/P_t$ is the expected inflation by the firm. Also, let us denote with $\underline{W}_t \equiv W_t/P_t$ the current real wage rate. Hence, after a little manipulation, the first-order condition for a maximum of profit is

$$\underline{W}_t R_{t+1} N_{Q,jt} = \Pi^e_{jt+1} \tag{2.3}$$

where the l.h.s. is the marginal cost of debt, which consists of the marginal labour input $N_Q \equiv Q_N^{-1}$, and the unit cost inclusive of the gross interest rate, $\underline{W}_t R_{jt+1}$. Therefore, the optimal labour demand and output supply are, respectively,

$$N^d_{jt} = N^d(\underline{W}_t, r_t, \pi^e_{jt+1}) \quad N^d_{\underline{w}} < 0, N^d_r < 0, N^d_\pi > 0 \qquad (2.4)$$

$$Q(t)_{jt+1} = Q(\underline{W}_t, r_t, \pi^e_{jt+1}) \quad Q_{\underline{w}} < 0, Q_r < 0, Q_\pi > 0 \qquad (2.5)$$

Thus the typical labour demand and output supply functions of the bank-dependent firm, in addition to the usual properties, (i) display a negative relationship with the interest rate, (ii) are systematically lower than the classical ones for any positive interest rate.

Considering now the solvency constraint (2.2), we can obtain an implicit probability measure of default of the firm. First, this constraint can be rewritten as

$$\underline{W}_t R_{t+1} \overline{N}_{jt} \leq \Pi_{t+1} \qquad (2.6)$$

where the l.h.s. is the average cost of debt, and $\overline{N}_{jt} \equiv N_{jt}/Q(t)_{jt+1}$ is the average labour input. Secondly, let us consider the fact that the firm may make a forecast error on the inflation rate, and let us express this as $\Pi^e_{jt+1} = \Pi_{t+1} u_{jt}$. Now let us consider a firm such that $\Pi^e_{jt+1} > \Pi_{t+1}$ as portrayed by Figure 2.1. The expected profit-maximizing output $Q^*(t)_{jt+1}$ chosen for the expected inflation Π^e_{jt+1} will give rise to lower actual profit at the actual inflation Π_{t+1}, and the firm will remain solvent only if $\Pi_{t+1} \geq \Pi^*_{t+1} = \underline{W}_t R_{t+1} \overline{N}^*_{jt}$. Therefore, the key to the solvency of the firm is the relationship between expected and

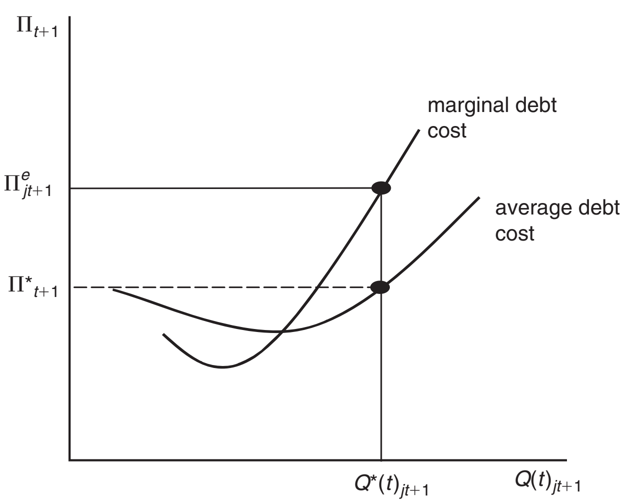

Figure 2.1 Default risk for the individual firm

actual inflation, and there exists a critical forecast error $u^*_{jt} > 1$ beyond which default will occur. That is to say, the default probability of the firm is

$$\phi_{jt} \equiv \text{Prob}(u_{jt} \geq u^*_{jt}) \tag{2.7}$$

Standard microeconomic conditions may help simplify this result in view of empirical analysis. First, note that

$$\begin{aligned} u^*_{jt} &= \Pi^e_{jt+1}/\Pi^*_{t+1} \\ &= N_{Q,jt}/\overline{N}^*_{jt} \end{aligned} \tag{2.8}$$

which is the input–output elasticity. The standard assumption of constant elasticity (e.g. a Cobb–Douglas production function) implies that the critical forecast error is constant and the same for all firms, u^*. Consequently, if forecast errors are distributed across firms according to some known statistical law $F(u_{jt})$, then the default probability, too, is the same for all firms, i.e.

$$\text{Prob}(u_{jt} \geq u^*) = 1 - F(u^*) \equiv \phi_t \text{ all } j \tag{2.9}$$

In this case, the default probability may still vary over time due to technical shocks or changes in the distribution of forecast errors.

2.2.2 Banks

Banks collect deposits from households at zero rate, and offer loans to firms in a competitive credit market. According to the time structure of the economy, at the beginning of each t, a bank b can grant loans L^s_{bt}. Aggregate loans finance the economy's wage bill for period t and are therefore redeposited by households as savings for period $t+1$ granting banks' balance-sheet equilibrium. This may not necessarily be the case for the single bank, but by the law of large numbers in a competitive market, we may assume that balance-sheet equilibrium on average holds for each bank.

In view of the fact that households will claim on deposits one period later, the bank should secure itself a sufficient amount of liquid resources. This requirement acts as a liquidity constraint on the bank's decision problem. As is clear from the above relations, if all firms repaid capital, the bank would be certain that its liquidity constraint would be satisfied. Yet each loan at time t embodies the firm's default risk. If the loans portfolio of the bank is well diversified it will only bear the undiversifiable risk ϕ_t given by (2.9). Therefore, the bank anticipates a liquidity risk (the probability of capital repayments falling short of deposits) equal to $L^s_{bt}\phi_t$ associated with its loans portfolio.

The bank can insure itself against this risk by borrowing reserves BR_t in the money market at the gross official rate set by the central bank, $K_t \equiv (1 + k_t)$, i.e. the bank can cover all illiquidity states $L^s_{bt}\phi_t$ under the obligation to repay $L^s_{bt}\phi_t K_t$ in $t+1$. Consequently we may expect that banks are ready to lend at a market rate that obeys to the general relationship

$$R_t = R(K_t, \rho(\phi_t)) \tag{2.10}$$

where $\rho(\phi_t)$ represents a risk premium related to the firms' default risk. At the rate R_t all credit demand is satisfied, and the interest rate is determined as an increasing risk-adjusted function of the official rate.

2.2.3 A testable model

In the first place, let us summarize the key relationships put forward in the previous paragraph.

Output supply differs across firms only as a consequence of different inflation forecasts. Hence, if forecast errors are distributed randomly around the actual inflation rate, aggregate supply is given by

$$Q(t)_{t+1} = Q(\underline{W}_t, r_t, \pi_{t+1}) \tag{2.11}$$

and by the same aggregation procedure we obtain total labour demand:

$$N^d_t = N^d(\underline{W}_t, r_t, \pi_{t+1}) \tag{2.12}$$

Since households supply inelastically their whole workforce N_t, labour market equilibrium establishes the real wage rate $\underline{W}_t$ that equates

$$N^d(\underline{W}_t, r_t, \pi_{t+1}) = N_t \tag{2.13}$$

Total employment and the nominal wage rate determine credit demand by firms. Since credit supply is infinitely elastic at the market interest rate, the credit market is closed by the interest rate equation that we simply assume to be given by the official rate plus the risk premium

$$r_t = \rho_t + k_t \tag{2.14}$$

Households also consume in each period out of their previous period's deposits, which yields a simple nominal demand function proportional to money holdings so that the period's general price level and the one-period inflation rate are given by

$$\begin{aligned} Q(t)_{t+1} &= Y(D_t)/P_{t+1} \\ \pi_{t+1} &= P_{t+1}/P_t - 1 \end{aligned} \tag{2.15}$$

The testable structural relationships that we expect to hold can be written as follows (lower-case letters denote logs of the previous variables except interest rates)

$$\begin{aligned} \underline{w}_t &= a_{10} + a_{11}q_{t+s} + a_{12}\pi_{t+s} + a_{13}k_t + a_{14}\rho_t + u_{\underline{\omega}_t} \\ r_t &= a_{20} + a_{21}q_{t+s} + a_{22}\pi_{t+s} + a_{23}k_t + a_{24}\rho_t + u_{r_t} \\ q_{t+s} &= a_{30} + a_{31}\underline{w}_t + a_{32}\pi_{t+s} + a_{33}k_t + a_{34}\rho_t + u_{q_{t+s}} \\ \pi_{t+s} &= a_{40} + a_{41}\underline{w}_t + a_{42}q_{t+s} + a_{43}k_t + a_{44}\rho_t + u_{\pi_{t+s}} \end{aligned} \tag{2.16}$$

We have two forward-looking variables, q_{t+s} and π_{t+s}, which depend on the contemporaneous variables $\underline{w}_t$, r_t, k_t, ρ_t. The presence of π_{t+s} on the r.h.s. of the equations reflect the hypothesis that firms' price forecasts are rational on average. The appropriate time lead s has been left to estimation. We have used this model to test two hypotheses. First, the sensitivity of *output supply* to the financial factors, the inter-bank rate k_t and the default risk premium ρ_t. Secondly, we wished to test whether these factors have distinguishable effects on output. These hypotheses are identified by the following expected signs of coefficients in a long-run structural relationship:

$$a_{13} < 0, a_{14} < 0, a_{23} > 0, a_{24} > 0, a_{33} < 0, a_{34} < 0, a_{43} < 0, a_{44} < 0 \tag{2.17}$$

The economic meaning of this pattern of coefficients is given by the theoretical model, which is here reproduced by means of Figure 2.2. Suppose that the central bank raises its official rate. Then banks raise the interest rate charged to firms ($a_{23} > 0$) (l.h.s. panel); unless firms on average anticipate an increase in the inflation rate, they will perceive a higher real interest rate, which leads them to cut labour demand and output plans ($a_{33} < 0$) (r.h.s. panel). If this supply-side channel of monetary policy operates, we should then observe a downward pressure on the real wage rate too ($a_{13} < 0$). Overall, firms demand less credit and supply less output. Credit is also the basis of creation of households' money balances and nominal demand, so that both aggregate demand and aggregate supply fall in next period's output market. The net effect on the inflation rate is thus ambiguous, though concavity of the production function suggests that labour demand (credit creation) should fall more than output supply so that the net effect on inflation should be negative ($a_{43} < 0$) (which rationalizes firms' expectations of higher real interest rates).[7] The picture is essentially the same if the initial impulse comes from a change in the default risk premium.

The above pattern of coefficient signs identifies the supply-side transmission mechanism of credit factors because if they operated through demand effects, and firms were insensitive to them, under rational expectations we should observe most of the adjustment taking place in the inflation rate with negligible effects on the real wage rate and output, i.e.

$$a_{13} = 0, a_{14} = 0, a_{23} > 0, a_{24} > 0, a_{33} = 0, a_{34} = 0, a_{43} < 0, a_{44} < 0 \tag{2.18}$$

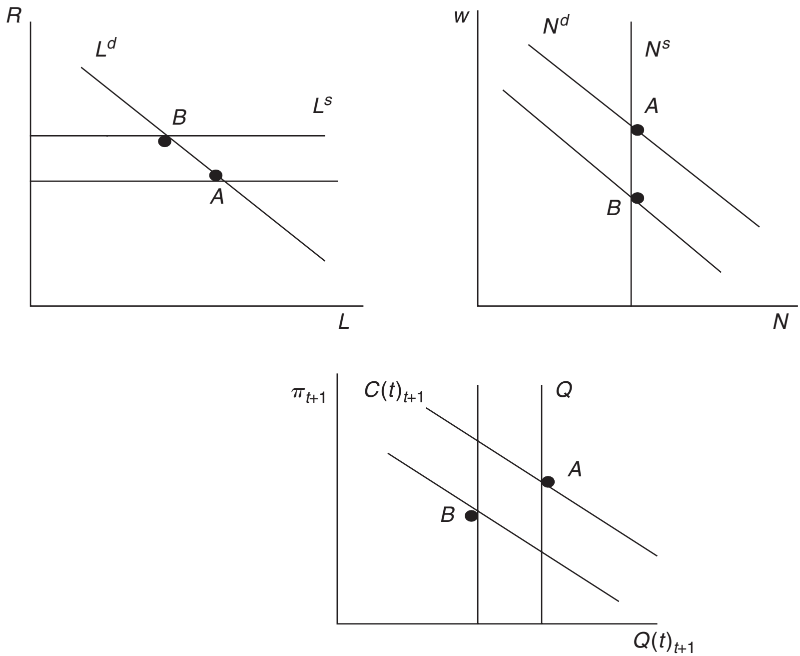

Figure 2.2 An increase in the official interest rate

2.3 Statistical analysis

2.3.1 The approach and the data[8]

Our methodological choice has been for Johansen's ML cointegration analysis (Johansen and Juselius, 1990; Johansen, 1995). This approach is based on a vector autoregressive model (VAR). In fact, rewriting the VAR as a vector error correction model (VECM), we have a specification where the stationary differences of the variables are modelled together with the stationary relations between the levels of the variables, and thus a specification that contains information on both the short and long-run adjustments to changes in the variables in the model.[9] The VECM specification is the following:

$$\Delta \mathbf{x}_t = \boldsymbol{\mu} + \sum_{i=1}^{k-1} \boldsymbol{\Gamma}_i \mathbf{x}_{t-i} + \boldsymbol{\Pi}\mathbf{x}_{t-1} + \boldsymbol{\Phi}\mathbf{D}_t + \boldsymbol{\varepsilon}_t, \tag{2.19}$$

which corresponds to a VAR(k) model, reparameterized to allow the presence of error correction (EC) terms represented by $\boldsymbol{\Pi}\mathbf{x}_{t-1}$. In (2.14) $\mathbf{x}_t$ is a $(p \times 1)$ vector made up by the $p = 6$ variables of interest $[\underline{w}_t, r_t, q_{t+s}, \pi_{t+s}, k_t, \rho_t]$, Δ is the first difference operator, μ is a $(p \times 1)$ vector of constant terms, $\mathbf{D}_t$ is a vector of intervention dummies, ε_t is a $(p \times 1)$ vector of white noise errors, Γ_i are $(p \times p)$ matrices of coefficients, Φ is the matrix of coefficients for the dummy variables and Π is a $(p \times p)$ matrix whose rank corresponds to the number of stationary relations, or cointegrating relations, between the variables of the model.

For the existence of cointegrating relations, the matrix Π must be of reduced rank r, where r is an integer such that $0 < r < p$. This implies that it is possible to factorize Π into $\Pi = \alpha\beta'$, where α and β can both be reduced to $(p \times r)$ matrices. In this case we say that there are r cointegration vectors – that is, r columns of β form r linearly independent combinations of the variables in $\mathbf{x}_t$, each of which is stationary – and $(p - r)$ non-stationary vectors, the common trends. The space spanned by the matrix α is the adjustment space and its elements are the adjustment coefficients.

The data set for the empirical analysis is monthly and covers the period from 1986:1 to 1998:12. According to the theoretical model, the variables of interest are:

- the real wage rate, $\underline{w}_t$, which is per capita nominal wages deflated by production prices;
- the industrial production index, q_{t+s}, seasonally adjusted;
- the inflation rate, π_{t+s}, defined as $\log(P_{t+s}/P_t)$, where P_t is the consumer's price index;
- the gross average bank lending rate, r_t;
- the gross inter-bank rate k_t which we have taken as a proxy of the monetary policy stance;
- the default risk premium, ρ_t; this variable is not observed and we have created a proxy as described in the next section.

In the data set we have picked observations on the twelfth lead of q_t, that is q_{t+12}. The time lead has been chosen empirically and is consistent with values found in other similar works on Italy (such as Bagliano and Favero, 1998b; Fiorentini and Tamborini, 2002), and more generally with the order of magnitude of the response lag of the economy to monetary impulses in most empirical works. Accordingly, we have also taken observed inflation with the same lead, π_{t+12}, as a proxy for the average expected inflation by firms. All the data charts are reproduced in Figure 2.3.

In order to obtain residuals close to normality, in our data set we have introduced four intervention dummies,[10] to account for the exit of Italian lira from the EMS in 1992 and for a couple of other events, and eleven centred seasonal dummies. Maximum lag analysis has led us to choose a lag parameter equal to five, that is $k = 5$. With five lags the hypotheses of white noise residuals and of no autocorrelation were not rejected.

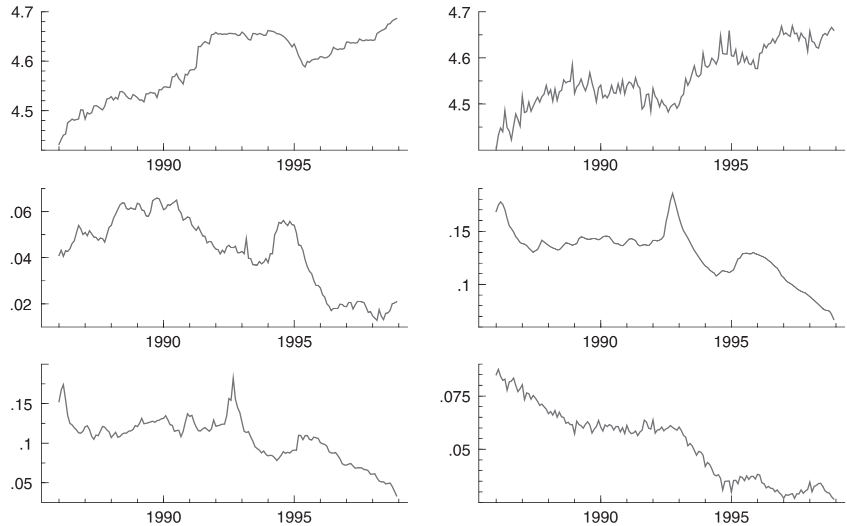

Figure 2.3 Levels of (logged) real wages, $\underline{w}_t$; (logged) industrial production 12 months ahead, q_{t+12}; (logged) inflation 12 months ahead, π_{t+12}; nominal bank lending rate, r_t; nominal interbank rate, k_t; and risk premium ρ_t

2.3.2 A theory-based proxy for the default risk

According to our model for firms, default of a firm j occurs whenever

$$P_{t+1}Q(t)_{jt+1} < L^d_{jt}R_t$$

or,

$$L^d_{jt}R_t/Q(t)_{jt+1} > P_{t+1}, \tag{2.20}$$

where $L^d_{jt} = W_tN_{jt}$ is the loan granted to the firm.

In section 2.2.1 we introduced the concept of an implicit probability measure of firms' default risk. In order to measure this default risk, we use a procedure where we consider risk any deviation from a stable 'solvency relation' given by (2.15) taken as an equality for the economy as a whole. That is, we assume that in the long run a stable linear relation should hold between the non-stationary variables L_tR_t and $P_{t+12}Q_{t+12}$, once they both have been log-transformed, i.e.:

$$\log(L_tR_t) = \beta_0 + \beta_1 \log(P_{t+12}Q_{t+12}) + u_t. \tag{2.21}$$

Following the Johansen–Juselius approach, the quantities u_t are to be considered as disequilibrium errors controlled by the short-run dynamics of the

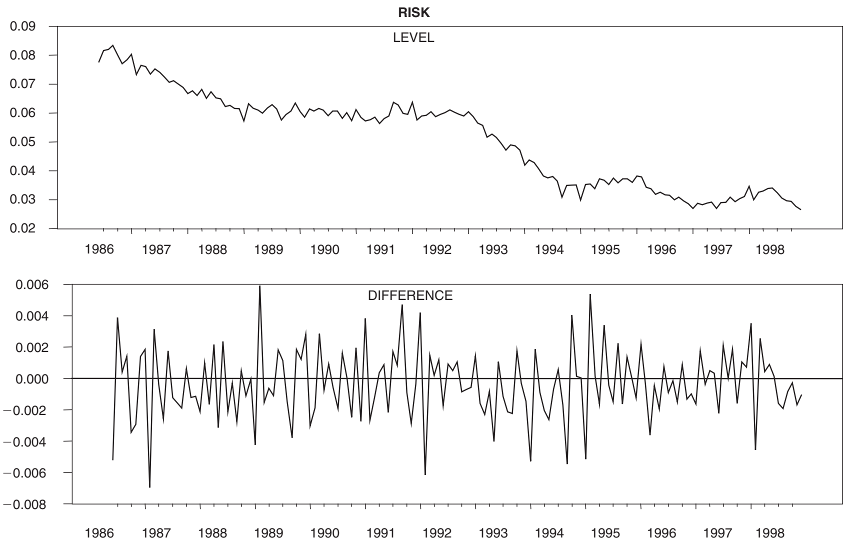

Figure 2.4 A proxy for firms' default risk

variables in the model. Whenever these errors tend to depart from the common trend of the model, they are pulled towards it by some adjustment coefficients estimated together with the long-run coefficients β (Johansen, 1995: 41). Thus, empirical analysis of this relation has been performed on the basis of a specification of the VECM (2.14), where the vector $\mathbf{x}_t$ consists of the indexed and log-transformed variables $\log(L_t R_t)$ and $\log(P_{t+12} Q_{t+12})$, the constant in the model is restricted to the cointegration space (that is a constant is allowed in the cointegrating relation), and the term $\boldsymbol{\beta}'\mathbf{x}_{t-1} - \boldsymbol{\beta}_0$ measures the deviations of the stationary relation $\boldsymbol{\beta}'\mathbf{x}_{t-1}$ from its expected value $\boldsymbol{\beta}_0$, that is the disequilibrium errors u_t.

The results of the analysis show that the variables cointegrate and thus we have $r = 1$ cointegration relation and $(p - r) = 1$ common trend. The estimated disequilibrium errors are represented in Figure 2.4. They show no particular stochastic variation, but they rather appear to be trend stationary. We have adopted them as a time series measure of default risk. Its representation shows that risk is characterized by a declining trend in the first period, followed by a period in which it stabilizes and then it declines again, until reaching a stabilization period starting from 1995.[11]

2.3.3 Cointegration analysis

Having the complete database for all the variables of interest, we turn now to cointegration analysis of the whole model. Given the VECM (2.14), we have

Table 2.1 The I(0) and I(1) components of $\mathbf{x}_t$

	w_t	r_t	q_{t+12}	π_{t+12}	k_t	ρ_t	$trend_t$
The cointegrating vectors $\hat{\boldsymbol{\beta}}$							
$\hat{\boldsymbol{\beta}}_1$	1.000	−10.500	−3.092	−0.761	8.352	−13.912	−0.007
$\hat{\boldsymbol{\beta}}_2$	0.000	1.000	0.399	−0.173	−1.179	−0.827	−0.000
$\hat{\boldsymbol{\beta}}_3$	0.200	−10.330	1.000	−1.875	11.710	−12.997	−0.001
$\hat{\boldsymbol{\beta}}_4$	0.275	0.656	−0.413	1.000	0.167	2.252	−0.000
The adjustment coefficients $\hat{\boldsymbol{\alpha}}$							
$\hat{\boldsymbol{\alpha}}_1$	0.004	0.016	0.005	−0.118	0.052	0.000	
$\hat{\boldsymbol{\alpha}}_2$	−0.558	0.008	−0.034	0.531	0.276	−0.002	
$\hat{\boldsymbol{\alpha}}_3$	−0.011	0.003	−0.013	−0.024	−0.003	0.000	
$\hat{\boldsymbol{\alpha}}_4$	−0.025	−0.013	0.013	−0.335	−0.020	−0.001	
The matrix $\hat{\boldsymbol{\alpha}}_\perp$ *defining the space of the common stochastic trends*							
$\hat{\boldsymbol{\alpha}}_{1\perp}$	0.1083	−0.6577	−0.2996	−0.0060	0.2082	−0.6500	
$\hat{\boldsymbol{\alpha}}_{2\perp}$	0.0868	−0.5844	−0.2072	−0.0044	0.1795	0.7588	
The loadings of the common stochastic trends $\boldsymbol{\beta}_\perp(\boldsymbol{\alpha}'_\perp\boldsymbol{\Gamma}\boldsymbol{\beta}_\perp)^{-1}$							
$\hat{\boldsymbol{\beta}}_{1\perp}$	6.027	−4.156	3.952	1.303	−2.967	0.839	
$\hat{\boldsymbol{\beta}}_{2\perp}$	13.161	−4.880	4.825	−1.442	−3.408	1.590	

first tested for the cointegration rank r. This is connected with determining the appropriate trend polynomial. Given that we initially chose a linear trend in the cointegrating relations, based on the 90 per cent critical value for the *trace* statistic, the selected rank would be 3. Some caution is needed because we have included dummy variables and the quantiles of the distribution are not appropriate in the presence of intervention dummies. Therefore, we further checked the rank r with a simple graphical analysis based on the stability of the cointegration rank and we ended up with the decision of a cointegrating rank $r = 4$. The test result for the trend polynomial with r given, confirms our initial choice of a linear trend in the cointegration space. Therefore, in our data set we have 4 cointegration relations and $(p - r) = 2$ common trends.

In Table 2.1 we report the decomposition of the vector $\mathbf{x}_t$ into the r cointegrating relations and the $(p - r)$ non-cointegrating relations or common trends, together with their coefficients, respectively, the adjustment coefficients and the common trend coefficients.

The interpretation of the cointegrating relations is difficult without imposing identifying restrictions; we have normalized, tentatively, the first one with respect to real wage, the second one with respect to the lending rate, the third one with respect to industrial production and the fourth one with respect to inflation. The estimated matrix $\hat{\boldsymbol{\alpha}}_\perp$ determines the stochastic common trends as given by $\hat{\boldsymbol{\alpha}}'_\perp \sum_{i=1}^{t} \hat{\boldsymbol{\varepsilon}}_i$, where $\hat{\boldsymbol{\varepsilon}}_i$ is the vector of estimated

Table 2.2 Structure of matrix $\boldsymbol{\beta}$

$\underline{w}_t$	1.0000	0.0000	$\boldsymbol{\beta}_{13}$	0.0000
r_t	0.0000	1.0000	0.0000	0.0000
q_{t+12}	0.0000	0.0000	1.0000	$\boldsymbol{\beta}_{34}$
π_{t+12}	$\boldsymbol{\beta}_{31}$	0.0000	$\boldsymbol{\beta}_{43}$	1.0000
k_t	$\boldsymbol{\beta}_{51}$	$\boldsymbol{\beta}_{52}$	$\boldsymbol{\beta}_{53}$	$\boldsymbol{\beta}_{54}$
ρ_t	$\boldsymbol{\beta}_{61}$	$\boldsymbol{\beta}_{62}$	$\boldsymbol{\beta}_{63}$	$\boldsymbol{\beta}_{64}$
$trend_t$	$\boldsymbol{\beta}_{71}$	0.0000	$\boldsymbol{\beta}_{73}$	$\boldsymbol{\beta}_{74}$

errors of the VECM. The cumulated shocks in the equation for the lending rate have the largest weight in the first trend, while the cumulated shocks in the equation for the risk have the largest weight in the second trend. In other words, the long-run stochastic trends appear to derive from unanticipated shocks to the nominal lending rate and to the risk.

2.3.4 Identifying the long-run structure

Having determined the dimension of the cointegration space, we have proceeded to the analysis of the identification of the cointegrating vectors. This step (Johansen, 1995) is performed by defining the restriction matrices that the estimated cointegration vectors $\hat{\boldsymbol{\beta}}$ should satisfy, in order to have unique cointegrating relations, interpretable as long-run structural relations among the observed variables. To this effect, we have exploited the time structure imposed by the theoretical model, namely that the contemporaneous t variables determine the forward $t+12$ variables, but not the other way round (except for anticipated inflation). The structure of the matrix $\boldsymbol{\beta}$ is therefore the one reported in Table 2.2, where the ones denote the variables on which we normalize. In matrix $\boldsymbol{\beta}$ the trend component is allowed to be present in the real wage equation, in the real industrial production equation and in the inflation equation.

The system thus contains one joint overidentifying restrictions and we have tested it using a Likelihood Ratio test. The *LR* test, which is asymptotically χ^2_1 distributed, is equal to 0.58 with an associated *p-value* $=0.45$, therefore the restrictions may not be rejected.

The estimated matrix $\hat{\boldsymbol{\alpha}}$, which gives information about the loadings of the four long-run relations in each equation of the system, shows that no cointegration relation enters significantly in the equation for the differenced risk, that is $\Delta\boldsymbol{\rho}_t$ does not contain information about the long-run parameters $\boldsymbol{\beta}$ and could be considered as weakly exogenous for $\boldsymbol{\beta}$ and the other loading parameters. Testing row restrictions for risk in the matrix $\boldsymbol{\alpha}$, together with the current restrictions on $\boldsymbol{\beta}$, we get that the LR test, with five degrees of freedom, is equal to 3.00 with an associated *p-value* $=0.70$.

The final estimated restricted steady-state relations are the following (standard errors in brackets, and significant parameters with asterisk):

$$\begin{aligned}
\underline{w}_t &= \underset{(0.495)}{3.491^*}\,\pi_{t+12} - \underset{(0.582)}{1.879^*}\,k_t + \underset{(1.123)}{10.761^*}\,\rho_t + 0.005\,trend_t + \hat{u}_{\overline{w}_t} \\
r_t &= \underset{(0.042)}{0.919^*}\,k_t + \underset{(0.067)}{0.053}\rho_t + \hat{u}_{r_t} \\
q_{t+12} &= \underset{(0.079)}{-0.269^*}\,\underline{w}_t + \underset{(0.369)}{2.597^*}\,\pi_{t+12} - \underset{(0.369)}{2.597^*}\,k_t - \underset{(0.518)}{1.788^*}\,\rho_t + \hat{u}_{y_{t+12}} \\
\pi_{t+12} &= \underset{(0.486)}{-2.981^*}\,k_t - 0.002\,trend_t + \hat{u}_{\pi_{t+12}}
\end{aligned} \tag{2.22}$$

It should be recalled that these statistical equations detect the long-run relationships that the r.h.s. variables entertain with the respective l.h.s. variables once short-run dynamics has petered out. In other words, they identify the determinants of the long-run equilibrium stochastic paths along which the l.h.s. variables are moved, and around which short-run dynamics gravitate. The relationships that we have obtained are broadly consistent with the theoretical model in section 2.2. As regards in particular the role of financial factors and the hypothesis that they exert supply-side effects, the most important results are the following.

First, the inter-bank rate k_t has always the expected, significant sign. That is, it has a positive effect on the bank lending rate and a negative effect on the real wage rate, output and inflation. As explained previously, this pattern of relationships can be considered evidence that this factor operates through the supply side of the economy, and moreover, that the hypothesis of wage rigidity should be rejected – or at least, that it is unnecessary in order to obtain real effects of interest rates.

Second, the evidence regarding firms' default risk ρ_t is mixed. It appears in the output equation with correct sign and significant value. If we look at this equation, we might conclude that firms' default risk is indeed a co-determinant, along with the bank lending rate, of the long-run equilibrium path of output. On the other hand, the puzzling role of this factor in the other equations does not allow us to draw a consistent explanation of this result. In fact, the hypothesis that default risk is a major determinant of the lending rate is not supported by the data as its sign is correct but not significant. Moreover, it enters the real wage equation significantly but with the wrong sign. It should be considered that measuring firms' default risk on bank loans at high frequencies is a difficult task, and that we have created a highly model-specific proxy measure; hence statistics may reject our risk measurement rather than our theory of how risk affects the economy.

Can we also conclude that if the central bank can control the inter-bank rate, it can also gain control over *both* output *and* inflation? In the next section we shall put forward a more rigorous statistical analysis of the idea the monetary policy can control the the long-run equilibrium path of output and inflation.

2.3.5 The inter-bank rate as a control variable

It is currently standard practice in applied analyses of monetary policy to perform impulse–response exercises based on VAR estimations that trace out the short-run dynamics of macroeconomic variables after monetary impulses. This practice is grounded in the widely-held presupposition that policy shocks do not affect the long-run equilibrium path of real variables. Moreover, some well-known statistical problems arise concerning the identification of policy shocks and of the impulse-response matrix (Bernanke and Mihov, 1995; Bagliano and Favero, 1998a; Rudebusch, 1998). As seen above, our statistical analysis does not confirm that presupposition, while at the same time it offers an alternative approach. This is based on construction of a matrix $\mathbf{C} = \boldsymbol{\beta}_\perp \left(\boldsymbol{\alpha}'_\perp \left[\mathbf{I}_p - \sum_{i=1}^{k-1} \Gamma_i \right] \boldsymbol{\beta}_\perp \right)^{-1} \boldsymbol{\alpha}'_\perp$, where the various components are those defined previously. This matrix plays an important role, within cointegrated VAR models, measuring the significance of the *long-run impact* of a shock to a variable on the process $\mathbf{x}$.[12]

The interesting information we get from this matrix is the long-run impact of unanticipated shocks to the inter-bank rate: they have a negative significant impact on industrial production and a negative, significant at 10 per cent, impact on inflation, but a positive, significant at 10 per cent, impact

Table 2.3 The long-run impact estimated matrix C for the VMA representation (t-statistics in parentheses)

	$\boldsymbol{\varepsilon}_{\overline{w}_t}$	$\boldsymbol{\varepsilon}_{r_t}$	$\boldsymbol{\varepsilon}_{\pi_{t+12}}$	$\boldsymbol{\varepsilon}_{q_{t+12}}$	$\boldsymbol{\varepsilon}_{k_t}$	$\boldsymbol{\varepsilon}_{\rho_t}$
$\underline{w}_t$	0.728	−1.481	−1.260	−0.022	1.061	8.602
	(4.757)	(−1.287)	(−1.668)	(−0.251)	(2.936)	(1.681)
r_t	0.131	−0.267	−0.227	−0.004	0.191	−1.839
	(3.010)	(−0.815)	(−1.056)	(−0.159)	(1.857)	(−0.814)
π_{t+12}	−0.030	0.061	0.051	0.001	−0.043	5.484
	(−3.010)	(0.815)	(1.056)	(0.159)	(−1.857)	(0.814)
q_{t+12}	−0.488	0.993	0.845	0.014	−0.711	2.637
	(−5.164)	(1.398)	(1.811)	(0.272)	(−3.187)	(−0.834)
k_t	0.116	−0.236	−0.201	−0.003	0.169	−2.163
	(3.161)	(−0.855)	(−1.109)	(−0.167)	(1.951)	(−0.887)
ρ_t	0.062	−0.126	−0.107	−0.002	0.090	2.101
	(3.305)	(−0.894)	(−1.159)	(−0.174)	(2.039)	(3.361)

on the lending rate. In other words, shifts in the values of k_t and r_t in system (2.17) trace out a negatively-sloped long-run Phillips curve. Surprisingly, our default risk measure fails on these grounds. Yet this asymmetry is informative as regards monetary policy, as the central bank may possibly control the inter-bank rate, not default risk. On the one hand, this lends support to the conclusion that the credit channel of monetary policy has operated in Italy (and possibly that structural conditions favourable to that channel persists). On the other hand, the evidence is such that monetary policy, via credit channel, affects the *long-run equilibrium path* of output and inflation and not merely their short-run dynamics.

2.4 Conclusions

Drawing on Keynes's earlier ideas of monetary theory of production and firms' finance motive of demand for money, reframed within the modern literature on capital market imperfections, in this chapter we have advanced a theoretical and empirical analysis of the monetary policy implications of firms' bank dependence and default risk.

First we developed a theoretical model showing how firms' reliance on bank loans makes *aggregate supply* dependent on financial factors, namely the inter-bank rate and a default risk premium charged on firms. Then we presented a statistical analysis of this model applied to Italian data from 1986:1 to 1998:12. The statistical methodology that we adopted has allowed us to treat in a single integrated framework both the identification of structural relationships among the variable of interest – i.e. the determinants of the long-run stochastic equilibrium path of these variables – and also their deviations from these paths. Our main conclusions are the following.

First, as expected theoretically, the inter-bank rate and the default risk premium are co-determinants of the equilibrium path of output and inflation. In other words, these variables are non-neutral as they determine with opposite sign the long-run equilibrium values of output and inflation along which short-run dynamics revolves. As regards the inter-bank rate, we have also found statistical support to the hypothesis that it works through supply-side effects by inducing firms to make permanent alterations to both output plans and labour demand. However, statistics do not also support the same hypothesis for default risk. This may be due to the want of a better measure of risk, which is notoriously problematic in applied macro-models with high frequency observations. Finally, the estimated long-run impact matrix indicates that, to the extent that the central bank can control the inter-bank rate, it also gains control over *both* inflation *and* output.

Notes

1 See e.g. Delli Gatti and Tamborini (2000) for an overview.

2 The approaches followed in this chapter are recent variations on a time-honoured theme. Other contributions to this idea include 'money-in-the-production-function' models (e.g. Simos, 1981), an instance of which are production models with a separable monetary counterpart of (or constraint on) specific inputs' demand (such as Vickers, 1981; Mitchell, 1984; Amendola, 1991). It is also worth noting that these are just some possible ways of *re-linking* the supply side of the economy with capital markets, that have been de-linked in the current standard macroeconomics of 'vertical AS' by means of unwarranted *ad hoc* assumptions as has been remarked by Dixon (1995).

3 At the microeconomic level see, for example, Angeloni *et al.* (1995), Angeloni *et al.* (1997), Conigliani *et al.* (1997), Rondi *et al.* (1998). At the macroeconomic level, main available studies focus on the detection of the bank lending channel in the monetary policy transmission mechanism following various approaches and methodologies. Buttiglione and Ferri (1994), Bagliano and Favero (1995, 1998b), Chiades and Gambacorta (2000), who work on models *à la* Bernanke and Blinder (1992), find evidence of the bank lending channel. Bertocco (1997), who follows a 'narrative approach' *à la* Romer and Romer (1990), and Favero *et al.* (1999), who use balance-sheet data from a sample of European banks, are less supportive. For a detailed discussion of the empirical findings on the Italian case see Fiorentini and Tamborini (2002).

4 Recent exceptions are Fiorentini and Tamborini (2002), and Gaiotti and Secchi (2004). Both find evidence of these effects, the former at the macro-level by estimating a version of the Greenwald–Stiglitz (1993a) type of general equilibrium model, the latter at industry-level data following the Barth–Ramey (2001) partial equilibrium approach with imperfect competition.

5 A reason may be that any external lender faces an ex-post verification problem of the firm's ability to pay which precludes efficient direct lending by households. External funds can instead be obtained in the credit market by means of 'standard debt contracts' (see e.g. Townsend, 1979; Diamond, 1984; Greenwald and Stiglitz 1993. Fiorentini and Tamborini (2002) have proved that under the assumptions made above, standard debt contracts are indeed the optimal financial contract.

6 See references in the Introduction.

7 As stressed by Greenwald and Stiglitz, credit creates a link between aggregate demand and supply; consequently, changes in credit conditions induce co-movements of aggregate demand and supply which create the typical 'Keynesian' pattern of small adjustments in price and large in quantities with no relation with price stickiness.

8 The empirical analysis has been performed by using the software CATS and the software MALCOLM. Both need the package RATS to be run.

All the results are available upon request.

9 This specification's 'flexibility allows not only the statistical description of a large number of real data sets, but it also allows the embedding of interesting economic hypotheses in a general statistical framework, in which one can define the concepts of interest, … in particular the notions of integration, cointegration and common trends … An economic theory is often formulated as a set of behavioural relations or structural equations between the levels of the variables … If the variables are I(1), that is, non-stationary with stationary differences, it is convenient to reformulate them in terms of levels and differences, such that if a structural relation is modelled by a stationary relation, then we are led to considering stationary relations between levels, that is, cointegrating relations … that capture the economic notion of long-run economic relations …' (Johansen, 1995: 4–6).

10 The intervention dummies are defined for 1992/VII, 1992/IX, 1991/V, 1993/III and 1995/III.

11 This path is consistent with other different measures of default risk on bank loans in Italy: see e.g. Morelli and Pittaluga (1997), Fiorentini and Tamborini (2002).

12 As Johansen (1995: 49–50) explains: 'One can interpret matrix **C** as indicating how the common trends

$$\boldsymbol{\alpha}'_{\perp} \sum_{i=1}^{t} \boldsymbol{\varepsilon}_i$$

contribute to the various variables through the matrix $\boldsymbol{\beta}_{\perp}$. Another interpretation is that a random shock to the first equation, say, at time $t = 1$, gives rise to short-run random effects as represented by $\mathbf{C}(L)\boldsymbol{\varepsilon}_t$ which die out over time, and a long-run effect to the stochastic part given by the first column of **C**. This is orthogonal to $\boldsymbol{\beta}$ such that the new position is a new point on the attractor …'.

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3

Assessing the New Keynesian Phillips Curve Under Competing Expectation Hypotheses

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3.1 Introduction

The current research on monetary business cycles introduces sticky prices as a source of monetary non-neutrality, but assumes otherwise that agents adopt an optimizing behaviour and have rational expectations. The main characteristic of the resulting inflation specification (known as the 'New Keynesian Phillips Curve', hereafter NKPC) is the dependence of current inflation on expected inflation and a measure of the output gap:

$$\pi_t = \beta E_t \pi_{t+1} + \alpha y_t$$

Under rational expectations, this equation implies that inflation depends only on the future behaviour of the driving variable:

$$\pi_t = \alpha \sum_{i=0}^{\infty} \beta^i y_{t+i} \tag{3.1}$$

Inflation does not depend on its own lags but only on a discounted sequence of expected output gaps. Consequently, it displays no persistence other than the persistence of the driving variable. When considering equation (3.1), it is easy to see that the implications of the NKPC under rational expectations are in contradiction with empirical studies, which show that inflation is well explained by its own lags and lags of the output gap:

$$\pi_t = \gamma(L)\pi_{t-1} + \delta(L)y_t + u_t \tag{3.2}$$

One possible way to reconcile equations (3.1) and (3.2) is to consider that expectations about the exogenous variable y_{t+i} are derived from the past behaviour of inflation and output. But as Rudd and Whelan (2001) illustrate, under rational expectations, there is no place for the presence of these lags in the NKPC. Fuhrer and Moore (1995) argue that the introduction of lagged inflation in the NKPC is able to reproduce some inflation persistence but Rudd and Whelan (2003) also demonstrate that implications of this hybrid specification under rational expectations are not in accordance with the data. They show that, in order to predict quarterly changes of inflation, a simple regression of $\triangle\pi_t$ on a constant and its own lag produces better results than the pure and the hybrid NKPC. They conclude that there is no evidence in postwar US data that inflation dynamics is driven by the forward-looking behaviour implied by the NKPC.

Rejections of the NKPC do not necessarily imply the invalidity of the structural model resulting from the theory. One interpretation of this failure could be that the way expectations are modelled is incorrect. Indeed, it is possible that inflation dynamics is effectively driven by expected inflation, but that expectations are not formed in the standard way hypothesized: the Rational Expectations Hypothesis (REH). For example, Adam and Padula (2003), or Paloviita and Mayes (2003) show that when rational expectations are replaced by direct measures of inflation expectations, the NKPC is not rejected. Since some studies (see Roberts, 1997) show that the expectations contained in these surveys are not fully rational, it is possible to infer that the failure of empirical estimates of the NKPC is due to the strong assumption of rational expectations.

In this chapter, we consider alternative hypotheses on expectation formation, and we analyse if those hypotheses can improve the empirical validity of the NKPC.

Comparing to the standard REH, we assume, for each of the alternative hypotheses, that agents do not know the true model of the economy and use an autoregressive representation to forecast inflation. We consider a large variety of models, which include from one to six dependent variables and different lags. Expectations formed with the largest set of information (a VAR model including 6 variables) and those based on the standard REH (resulting from a GMM estimation of the NKPC using appropriate instrumental variables) are expected to provide rather similar results. By reducing the number of variables included in the VAR, we analyse the outcome of gradually lesser sophisticated inflation expectations on the empirical validity of the NKPC. We study the 'Near-Rational' alternative proposed by Ball (2000). To make our comparison complete, we also consider the old hypothesis of naïve expectations. Agents use only the last-known value on inflation to predict future inflation. In this case, inflation expectations follow a random walk.

In a first step, we undertake a statistical analysis of these different assumptions. We study the predictive properties of five expectation schemes: the random walk (RW), the AR process, and VAR with respectively 2, 3 and 6 variables. We show that only three models lead to significantly different forecasts: RW, AR and VAR-6. Predictive performances of the AR and VAR-2 and VAR-3 are the same.

In a second step, we include these forecasts in New Keynesian macromodels to determine which hypothesis on expectations best fits the data. We analyse two versions of the NKPC: one is built on the work of Taylor (1980) and the other on the work of Calvo (1983). Our results show that the most sophisticated process (the 6-VAR) and the rational expectation estimates lead to a rejection of both versions of the NKPC. Upon this result, competing expectation models that consider that agents use a lot of information for forming their forecasts are rejected by the data. On the contrary, restricting the set of information as in the univariate near rational expectation model or the random walk makes the NKPC fit the data.

The chapter is organized as follows. The next section briefly presents the two models of the NKPC. In section 3.3, we estimate these models under rational expectations. In section 3.4, we present the different forecasting models we use in order to compute series of expected inflation. Then we pay attention to models that produce significantly different forecasting performance. In section 3.5, these series are introduced in the NKPC. In section 3.6, we analyse the predictive performances of each hypothesis on expectations. In the last section, we conclude.

3.2 The New Keynesian Phillips Curve

3.2.1 Price adjustment rules

In order to reproduce the real impact of monetary shocks, the NKPC relies on the presence of nominal rigidities in an otherwise optimizing environment. According to empirical studies (summarized by Taylor, 1999), the hypothesis on pricing technology implies that each firm can change its price only at discrete intervals of time. Two alternative hypotheses about the timing of price changes have been considered in the literature. The first one assumes that price length is the same and for all firms (Taylor 1980). The second hypothesis, which is most often used, assumes that each firm faces a given, constant probability of changing its price during each period (Calvo 1983). This generates a different distribution of prices, but under rational expectations, both hypotheses imply the same relationship between inflation and production (Roberts 1995).

On average, each firm charges the same price during N periods. Individual price duration lasts exactly N periods in the structure of Taylor, with an individual probability of price change equal to 1 every N periods and 0 otherwise. Firms in the economy are divided between N cohorts of equal size, differentiated by the dates of price changes, so price adjustment is staggered. In the partial adjustment model of Calvo (1983), each period a firm has a constant probability $1/N$ of changing its price, this probability is independent of the date of the last price change. We define p_t^* as the price a firm would charge each period in the absence of nominal rigidities. Given the existence of imperfect price adjustment, firms that could change prices at time t set their price x_t in order to minimize the following loss function:

$$L_t = \left[\sum_{j=0}^{k-1} E_t \beta^j (1-\lambda)^j (x_t - p^*_{t+j})^2 \right]$$

where k is the maximal length of contracts (N in Taylor's model, ∞ in Calvo's model) and λ is the individual probability of price change each period. Given these probabilities, the optimal price x_t set by a firm operating respectively under Taylor and Calvo arrangements is given by:

$$x_t = \frac{\sum_{j=0}^{N-1} \beta^j E_t(p^*_{t+j})}{\sum_{j=0}^{N-1} \beta^j} \tag{3.3}$$

$$x_t = \left[\frac{N(1-\beta)+\beta}{N} \right] \sum_{j=0}^{\infty} \left(\frac{N-1}{N} \right)^j \beta^j E_t p^*_{t+j} \tag{3.4}$$

The aggregate price level in each model is a simple weighted average of all prices coexisting at time t, that is (respectively for Taylor and Calvo):

$$p_t = \frac{1}{N} \sum_{j=0}^{N-1} (x_{t-j}) \tag{3.5}$$

$$p_t = \frac{1}{N} \sum_{j=0}^{\infty} \left(\frac{N-1}{N} \right)^j x_{t-j} \tag{3.6}$$

The optimal flexible price is given by[1]:

$$p^*_t = p_t + \phi y_t \tag{3.7}$$

where p_t is the aggregate price level, y_t the output gap and ϕ a parameter measuring the sensitivity to excess demand. The desired price rises with the aggregate price level p and the aggregate output y. When y goes up, the demand faced by each firm increases, and leads to a rise in their marginal cost, and then in their desired price. Consequently, the sign of ϕ is strictly positive.

3.2.2 2-period contracts

In order to have comparable results between the two structures, we assume an average price duration of two periods[2] (equivalent to a 6-month price rigidity in a quarterly model). Given the different pricing structures, the

Phillips Curve for staggered prices model and the partial adjustment model are respectively:

$$\pi_t = \frac{\beta}{1+\beta}(E_{t-1}\pi_t + E_t\pi_{t+1}) + \frac{\phi}{1+\beta}(y_{t-1} + \beta E_{t-1}y_t + y_t + \beta E_t y_{t+1}) \quad (3.8)$$

$$\pi_t = \beta E_t\pi_{t+1} + \left(\frac{\phi(2-\beta)}{2}\right) y_t \quad (3.9)$$

where $\pi_t \equiv p_t - p_{t-1}$ is the inflation rate. As in Roberts (1995) or Walsh (1998), the model of Taylor is often rewritten as:

$$\pi_t = \beta E_t\pi_{t+1} + 2\phi(\widetilde{y}_t) + \beta\eta_t$$

where η_t is a term regrouping expectations errors on inflation and output, and $\widetilde{y}_t = y_{t-1} + y_t(1+\beta) + y_{t+1}$ is a moving average of output. Under purely rational expectations, η_t is equal to 0 on average and both specifications can reduce to the following testable form:

$$\pi_t = \alpha_1\pi_{t+1} + \alpha_2 y_t + \varepsilon_t \quad (3.10)$$

This equation implies that inflation is negatively correlated with past output:

$$\pi_{t+1} = \frac{1}{\alpha_1}\pi_t - \frac{\alpha_2}{\alpha_1}y_t - \varepsilon_t \quad (3.11)$$

As in the data, inflation is positively correlated with past output and past inflation, estimation of the previous equation gives $\alpha_2 < 0$, so that $\phi < 0$, which is in contradiction with the underlying theory. Under rational expectations, implications of the model are clearly counterfactual.

3.3 NKPC estimates under rational expectations

Galí and Gertler (1999) have proposed using a General Method of Moments for estimating the NKPC under the rational expectations hypothesis. Defining Z_t as the vector of instrumental variables used to form expectations, parameters of the model are estimated in the following way (respectively for the model of Taylor, then the model of Calvo):

$$E_t\left\{\left[\pi_t - \frac{\beta}{1+\beta}(\pi_t + \pi_{t+1}) - \frac{\phi}{1+\beta}(y_{t-1} + (1+\beta)y_t + \beta y_{t+1})\right]/Z_t\right\} = 0$$

$$E_t\left\{\left[\pi_t - \beta\pi_{t+1} - \frac{\phi(2-\beta)}{2}y_t\right]/Z_t\right\} = 0$$

Table 3.1 Estimates of the Phillips Curve under GMM

	β	ϕ	J
TAYLOR	0.99***	−0.005**	14,47
	(0.019)	(0.002)	[0,15]
CALVO	0.99***	−0.04**	14,43
	(0.019)	(0.016)	[0,15]

Time period: 1963:3–2004:4
Data source: OECD Economic Outlook
GMM estimates, standard error in brackets
Confidence level: *** for 1% and ** for 5%
J: Hansen Tests (1982) for over-identification, p-value in brackets

In the vector Z_t of instrumental variables, we include: four lags of inflation, four lags of output gap, and four lags of the unit labour costs. We present the estimation results in Table 3.1.

According to the Hansen test (1982), we cannot reject the null hypothesis of no over-identification. This means that instrumental variables correctly captured the set of information used for computing the expectation of the structural model, there is no missing variable. As in Galí and Gertler, the GMM routine leads to significant and negative estimates of the real rigidity coefficient in both Taylor and Calvo structural models. Consequently, the database and the time period we chose confirm the main result of related empirical literature: the New Keynesian Model of the Phillips Curve under the Rational Expectations Hypothesis is not consistent with the data.

3.4 Presentation of the forecasting models

The empirical failure of the NKPC must be due to: (i) the forward-looking component per se, which depends upon a misspecification in the structure of the economy; (ii) the unrealistic assumption of a rational expectations behaviour. Literature have shown that the NKPC does not fit the data when the REH is made (Fuhrer and Moore, 1995; Galí and Gertler, 1999;[3] Rudd and Whelan, 2001). However, it is not evident that these results lead to a rejection of the NKPC because these papers simultaneously test both the structure of the model and also the REH. Here, we try to examine if other schemes of expectations can help to restore the empirical validity to the NKPC.

Actually, several papers criticize the rational expectations hypothesis because it confers a very high level of knowledge, perfectly widespread among agents (Evans and Honkapohja, 2001). Moreover, as indicated in the introduction, studies on inflation surveys conclude that effective expectations are imperfectly rational, in the sense that not all of the available information is used.[4]

We propose to define a series of alternative expectations schemes in which we restrict the set of available information. The common hypothesis for all alternatives considered is that agents do not know the true model of the economy (which we assume to be the NKPC). Restricting the set of available information can be justified on the basis of 'calculation costs' necessary to form expectations. We can reasonably assume that these costs increase with the sophistication of the forecast, the larger set of information the higher cost of collection, treatment and computation. Consequently, rational agents choose to use the set of information such as the marginal cost of rising the amount of information equals the marginal benefit of a more precise forecast. Following Ball (2000), we call those restrictive-information-based expectations[5] 'Near-Rational'.

3.4.1 Modelling expectations

Agents form their expectations using information about the present and past behaviour of economic variables. They predict the inflation rate by using the present and lagged values of several economic variables (which can approximate the reduced form of a model solved under rational expectations). Inflation expectations are derived from a VAR(q):

$$\Phi(L)X_t = \varepsilon_t$$

where $\Phi(L)$ is a lagged polynomial system to estimate, X_t the vector of dependent variables representing the set of information and ε_t a white noise.

Different macroeconomic indicators are introduced in the X_t vector: π_t, the inflation rate, based on the US GDP deflator, and various indicators of the cyclical position of the US economy. Those indicators are y_t, the output gap (estimated by OECD with HP filter), S_t, the total stock of manufactured goods, ULC_t, the unit labour cost index, UPR_t, the unit profit index and r_t, the short-term nominal interest rate.

All the series come from OECD Economic Outlook, with the exception of the unit profit index, which is from the Bureau of Economic Analysis. Annual and quarterly series have been collected from 1965 to 2004.

During this period, all this series (excepting output gap) cannot be considered as stationary. We have computed several unit root tests (ADF, Phillips-Perron, Elliott *et al.*), and accepted the null of nonstationarity. Thus, most of the series have been transformed in first difference and others in growth rate (stocks).

These variables allows us to distinguish three optimal multivariate processes. They are defined as follows:

- a bivariate representation (hereafter 2-VAR):
  $X_t = (\Delta\pi_{t+1} \;\; y_{t+1})'$ where agents use a single indicator of the business cycle y_t to form their inflation expectations.

- a 3-variable-specification (3-VAR):
  $X_t = (\Delta\pi_{t+1} \;\; y_{t+1} \;\; \Delta r_{t+1})'$ where information on monetary policy (captured with the short-run nominal interest rate) is introduced in the relevant set of information.
- a 6-variable-specification (6-VAR):
  $X_t = (\Delta\pi_{t+1} \;\; y_{t+1} \;\; \Delta r_{t+1} \;\; (\Delta S/S)_{t+1} \;\; \Delta ULC_{t+1} \;\; \Delta UPR_{t+1})'$, with other real and financial indicators of the cyclical position.

The inflation forecast is provided by the inflation equation of each VAR:

$$E_t(\pi_{t+1}) = \pi_t + \widehat{\rho}_1 \Delta\pi_t + \widehat{\rho}_2 \Delta\pi_{t-1} + \cdots + \widehat{\rho}_q \Delta\pi_{t-q+1} + \widehat{\Gamma}(L)x_t$$

with x_t representing the other variables included in the VAR.

As in Ball (2000), we also consider that agents can forecast inflation using only the information contained in the behaviour of inflation. They ignore other variables. The representation of the economy is then a regressive structure where inflation is explained by its own lags. Inflation dynamics are then seen as an AR(p) process:

$$\Delta\pi_{t+1} = \rho_1 \Delta\pi_t + \rho_2 \Delta\pi_{t-1} + \cdots + \rho_p \Delta\pi_{t-p+1} + \epsilon_{t+1}$$

with $\epsilon_t \sim N(0, 1)$. Expected inflation is given by:

$$E_t(\pi_{t+1}) = \pi_t + \widehat{\rho}_1 \Delta\pi_t + \widehat{\rho_2} \Delta\pi_{t-1} + \cdots + \widehat{\rho}_p \Delta\pi_{t-p+1}$$

We use the minimization of the Akaike Information Criteria for computing the optimal number of lags. It ensures that the introduction of supplementary lags does not provide better forecasts. We select 2 lags in univariate and multivariate models when using annual data. With quarterly data the optimal number of lags is 5 for the 6-VAR specification but only 3 for other multivariate specifications (3-VAR and 2-VAR), and 4 lags for the optimal univariate specification.

3.4.2 Naïve expectations

Under this hypothesis, agents forecast inflation for the next period using only the present observation of the inflation rate, assuming that it will be unmodified. Restrictions on the set of information are strong in the sense that only one lag is imposed, and the coefficient attributed to this lag is unity: $E_t(\pi_{t+1}) = \pi_t$. Inflation is regarded as a random walk. Forecast errors might be very large excepting if inflation is very persistent. The performance of this forecast scheme is then depending on the monetary regime.

3.4.3 Measures and tests of inflation forecasts

In order to compare the performance of alternative expectations schemes, we focus on the forecast errors provided by each of them. We compute the

Table 3.2 Root mean squared errors of inflation forecasts

	1965–2004	1965–1981	1982–2004	1982–1991	1992–2004
Annual data					
3-VAR	0.790	0.867	0.709		
2-VAR	0.863	1.017	0.709		
Univariate forecast	1.201	1.507	0.929		
Adaptive expectations	1.464	1.922	1.065	1.440	0.640
Quarterly data					
6-VAR	0.269	0.344	0.182		
3-VAR	0.304	0.358	0.231	0.259	0.197
2-VAR	0.306	0.371	0.232	0.262	0.199
Univariate forecast	0.310	0.383	0.244	0.270	0.215
Adaptive expectations	0.499	0.600	0.410	0.471	0.356

Root-Mean-Squared-Error (RMSE) of inflation forecasts for the different model we use. The RMSE is given by $\sqrt{\frac{1}{T}\sum(\Delta\widehat{\pi}_t - \Delta\pi_t)^2}$. Table 3.2 summarizes the empirical results. We allow for a structural break at the end of 1981.

With annual data, the difference between the RMSE of naïve expectations and the RMSE of the 3-Var specification is quite important (forecast errors of the random walk are twice as high as those of the 3-VAR process). In average, the forecast error is about 0.8 points of the annual inflation rate with the 3-Var model and 1.46 with naïve expectations. This confirms that the cost of applying a rule-of-thumb behaviour when forecasting inflation is quite important. Nevertheless, this error seems to diminish during the period. In the post-Volcker period (when monetary policy becomes more legible and inflation more stable) the error forecast of the random walk is about 1 point, during the last decade it falls to 0.6.

It is worth noting that the RMSE of other forecasting models is also declining, but somewhat more gradually. Until the 1980s the difference between naïve expectations and 3-VAR was only about 0.3 points. The difference is similar with the univariate forecast.

Quarterly data show the same feature but allow for a richer specification because we can use the 6-VAR. The minimal error of inflation forecast is about 0.27 points of the quarterly inflation rate (roughly 1 point of annual inflation rate) using the 6-VAR forecasting specification and the maximal error is about 0.499 points of the quarterly inflation rate (about 2 points of annual rate) using a random walk.

Sub-period analysis provides some interesting results. Whatever the forecast model is, forecast errors become smaller. Results are more precise compared to those with annual data, and several differences between models appear. During the pre-Volcker period (1965–1981) there is a large difference between the error of naïve expectations, and the 6-VAR forecast (0.6 against 0.34). But there is no very important difference between multivariate and univariate forecasts (0.38 against 0.34). During the post-Volcker period, naïve expectations lead to a RMSE of 0.4 points, it is less than 0.2 for the 6-VAR and 0.24 for the univariate forecasts. Then, as Ball (2000) has shown, if a simple adaptive behaviour produces much more important errors than an optimal multivariate forecast, the utilization of an univariate forecast produces only few additional errors.

Ball does not use a formal test to distinguish the accuracy of forecasts. One logical way to analyze the differences between forecasts is to discriminate them on purely statistical grounds. We perform the Diebolt–Mariano Test (1995) in order to asses whether the mean-squared-error of inflation forecast is statistically different or not between models.

For instance, we compare the performance of optimal univariate forecasts with the performance of the random walk. Let $e_{AR,t}$ be $(\Delta\hat{\pi}_t^{AR} - \Delta\pi_t)^2$, the squared error of inflation forecast with the AR process and $e_{RW,t}$ be $(\Delta\hat{\pi}_t^{RW} - \Delta\pi_t)^2$, the squared error of the random walk. The Diebolt–Mariano test wonders if $d_{AR/RW,t} = e_{AR,t} - e_{RW,t}$ is significantly different from zero or not. We compute the mean of squared error differences:

$$\overline{d_{AR/RW,t}} = \frac{\sum_{t=1}^{n} d_{AR/RW,t}}{n}$$

and the Heteroskedasticity-Autocorrelation-Consistent standard deviation of $d_{AR/RW,t}$ (West, 1996), named $\hat{s}_{AR/RW}$. Under the null of equal accuracy between the AR process and the random walk, the Diebolt–Mariano test statistics is simply the Student of $d_{AR/RW,t}$:

$$DM = \frac{\overline{d_{AR/RW,t}}}{\hat{s}_{AR/RW}}$$

We apply the same test to compare the AR with the different VAR specifications. Table 3.3 summarizes the results. From this table, we can conclude that the Random Walk is quite imprecise and leads to very large errors, throughout the period. Every alternative forecasting model performs significantly better.

Throughout the period, there is no significant difference between, on one side the 3-VAR and the 2-VAR specification, and, on the other side, the AR specification. Nevertheless, there is a significant difference in the performance of the 6-VAR with respect to the AR. In average, the cost for limiting the set of information is not trivial. During the first sub-period the null hypothesis of equal accuracy of the 6-VAR and the AR is accepted, but it is rejected for the second sub-period.

In his paper, Ball (2000) compares the AR process with a 3-VAR process and concludes, without formal testing, that the difference between forecast

Table 3.3 Diebolt–Mariano Test (1995) for equal accuracy of forecasts

	Optimal Multivariate			*Optimal Univariate*	
	6-VAR	*3-VAR*	*2-VAR*	*AR*	*RW*
1965–2004					
$\bar{d}$	–0.176	–0.157	–0.155	–0.152	0
HAC Sdt.Dev.	0.029	0.027	0.027	0.027	—
P.value	0.000	0.000	0.000	0.000	—
$\bar{d}$	–0.024	–0.004	–0.003	0	
HAC Sdt.Dev	0.008	0.005	0.003	—	
P.value	0.003	0.372	0.344	—	
1965–1981					
$\bar{d}$	–0.242	–0.233	–0.217	–0.214	0
HAC Sdt.Dev.	0.064	0.059	0.058	0.058	—
P.value	0.000	0.000	0.000	0.000	—
$\bar{d}$	–0.029	–0.019	–0.003	0	
HAC Sdt.Dev	0.022	0.011	0.006	—	
P.value	0.188	0.102	0.566	—	
1982–2004					
$\bar{d}$	–0.135	–0.115	–0.114	–0.109	0
HAC Sdt.Dev.	0.021	0.018	0.018	0.017	—
P.value	0.000	0.000	0.000	0.000	—
$\bar{d}$	–0.026	–0.006	–0.006	0	
HAC Sdt.Dev	0.007	0.004	0.004	—	
P.value	0.00	0.136	0.181	—	

errors is small and does not depend on the monetary regime (he considers the postwar period as a whole). Then, he concludes that the univariate process is 'near-rational' because it is not less precise than the 'optimal' prediction obtained with the 3-VAR, and it is protected against the Lucas critique. Our results are different. We show that the accuracy of forecasts from the 3-VAR is not significantly different from that of the AR process. Nevertheless both are significantly less accurate than the prediction of the 6-VAR process. In addition, the difference of accuracy between the AR and the 6-VAR depends on the monetary regime if we allow for a break around 1981. The greater precision of our estimates compared to those of Ball allows us to distinguish the AR and the 6-VAR process as distinct hypotheses on the formation of expectations. The naïve expectations can be considered as a third distinct hypothesis. In the next section, we shall introduce each of this series of expectations in the NKPC presented in section 3.1.

3.5 New Keynesian Phillips Curve estimates under different expectations hypothesis

The NKPC can be seen as a model with two components. A price dynamics equation with forward-looking explicative variables:

$$\pi_t = f(E_t\pi_{t+1}, E_{t-1}\pi_t, y_t, y_{t-1}, E_t y_{t+1}, E_{t-1}y_t)$$

and a Data Generating Process (DGP) of expected variables $\Phi(L)X_t = \epsilon_t$, such as $E(\epsilon_t) = 0$.

We choose to estimate this model using a step-by-step approach, based on a limited information inference. We collect the expectations series estimated in the previous section, and introduced them in the Phillips Curves presented in section 3.1. In this section, we report various results provided by different estimation methods and specifications to stress the robustness of our outcomes.

3.5.1 NKPC structural estimates

In both Calvo and Taylor specifications, once we have assumed 2-period contracts, the Phillips Curve contains two structural parameters to estimate. The first is β representing the discount rate. This parameter is expected to be close to one. The other parameter is ϕ, measuring price sensitivity to aggregate demand. This coefficient must be positive.

We use two methods of estimation. The first is standard OLS, used by Ball (2000). Since structural equations are not linear, standard OLS estimates require to constraint one parameter. We restrict $\beta = 1$ so structural equations (3.8) and (3.9) become respectively:

$$\text{CALVO:} \quad \pi_t = E_t\pi_{t+1} + \frac{\phi}{2}y_t + u_t$$

$$\text{TAYLOR:} \quad \pi_t = \frac{1}{2}(E_t\pi_{t+1} + E_{t-1}\pi_t) + \frac{\phi}{2}(y_t + y_{t-1} + E_t y_{t+1} + E_{t-1}y_t) + u_t$$

Another possibility is to use a non-linear methods (3SLS) to obtain direct estimates of the ϕ and β coefficients in equations:

$$\text{CALVO:} \quad \pi_t = \beta E_t\pi_{t+1} + \frac{\phi(2-\beta)}{2}y_t + u_t$$

$$\text{TAYLOR:} \quad \pi_t = \frac{\beta}{1+\beta}(E_t\pi_{t+1} + E_{t-1}\pi_t) + \frac{\phi}{1+\beta} \times (y_t + y_{t-1} + \beta E_t y_{t+1} + \beta E_{t-1}y_t) + u_t$$

Table 3.4 displays the results of this two estimation methods.

Table 3.4 NKPC estimates

	Inflation forecast	*Calvo*		*Taylor*	
		β	ϕ	β	ϕ
OLS	6-VAR	1	−0.19	1	−0.004
			(−1.28)		(0.003)
	AR	1	−0.00	1	0.012*
			(−0.63)		(0.005)
	RW	—	—	1	0.006*
					(0.003)
3 SLS	6-VAR	0.99*	−0.02*	1.00*	−0.00
		(0.01)	(0.01)	(0.02)	(0.00)
AR	0.99*	−0.00	1.01*	0.012*	
	(0.00)	(0.00)	(0.12)	(0.006)	
RW	—	—	1.00*	0.006*	
			(0.02)	(0.003)	

*indicates a p. value lower than 10 per cent, standard errors in parenthesis.

One can observe that the OLS method does not provide any significant results for the Calvo specification, whereas it seems to work better with the Taylor specification. There are few differences between OLS and 3SLS estimates for the Taylor equation. With 3SLS, the model of Calvo produces significant estimates of ϕ with the 6-VAR, but with a negative sign contradicting the underlying theory.

We obtain a positive and significant ϕ coefficient in the structure of Taylor when the DGP of expected variable is an AR process or a random walk. We are unable to find a significant and positive coefficient for ϕ when we estimate NKPC with the 6-VAR as a proxy of expectations. Even if the 6-VAR imposes some restrictions on the set of information used, it remains a sophisticated scheme of expectations, and, like the REH, it is rejected by the data. Assumptions in favour of a simpler behaviour of agents are better accepted. With the pricing structure of Taylor, both the naïve expectations hypothesis and the ‘near-rational’ hypothesis of Ball are supported.

3.5.2 Robustness analysis

In order to assess the robustness of those results we use alternative specifications structural curves and competing econometric methods. We also investigate the time-stability of our previous results in order to confirm their ‘structural’ nature. Then we display some graphs to appreciate the goodness-of-fit of the Phillips Curve with respect to the nature of inflation expectations. The alternatives considered are the replacement of the output gap term by a measure of the real marginal cost, the introduction of delays in the use of information, and the introduction of an output equation.

3.5.2.1 *Output gap vs marginal cost*

Galí and Gertler (1999) and a number of subsequent studies use the real wage share instead of the output gap as a measure of the business cycle. This results from the underlying foundations of the NKPC. A linear relation between the output gap and the marginal cost can be obtained under some hypotheses (see Rotemberg and Woodford, 1997; or King, 2000). However, if those hypotheses are not made, one should replace the output gap by the real marginal cost, which can be approximated by the unit labour cost.

3.5.2.2 *Sticky information*

It is possible that information gathering is slow and that expectations should be formed with a delayed set of information, because agents cannot update their set of information instantaneously (Mankiw and Reis, 2002). While NKPC are usually written as $\pi_t = f(E_t\pi_{t+1})$, we can make the hypothesis that $\pi_t = f(E_{t-1}\pi_{t+1})$. We build this new forecast series by imposing coefficient of current variable in the 6-VAR and in the AR process to be equal to zero.

3.5.2.3 *Endogeneity bias*

Another improvement of the basic NKPC estimates is to wonder if the current driving variable creates some endogeneity bias. To overlook a fallacy in estimating NKPC with standard OLS techniques, one might prefer estimate a simultaneous equation as proposed by Bardsen, Jansen and Nymoen (2002):

$$\pi_t = f(E_t\pi_{t+1}, y_t) + u_t$$
$$y_t = a_0 y_{t-1} + a_1 \Delta\pi_{t-1} + v_t$$

The first equation represents the NKPC and the second is an IS curve.

Table 3.5 displays the results of NKPC estimates when it takes into account the previous modifications.

The first row shows the result when the driving variable is the change of unit labour cost taken as a proxy of real marginal labour cost. This modification seems to improve the Calvo specification with the 6-VAR, confirming the results of Galí and Gertler (1999), but it does not provide significant results for the Taylor specification. The use of marginal cost is not a guarantee of empirical success for the NKPC.

Row 2 gives the result of the NKPC with lagged expectations. Concerning the Taylor specification, the coefficients are significant. The general conclusion of the previous section remains verified: the ϕ coefficient is not different from 0 with the most sophisticated expectation, while it appears positive under simpler forecasts. With this expectations timing, it is possible to estimate the model of Calvo with naïve expectations. The resulting estimate of ϕ is positive and significant, giving some empirical support to the traditional Phillips Curve.

Table 3.5 Robustness of NKPC estimates

	Inflation forecast	*Calvo*		*Taylor*	
		β	ϕ	β	ϕ
1. using ULC	6-VAR	0.98*	0.08*	1.02*	−0.00
		(0.02)	(0.04)	(0.05)	(0.03)
	AR	1.00*	0.00	0.98*	0.02
		(0.00)	(0.00)	(0.04)	(0.03)
	RW	—	—	0.98*	0.01
				(0.04)	(0.02)
2. using $E_{t-1}\pi_{t+1}$	6-VAR	0.00	−0.09*	0.00	−0.05*
		(0.00)	(0.04)	(0.00)	(0.02)
	AR	0.99*	0.00	1.01*	0.01*
		(0.00)	(0.00)	(0.02)	(0.01)
	RW	0.97*	0.04*	0.97*	0.02*
		(0.02)	(0.02)	(0.04)	(0.01)
3. using a system	6-VAR	0.99*	−0.01	1.01*	−0.002
		(0.01)	(0.01)	(0.02)	(0.003)
	AR	0.99*	−0.00	1.01*	0.013*
		(0.00)	(0.00)	(0.02)	(0.00)
	RW	—	—	1.01*	0.007*
				(0.02)	(0.003)

1. The driving variable is the change in unit labour cost, instead of the output gap.
2. $E_t\pi_{t+1}$ is replaced by $E_{t-1}\pi_{t+1}$.
3. The NKPC is estimated simultaneously with $y_t = a_0 y_{t-1} + a_1 \Delta\pi_{t-1} + v_t$. Non-linear NKPC are estimated with 3SLS.

In order to address the problem of endogeneity, we have estimated a simple New Keynesian model, adding a demand relation simultaneously estimated with the Phillips Curve. Results of row 3 are quite similar to those of Table 3.3.

3.5.2.4 Analysis of parameter stability

To address the issue of time stability we compute recursive estimations of NKPC. We begin with the data from 1965:3 to 1975:4, we add a quarter at each iteration. The top panels of Figure 3.1 show the recursive β coefficients with their 5% confidence interval, bottom panels display recursive ϕ coefficients. On the left-hand side, graphs correspond to the estimation of NKPC using the 6-VAR, while the right-hand side of the figure reproduces the NKPC estimates using the AR process. Figure 3.2 shows the same for the Taylor specification.

According to this figure, coefficients of the NKPC model look rather invariant. The ϕ parameter is always non-significant under the structure of Calvo, it is otherwise higher (in absolute value) under more complex expectations (6-VAR) than under the AR process.

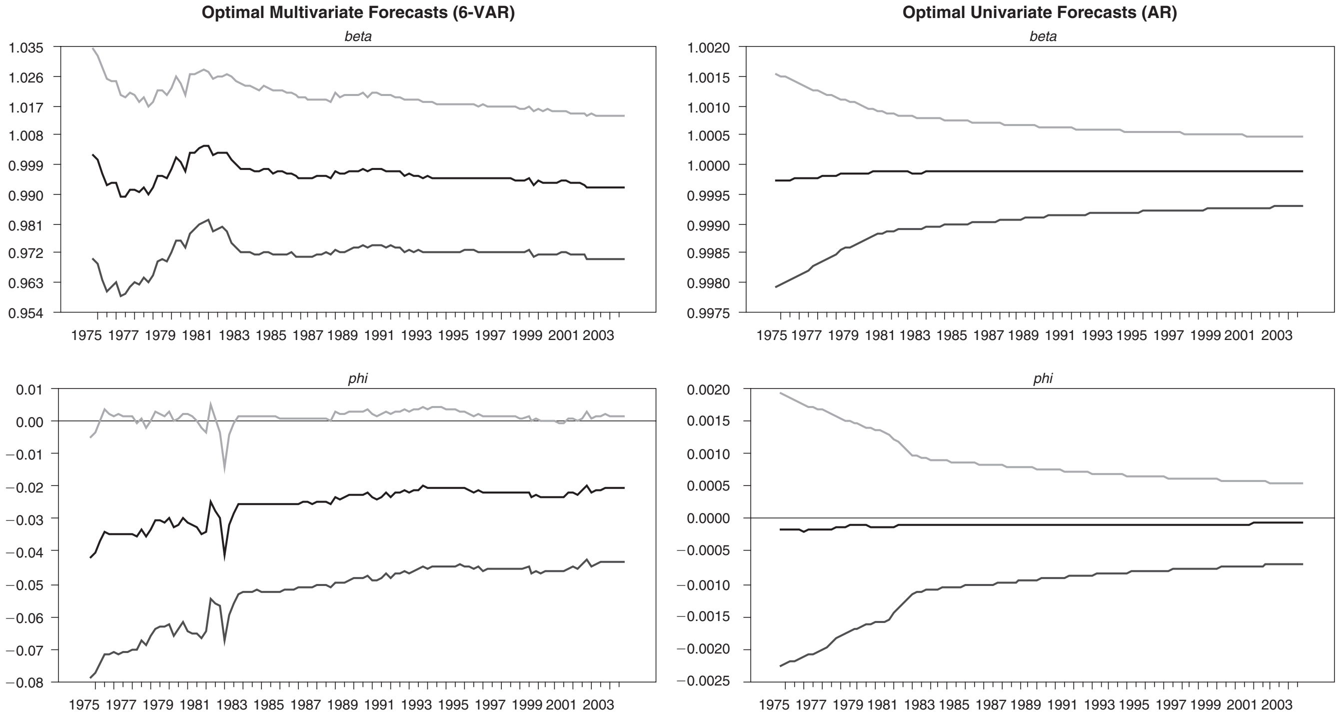

Figure 3.1 Structural Stability of Calvo Specification

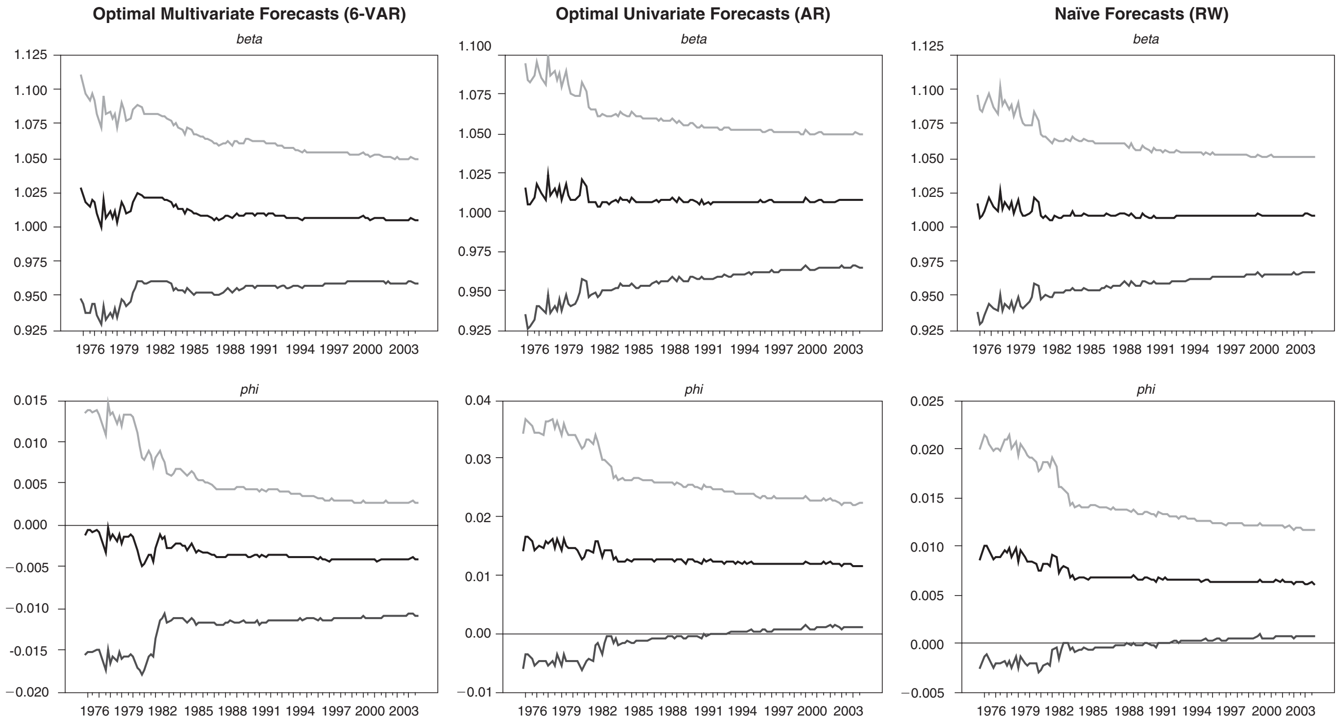

Figure 3.2 Structural Stability of Taylor Specification

As far as the Taylor specification is concerned, the 6-VAR forecast leads to a time-invariant result of a non-significant ϕ coefficient. On the contrary, when expectations are assumed to be less sophisticated, real rigidity seems to have greater importance. The ϕ coefficient is significant until the mid-1990s. When assuming that expected inflation driven by a random walk, real rigidities are significant for the early 1990s.

3.5.3 To what extent does expectation behaviour affect the goodness-of-fit of NKPCs?

We will now verify if the previous results fit US inflation dynamics correctly. We focus on the Taylor specification, because the results presented show that when estimated with the output gap, the Taylor specification is supported more strongly by the data. Top panels display the estimated inflation rate (dotted line) and the actual inflation rate (straight line) (see Figure 3.3). Low panels plot estimated and actual inflations rates. The less widespread around the 45 degree line the better fit.

There are no viewable differences between the competing expectations hypothesis with the Taylor specification. Nevertheless, the performance of the univariate process ('Near-Rational' expectations in the sense of Ball) is better because it produces a more precise estimate than the hypothesis of a 6-VAR process as proxy for expectations. Our problem, so far, remains that we cannot distinguish between the relative performance of the optimal univariate forecasting process and the rule-of-thumb behaviour implied by the random walk because they both produce acceptable results with the methods used so far.

3.6 Forecasting performance of competing expectations assumptions

To address the issue of the relative performances of the AR and the RW models of private expectations, we submit our previous result to a simple exercise of out-of-sample forecasting.

We wonder if it matters, for the macro-model used by a central bank, to assume that private agents use a more restricted set of information. To answer this question we provide 2-year-ahead out-of-sample forecast. Estimates of the Taylor specification of the NKPC are updated every year. Table 3.6 presents usual statistics of forecasting performance: the Mean Error, the Root Mean Squared Error and the Theil U statistics that compare the forecasting performance of the model with respect to the naive assumption of no change over the time:

$$U = \sqrt{\frac{\left(\frac{1}{n}\right)\sum_i (\pi_i - \widehat{\pi}_i)^2}{\left(\frac{1}{n}\right)\sum_i \pi_i^2}}$$

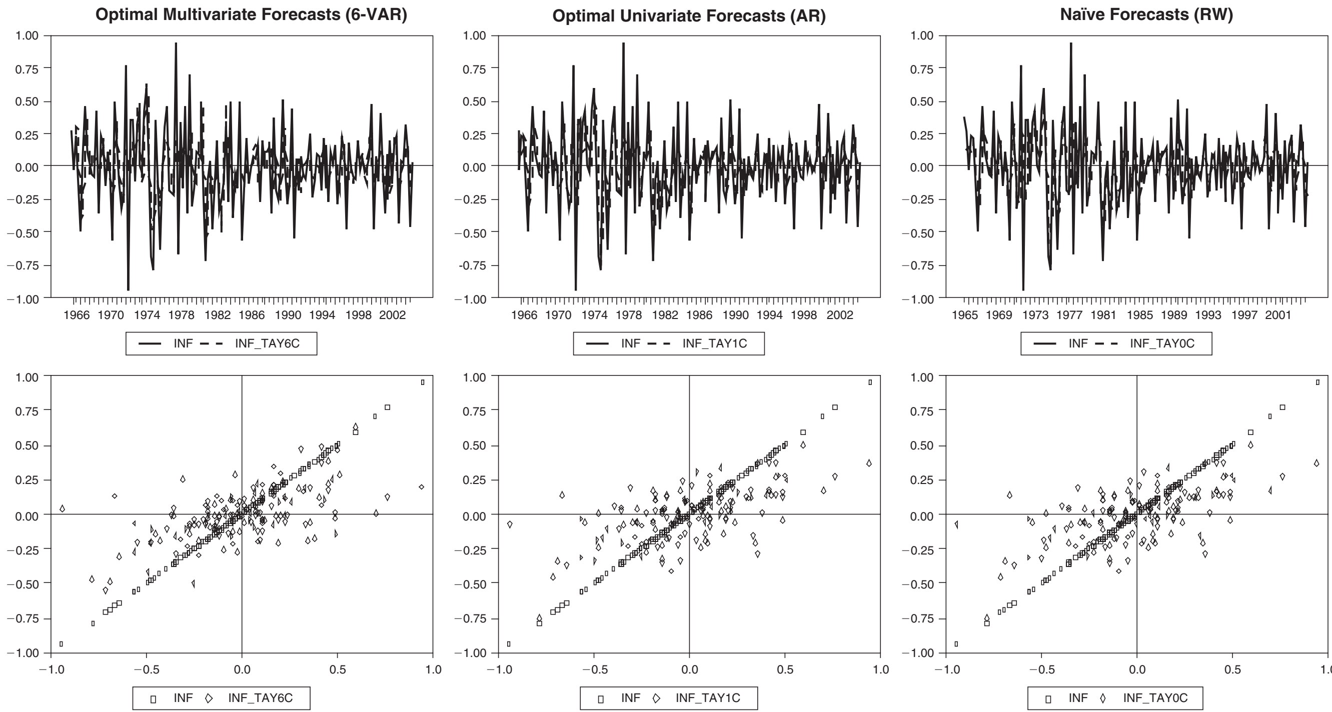

Figure 3.3 Goodness-of-fit of Taylor specification

Table 3.6 Forecasting performances

TAYLOR		Quarters				
		1st	2nd	4th	6th	8th
6-VAR	ME	–0.010	–0.014	–0.009	–0.009	–0.009
	RMSE	0.124	0.120	0.117	0.118	0.120
	U Theil	0.533	0.489	0.532	0.433	0.452
AR	ME	0.005	0.002	0.006	0.006	0.005
	RMSE	0.116	0.113	0.110	0.110	0.112
	U Theil	0.499	0.462	0.501	0.404	0.422
RW	ME	0.005	0.002	0.006	0.006	0.006
	RMSE	0.116	0.113	0.110	0.111	0.112
	U Theil	0.499	0.463	0.502	0.405	0.422

Using a 6-VAR hypothesis to model expectations always produces an overestimation of inflation rates. The 2-year forecast error under this hypothesis represents 45 per cent of the assumption of no change over time. Assuming an AR process leads to a smaller error (42 per cent of the naïve forecast error). The RMSE is also smaller in the latter case. However, it is still not possible to distinguish a significant difference between the performance of the 'Near-Rational' assumption based on the optimal univariate process and the naïve expectations assumption.

3.7 Conclusion

In this chapter, we have shown that one possible reason for the failure of traditional estimates of the NKPC can be due to the strong hypothesis of rational expectations. We use several alternative hypotheses on the formation of non-rational expectations, and we show that the most sophisticated hypothesis conduct to a rejection of the two main versions of the NKPC, as under rational expectations.

Restrictions on the set of information leads us to estimate a positive and significant coefficient for the parameter of real rigidity, between 0.006 and 0.013, in Taylor's model. It is still insignificant in the model of Calvo. However, it is not possible to assess if the hypothesis of 'Near-Rational' expectations made by Ball is better supported by the data than the rule-of-thumb behaviour of naïve expectations. The empirical performance of the latter hypothesis is very good. However, this could be a particular feature of the current monetary regime in which inflation has been very persistent. In this case, the 'Near-Rational' expectations of Ball, based on a AR process, can be preferable, as Ball shows that it conducts to a stable additional forecasting error across different monetary regimes.

Notes

1 See Romer (2001).
2 For $N \succ 2$, the difference between the two models is reinforced. For $N = 2$, most of the literature considers both models to be equivalent.
3 Galí and Gertler (1999) and Sbordone (2002) show the NKPC with rational expectations is coherent with the facts if the real marginal cost is used in place of the output gap. Rudd and Whelan (2002) contest these results. We test the performance of the models using both hypotheses (see section 3.5).
4 In addition to Roberts (1997), other references are Caskey (1985), Croushore (1993, 1997), Jeong and Maddala (1996) and Souleles (2002).
5 He uses this term in reference to Akerlof and Yellen (1985a, 1985b).

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4

The Taylor Rule and Financial Derivatives: The Case of Options*

Chiara Oldani

4.1 Introduction

Modern macroeconomics considers the role of financial assets when modelling the behaviour of agents, policy implementing and transmission mechanisms. Financial innovation emerges in markets and exploits new opportunities, giving rise to (new) profits. The most significant financial innovations of the last thirty years have been in the area of derivatives (futures, options, swaps and forwards). The amount of derivatives trading is steadily growing on both exchange traded (ET) markets and OTC, and it is this growth that accounts for the present interest in these areas. According to BIS data, the ratio between the notional amount outstanding of derivatives (exchange traded and OTC) and world GDP was equal to 3.73 in 2001 and to 6.68 in 2004. Options are by far the most common derivatives contracts in ET markets. The role of derivatives in asset pricing is widely known and accepted. Here I shall start from their economic functions (leverage, substitutability, hedging) (Savona, 2003) in order to conduct further macroeconomic analysis.

Monetary policy should concern itself with financial innovation because such innovation modifies the effectiveness of policy implementing and its ability to achieve predefined goals (e.g. price and financial stability) (Vrolijk, 1997). The New Keynesian model (Woodford, 2003) represents optimizing conditions in the presence of real frictions. Significant financial innovation should be considered in policy making, both fiscal[1] and monetary, and with

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respect to coordination for the purpose of controlling inflation and achieving market stability.

The study is structured as follows: section 4.2 describes the main features of New Keynesian macroeconomics and monetary policy; section 4.3 sets out the reasons why options should be included in a monetary rule; section 4.4 describes the modified monetary policy rule; section 4.5 shows the long-run solution of the model; section 4.6 presents some preliminary empirical results. A brief conclusion draws together the main findings.

4.2 The New Keynesian economic approach to monetary policy

On the New Keynesian view as put forward by Woodford (2003), monetary policy and central banking are an *Expectation Management Exercise*, so that the ability to influence expectations is of central importance in achieving stability. The private sector should be forward looking, and future market conditions are important determinants of current agents' behaviour (Woodford, 2003: 15). Policy implementing through a forward-looking rule, when the private sector is also forward looking, gives rise to sub-optimal results. Systematic rules linked to past values of target variables (income, price, interest rate) are therefore necessary to respond to random disturbances. These are the main justifications for the Taylor rule.

Monetary policy can be implemented by an interest rate rule in a 'pure credit economy' first described by Wicksell (1898) more than a century ago, where no money or currency is necessary to finance consumption, trade or investment. This is not simply a cashless society, as argued by the Money From the Helicopter Theory, but a modern electronic-based transactions and payments system. Criticism of the interest rate rule refers to the possibility that there may be multiple equilibria. But this is true if the interest rate rule relies on exogenous evolution of the variables, not if such evolution is endogenous.[2]

The commitment of the monetary authority should be specified on nominal interest rates, not real ones, which are driven also by other variables not entirely under the central bank's control. Formally, a (Federal Reserve reaction) function, as introduced by Taylor, can be specified as

$$r_t = \bar{r} + \phi_\pi(\bar{\pi}_t - \bar{\pi}) + \phi_x x_t \tag{4.1}$$

where r_t is the interest rate (Federal Fund rate), $\bar{r}$ the natural rate, $\bar{\pi}_t$ the inflation rate, $\bar{\pi}$ the target of inflation, and x_t the output gap. Partial adjustment can be introduced, for example, through a lagged interest rate or an output gap. This rule represents the basic monetary rule in New Keynesian frameworks.

Carare and Tchaidze (2005) point out that a simple policy rule like Taylor's has been abused as a tool for policy setting. On observing the poor data fit yielded by the simple Taylor rule, numerous authors have tried to add lagged or forward-dependent variables. I do not agree with the sceptical view expressed by Carare, since the evolution of markets and agents cannot be captured by the variations in inflation and output gap alone. Financial innovation is the manifestation of the evolution of markets. By considering an innovative, though representative instrument, I shall seek to enrich the Taylor rule with a powerfully informative variable.

4.3 The role of options on monetary and financial markets and management

Financial innovation is a variable considered responsible for money demand instability and for altering financial markets. The aim of the monetary policy rule in New Keynesian models is not to control money supply but to achieve inflationary and financial stability (Woodford, 2003). Hence financial innovation should be considered in monetary policy operating procedures if it is able to alter the ability to achieve the desired stability of goods prices and of financial markets.

Financial innovation broadly defined (derivatives, securitisation, e-money and so on) can have various effects on monetary policy transmission mechanisms.

Monetary policy channels	*Effects*
Interest rates	Market liquidity
	Cost of capital
Valuation	Wealth (consumption)
	Capital valuation (investments)
	Exchange rates (net exports)
Credit	Bank lending
	Balance sheet

Source: Estrella (2001).

According to Estrella, derivatives have various effects on all channels of monetary policy. They positively influence market liquidity and the cost of capital by increasing market efficiency; and they influence wealth and capital valuation (in periods when capital markets are not subject to exogenous shocks), although they do so in an (empirically) unclear manner because the influence depends mostly on the (economic) function for which they are used (hedging, leverage or substitution). Extensive use is made of derivatives for exchange rate hedging. The effects on banks' lending and balance sheets depend upon the functions of derivatives, and they are mixed. The scant empirical evidence surveyed by Estrella confirms that treating derivatives as a general category of financial instruments leads to almost inconclusive results.

The problem is identifying the data on derivatives used for hedging, leverage and substitution. Current accounting rules (and Basle II or IAS-FASB rules) have the merit of letting derivatives enter firms' balance sheets (they are no longer off-balance-sheet items), but not yet with their explicit (economic) function, so that the (poor) empirical evidence has not improved.

Derivatives are by far the most commonly traded financial assets on exchange traded markets and OTC; derivatives increase the liquidity of (underlying) financial markets and are efficient at microeconomic level.[3] Within the broad category of derivatives, option contracts can be considered to be the most attractive assets, owing to their leverage effects and high flexibility. Their implied volatility is the key parameter used for pricing and to analyse their efficiency.

Financial innovation modifies the ability of monetary policy to achieve predefined targets and alters its policy rules setting. Vrolijk (1997) argues that derivatives have accelerated the transmission mechanism in financial markets, so that monetary policy is no longer able to use the surprise effect.

As underlined by Savona (2003), the functions on whose basis derivatives are used by investors drive the investment decision; if we cannot disentangle the motives for investments and then the amount of derivatives bought or sold for hedging, substitution or leverage, we cannot infer anything for a specific theory on the role of derivatives at the macroeconomic level. This is by far the greatest weakness in all the (empirical) derivatives literature of recent years.

However, an empirical limitation does not impede theoretical analysis. Given the important role of derivatives in financial markets, especially since the 1980s, addressing their impact on monetary policy rule can no longer be postponed.

The New Keynesian monetary policy rule should be implemented by considering those variables relevant to achieving stability. Financial markets in this type of model are perfect (frictions are mainly in the real sector, i.e. wage and consumer preferences), so that we can apply the Black and Scholes framework to analyse the role of derivatives in the model. The monetary policy rule is based on the interest rate setting. Given that it is possible to determine that a positive relationship exists between the implied volatility of option contracts and the (risk-free) interest rate (Brenner and Subrahmanyam, 1988), and that there is a positive relationship among the expected volatility of equity prices, information about real activity and inflation, and the path of monetary policy reflected in the interest rate (Kearney and Lombra, 2004), it is reasonable to introduce the implied volatility into the Taylor rule as an explanatory variable.

The policy rule sets the interest rate in response to certain perceived risks. The existence of a (positive) relationship between the interest rate and the implied volatility, and among the expected volatility of equity prices, information about real activity, inflation and the path of monetary policy reflected in the interest rate, helps us to implement the policy rule with an option contract written on the (representative) equity price. In the US economy, the principal equity price is the Dow Jones Industrial Average index, and the corresponding option contract written on this index is the chosen derivative.

4.4 The Taylor rule

The Taylor rule can be described by an augmented interest rate rule taking the form:

$$r_t = \phi E_t \pi_{t+1} + \psi x_t + \rho r_{t-1} + \delta \sigma_t \tag{4.2}$$

where x_t is the output gap, r_t the nominal interest rate, π_{t+1} the inflation rate, E_t the expectation operator, and σ_t the implied volatility of options. The lagged interest rate (r_{t-1}) represents the *inertia* of monetary policy, and its coefficient (ρ) should be less than one but greater than zero.

The implied volatility is supposed to behave like an AR(1) shock, i.e.:

$$\begin{aligned} \sigma_t &= \omega \sigma_{t-1} + \varepsilon_t \\ \varepsilon_t &\approx (\mu, VAR) \approx \chi^2 \end{aligned} \tag{4.3}$$

The error term of the monetary rule (ε_t) is a random shock, with a given mean (μ) and variance (VAR), and it is distributed like a χ^2, which is a positively-skewed distribution and allows for asymmetric effects of increasing versus decreasing volatility. In fact, the authority should react to higher (increasing) volatility by acting on the (nominal) interest rate, while, in the case of decreasing volatility, a less strong monetary reaction is supposed to take place.

Expectations about the interest rate influence the behaviour of investment demand and supply, thereby affecting aggregate demand, growth and prices. In the standard New Keynesian model the last term of eq. 4.2 ($\delta\sigma_t$) is not present because the monetary policy rule is not supposed to react to expectations in the financial market. My intention in introducing expectations about the interest rate into the monetary rule is to stress the informational content of options, which are used by policy makers to extract future expected price patterns. This is rational behaviour because it acknowledges their economic and informational content, together with their high liquidity, efficiency and diffusion across worldwide markets.[4]

Since modern monetary policy does not consider price rules ($\phi E_t \pi_{t+1}$) without *also having some* concern for growth, it seems reasonable to include expectations about an important instrument into the policy rule, which has a long-run relationship with prices. This, of course, makes the behaviour of monetary policy subject to two different expectations-setting mechanisms, those concerning inflation and volatility. The Taylor rule is itself sub-optimal, regardless of its specification, and the relevance has to be put over stabilization and expectations management.

If the implied volatility of options is subject to instability (that is, it increases or decreases because of unanticipated shocks), the behaviour of monetary policy is not specified in such a way that the interest rate will jump to the same extent. The Taylor rule is not an automatic policy rule; rather, it is a behavioural function of modern policy making.

Changing expectations about growth affect the natural rate of interest desired by the authorities, and, in this specification, it affects the interest rate rule via the equilibrium setting. The monetary and fiscal authorities have expectations about important economic variables. The recent literature and common sense also show that policy coordination on targets and instruments can give rise to a better equilibrium, so that the explicit introduction of the natural rate into the interest rule is justified. The Austrian School recognised that human manipulation influences the level of the natural interest rate, because it is determined by the interaction between demand and supply and is heavily affected by expectations.

Monetary policy is responsible for long-run price stability and growth stimulation through its instruments. Expectations about prices are a fundamental part of the strategy, but growth should not be sacrificed, as shown by the Federal Reserve's behaviour.

4.5 The long-run solution

The macro model can be solved in the long run, starting from the reduced form:

$$E_t Z_{t+1} = AZ + ar_t^n + b\varepsilon_t \tag{4.4}$$

where A is a 4×4 matrix and a, b are 1×4 vectors. The complete algebra is given in the appendix, but as shown by Woodford (2003), a stable equilibrium exists *iff* two eigenvalues of matrix A are inside the unit circle.[5]

Matrix A is:

$$\begin{pmatrix} 1/\alpha & 0 & 0 & 0 \\ \dfrac{-\theta + \varphi\gamma}{\alpha\beta} - \dfrac{\lambda}{\alpha} & \dfrac{1}{\beta} & \dfrac{\varphi}{\beta} & 0 \\ -\dfrac{\psi}{\alpha} + \dfrac{\rho\gamma}{\alpha} & 0 & \rho & 0 \\ \dfrac{\omega\delta\gamma}{\alpha} & 0 & \omega\delta & \omega \end{pmatrix} \tag{4.5}$$

Eigenvalues of matrix A can be represented as:

$$\begin{pmatrix} \rho & \omega & \frac{1}{\alpha} & \frac{1}{\beta} \end{pmatrix} \tag{4.6}$$

and, since $\rho < 1$, and $\omega < 1$, the equilibrium condition is satisfied. ρ is the *inertia* of the interest rate, and ω is that of the implied volatility. Both *inertias* are less than one, otherwise there would be overshooting phenomena.

4.6 Empirical evidence

Many authors agree that the Taylor rule should be implemented with forward-looking variables if it is to be optimal. We know from the model setting that monetary policy with rational optimizing agents can set a linear rule of contemporaneous variables because the forward-looking component is incorporated into the agents' behaviour. Then it becomes simply a matter of specifying the model coherently. In our setting, agents are forward looking, so that the policy rule can be specified in terms of contemporaneous variables. The implied volatility of options serves the purpose of incorporating the expectations of financial markets and then signals the expected future behaviour of markets.

Increasing implied volatility signals financial market turbulence. Monetary policy should react by strengthening the money stance (increase the interest rate); if the volatility is decreasing, the reaction may be asymmetrical in that it does not reduce the interest rate by the same amount. This stylized fact is incorporated into the asymmetrical shape of the epsilon shock.

In what follows, the quarterly data used for estimation over the period 1998–2005 are taken from the Thomson Financial Datastream and Bloomberg; x_t is the Holdrick–Prescott filtered output gap computed from the US output gap, defined as the deviation of the actual GDP from its potential, as a percentage of potential GDP. The interest rate (r_t) is the Federal Fund rate and is expressed in percentage terms; the expected inflation rate ($E_t\pi_{t+1}$) is taken from the US consumer opinion survey; the implied volatility (σ_t) is computed by Bloomberg using their own algorithm, and it refers to the option contracts (put and call) on the Dow Jones Industrial Average index.[6] These contracts are the most frequently traded, liquid and representative of the entire US market. They are traded at the Chicago Board Option Exchange, the biggest option exchange in the world, and are among the very first contracts to be settled, so that a 'long' time series is available.

The econometric estimate starts with analysis of the variables' behaviour. Over the period 1998–2005 inflation was not a major phenomenon in the US, and it was not a particular concern for the monetary policy authority.[7] The inflation rate was between 2 and 4 per cent in the presence of sustained growth (Figure 4.2). We may therefore conclude that either the coefficient of

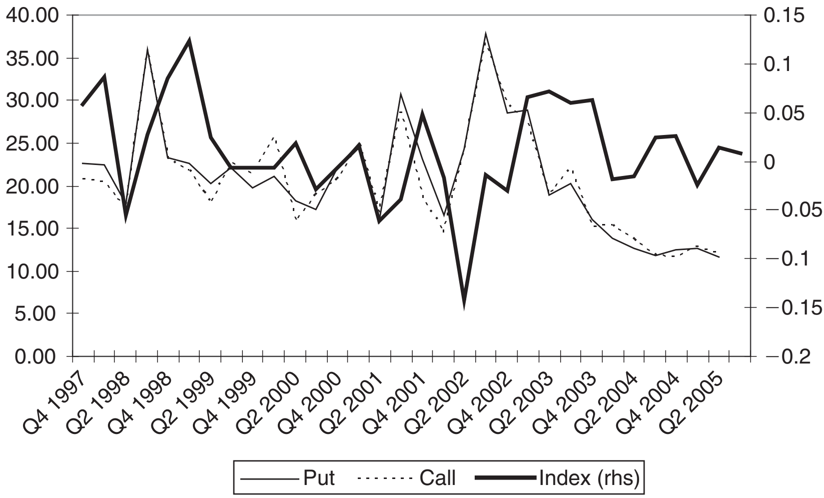

Figure 4.1 Implied volatility of DJIA options and the variation of the underlying stock index
Source: Own elaboration on Bloomberg and Thomson Financial Datastream data.

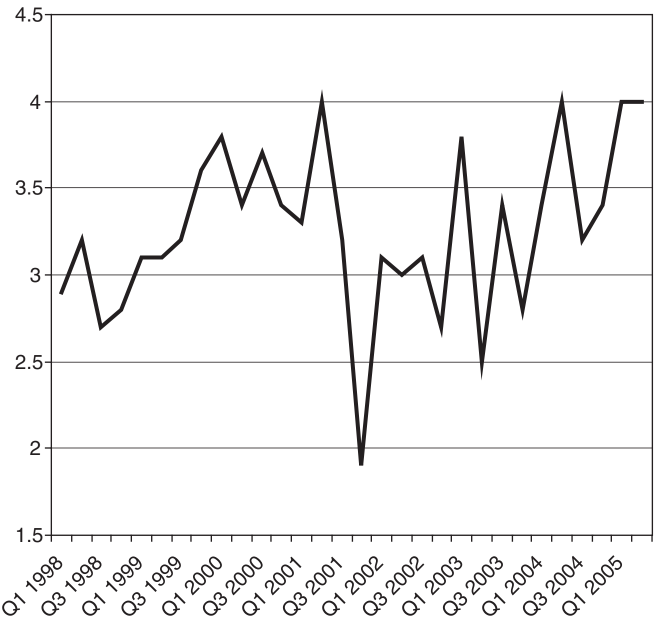

Figure 4.2 US expected inflation rate (%)
Source: Own elaboration on Thomson Financial Datastream data.

the inflation rate in the Taylor rule is not significant, or that its sign is not particularly meaningful. The output gap exhibited negative values throughout most of the period, i.e. the US economy performed very well. The US Fed Fund rate increased until the end of 2000, when monetary policy switched to being expansionary. The maximum interest rate was 6.47 per cent and the minimum was 1 per cent. The implied volatility varied between 38 and 12, and its shape was very similar to that of the variation in the underlying stock index.

The Taylor rule (eq. 4.2) has non-stationary variables and was estimated using different specifications and econometric methods. According to the literature[8] and the model, the function should be specified in terms of contemporaneous variables, but the lagged interest rate is meaningful and represents the *inertia* of the policy. I estimated the function first without the implied volatilities;[9] as a second step, I included the implied volatility of call and put.[10] The complete results are set out in the appendix to this chapter.

The estimators used were the Least Squares (LS) and the Maximum Likelihood (ML). The LS estimator yielded super-consistent coefficients owing to the non-stationarity of the variables,[11] which were I(1). The ML estimator yielded consistent coefficients, and considered the autoregressive effect due to the presence of unit roots.[12]

The LS results confirm that inflation did not play a role in monetary policy setting in the period 1998–2005: its coefficient is either very small or not statistically significant. Fed Board members never expressed particular worries about inflation during the period; they paid most attention to growth[13] and the stability of financial markets. Stock exchange exuberance, the consequent financial turbulence and the number of corporate crises experienced by the US during the period were the main sources of concern for the Fed.

The ML results are consistent econometrically and interesting in terms of magnitude, but they confirm that inflation was not a cause of concern for the Federal Reserve. The *inertia* of the interest rate was high, as many other authors have observed, and the output gap was an important variable in the period 1998–2005: its coefficient varied around 0.40.[14] The implied volatility (of put and call options) was significant in the Taylor rule; its coefficient was small, a finding which can be explained by the fact that the informative content deriving from the Dow Jones Industrial Average was a portion of the entire information set available in the US economy, as well as by the fact that the implied volatility did not vary greatly over the period under analysis, while the Fed made active use of the interest rate. If the goal of monetary policy is to achieve financial stability, the information furnished by the Dow Jones index is important because the wealth invested in the stock exchange is a large share of the total.

The main econometric findings can be briefly synthesized as follows:

- inflation was not a concern for the US monetary policy authority during the period 1998–2005;

- the output gap was the main goal of Federal Reserve policy;
- the volatility of options can be a useful source of information and then could be used to implement the policy rule.

The Taylor rule results are consistent with public statements by the Federal Reserve, which focused mainly on growth and the maintenance of financial stability.

The long-run model specification and econometric solution are set out in the appendix to this chapter. However, given the lack of complete data on derivatives amounts outstanding, counterpart distribution and balance sheet effects, they are not fully reliable for further inferences to be drawn.

4.7 Concluding remarks

This study has explicitly considered the role of financial derivatives, namely options, in a macroeconomic monetary rule. The New Keynesian model rebuts the criticisms brought against the IS–LM and AS–AD frameworks, and it adds meaningful real rigidities for the consideration of the real-world behaviour of agents, markets and institutions. Numerous criticisms have been made of these models, especially by neoclassical economists. Nevertheless, I maintain that they aid the understanding of the economic transmission mechanism by considering real rigidities and shocks in an optimising microeconomic framework.

Financial innovation plays a prominent role in the evolution of financial markets, and its disruptive/creative process is considered within the transmission mechanism when it becomes of significant magnitude. Modern monetary policy uses an instrument – the interest rate – to attain price and financial stability; while financial innovation influences monetary channels and the ability to achieve both targets. The recent literature has shown that there is a positive relationship between the implied volatility and the interest rate, and, moreover, that it can be used for monetary policy.

The Taylor rule modified in order to consider the implied volatility of option contracts yields encouraging empirical results on the basis of US data. The long-run (state-space) solution to the model exists and confirms that a stable equilibrium can be achieved. However, the economic exercise is heavily affected by the short length of the data available, and by the complete absence of data on the economic function of derivatives use. It is consequently not fully reliable for the purpose of drawing further inferences.

The main econometric findings with regard to the US in the period 1998–2005 at a monthly level can be briefly summarised as:

- inflation was not a concern for the US monetary policy authority in the period 1998–2005;
- the output gap was the main goal of Federal Reserve policy;

- the implied volatility of options on the Dow Jones Industrial Average Index is a useful source of information and implements the policy rule.

The Taylor rule results are consistent with public statements by the Federal Reserve, which were focused mainly on growth and on the maintenance of financial stability during the period. The information furnished by the Dow Jones Index is important because wealth invested in the US stock exchange is huge.

This study has been a first attempt to take explicit account of the role of options in macroeconomics. The macro-analysis of financial phenomena like asset innovation is new to New Keynesian economics, and it has yielded some encouraging preliminary results.

In this largely unexplored area of the literature on both finance and economics, further research on the relationship between asset prices and monetary policy – as urged by Alan Greenspan in his Jackson Hole speech of August 2005 – must necessarily remedy the lack of detailed and comprehensive data on derivatives contract volumes, counterparts, and geographical distribution. This is a shortcoming that we cannot overcome in the short run.

But in the long run we are all dead.

Appendix

A Model specification

The short-run model with explicit parameters can be described by the following equations:

$$\begin{aligned}
x_t &= \alpha E_t x_{t+1} - \gamma r_t + \eta r_t^n + \theta E_t \pi_{t+1} \\
\pi_t &= \beta E_t \pi_{t+1} + \lambda x_t \\
r_t &= \phi E_t \pi_{t+1} + \psi x_t + \rho r_{t-1} + \delta \sigma_t \\
\sigma_t &= \omega \sigma_{t-1} + \varepsilon_t \\
\varepsilon_t &\approx \chi^2
\end{aligned}$$

B The analytic solution to the model

Characteristic polynomial of a matrix is of the form:

$$x^4 + A_3 x^3 + A_2 x^2 + A_1 x + A_0 \qquad \text{(A4.B.1)}$$

Substituting the values of A matrix we obtain:

$$x^4 - \frac{(\omega\alpha\beta + \rho\alpha\beta + \alpha + \beta)}{\alpha\beta} x^3 + \frac{(\omega\rho\alpha\beta + \omega\alpha + \omega\beta + \rho\alpha + \rho\beta + 1)}{\alpha\beta} x^2 \pm \frac{(\omega\rho\alpha + \omega\rho\beta + \omega + \rho)}{\alpha\beta} x + \frac{\omega\rho}{\alpha\beta} \qquad \text{(A4.B.2)}$$

Eigenvalues are:

$$\frac{1}{\alpha} \quad \frac{1}{\beta} \quad \omega \quad \rho \tag{A4.B.3}$$

C Option pricing and volatility

The Black and Scholes (1973) option pricing formula is given by:

$$\begin{aligned}
C &= S\Phi(d_1) - Xe^{-rt}\Phi(d_2) \\
P &= Xe^{-rt}\Phi(-d_2) - S\Phi(-d_1) \\
d_1 &= \frac{\log(S/X) + (r + \sigma^2/2)t}{\sigma\sqrt{t}} \\
d_2 &= d_1 - \sigma\sqrt{t}
\end{aligned} \tag{A4.C.1}$$

where C is the price of the call option, P the put price, S the spot price of the underlying asset not paying a dividend or carrying transaction or storage costs, X the strike price of the option, r the risk-less rate of interest, t the length of the option contract, Φ the standard normal, and σ the volatility of the underlying asset.

The no-arbitrage condition in option markets implies that put/call parity should hold $\forall t$; then:

$$C + Xe^{-rt} = P + S \tag{A4.C.2}$$

The option price is set on the basis of the no-arbitrage condition, and the volatility of the underlying asset, extracted from the option price (i.e. having C, P, X, S, r, t compute σ), is key variable for financial engineers to price other derivatives written on the same underlying but not widely traded (Black, 1976).

Since asset prices S are considered to be stochastic processes, independently and identically distributed (*iid*), their volatility is the standard deviation of their (log) returns. Theoretically, when starting from different option contracts written on the same underlying, the implied volatility should be the same, confirming the goodness of the log-normal hypothesis and of stochastic asset prices.

I am aware that different volatility can be computed on the same underlying statistics depending on the strike price, and the length of the option contract. The plot of σ is usually called the 'volatility smile' (or skew), and it is the function used by financial engineers to price other derivatives written on the same underlying. This violation of the Black–Scholes formula can be justified by a non-log-normal distribution function and/or a non *iid* process of asset prices in real financial markets, where transaction costs, liquidity constraints, asymmetric information play a role.

D Statistical data

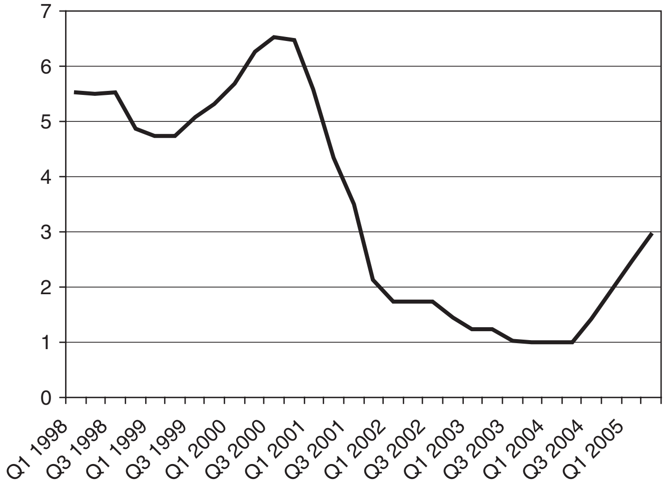

Figure 4.3 US Federal Fund rate (%)
Source: Own elaboration on Thomson Financial Datastream data.

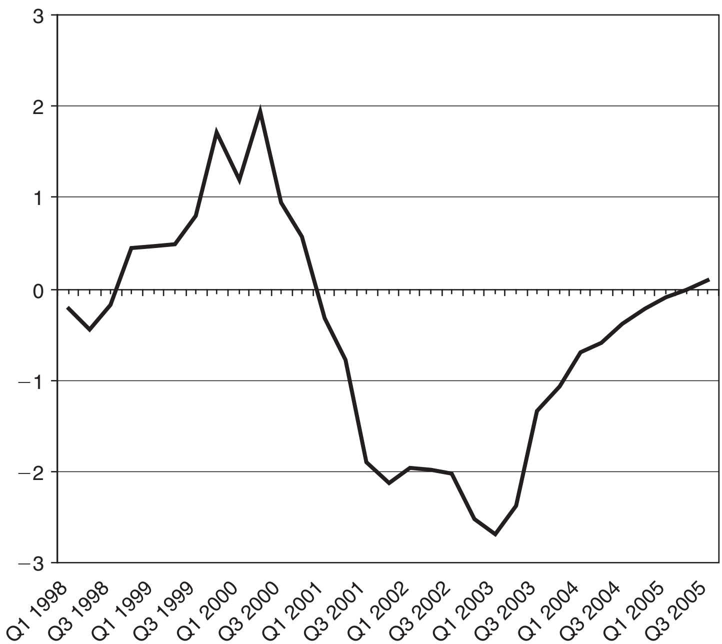

Figure 4.4 US output gap as % of potential GDP
Source: Own elaboration on Thomson Financial Datastream data.

E Econometric results

Table A4.1 Unit root test, 1998Q1–2005Q2

Variable	*Phillips Perron*	*P value*
Interest rate	−1.1597	0.2188
Diff(interest rate)	−2.1381	0.0334
Inflation	0.0449	0.6894
Diff(inflation)	−6.8825	0.0000
Output gap	−1.7352	0.0783
Diff(output gap)	−4.6742	0.0000
Put	−0.9175	0.3109
Diff(put)	−9.9892	0.0000
Call	−0.8915	0.3217
Diff(call)	−13.2783	0.0000

Null hypothesis: presence of unit root.
MacKinnon (1996) one-sided *p*-values.

Table A4.2 Taylor rule estimates, 1998Q1–2005Q2

Dependent Variable: Interest Rate (Fed Fund rate)			
Least squares			
Inflation	0.082	−0.0356	−0.04328
p. value	0.196	0.687	0.6332
Output gap	0.336	0.422	0.444
p. value	0.0001	0.000	0.001
Interest rate(−1)	0.913	0.879	0.8737
p. value	0.000	0.000	0.000
Put			0.0213
p. value			0.0741
Call		0.0197	
p. value		0.0783	
C. R-squared	0.963	0.966	0.966
S.E. of regression	0.3859	0.3701	0.3695
Obs.	30	30	30
Maximum likelihood			
Inflation	0.1326	0.1439	0.2729
p. value	0.000	0.000	0.000
Output gap	0.3057	0.4112	0.4006
p. value	0.000	0.000	0.000

(Continued)

Table A4.2 (*Continued*)

Dependent Variable: Interest Rate (Fed Fund rate)			
Interest rate(−1)	0.9391	0.8146	0.8881
p. value	0.000	0.000	0.000
Put			0.015
p. value			0.01
Call		0.0122	
p. value		0.000	
Log likelihood	−3.9444	−4.2663	−3.2761
Akaike	0.4629	0.5511	0.4851
Obs.	30.0000	30.0000	30.0000
Variance equation			
C	−0.0008	0.0000	0.0014
p. value	0.8587	0.9574	0.8050
Resid(−1)^2	2.3509	1.9847	2.3168
p. value	0.0097	0.0163	0.0258

Notes

1 See Oldani and Savona (2005) on the use of derivatives by European governments, and Oldani (2004) for a survey on the use of derivatives in economic policy.
2 See Sargent and Wallace's (1975) indeterminacy rule in Woodford (2003: 45).
3 Derivatives are efficient assets and have some special characteristics, such as price discovery and matching price.
4 See the appendix for an outline of the main derivatives pricing rules.
5 See Woodford (2003: 721).
6 For a definition of implied volatility refer to the appendix.
7 According to the Federal Reserve Board members and the president, the closest attention was paid to economic growth, asset prices, and financial market stability. From 2006 on the Fed Chairman, Ben Bernanke, has been more concerned with inflationary pressures due to rising energy prices.
8 See Carare and Tchaidze (2005) for a survey of results.
9 This practice is used in the econometric literature to check for robustness.
10 The implied volatility of options was estimated separately in the function, since considering put and call options together yields statistical insignificant results because of the Put–Call parity used to compute the implied volatility.
11 Unit root tests are provided in Appendix E, Table A4.1.
12 As observed by Carare and Tchaidze (2005), having non-stationary variables in the Taylor rule raises a number of econometric problems. The VAR-VECM approach, widely used to consider this behaviour in the econometric literature, needs a longer length of data, with the consequence that the OLS and ML were chosen. The order of the ML-ARCH was selected according to the Akaike Information criteria.

13 This is confirmed by the magnitude of the coefficient of the output gap.
14 The variance equation gives positive and significant coefficient of squared residuals, as expected.

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5

Credit Risk Management: Rationing vs Credit Derivatives and Consequences for Financial Stability

Stefania Vanacore

5.1 Introduction

The great expansion of financial markets in recent decades, on both the demand and the supply sides, has stimulated debate concerning whether or not monetary policies have to take into account the volatility of market asset prices. To date, the prevalent position is that central banks do not have to react to asset price volatility, in particular the reliable negative answer of Bernanke and Gertler (1999). Indeed, Bernanke and Gertler show that: 'The inflation-targeting approach [...] implies that policy should *not* respond to changes in asset prices, except insofar as the signal changes in expected inflation.'

The main interest of a central bank is to guarantee price stability. Monetary authorities have to pay attention to market price volatility since there is a connection between asset prices and the real economy that operates through the balance sheet channel. In fact, if the financial assets are used as collateral to borrow against, then when the asset price changes, the balance sheet of the borrower changes. This relation that affects directly the external risk premium can be magnified by a mechanism known as a financial accelerator (Kiyotaki and Moore, 1997; Bernanke, Gertler and Gilchrist, 1998).

When monetary policy responds to stock prices as well as to expected inflation, the financial shocks have a worse effect on output and price stability than when monetary policy responds only to expected inflation. An exception occurs when the financial shock exclusively affects the risk premium without modifying the agents' balance sheets. In fact, only in this case does the aggressive policy response work better.

The strong position of Bernanke and Gertler (1999) is due principally to work in a standard dynamic New Keynesian framework, slightly modified to introduce the existence of credit-market frictions. Thus, bottom line, the priority of central bank is to control inflation (Taylor rule slightly modified to introduce financial bubble), while the interest for financial fragility is not taken into consideration.

In this chapter, we want to make an extensive examination of the effects of financial volatility on output, analysing how it affects the degree of financial fragility. We define financial fragility as an increasing exposure to the debt level of most agents in the economy, defined also as *systematic risk* (Borio, Furfine and Lowe 2001). For this reason, we refer principally to the theories of inside money, where commercial banks are able to expand the credit almost independently of the level of money quantity created directly by the central bank. In particular, we refer to the theory of the settlement system (Cartelier, 1996), where money is defined as a medium of settlement. In this context, we show that a developed financial market is able to influence the process of money creation by commercial banks, and that therefore the financial market becomes important in determining the fragility degree of the economy.

In contrast to the accelerator mechanism used by Bernanke and Gertler (1999), the financial volatility directly influences the risk premium without previously affecting the collateral prices. This is possible because of the existence of sophisticated derivative instruments. In particular, we introduce credit derivatives, which allow the transfer of the credit risk charged by the lending bank to the market.[1]

By introducing credit derivatives we have an analysis that is more efficient at catching the financial innovations, but it also allows the study of the financial fragility completely isolated from inflation.

The chapter is organized as follows. In 5.2 we describe the economy: agents and timing. In 5.3 we describe and determine the equilibrium conditions in financial markets and in 5.4 we introduce the connected credit derivatives market. In 5.5, we introduce the credit market and determine the equilibrium when it is independent from the financial market. After that, in sections 5.6 and 5.7, we analyse different ways for the credit derivatives to influence the credit quantity. In particular, in section 5.6 we suppose that banks do not buy credit derivatives, but use them as a benchmark to calculate the default probability of financed firms. In section 5.7, we consider the scenario where banks buy credit derivatives for hedging the default risk and we analyse how credit quantity changes consequentially. Finally, in section 5.8, we consider an economy where both the two scenarios exist and banks choose efficiently optimal strategies. In section 5.9, we summarize our findings and conclusions.

5.2 The framework

Our economy is composed of a central bank and several classes of commercial banks, industrial firms and workers. These agents interact on different markets: inter-bank market, credit market, labour market and bond market. We do not consider the labour market in our analysis, but we will

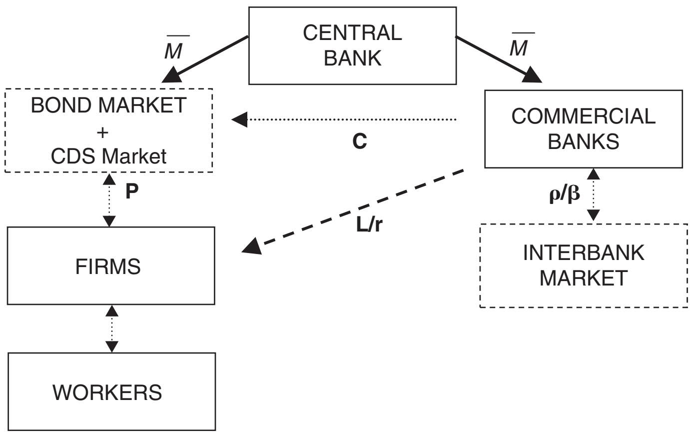

Figure 5.1 Economy description

introduce the bond market and its related derivatives instruments for credit risk purposes.

The agents are distinguished by their capability to raise money: central bank money or commercial bank liabilities. Figure 5.1 synthesizes the connections within this economy.

The *central bank* creates, independently, the outside money $\overline{M}$, by two different processes (represented in Figure 5.1 by the solid lines). Firstly, the central bank gives money directly to commercial banks as endowment. We assume that bank endowment is given and does not change during the timing. In addition, following the theory of exogenous money, the central bank lends money on the bond market directly to firms, but the quantity is decided unilaterally by the central bank. Besides, we assume the central bank introduces new money by a fixed rule and its money supply will be always accepted for a suitable interest rate.

The *commercial banks* use their central bank money to settle the exchanges with other commercial banks on money or inter-bank market. Following Benetti and Cartelier's settlement system theory, commercial bank liabilities are accepted as a medium of settlement by all agents, but the exchanges among commercial banks can be regulated only by central bank money.[2] The interaction among commercial banks takes place within the inter-bank market, where commercial banks borrow to face a lack of liquidity at interest rate ρ_t. We could show that the simultaneous existence of inside money (the dash line in Figure 5.1) and asymmetric information between lenders and borrowers produces a credit risk aversion for the entire commercial banking sector (β), since the central bank money is given and credit default determines a definitive loss of central bank money for involved banks. During the analysis, we impose that β is equal to 2, so bank credit supply is rationed independently of the quantity of central bank money.

Workers have only labour hours within their endowment that they sell to the firm to obtain the money necessary to consume. Furthermore, we assume the unrealistic hypothesis that workers do not save. So we have an agent (worker) that only consumes and a different agent (Central Bank) that provides the exogenous saving. That separation allows us to distinguish between the inside and outside money circuit.[3]

Finally, the *firms* hold capital goods as endowment and no cash. To produce consumer goods, they can borrow by bank credit or, alternatively, by issuing bonds. Furthermore, every firm can be distinguished by their excepted return (R_1^e and R_2^e, such that $R_1^e > R_2^e$) and, within the same class, by the returns volatility (high H and low L volatility) that the lenders do not know *ex ante*. To enter into the bond market, firms have to pay a cost[4] ($\Psi e^{(1-\pi)}$) that allows them to gain transparency in their consideration of lenders. In this way, we suppose the asymmetric information on firm returns does not persist *ex post* on the bond market, but only on the credit market. Furthermore, the cost $\Psi e^{(1-\pi)}$ can be paid only by firm type 1.

As far as the timing is concerned, the economy has an endless life and so do its agents. Every investment has a length of two periods. In the first period, firms find the finance to pay the production factor (labour), remunerate it and start the production. In the second period, firms sell the production and refund the credit.[5] Consequentially, the profit is a residual variable. All investments are simultaneous at the beginning of each period. Different from standard inside money model, workers consume at the same period as soon as they are paid, so they buy the goods produced as a result of the previous period of investment. Thus, we have a sequential economy driven by investment firms' demand. Since we do not consider a growth path, we can suppose all profits are consumed, so the self-financing is always absent.[6]

5.3 Bond market

In every period central bank creates a money quantity that is exogenously fixed,[7] $\overline{M}$, that it brings in our economy directly financing firm investments on bond market or the lack of liquidity of commercial banks in the inter-bank market.

For what it concerns the firms, in t they issue a quantity of bond at price P_t and they promise to pay back the money borrowed plus a returns r_t at $t+1$. Reminding that in the bond market it is possible to distinguish between the firm H and L, the interest rate r_t paid on the primary bond market will be respectively for firm H and L equal to:[8]

$$r_{tH} = \rho_t + (1 - \pi_{t,H})(\overline{\xi}_{1H} - \xi_{1H}) - \frac{L_t^1}{\overline{S}_t}(\overline{\xi}_{1H} - r_t^{1B})(1 - \pi_{t,H}) \tag{5.1}$$

$$r_{tL} = \rho_t + (1 - \pi_{t,L})(\overline{\xi}_{1L} - \xi_{1L}) - \frac{L_t^1}{\overline{S}_t}(\overline{\xi}_{1L} - r_t^{1B})(1 - \pi_{t,L}) \qquad (5.2)$$

The firms, which want to borrow on the bond market, have to pay an interest rate at least equal to the risk-free or inter-bank rate ρ_t, plus the credit risk premium, that is a function of default probability and return volatility. The second term of firm H is always smaller than that of firm L, since $(1-\pi_H) < (1-\pi_L)$ and $(\overline{\xi}_{1H} - \overline{\xi}_{1H}) < (\overline{\xi}_{1L} - \overline{\xi}_{1L})$ by construction. Third term of both equations is the convenience of choosing a bond issue rather a bank loan. Since in pooling equilibrium, firm L is better than firm H, the third term of r_{tH} is lower than the third term of r_{tL}. This effect depends positively on the credit supply of the banking sector. Therefore, when the banks' risk aversion increases, the bond rate of return will be higher. We will suppose $r_{tH} < r_{tL}$. In conclusion, the bond rate increases with the risk-free rate, the credit spread, and it decreases if the bank loan cost deteriorates.

At this point, we introduce the secondary market and we consider the possibility that, in the short term, the secondary asset price can be different from the issued price, because of the financial shocks that can occur. The difference between market rate and issue rate is a multiplicative stochastic variable σ_t that has a uniform distribution on interval $\{\Re^+/0\}$. We can interpret σ_t as sentiment state of market, if $\sigma_t > 1$ the market is dominated by *bears*, on the contrary if $\sigma_t < 1$ it is dominated by *bulls*.

Analysing the macroeconomic condition, it is necessary to introduce the finance demand of firms. Since self-financing does not exist, the external fund demand is equal to investment demand. For simplicity, we suppose that workers consume the goods produced by the same firm where they work. In this way we do not consider the cross-income effects between the firms that borrow on the bond market and the credit market, and we have two sectors completely isolated *ex ante*, so when we will include the contagion effect our results will be stronger.

We can assume the following forward-looking demand of funds Z_t for firm 1:

$$Z_t \equiv Z_t^H + Z_t^L = Z_{t-1} + h[E_t(Z_{t+1} - Z_t)] - \gamma(r_t - r_{t-1}^m) \qquad (5.3)$$

The variation of demand in t depends – positively – on the variation of anticipated income and – negatively – on the variation of interest rate. The parameters h and γ represent, respectively, the elasticity of demand at anticipated income and interest rate, hence we can suppose that both are less than one. In particular, if h is bigger than one the firms always have negative profits. Under rational anticipation, we can exclude this case. In the simulation, we will assume that h is equal to the intertemporal discount factor. For construction, we recall that every period the worker available income is equal to new investment in the same period, so the aggregate consumption[9] is equal to the global investment financed during the same period.

At this point, substituting the micro conditions into the investment function and defining the equilibrium on bond market as the equality between the demand and supply fund, we obtain the following equilibrium condition[10] for the default probability:

$$(1-\pi_t)^* = (1-\pi_{t-1})\sigma_{t-1} - \frac{(\rho_t - \rho_{t-1}\sigma_{t-1})}{\gamma} + S_{t-1}\frac{[h\rho_t(1+\rho_{t-1}) - \rho_{t-1}]}{\gamma\nu} \tag{5.4}$$

The default probability at t is equal to that at $t-1$ observed in the secondary market, modified by the variation of risk-free rate and the variation of available money, weighed by volatility degree $\nu = (\bar{\xi}_1 - \underline{\xi}_{-1})$ and γ. If at t, default probability is not optimal, for example $(1-\pi_t) > (1-\pi_t)^*$, supply is higher than demand and vice versa. From now on, we assume that the risk-free interest rate is constant and equal to $\bar{\rho} = 0$, so that the equilibrium is reduced to:

$$\Delta(1-\pi)^* = 0 \tag{5.5}$$

and the deviation from the equilibrium (5.4) are due only by shocks of secondary market:

$$(1-\pi_t) = (1-\pi_{t-1})\sigma_{t-1} \tag{5.6}$$

5.4 Credit derivatives market

Credit derivatives are contracts between two financial market participants. The essence of contract is concerned with transferring credit risk from one party to another. We consider among different structures of credit derivatives only the *Credit Default Swap (CDS)*. The CDS consists of a single upfront payment, or possibly a series of payments, in exchange for the counterpart's obligation to make a payment that is contingent upon the occurrence of a specified credit event.[11] In our case, the buyer pays a single premium at t, while the default event is observed at $t+1$. In particular, the specified credit event is the default of a bond index that we construct with two bonds of firms H and L:

$$\bar{r}_t^m = \eta_{1H} r_{tH}^m + (1-\eta_{1H}) r_{tL}^m \tag{5.7}$$

The premium is the price of credit risk and it is a function of credit spreads of different bonds that composes the index:

$$C_t^m = \eta_{1H}(1-\pi_H)(\bar{\xi}_H - \underline{\xi_H})\sigma_t + (1-\eta_{1H})(1-\pi_L)(\bar{\xi}_L - \underline{\xi_L})\sigma_t \tag{5.8}$$

For simplicity, we utilize a notion of expected loss that does not include the unrealized gain, so that the specific market shocks do not influence the entity of loss.

Since we are primarily interested in determining the quantity of suitable resources, we do not study how the existence of credit derivatives modifies the bond market. Furthermore, in our economy the credit derivatives can change only the credit spreads determination, since the maximum of available fund supply is predetermined in the bond market. Therefore we consider as risk seller only commercial banks, which want to hedge the credit risk embedded into the loan.

At this point, we introduce the credit market.

5.5 Credit market

Commercial banks can extend their credit supply beyond their quantity of central bank money, because their liabilities can be utilized as a medium of exchange and, at the same time, they can borrow from other banks in order to relax the settlement constraint.[12] Simplifying, we suppose that banks do not borrow directly on inter-bank market, but that they obtain a delay to settle their inter-bank debts. For example, if the banking sector is composed of only two banks: A and B, and at t bank A lends more money than $\overline{M}_A$ and, at the end of period t, it owes to B a quantity greater than $\overline{M}_A$, accordingly it is unable to respect the settlement constraint. In other words, the settlement constraint is a mean to regulate automatically the credit supply growth. But if B requires the settlement at $t+1$ instead of at t, unless A's loans default, A is able to settle its position in the inter-bank market. In order to make A's supply unconstrained, it occurs that at t it obtains the trust of the other banks. Therefore the solvency of the financed firm is the main element to determine the credit supply.

By determining the credit supply, we remind that only firms of type 2 prefer to borrow on the credit market, since their investment returns are not sufficient to pay the entry costs on the capital market. Banks cannot distinguish among firms with respect to their quality, hence on the credit market we have a *pooling* equilibrium. The credit conditions are determined by solving a maximization problem, where the average profit of firm of type 2 is maximized under a participation constraint of the lending bank (see Appendix). The optimal choice of credit supply L_t and interest rate r_t^B on the credit market are described by the following functions:

$$L_t = \frac{p_t(\overline{y}_{t+1} - \rho_t)}{(1 - p_t)2x^2\delta} \tag{5.9}$$

$$r_t^B = \rho_t + \frac{\overline{y}_{t+1} - \rho_t}{2} \tag{5.10}$$

where p_t is the success probability valued by banks, $\overline{y}_t$ the linear average returns in case of success, x is the bank loss in case of default and δ is the intertemporal preference discount factor.

Banks have a backward-bending supply curve, where (5.9) represents the maximum quantity of loans. The optimal L_t is an increasing function of the success probability and the investment returns. It is a decreasing function of the risk aversion, money loss and intertemporal preference discount factoring. The optimal interest rate r_t^B is composed by the risk-free rate, which covers borrowing costs in the inter-bank market, and a credit risk premium. We note that the lending bank does not capture all of the investment returns,[13] because the risk aversion binds the credit cost, avoiding aversion selection experiences.

In the same way that we calculated fund demand in the bond market, we will proceed to calculate the investment demand in the credit market. So the credit demand at t is equal to the previous period's demand, but it is increasing in the expected variation of credit demand at $t+1$ and it is decreasing in the variation of credit interest rate:

$$L_t^D = L_{t-1} + kE_t(L_{t+1} - L_t) - \lambda(r_t^B - r_{t-1}^B) \tag{5.11}$$

where k and λ are, respectively, the elasticity of the variation of the future available income and of the variation to the interest rate. Both are less than one. For $k \leq 1$ we obtain a standard acceleration mechanism, since it influences directly investment demand delays and is not transmitted by capital goods' prices, which we assume to be constant.

We define the macroeconomic equilibrium as the equality between the credit demand and supply. Hence, we proceed to substitute the micro conditions (5.9) and (5.10) in the aggregate demand (5.11) and we obtain the following equation:

$$\begin{aligned}
&\left[\frac{(1+k)P_{t-2} + \lambda x^2\delta}{x^2\delta}\right] y_{t-1} - \left[\frac{P_{t-3} + \lambda x^2\delta}{x^2\delta}\right] y_{t-2} - \left[\frac{kP_{t-1}}{x^2\delta}\right] y_t \\
&\quad = \left[\frac{(1+k)P_{t-2} + \lambda x^2\delta}{x^2\delta}\right] \rho_{t-2} - \left[\frac{P_{t-3} + \lambda x^2\delta}{x^2\delta}\right] \rho_{t-3} - \left[\frac{kP_{t-1}}{x^2\delta}\right] \rho_{t-1}
\end{aligned} \tag{5.12}$$

where $P_{t-i} = \frac{p_{t-i}}{1-p_{t-i}}$. Remarking that the investment return rates can be interpreted as the percentage variation of the credit quantity effectively lent, (5.12) is the dynamic equation of credit quantity percentage variation effectively lent. We define the equilibrium like the state of world where both[14] the credit variation and the probability are constant. Therefore, the equilibrium is realized for every level of credit, if only the growth rate of credit quantity is zero. So as we have proceeded for the capital market equilibrium, we assume that the risk-free rate is constant and equal to zero. This equilibrium is not stable, because the credit demand has an acceleration component, which allows a cumulative rise in the monetary income. In order to overcome the bias from the equilibrium, we analyse the dynamic equation:

$$\left[\frac{kP_{t-1}}{x^2\delta}\right]y_t - \left[\frac{(1+k)P_{t-2}+\lambda x^2\delta}{x^2\delta}\right]y_{t-1} + \left[\frac{P_{t-3}+\lambda x^2\delta}{x^2\delta}\right]y_{t-2} = 0 \qquad (5.13)$$

The difference equation (5.13) has an explosive trend, which will be monotonic explosive or cyclical explosive respect to the values of coefficients.

At this point, we introduce Minsky's hypothesis that both firms and banks are interested in their balance sheets, and, in particular, in their financial exposure. Introducing this behaviour, the success probability of every firm partially depends, negatively, on the global debt of credit economy that is the aggregate leverage, defined as the ratio between the aggregate credit quantity and the central bank money owned by the banking sector. Therefore, microeconomic probability embeds a component of systematic risk that is financial fragility: $p_t = \exp(-\alpha\frac{L_t}{M})$.

Success probability is decreasing in aggregate leverage and, if the quantity of central bank money is constant, an increasingly divergent behaviour of credit quantity determines an increasing tendency to default. Remarking that probability is variable within a limited interval by construction, the divergent tendency cannot be infinite.

To show the cyclical behaviour of credit quantity, we suppose that at t_0, the fundamentals determine a credit demand that is smaller than the maximum credit supply, for example if the demand is zero, consequently the supply is zero. Therefore, if the demand is equal to central bank money, the credit is exactly equals to the outside money. Then, an exogenous shock at t_1 increases the demand. At this point, the accelerator mechanism creates a monotonic growth of credit quantity and financed investments. As the credit quantity increases, firms' finance structure deteriorates, the leverage increases and so does the default probability. Banks continue to lend until the credit supply touches the ceiling or, equally, the success probability reaches the floor.

When these critical values are realized, banks stop their supply. The profits expected are revised by the firms, which anticipate a decrease of the available income expected. Therefore, the demand for credit is reduced. The accelerator mechanism starts again, but now it determines a monotonic decrease in the credit quantity. On the contrary, as credit quantity decreases, the firms' balance sheet and the success probability improves. When success probability is close to *1*, banks are favourable to meet the entire credit demand, firms are aware of that and they start to have positive expectations about available income growth rate. So credit cycle starts again.

We underline that y_t is not a continuous variable, but discrete. The acceleration does not appear at the beginning of the cycle, since the debt growth rate is higher when balance sheets are already deteriorated. If the banking sector recognizes the deterioration of the finance structure in time, several cycles are possible which show smooth patterns. If the banking sector recognizes the deterioration when finance fragility is strong and the financial structures are unavoidably compromised, a deceleration of the credit supply determines a collapse in the credit quantity and the end of the cycle. It is the case of financial crises. The second case is more likely since the floor of success probability is lower.

The default risk increases during the upward phase of the cycle, while it decreases in the downward phase. Furthermore, banks reduce their credit supply when firms need more finance that is when firms have more debts and the profit expectations decline.

Here, the cycle is determined by the financial accelerator of the credit demand and, on the other side, the variation of the systematic risk during the cycle.

Real effects of credit crunch depend upon the economic structure. In fact, the risk aversion of the banking sector, β, and the elasticity probability at leverage, α, determines if a recession or a crisis happens during the downward cycle. A floor of lower success probability produces a crisis rather than a recession, *ceteris paribus*. Furthermore, the existence of a minimal demand will make the recovery after the recession faster. Therefore the recession will be shorter as the minimal demand is higher. In fact, while the change of phase depends on the credit supply, the length of phase depends on the demand.

5.6 Credit derivatives as a benchmark

Now we analyse how the credit supply changes when credit derivatives exist. In the appendix we show that when the bank buys a credit derivative, the credit supply is not rationed and the optimal condition on the interest rate is:

$$r_t^C = \rho_t + C_t^m \tag{5.14}$$

where C_t^m is determined directly by the financial markets, hence an exogenous variable for single firms and banks. Furthermore, a structural limit exists to hedge credit risk on the market:

$$C_t^m > \overline{C}_t \equiv \overline{y_H} - \rho_t \tag{5.15}$$

In fact, if derivatives cost is higher than the lowest net return when the investment is successful, then the entire class of firms of type 2 shows negative profits and, hence, its credit demand is zero. So, it is necessary to distinguish between the cases when $C_t^m > \overline{C}_t$ and those when $C_t^m \leq \overline{C}_t$. When $C_t^m > \overline{C}_t$, the lending bank cannot hedge default risk on the financial market, but the bond market again influences the credit market by the evaluation of the default probability. On the contrary, when $C_t^m \leq \overline{C}_t$ is verified, the bank buys a credit derivative and the credit quantity depends only on credit demand. We remind ourselves that, under our hypothesis, the limit value $\overline{C}$ is constant, while C_t^m, under the equilibrium condition in the bond market, changes only if market shocks are realized. For the bank strategy choice, it is not important how the value C_t^m is determined by financial shocks. Indeed, if the market underestimates the default probability, so that $C_t^m \leq \overline{C}$, the bank buys *a fortiori* the CDS. If the probability is overestimated and $C_t^m > \overline{C}$, the bank does not buy the CDS, but equally it changes its evaluation accordingly. In fact, every other bank, which constitutes the inter-bank market, applies the market probability as a benchmark since they do not have the same access to private information as the lending bank. Hence, they lend on the money market based on the benchmark for the same category of risk. Therefore, default probability can be rewritten as:

$$p_t^C = \pi_{t-1}\sigma_{t-1} + (1-\sigma_{t-1}) + \left[\exp\left(-\alpha\frac{L_t - L_{t-1}}{K}\right) - 1\right](\pi_{t-1}\sigma_{t-1} + (1-\sigma_{t-1})) \tag{5.16}$$

The first part is composed of the benchmark, while the second one introduces the credit quantity variation and, hence, financial fragility inducted by the growth of the debt rate. In fact, if the credit variation is zero, (5.16) is reduced at first term and the probability is simply the market probability.

Firstly, we analyse the case when $C_t^m > \overline{C}$. In this case the dominant bank strategy is to ration the credit supply but, since the market of CDS gives public information about credit risk, the bank must incorporate market valuations to calculate default probability. In particular, we assume that banks calculate the default probability-adjusting market default probability by the degree of financial fragility. Hence, we present the simulation for (5.11) modified to consider (5.16) where $P_{t-i}^C = \frac{p_{t-i}^C}{1-p_{t-i}^C}$:

$$y_t = \left[\frac{(1+k)P_{t-2}^C + \lambda x^2\delta}{kP_{t-1}^C}\right]y_{t-1} - \left[\frac{P_{t-3}^C + \lambda x^2\delta}{kP_{t-1}^C}\right]y_{t-2} \tag{5.17}$$

In the simulations, starting from equilibrium where $p_t^C = p_t = \pi_t$, we suppose that the leverage is equal to unity and the existence of only one shock during the considered period, since any enrichment goes in the same direction.

We consider the following parameters:[15] $\lambda = 0.8$; $x = 0.6$; $k = \delta = 0.99$ and $\alpha = 0.3567$ so that the success probability is 0.7 when the leverage is equal to unity. The classic bell-shape cycle is assured by a k smaller than or equal to unity, which is guaranteed by a rational firm behaviour (as we showed in section 5.5). Smaller is k, stronger is the acceleration mechanism, so that fluctuations are bigger but the cycle length is shorter. Furthermore, λ, x and δ contribution goes towards the same direction, but their effect on cycle dynamics is such an important value, relatively speaking. Moreover the expected loss x is less important since it is weighted at square. By contrast,

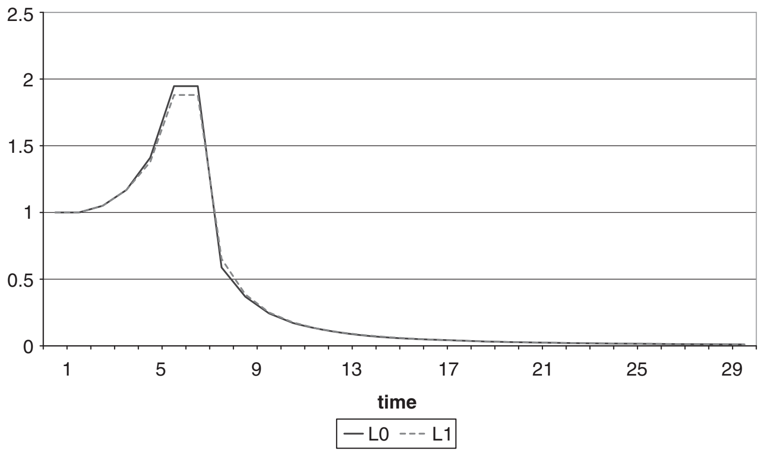

Figure 5.2 Rationing strategy with positive small shock

the value of α is essential for cycle dynamics, but differently from k it is not determined directly by the agent behaviour, so this parameter value is discretional. For α value close to unity, the success probability is more sensitive to variations in leverage (and vice versa), so it involves a success probability evaluation smaller under the same leverage condition (and vice versa). *Ceteris paribus*, if we assume $\alpha \leq 0.2$, credit supply is negative, we need to enhance other parameters, for example the recovery rate, to allow positive bank supply. We remark that α value influences directly the minimum success probability accepted by banks, so credit supply is higher for smaller values of α, but it involves a more restrictive ex ante firm selection, so the credit cycle is more unstable and crises can happen.

Furthermore, we suppose an initial level of credit lower than the maximal quantity and, in particular, we assume that leverage is unitary. In fact, it is necessary to fix on the initial equilibrium. Then, we start from maximum credit where the ceiling of total borrowed funds is given by the quantity of aggregate outside money created by the central bank. We will find that, with inside money, the credit can go too far, but, on the other hand, it can be also less than existent money,[16] until it becomes zero. Finally, we have that the floor[17] value of probability of success is 0.515, while the ceiling is 1, the maximum value for probability measure. We start with an exogenous variation of credit quantity equals to 5 per cent.[18]

Initially, we compare the case, L_1, where a financial shock – exclusive to the financial market – exists, and the case, L_0, where market and bank evaluations are the same. In particular, we assume firstly a positive small shock $\sigma_t = 0.9$ (Figure 5.2), medium/small shock $\sigma_t = 0.8$ (Figure 5.3), and then a larger shock $\sigma_t = 0.1$ (Figure 5.4). We find that with positive shocks, the credit increases,

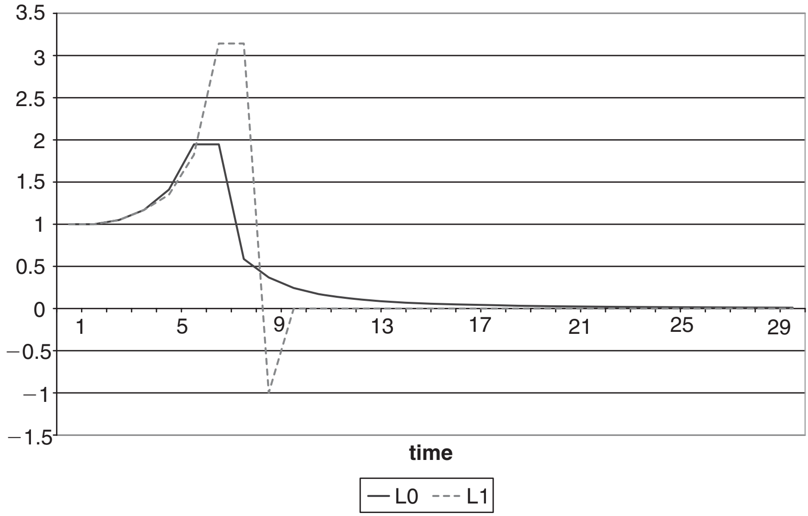

Figure 5.3 Rationing strategy with positive medium shock

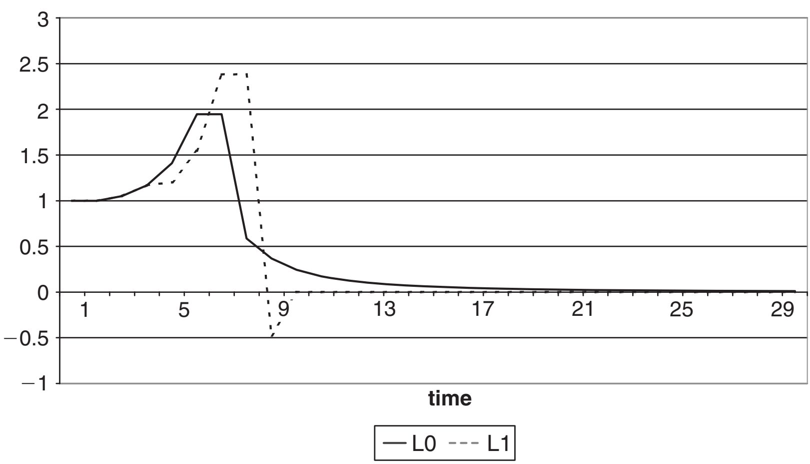

Figure 5.4 Rationing strategy with positive large shock

but the effect is more pronounced with a medium/small shock, since at the same time the initial acceleration is stronger than the small shock, but it is weaker to anticipate the downward with respect to big shocks. When the shock is negative, $\sigma_t = 1.9$, we have a reduction of credit with respect to the case without shocks (Figure 5.5).

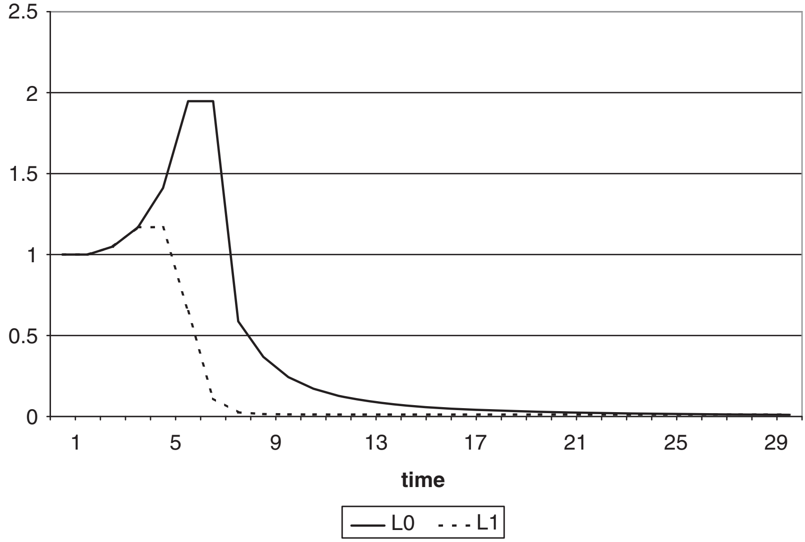

Figure 5.5 Rationing strategy with negative small shock

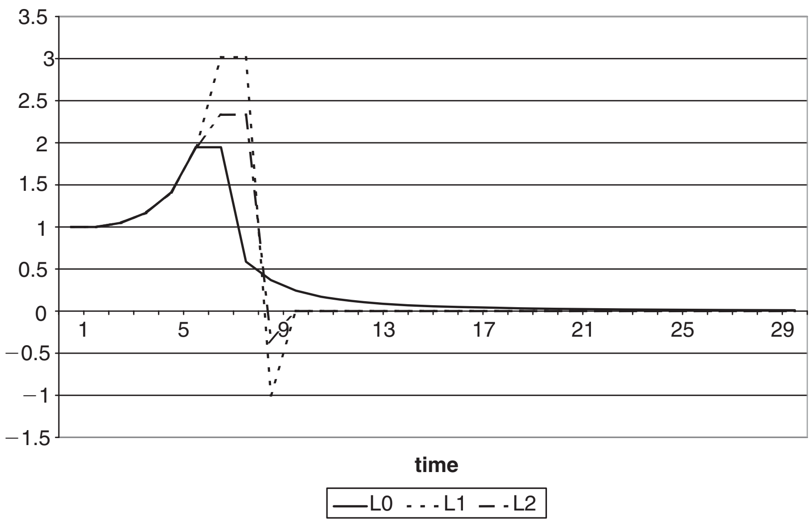

Figure 5.6 Rationing strategy with shock on the cycle top

Then, we assume that a positive shock happens just before the credit quantity reverses the tendency because of the total leverage increase: both if it is medium/small (*L1*) and large (*L2*), the credit quantity grows (Figure 5.6), but if there is a large shock a credit crisis occurs (*L2*).

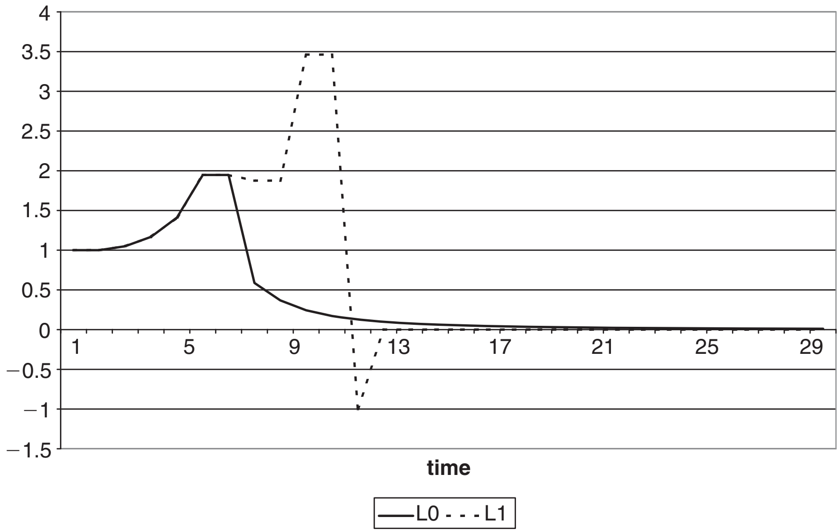

Figure 5.7 Rationing strategy with shock after the cycle top

If the positive shock happens when the credit quantity has already started its downturn and it is either medium or large, it can reverse the tendency as Figure 5.7 shows.

5.7 Credit derivatives as hedging default risk strategy

When $C_t^m \leq \overline{C}$ the lending bank finds it convenient to hedge with credit derivatives, so the credit supply is not rationed and it depends on credit demand for an optimal interest rate. The dynamic condition for credit quantity is in this case:

$$(1+k)L_t = L_{t-1} + kL_{t+1} - \lambda(\rho_t - \rho_{t-1}) - \lambda(C_t^m - C_{t-1}^m) \tag{5.18}$$

Resolving (5.18) we obtain a moving equilibrium where the variations of credit over time depend negatively on variations of the risk-free rate and on variations of the credit risk premium quoted in the market. Furthermore, this equilibrium is not stable, since, broken the equilibrium, it generates a monotonic constant movement of credit toward the same direction of the initial shift. With (5.8) and $\overline{\rho} = 0$, the equilibrium can be written[19] as:

$$\overline{L}_t = \frac{-\lambda v(1-\pi_{t-2})\sigma_{t-2}(\sigma_{t-1}-1)}{(1-k)} t \tag{5.19}$$

The variation of the credit quantity over time depends on the market default probability, but also on the specific shocks of the previous period in the financial market. By construction, the market supply is stable and equal to zero when the financial market is at equilibrium. Hence, there were not market fluctuations, that is $\sigma_{t-1} = 1$. When $\sigma_{t-1} < 1$ – which is equivalent to saying that bulls dominate the market – the equilibrium credit quantity is positive and it is increasing in t. On the contrary, when expectations in the financial markets are pessimistic, so that $\sigma_{t-1} > 1$, bank credits are also reduced, in fact the equilibrium is negative. Hence, a strong relation exists between market valuation *bias* and bank behaviour, which, apparently, is not supported by fundamentals. Hence, when bank employs market instruments to ameliorate its credit management, inevitably its credit supply is affected also by market events. Furthermore, the more the bank participates to the market, the more the market engages the credit. In this way, not only an alternative between two ways of financing disappears, but also we look at how financial shocks have an impact on the real economy. In particular, we remark that this influence is not direct, but mediated by the banking sector. The financial market affects banks, which consequently modified optimally their credit supply that determines real investments.

We assist at a constant quantity of outside money, strictly controlled, but a variation of financial fragility, that does not upset anybody, commercial banks included. In fact, when banks can hedge the default risk buying credit derivatives, they are not motivated to control the systematic risk. Derivatives can constraint the bank not to assume unfair behaviours, but it is not capable to control systematic risk. Furthermore, the market is not capable to value the increasing financial fragility. Differently from the previous case, when banks apply the market probability as benchmark but they continue to support the cost of default, here banks are hedged and, hence, they leave this evaluation to the market. In the first case, the banking sector has again interest that the aggregate leverage does not get worse. In the second case, it is the market that must incorporate this information, when it values the default probability, but it is not capable since its supply is fixed.

Indeed, banks could again control the growth of the credit quantity, if a rise in financial fragility can affect the counterpart risk, but surely their reaction to the leverage is weaker (α is smaller) than the case without credit derivatives. In this case, banking sector declasses its financed firms with respect to the market, so the information on financial fragility passes to the market.

Following, we present simulations on the credit quantity, where we assume the same previous parameters, keeping α aside, since we suppose that $\alpha' < \alpha$ with $\alpha' = 0.25$[20] with a floor value equal to 0.545. In addition we assume $v = 500$. We find that the credit quantity is higher with credit derivatives, and it is bigger when the banks do not consider the effect of leverage on counterpart risk (Figure 5.8). Furthermore, different shocks to the financial market can affect the credit equilibrium, without that any variation of the fundamentals occurs (Figure 5.9). This case is impossible when the derivatives premium is utilised only like benchmark.

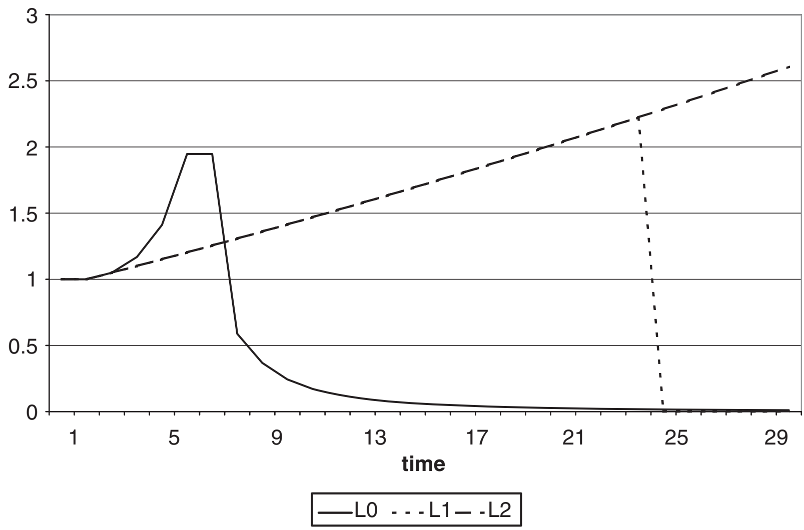

Figure 5.8 Hedging default risk strategy

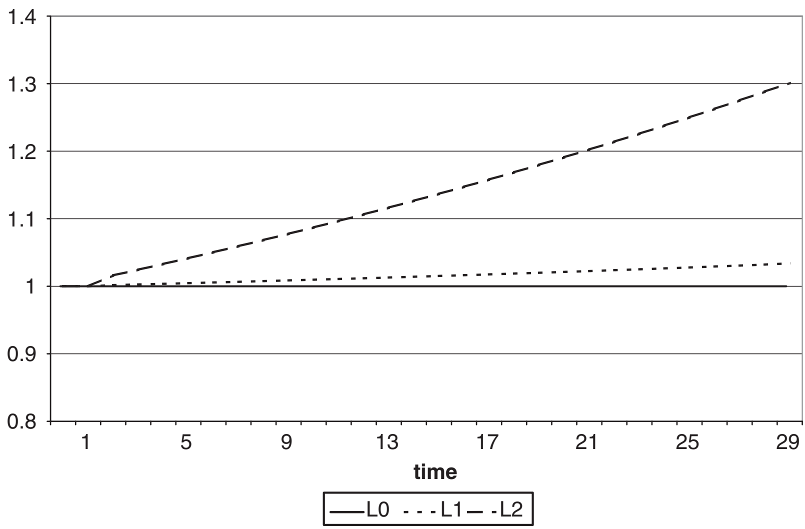

Figure 5.9 Hedging default risk strategy with shocks

5.8 Credit cycle with credit derivatives

At this point we can describe the credit cycle when the bank chooses in every period if it is optimal to hedge the default risk with credit derivatives. In order to show that, we can rewrite the limit condition $\overline{C}$ as function of default probability evaluated in the bond market. In fact, if the default probability increases, the premium increases as well, thus, hedging with credit derivatives is less efficient:

$$\overline{(1-\pi_t)}\sigma_t \leq \frac{\overline{y}_H}{v} \tag{5.20}$$

We can see that the barrier $\overline{(1-\pi)}$ depends on fundamentals, in fact if the volatility of remuneration is high, we have a $\overline{(1-\pi)}$ smaller, and *vice versa*. Hence, if $\overline{(1-\pi_t)}\sigma_t > \frac{\overline{y}_H}{v}$, the bank rations the supply *(§6)*, while if $\overline{(1-\pi_t)}\sigma_t \leq \frac{\overline{y}_H}{v}$, the bank satisfies the entire demand *(§7)*.

In order to understand the total effect of credit derivatives on credit quantity, it is necessary to compare the maximum default probability $(1-p_t^C)_{\max}$, when rationing is the best strategy, the maximum default probability $(1-\pi_t)_{\max}$, when hedging on derivatives market is the optimal strategy and the probability $\overline{(1-\pi)}$, which is determined by the efficient condition $\overline{C}$.

In case of rationing, we have assumed a ceiling equals to the default probability (or a floor in case of success probability), beyond this level the bank stops its supply. When the bank adopts the CDS strategy, we must consider two default probabilities. Beyond the $\overline{(1-\pi)}$, this hedging strategy is not efficient – following (5.20) – while beyond $(1-\pi_t)_{\max}$ the bank considers the counterpart risk too high. For both case, the bank prefers to switch its hedging strategy to rationing strategy. Furthermore we remind that by construction $(1-p_t^C)_{\max}$ is bigger than $(1-\pi_t)_{\max}$ owing to the different level for α^m.

In the simulations we consider two levels for $\overline{(1-\pi)}$. First, we assume $\overline{(1-\pi)} = 0.44$, so that it is smaller both $(1-\pi_t)_{\max}$ that is equal to 0.455 and $(1-p_t^C)_{\max}$ that is 0.485. Then we assume $\overline{(1-\pi)} = 0.55$. Comparing the credit cycle for the different levels for $\overline{(1-\pi)}$, we find how this level is important to determine the maximum credit quantity, indeed if $\overline{(1-\pi)}$ decreases – that is, the fundamentals get worse – the credit quantity diminishes (Figure 5.10).

At this point, we consider the financial shock effects on the quantity of credit. The credit cycle is differently affected by financial shocks, because of the different level of fundamentals. When the fundamentals are worse, a lower value for α^m prevails, determining the default probability, so an exogenous variation of probability has a smaller influence on bank decisions than when the fundamentals are healthier. On the contrary, since the bank underestimates the degree of financial fragility (given smaller α^m) the economy loses a structural mechanism against the financial fragility. It is possible to discover a paradox between this contagion risk and financial fragility; in fact, when the banking sector tries to limit the contagion risk, the entire economy is more exposed to financial fragility. Vice versa, when the banking sector tries to restrain the financial fragility, the credit supply is more affected by financial shocks. It is fair in the simulations, in fact, to compare Figures 5.11 and 5.12 against Figures 5.13 and 5.14, we can see that when $\overline{(1-\pi)} = 0.44$, the size of shock is not so important for the cycle: a positive

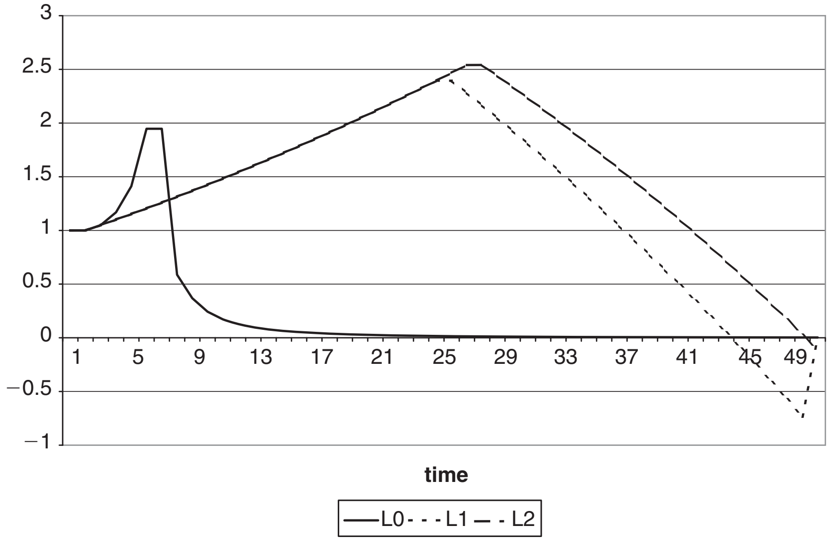

Figure 5.10 Credit cycle with composite strategy

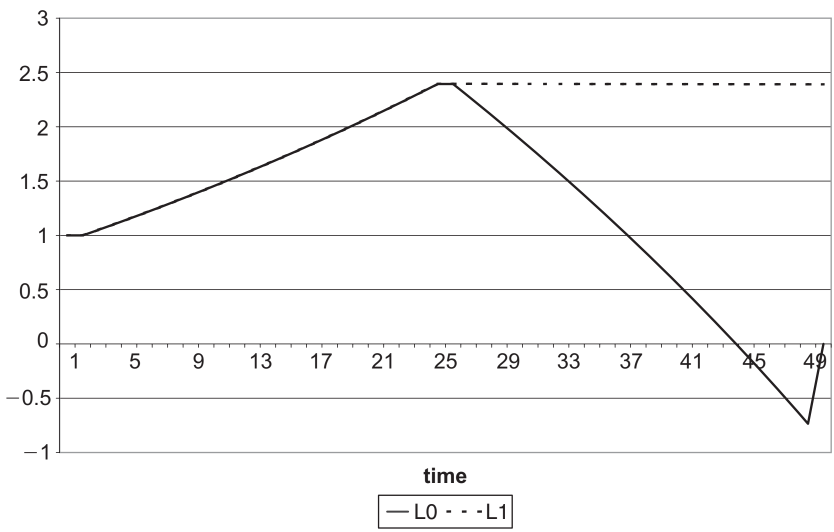

Figure 5.11 Credit cycle with a low fundamental level and with large shock

shock just before the downturn stabilizes the credit at its maximum level. On the contrary when $\overline{(1-\pi)}=0.55$, the size of the shock is important. Indeed, if the size is large, it determines a further upturn that, since it is not supported by fundamentals, will be followed by a credit crunch.

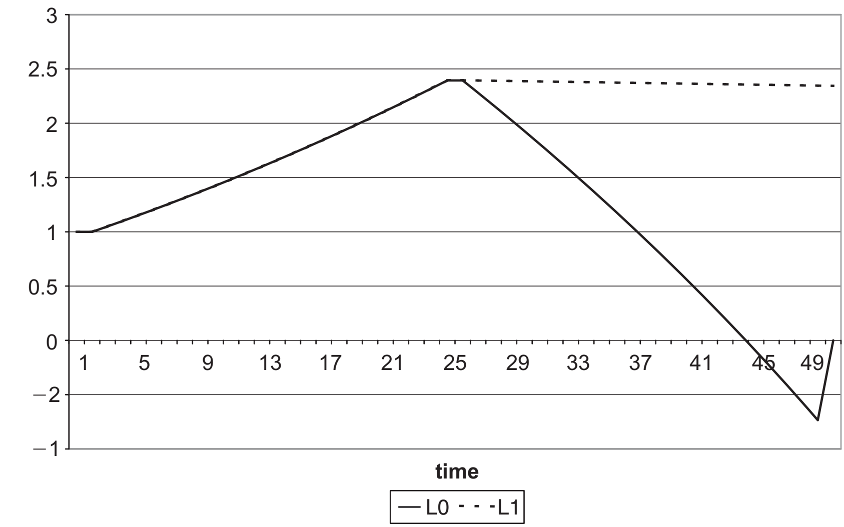

Figure 5.12 Credit cycle with a low fundamental level and with small shock

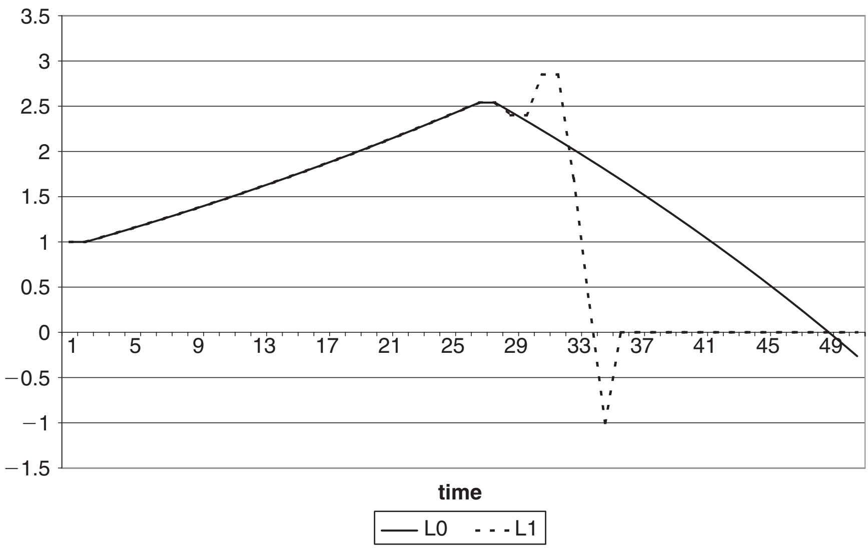

Figure 5.13 Credit cycle with a high fundamental level and with big shock

5.9 Conclusions

In an economy where the inter-bank market allows lending independently of central bank money, information asymmetries also make credit rationing

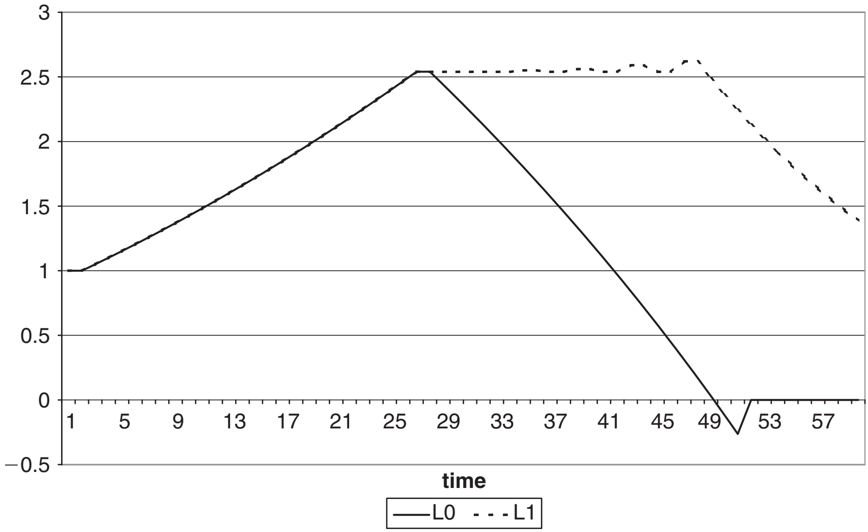

Figure 5.14 Credit cycle with a high fundamental level and with small shock

the optimal strategy. Indeed, information asymmetries reduce the capability of banks to borrow on the money market and, consequently, reduce their credit supply. In practise, frictions embedded in credit contracts make bank solvency uncertain in the eyes of the money market. Hence, the final result is that the banking sector prefers rationing. On the contrary, when the bank buys credit derivatives, it buys an insurance against default risk, so its capability to get the credit back is no longer contingent; hence it is always solvable on the money market. That allows it to satisfy all credit demand, within the limit imposed by the systematic risk control mechanisms.

Analysing the different simulated scenarios when the bank can choose the best hedging strategy, we find two important conclusions.

Firstly, when the bank buys credit derivatives can extend its credit supply, but it retains 'virtuous' behaviour with respect to credit risk. Hence, the expansion of credit supply is not supported by a worse selection of firms. Furthermore, since a growth of credit determines an increase of aggregate leverage – that is, the ratio of commercial banking money over central bank money – the financial fragility rises when hedging on financial markets is possible.

Additionally, a strong relation between the banking sector and the financial markets makes the credit supply more susceptible to market fluctuations. The influence degree depends positively upon the elasticity of default probability to aggregate leverage. We have a paradox, in fact, if the monetary authorities force the bank to pay major attention to the financial fragility – in practice to control credit supply – the result is that, at the bottom line, the financial market determines, the credit quantity. That happens given that the default probability evaluated by the financial market becomes the focus where the different expectations of the different banks converge. In fact, we are reminded that the information asymmetries that characterize the contract between bank and firm, pass to the relations on the money market.

One lesson is that the strict relationship realized when banks use the financial markets to hedge their risks, requires attention also to be paid to the financial market itself, in particular in an economy where the bank-financing system is more important than in a market-oriented economy. In fact, the economies where the development of the market does not diminish the bank-financing role, are more exposed to this risk, since banks largely use these instruments and market fluctuations receive less attention from regulators.

In order to evaluate the efficient and effective response of the central bank to the financial fluctuations, it is necessary to build a framework where both inflation and the degree of financial fragility are acknowledged. We judge that the framework presented here can be a useful starting point, unless introducing the price determination to also consider inflation.

Appendix

Maximization problem in the bond market

Determining the microeconomic optimal condition in the bond market, we present only the case for the firm H, but the same results are suitable for firms L. In the success case, the firm profit is the difference between investment returns and cost of lending. The cost of lending is the sum of the right to enter into the bond market plus risk premium. In the failure case, a firm loses its initial capital $\overline{K}$. It is worth reminding that firms and central bank are risk neutral.

In order for a firm to issue bonds it is necessary that its profits are not negative (3), but principally it does not pretend to be of type 2, because otherwise it demands bank credit. The incentive compatibility (4) has to be respected then. For firm of type 1, it is necessary that the profit of the bond market financed firm is bigger than the profit earned by a credit market financed firm. Finally, firms maximise its profits based on central bank's bond market participation constraint (1), central bank can prefer to introduce alternatively its money into the money market at risk free rate (reminding that central bank is indifferent between two channels because it does not pay attention to financial stability), and based on central bank's balance constraint (2) since central bank chooses a fixed rule, the money supply is fixed. With linear remuneration, we can resolve the following maximization problem:

$$\max_{r_{tH}, Z_{tH}} \pi_H[(1+\overline{\xi}_{1H})Z_{tH} - \Psi e^{(1-\pi_H)} - (1+r_{tH})Z_{tH}] - (1-\pi_H)\overline{K}$$

s.t.

(1) $\{\pi_H(1+r_{tH})Z_{tH}+(1-\pi_H)[(1+\underline{\xi}_{1H})Z_{tH}-\Psi e^{(1-\pi_H)}]\}-(1-\pi_H)\overline{K}$

$\geq (1+\rho_t)Z_{tH}$

(2) $\overline{S}_t \geq Z_{tH}+Z_{tL}$

(3) $\pi_H[(1+\overline{\xi}_{1H})Z_{tH}-\Psi e^{(1-\pi_H)}-(1+r_{tH})Z_{tH}]-(1-\pi_H)\overline{K}\geq 0$

(4) $\pi_H[(1+\overline{\xi}_{1H})Z_{tH}-\Psi e^{(1-\pi_H)}-(1+r_{tH})Z_{tHt}]-(1-\pi_H)\overline{K}$

$\geq \pi_H[(1+\overline{\xi}_{1H})L_t^1-(1+r_t^{1B})L_t^1]-(1-\pi_H)\overline{K}>\overline{p}[(1+\overline{\overline{\xi}}_2)$

$-(1+\overline{r}_t^{2B})L_t^2]-(1-p)\overline{K}\geq 0$

Maximization problem on the credit market

The credit conditions are determined solving the following maximization problem, where average profit of firms of type 2 is maximized under participation constraint of the lending bank.

$$\max_{L_t,r_t^B} p_t[(1+\overline{y}_{t+1})L_t-(1+r_t^B)L_t]-(1-p_t)\overline{K}$$

s.t.

$$p_t[(1+r_t^B)-(1+\rho_t)]L_t-\delta(1-p_t)(xL_t)^2\geq 0$$

Parties negotiate at t a quantity of loan L_t and, in exchange for that, the firm promises to repay L_t at $t+1$ plus an interest rate r_t^B that is proportional to L_t, in case of success, hence with a probability p_t. Otherwise, in case of default, the firm is unable to repay the funds borrowed, but the bank obtains the firm's net worth that, by construction, is smaller than the repayment promised.

Maximization problem on credit market with credit derivatives

When the bank buys a credit derivative, it hedges its credit risk at cost C_t^m so in its profit function the variable x becomes zero and the cost C_t^m must be added. The bank's profit maximization becomes:

$$\max_{L_t} p((1+\overline{y}_t)-(1+r_t^C))L_t$$

s.t.

$$(1+r_t^C)L_t-(1+\rho_t)L_t-C_t^m L_t=0$$

Notes

1 We introduce the passage from traditional intermediation by balance sheet to intermediation by market.

2 Finally, we want to remark the role of central bank money as definitively settlement medium pays attention to institutional theories about money, so that central bank institution guarantees the money acceptance.

3 In fact, if workers consume and save at the same time, the analysis to distinguish the investment financed by outside money and inside money without to change essentially the results gets more complicated. Another theoretical representation can consider the existence of a householder class that owns the central bank money as endowment and invests it on bond market.

4 The cost to entry into bond market is composed by a fixed part ψ, plus a variables part that is an increasing function of default probability given to firm by market $(1-\pi)$.

5 It is not important if labour is remunerated prior or after starting the production, but labour remuneration does not wait that production to be sold so the bank credit is necessary. On the contrary, refund bank credit happens after production is sold. Therefore, agent heterogeneity allows investment risk socially sharing among firms and banks however that among firms and workers. In this paper we assume it, but it can be explained by asymmetric information and heterogeneous risk aversion.

6 In general equilibrium it is equal to assume profits are entirely distributed as dividends.

7 We assume that $\overline{M}$ is given, but in an extension of this model it can be determined to express the central bank behaviour.

8 In the appendix we show how we determine the macroeconomic conditions on bond market and following credit market conditions.

9 Every period, the firms obtain the finance for paying the labour and for starting the production. So, the money obtained represents also available income for the workers. Indeed, the aggregate available income is done by sum of the worker available income (investment of same period) and of the profits obtained by previous investment. That later term is neglected for simplicity without affecting the results.

10 Equation (3.4) is a simplified version for the equilibrium condition, obtained assuming that when default probability on bond market increases, also the interest rate in credit market grows and/or the credit quantity decreases. The general condition is:

$$(1-\pi_t) = (1-\pi_{t-1})\sigma_{t-1}\frac{\nu - \frac{L_{t-1}}{S_{t-1}}(\overline{\xi} - r^B_{t-1})}{\nu - \frac{L_t}{(1+\rho_t)S_{t-1}}(\overline{\xi} - r^B_t)} + \rho_t\frac{[h(1+\rho_t)S_{t-1} - \gamma]}{\gamma\left(\nu - \frac{L_t}{(1+\rho_t)S_{t-1}}(\overline{\xi} - r^B_t)\right)}$$
$$- \rho_{t-1}\frac{(S_{t-1} - \gamma\sigma_{t-1})}{\gamma\left(\nu - \frac{L_t}{(1+\rho_t)S_{t-1}}(\overline{\xi} - r^B_t)\right)}$$

11 For more details see Das (1998) and Rule (2001).

12 See also Minsky (1957b).

13 We remind that for the firm credit strategy is residual respect to issue bond.

14 We remind that the risk free rate is always assumed constant in this analysis.

15 These values are equal to those utilized by (Bernanke *et al*. 1998), except recovery rate that is equal to average recovery rate on CDS market for 2005. The parameters are expressed for quarterly period.
16 If a relation between outside money and pre-existent capital endowment existents, these results can be also extend to the theories that introduce capital as collateral.
17 Differently from the ceiling value, the floor is obtainable endogenously by the rationing strategy of the bank. Hence this value is compatible with the other parameters assumed.
18 Initial variation size influences length and strong of cycle. A small initial perturbation produces a cycle longer and smother, and no crises will happen, while a big initial variation makes shorter dynamic and can produce crises.
19 The general equilibrium is:

$$\overline{L}_t = \frac{-\lambda(\rho_{t-1} - \rho_{t-2}) - \lambda(C^m_{t-1} - C^m_{t-2})}{(1-k)}t$$

20 We can show that when α decreases the floor value of success probability increases.

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6 Animal Spirits, Confidence and Monetary Policy*

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6.1 Introduction

From 2001 until the last months of Alan Greenspan's administration, the Fed's policy was intended to support output growth and price stability. Monetary policy was accommodative whenever prices tended to fall too much, as in 2003, and accommodation was removed when prices tended to rise. The Fed conducted monetary policy, privileging the action on the short-run Federal Fund rate. As a result, in a context of recession and deflation, short-run interest rates dropped from 6 per cent to 1 per cent between 2000 and mid-2004 but, after several years of decreases, a tightening in monetary policy was decided upon in June 2004. Because of an increase in inflation in 2004, rates rose from 1 per cent to 3 per cent in 2004 in order to curb inflationary pressures. Beyond the technical aspects of policy making, the way Fed addressed markets is of primary interest. It openly communicated its strategy to markets and it favoured gradualism in interest rate adjustment in order to influence the economy's expectations. Nevertheless, the door was left open for incremental changes in stabilization plans in case indicators like the current values of profits, labour productivity or the rate of capacity utilization capsized. The Fed's objective was to be able to gauge the impact of its intervention 'in real time' instead of being constrained to make that judgement in advance. As a consequence, monetary policy was defined in a flexible way that avoided monetary surprises.

At the same time, the young and independent ECB, whose mission was stated in a few lines in art. 105b of the Maastricht Treaty, rapidly announced a two-pillar policy based on the strict achievement of an estimated target of 2 per cent inflation and incremented by a quantitative control. On the

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analytical ground, ECB's action has been supported by many contributions that aim to show that independence and commitment are key factors in the Central Bank's success. Committed to maintaining the target inflation below 2 per cent and the M3 growth under a maximum of 4.5 per cent, ECB has lost almost all of its degrees of freedom in conducting monetary policy. Almost immediately, the intermediate target of 4.5 per cent of M3 progression proved to be irrelevant and totally uncorrelated, even with a lag, with the subsequent level of inflation. Abandoning this secondary reference, ECB gained flexibility in its counter-cyclical initiatives. The inflation reference has, however, been maintained, without any consideration of real performances of the European economies. This attitude was undoubtedly linked to an implicit adhesion of ECB economists to the validity of the Lucas–Kydland and Prescott propositions: in a world of forward-looking rational agents, no long-term gain can be expected from current inflation and time-inconsistent monetary policies.

Paradoxically, those Central Banks that had achieved the highest credibility in recent decades, for instance the Bundesbank or the Federal Reserve Bank, were neither the ones which had adopted the most transparent behaviour, nor the ones which had never deviated from their commitments. On the contrary, it seemed that both banks succeeded in adopting a pragmatic approach to monetary policy, thereby addressing the credibility pattern. One may think that this behaviour cannot last long if agents perceive that the constraints surrounding policy making are too strong and will ultimately induce the Bank to deviate. This kind of 'rational pragmatism' could be concerned in a more general perspective when the different ways of learning between the Bank and agents are considered. One may indeed presume that the more the Bank has succeeded in managing a reasonable trade-off between inflation and growth, the more it generates confidence in its ongoing capacity to maintain inflation at a level that is compatible with growth.

Rationalizing this conjecture involves a few hypotheses. First, it is necessary to define the transmission channels of such persuasive influence from the Bank to agents. Then the rational objective of the Bank has to be characterized. Our specific point in this chapter is that such an objective has to be developed in a world where agents are heterogeneous. The first component of heterogeneity is associated with inflation. Part of the population is over-inflationary and the rest is under-inflationary. The respective size of each sub-population changes over time, according to the Central Bank's realizations and the other circumstances influencing agents' appreciations. Agents are also heterogeneous according to their estimation of the real effects of inflation. Inflation-averse agents are more sensitive to the negative aspects of inflation than to its positive aspects. Conversely, inflation lovers are convinced that there is a positive relationship between inflation and welfare. Agents have incomplete information about their environment and the monetary practices of the Bank. This incompleteness is, however, compensated by their propensity to interpret the combined results of their own actions and the monetary policy of the Bank. Without any real intention or any precise initiative of communication, the Bank then progressively reveals its own rate of conservatism, its propensity to target a stable nominal reference and its propensity to use short-term degrees of freedom to develop a counter-cyclical monetary policy. Agents simultaneously adjust their reference to the most desirable level of inflation, their inflationary expectations and their level of aversion to inflation. In the interaction process, the Central Bank and agents have asymmetric positions. The Bank plays the leader's role in a Stackelberg game where the consequences of its actions are, however, not fully predictable due to the uncertainty related to the weight of economic shocks. Agents' adjustments are inserted into the plans of the Bank which is able – to some extent – to drive agents towards middle-term reactions more adapted to its own trade-off between nominal and real references.

In the model we present in section 6.2, we propose a simplified presentation of both the transmission channels of the agents' learning process from the Bank to agents, and the style of monetary policy the Bank is able to implement. Agents react according to the tangible fundamentals of the economy (related to real and financial development of the economy and to the distribution of wealth) and the intangible ones (related to the beliefs, expectations and preferences of agents concerning inflation and growth). The transmission channel integrates two main elements: the differentiated inflation expectations of agents and their heterogeneous inflation-aversion (or preference); both components of heterogeneity could be iterated and transformed according to the nominal performances of the Bank and the observed real sacrifice. Monetary policy would consist in exploiting one of the possible trade-offs between inflation and growth that are induced by both sources of heterogeneity. The trade-off can be *Lucasian* in style: in this case, the Bank, through its actions, has to convince agents that an inverse relation exists between inflation and growth. Another trade-off may be seen as a renewed *Phillips* style: in this case, agents consider that, even in a world where time-inconsistencies are not costless, an adequate level of inflation does not preclude growth. In our model, these two kinds of trade-offs – and the related monetary policies they suppose – are not limited by a typical form of agents' rationality, but rather by differences in tangible or intangible fundamentals. Usually, the Phillips-style trade-off corresponds to a world where agents are not so rational, financial markets are not so developed and the political authorities are not principally interested in their re-election. The Lucasian-style trade-off is generally associated with a world showing the opposite specifications. This chapter aims to challenge this partition between a non-rational Keynesian world on the one hand and fully rational Lucasian approaches on the other. In our view, the design of monetary policy is built on the confidence generated by the past growth and inflation performances of the Central Bank and also on the future behaviour and actions of agents. Section 6.3 displays some interesting results obtained on the basis of a set of numerical simulations applied to the model developed in section 6.2.

6.2 The model

We present a simplified closed economy where the government delegates monetary policy to an independent Central Bank. The mandate of the Central Bank is submitted to periodic control and its revocability acts as an incentive to do its best to reach the delegated objective. Agents are heterogeneous and react to the actions of the Central Bank by consuming, producing and investing, according to their expected levels or inflation and output.

6.2.1 The Central Bank and the political authority

The political authority is the product of a democratic delegation. Its objective reflects the preference of the nation as a whole for the relative importance of the stabilization of nominal magnitudes related to the trend (or stabilization) of real output. The political authority delegates monetary policy to an independent Central Bank which operates without intermediate control for two periods. At the end of the second period, the Council is renewed or not, according to its observed realizations during the two years of exercise, *i.e.* its capacity to cope with the public preferences relative to macroeconomic performances.

The content of the explicit mandate of the Central Bank may take different forms. One of the components of the mandate is to control inflation. The other component is expressed in real terms. It consists in promoting growth or in stabilizing output. These two objectives can be combined in different ways. The instrumental variable of action is not specified in the model, but the short-term interest rate is the natural candidate. The instrumental variable is supposed to have a twofold effect. It has a short-run direct effect on both prices and output. This direct effect does not pass through changes of agents' behaviours and beliefs. The long-run indirect effect depends on the changes in expectations and animal spirits and has an initial impact on output, then on prices. We could identify two relevant cases. In the first case, the one which we will study, the Bank considers that there is a way to boost growth by an adequate combination of monetary policy measures coping with agents' actions and reactions. In the second case, the option would integrate the standard results of the NEC relative to the potential growth while the first is related to a more Keynesian world of structural under-employment, where the 'natural rate of output' results more from of a convention than from the existence of short-term limited capacities.

During the two periods, the sequence of the Central Bank's decisions can be described as follows:

(i) During period 0, the Bank announces and applies the weight of conservatism of the political authority and of agents.[1] It chooses a short-term tacit inflation target for the period 0, given the current state of confidence (expectations, behaviours and actions of agents),
(ii) During period 1, the Bank observes the new state of confidence as resulting from three simultaneous events: the influence of the initial level of confidence of agents, the Bank's own previous actions and interactions with agents' behaviour, the demand and transmission shocks occurred since the Bank's previous decision: the Bank then chooses a new inflation target.

We express inflation π_i and output y_i as indexes in normalized values around the 'normal' references.[2] The objective from which the Bank extracts its targeted levels of inflation for period 0 and period 1 is respectively given by expression (6.1)[3] for the first case and by expression (6.2)[4] in the second case:

$$\left(\pi_0^*, \pi_1^*\right) \text{ Maximizing } L_b = \frac{1}{2}\left[\left(y_0 + y_1\right) - \alpha\left(\pi_0^2 + \pi_1^2\right)\right] \tag{6.1}$$

$$\left(\pi_0^*, \pi_1^*\right) \text{ Minimizing } L_b = \frac{1}{2}\left[\left(y_0^2 + y_1^2\right) + \alpha\left(\pi_0^2 + \pi_1^2\right)\right] \tag{6.2}$$

In this chapter, we focus on the case delimited by the objective (6.1).

Monetary policy is assumed to incur a real cost. This cost depends on the domestic transmission channels, on the technical choices available to the Bank in order to contain nominal values or to accommodate economic activity. During the period this real cost, y_i^{s*}, $(i=0,1)$ can be assimilated to an 'output sacrifice' resulting from the interest rate variations necessary to target a lower (or larger) inflation. When the Central Bank targets inflation cutting (*i.e.* it chooses a planned level of inflation that is lower than the current one), it has to increase interest rates, which temporarily decreases output; when the Central Bank chooses a more accommodative policy, it decreases interest rates, and temporarily boosts output. As a consequence, the sacrifice ratio is given by (6.3):

$$y_i^{s*} = \gamma(\pi_i^* - \pi_{i-1}), \quad i = 1, 2 \tag{6.3}$$

Effective inflation differs from planned inflation by the amount of an additional shock on the financial transmission channels. This shock takes the form of a white noise ε_i, $(i=1,2)$, in such a way that the effective level of inflation π_i equals the planned level of inflation incremented by of the noise:

$$\pi_i = \pi_i^* + \varepsilon_i, \quad i = 1, 2 \tag{6.4}$$

As a consequence, the effective output sacrifice y_i^s also integrates the effect of the shock on transmission channels:

$$y_i^s = \gamma\pi_i^* - \gamma\pi_{i-1} + \gamma\varepsilon_i, \quad i = 1, 2 \tag{6.5}$$

6.2.2 Agents

Agents can be either consumers or firms. They consume, invest or produce for selling, according to their expectations about the level of activity (or the level of effective demand) and the level of prices. The origin of their heterogeneity lies on the one hand in objective components such as their age, profession, their position in the economic circular flow (creditor or debtor) and their level of wealth. It also lies, on the other hand, in other more subjective and semi-rational attributes. These elements may be gathered under the label of 'animal spirits'. As a consequence, and as far as monetary policy is concerned, agents are divided in each period in two groups according to two criteria:

- The first discriminating criterion is related to the proportions of Over-Inflationists and Under-Inflationists within the whole population. Let m_0 and m_1 (π_0) be the respective proportions of Over-Inflationists at time $t=0$ and $t=1$, *i.e.* the proportions of agents expecting for the related period a rate of inflation higher than the publicly targeted rate 0. From period 0 to period 1, the proportion of Over-Inflationists varies according the difference between the observed rate of inflation at period 0 and the normal one.

  Let $m_0 = \overline{m}_0$; then,

  $$m_1 = \overline{m}_0 + m(\pi_0) \tag{6.6}$$

  with $m_1'(\pi_0) > 0, m(0) = 0, \lim_{\pi_0 \to +1} m(\cdot) = 1 - \overline{m}_0, \lim_{\pi_0 \to -1} m(\cdot) = -\overline{m}_0.$

- The second discriminating criterion is related to individual and collective behaviours with respect to inflation. Agents are inflation-averse if they consider that the recessionary effects of inflation (on portfolio returns, on indexation, on future taxes...) outweigh its stimulating effects on economic activity (reducing the cost of credit, generating additional private expenses and public receipts). They are inflation-lovers in the opposite case. Let $k_0 = \overline{k}_0$ and $k_1 = (k_0, y_0, \pi_0)$ be the respective proportions of inflation-averse agents in periods 0 and 1. From period 0 to period 1, changes in the proportion of inflation-averse agents depend upon the observed levels of inflation and output. Agents are more numerous in inferring that there is a negative trade-off between output (and employment) and inflation when inflation is high and output is low, or when inflation is low and output is high; they are more numerous in inferring that there is a positive trade-off between output (and employment) and inflation when output and inflation are both high or low. In other words, there is an increasing number of agents who consider that the Phillips Curve is downward sloping when current observations relating to nominal and real magnitudes are consistent with such a negative slope and they are more numerous to believe that this curve has a positive slope when current observations are consistent with such an 'inversion' of the Phillips Curve. In formal terms, $k_1 = (k_0, y_0, \pi_0)$ is expressed as follows:

$$
\begin{aligned}
k_1 &= k_0 + f(y_0, \pi_0) \\
\text{with,} \quad & f(0, \pi_0) = f(y_0, 0) = -k_0, \\
& \lim_{\substack{y_0 \to -1, \\ \pi_0 \to +1}} f\left(y_0, \pi_0\right) = \lim_{\substack{y_0 \to +1, \\ \pi_0 \to -1}} f\left(y_0, \pi_0\right) = 1 - k_0 \quad \text{and} \\
& f(0,0) = f(0, \pi_0) = f(y_0, 0) = 0.
\end{aligned}
\tag{6.7}
$$

Inflation-averse agents generate an excess of output when they are under-inflationist and inflation-lovers do the same when they are over-inflationist. These two sub-populations constitute the bullish share of the whole population. The complement constitutes the bearish sub-population and generates an output deficit. If we suppose that the global effect is proportionate to the size of the bullish and bearish sub-populations incremented by a demand shock u_i[5], the autonomous short-term output will be given by

$$
\begin{aligned}
y_i^a &= \delta[(k_i + m_i - 2m_i k_i) - (1 - k_i - m_i + 2m_i k_i) + u_i] \\
&= \delta[2(k_i + m_i - 2m_i k_i) - 1 + u_i]
\end{aligned}
\tag{6.8}
$$

at time i, where δ, $\delta \geq 0$ is an index related to the size of the individual impulse (the higher δ, the larger the effect of positive or negative autonomous impulses on output) (see Table 6.1).

The short-term real output y_i of period i is given by (6.9) which is the resulting amount of the autonomous output (6.8) and of the sacrifice (6.5):

$$
y_i = \delta[2(k_i + m_i - 2m_i k_i) - 1 + u_i] + \gamma\pi_i^* - \gamma\pi_{i-1} + \gamma\varepsilon_i \tag{6.9}
$$

Table 6.1 Bulls and bears

	Over-inflationist agents m_i	*Under-inflationist agents $1 - m_i$*
Inflation-averse k_i	$m_i k_i$	$(1 - m_i)k_i$
Inflation-lovers $1 - k_i$	$m_i(1 - k_i)$	$(1 - m_i)(1 - k_i)$

[shaded box] proportion of bullish agents $k_i + m_i - 2m_i k_i$

[white box] proportion of bearish agents $(1 - k_i - m_i) + 2m_i k_i$

6.2.3 The sequence of events

The sequence of events is the following:
Period 0

1. At the beginning of period 0, agents' deterministic impulse on output results from the proportion of bulls and bears (in relation to inflationary expectations and the proportion of inflation-averse agents); simultaneously the stochastic demand shock occurs.
2. Central Bank observes the autonomous output and determines the planned rate of inflation and the planned sacrifice resulting from the monetary policy.
3. Shocks on transmission channels occur and complete the determination of inflation and real output.

Period 1

1. Given output and inflation of period 0, agents revise their expectations on inflation and behaviour. The proportion of bulls and bears varies.
2. Agents' deterministic impulse on output is determined and completed by a stochastic demand shock.
3. Central Bank observes the autonomous output and determines the planned rate of inflation and the planned sacrifice resulting from the monetary policy.
4. Shocks on transmission channels occur and complete the determination of inflation and real output.

6.2.4 The analytical solution of the model

During both periods, the completely (but imperfectly) informed Central Bank interacts with incompletely (and imperfectly) informed agents. Agents act first, at the period 0, step 1. The Bank, observing their first action at the period 0, step 2 and given (6.9) can infer in expected values (given that the future shocks will occur on the future both on demand $u_1$and the present and future shocks and on transmission channels ε_0 and ε_1) the present output y_0 resulting from its current targeted inflation π_0^*. Given π_0^* and y_0, applying (6.6), (6.7), (6.8) and again (6.9) in expected values, the Bank can also infer, still in expected values, the autonomous output of the period 1, the future targeted level of inflation π_1^* and the future output y_1. Considering these expected sequences, the Bank determines its targeted current rate π_0^* by a backward induction process in the following way. First, the future optimal planned rate of inflation π_1^* is determined together with the expected output sacrifice of period 1 y_1^{s*}. Then, these values are reinjected in the gain function (6.1) which, after the substitution of the real components of periods 0 and 1 using (6.6), (6.7), (6.8), (6.9) and (6.5) in expected values, gives π_0^* and the expected value of y_1^a.

The analytical properties of the model depend on the form of the functions $f(\cdot,\cdot)$ and $m(\cdot)$. When these functions are always defined, continuous and derivable, the existence of an analytical solution is established, except for some singular values of the parameters. The general form of the analytical solutions, however, involves too many complexities to allow an exhaustive analysis of the different influences exerted by the main operating mechanisms (expectations, inflation-aversion, size of autonomous impact, degree of conservatism, output sacrifice, shocks). Therefore, we have chosen to specify simple forms of functions $f(\cdot,\cdot)$ and $m(\cdot)$. With the help of numerical experiments, we are able to exhibit different strategies that the Central Bank can use to reach its mixed objective to control inflation and to promote growth.

6.3 Illustrative patterns of monetary policy

The reduced form of the model has been analysed by the use of the specifications of the functions $f(y_i, \pi_i)$ and $m(\pi_i)$. The expressions $f(\pi_i, y_i) = ((1/2) - k_i)[(\pi_i)^2(y_i)^2]^{1/2} - (1/2)\pi_i y_i$ and $m(\pi_i) = 1/2(\pi_i)$ have been selected. The parameters have been calibrated in adequate ranges of variations, except for the initial inflationary expectations that are always assumed initially to be equal to 0.5.[7] Inflation and output have been normalized and expressed between -1 and 1. Initial conditions relative to π_{-1} have been introduced, in accordance with the term of sacrifice. The numerical experiments have been applied to this specification of the analytical model. We have solved the model as indicated in section 2.4. We have verified the existence, uniqueness and continuity of the solutions. The inflation and output values we found as solutions of the simulations are expected magnitudes that express more the planned strategies of the Central Bank than the effective magnitudes affected by demand and transmission shocks. We have chosen to present representative patterns of monetary policy, associated with different values of the tangible and non-tangible fundamentals. In all cases, we find from the function of gain (1) that the optimal levels of inflation and output selected by the Bank are generally above the norms. The optimal path of the economy differs, however, with respect to the level of conservatism of the Bank, the output sacrifice of an anti-inflationary policy, the initial inflation aversion of agents and their inflationary expectations. Four styles of monetary policy have been pointed out. These policies correspond to distinct strategies selected by the Central Bank to attain its mixed objective of increasing real output while stabilizing inflation. Strategies I and II are compatible with an inversion of the Phillips Curve (we hereafter labeled them 'Lucas-style' strategies). Strategies III and IV are compatible with a traditional Phillips trade-off (we hereafter labeled them 'Phillips-style' strategies.

In the case of example I (Table 6.1), inflation decreases slightly from period 0 to period 1 while output increases more significantly. Agents are rather inflation-lovers. In period 0, a positive shock occurs. This shock generates a current output above the norm. The Bank exploits this disposition and progressively increases output. While it adds initially to the positive shock the boost involved by the decrease of interest rates and accepts a rather significant level of inflation in period 0, the Bank dampens inflation at period 1, while the period 1 issues suffice to induce a consequent autonomous output generated by inflation-lover bulls. While this style of monetary policy belongs apparently to the Lucas family (output increases while inflation decreases) it is in reality rooted in the nature of animal spirits and of the capacity of Central Bank to interact with agents by the evolution of the output/inflation trade-off. The bulls are in this case essentially formed by the inflation lovers over inflationist agents.

Example II (Table 6.3) is a Phillips sequence. The Bank is rather conservative ($\alpha = 6$) and agents are rather inflation-averse ($k = 17/25$). The initial negative shock initially has a negative impact on output and inflation. Despite its conservatism, the Central Bank chooses to increase inflation between 0 and

Table 6.2 Lucasian sequence

α	γ	π_{-1}	u_0	δ
3	0.2	–0.1	1/127	1

	k	m	π	y	$L(\cdot)$
t_0	93/253	0.5	0.0448725	0.00472253	0.00250699
t_1	0.367589	0.522436	0.0333333	0.0096654	

Table 6.3 Phillips sequence

α	γ	π_{-1}	u_0	δ
6	1/6	–0.1	–1/5	3/7

	k	m	π	y	$L(\cdot)$
t_0	17/25	0.5	–0.0127911	–0.104513	–0.0501184
t_1	0.679331	0.493604	0.0138889	0.00641516	

1 in order to boost output. The initial reversed signs of inflation and output increase the weight of inflation-averse and under-inflationist agents. Despite its rather high level of conservatism, the Central Bank chooses to increase inflation between the two periods and to add a positive 'output sacrifice' to the autonomous impulse. This effect cumulates with the autonomous agents' impulse generated by the inflation-averse/under-inflationist agents that constitute in this case the major part of the 'bulls'.

Example III (Table 6.4) is also a sequence of the Phillips type, but the strategy of the Bank is to reduce inflation, making clear cuts in output which was initially above norms after a positive shock. In the absence of any expectation of output shock for period 1 (this shock is a white noise) and given the weight of the negative output sacrifice associated with the planned reduction of inflation, output impulse is mainly generated by bullish inflation lovers and over-inflationist agents. This impulse maintains output above the norm after the shock and counter-balances the sacrifice involved by the stabilization of inflation. If the Bank had chosen a low level of inflation and of output at the period 0 and tried to increase both output and inflation during period

Table 6.4 Reverse Phillips sequence

α	γ	π_{-1}	u_0	δ
3	0.2	−0.1	33/127	7013/7145

	k	m	π	y	$L(\cdot)$
t_0	93/253	0.5	0.0478251	0.244607	0.122291
t_1	0.361758	0.523913	0.03333333	0.0101694	

Table 6.5 Reverse Lucas sequence

α	γ	π_{-1}	u_0	δ
17	0.25	0	1/7	3/7

	k	m	π	y	$L(\cdot)$
t_0	174/253	0.5	−0.00474022	0.0600394	0.0312625
t_1	0.687889	0.49763	0.00735294	0.00378669	

1, the subsequent effects on the variation of inflation aversion and inflationary expectations would not have been sufficient to generate a level of output in period 1 compatible with the maximization of the function of gain.

Example IV (Table 6.5) is a sequence involving an apparent reversed Phillips curve. Instead of choosing to dampen inflation and increase output, the Central Bank, whose action is – in our setting – not evaluated dynamically but only on average, chooses to benefit very moderately from the effects of the shock and to plan a level of inflation under the norm. This low inflation immediately generates an output sacrifice, but copes rather well with the inflation-aversion of agents which provides, associated with the slightly increase of the under-inflationist proportion, the autonomous output of period 1, which added to the output (positive sacrifice between periods 0 and 2) is sufficient to maintain output above the norm after with no expected shock.

6.4 Comments and conclusion

The model presented in section 6.2 analyses the monetary policy strategies of an independent Central Bank committed by a political authority to the achievement of a mixed objective. We chose as an objective a function of gain to be maximized, including growth as positive term and deviation of inflation from the nominal norm as negative term. The fully informed Bank interacts with incompletely informed heterogeneous agents who are split between under- and over-inflationists and inflation-averse/lovers. We have experimented diverse values of relevant parameters like the degree of conservatism, the output sacrifice, initial conditions relative to average inflation aversion, completed by the influence of initial demand shocks. In section 6.3, with the help of numerical simulations, we pointed out that the relevant monetary policy responds to initial signals and evolves along with macroeconomic interactions between the Bank and agents. The animal spirits that create the deterministic part of the impulse are also influenced by the results of monetary policy. If the relative size of bullish behaviours increases between period 0 and period 1, the level of deterministic autonomous impulse is higher during period 1 and, for a given output sacrifice, the Central Bank can improve its inflation/output trade-off. Successful monetary policies are founded more on a relationship of confidence between Bank and agents, than on the implementation of the logic transparency–commitment–credibility. Confidence is not given, but it can increase over time by the observation of initial real and nominal results of monetary strategies.

In such a setting, a 'confidence regime' founded on the role of animal spirits ceases to pit agents against central monetary authorities, and then to present both sides as playing a strategic game. It depends upon the mutual recognition that agents are experimenting in a context of incomplete information. This confidence regime is not so far from the state of coordination referred to by Aglietta and Orléan in their 1998 book (Aglietta, Orléan *et al.*, 1998: 24). The confidence relationship develops and becomes durable through experience and in that sense it can be considered to be the direct result of a learning process. Perhaps such a process has greater chances to be successful for all participants if the Central Bank has a margin of action, if it is not trapped in the transparency requirement and if it is not submitted to the strict respect of a monetary target as did the Fed during Greenspan's mandate.

The success of a monetary policy logically depends upon the combination of a small number of macroeconomic indices and on the way in which agents appreciate a monetary authority's actions. When information is not complete, agents are no longer able to decide *ex-ante* if the policy is well-founded: they have to postpone their evaluation to the moment that the macroeconomic effects of the intervention appear. In the same context, monetary authorities dispose of a considerable degree of freedom which is independent of both opportunist behaviour and the objectives of political authorities. The Central Bank should therefore exploit this variability in agents' perception concerning the optimal inflation rate (whether growth is high or low). The economy's confidence in the Central Bank is not exclusively linked to an intangible norm in terms of nominal objectives; it depends on the Bank's capacity to make inflation match with the pace of growth.

Notes

1 See Dal-Pont, Torre, Tosi (2005) for a different assumption in the case of an ambiguous announcement of the Central Bank.
2 For calibrating the subsequent numerical experiments and without loss of generality, we choose to normalize the variables between -1 and 1. This normalization amounts to substitute to $x,(x \in \square)$, a variable $z = \tanh x$, $z \in]-1, 1[$.
3 This case could be considered as a stylized gain function representative of the reference of the Fed.
4 This case could be considered as a stylized gain function representative of the reference of the ECB.
5 This shock is assimilated to a white noise such that $E(u_i) = 0$, and $-1 \leq u^{\text{inf}} \leq u_i \leq u^{\text{sup}} \leq 1$.
6 This shock is assimilated to a white noise such that $E(u_i) = 0$, and $-1 \leq u^{\text{inf}} \leq u_i \leq u^{\text{sup}} \leq 1$.
7 This limitation has been introduced for technical reasons (it allows to choose a linear specification of under the form and corresponds to an initial neutrality of the agents' expectations). We plan to undertake more general experiments.

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7

Asymmetries as Sources of Conflict in a Monetary Union

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7.1 Introduction

In the long run the replacement of national notes and coins by the euro is expected to benefit national economies. Such benefits will be materialized by reducing uncertainty on interest rates and exchange rates, providing a stable exchange for trade and financial transactions, lessening red tape in financial intermediation, minimizing transaction costs, promoting trade and establishing a strong currency whose stability will be safeguarded by the European Central Bank (ECB). It is argued that in the near future the euro will also allow better access to markets within and outside the EMU for enterprises, thereby raising their competitiveness, while, on the other hand, this process will promote benefits such as price transparency for EMU consumers. Pro-EMU professional economists, politicians and policy makers also argue that the euro will bring higher growth rates, which will help to reduce unemployment (European Economy, 1990; Emerson *et al.*, 1992; Gros and Thygesen, 1992).

On the other hand, scepticism about the economic shortcomings of the euro focus mainly on the degree to which the criteria implied by the theory of Optimum Currency Areas (OCA) (Mundell, 1961; McKinnon, 1963; Kenen, 1969) are met. This often comes down against a common monetary policy. The mobility of the factors of production across Europe, the antidote to asymmetrical demand shocks according to the OCA theory, still remain at low levels – and in any case they do not seem to have increased to the expected degree. Despite recent reforms, labour markets in the EMU are still considered to be relatively rigid. Nevertheless, those reforms are not sufficient to be viewed as a significant regime change since the introduction of the euro. Furthermore it is interesting to observe that even before the introduction of the euro, many economists were complaining that the proposed euro area was only slightly better prepared during the last decade of the run-up to its introduction (e.g. Cohen, Lefranc and Saint-Paul, 1997). The EMU fiscal stabilizer – that is, the funds going to disadvantaged regions and cohesion countries – are still less than the aid needed in order for economic activity to be restored to near full employment and the recent enlargement of the European Union (EU) only makes this constraint even tighter. It is thus argued that Europe does not fulfill the basic conditions to be an optimum currency area and the costs of a single currency, mainly output loss and high unemployment, are said to be too high to offset the benefits, at least in the short term. In terms of monetary policy such concerns are formulated around the difficulties with which the 'one-size-fits-all' policy presents the national authorities in stabilizing their economies.

Even if the criteria of the OCA theory are not met in the case of EMU, the purpose of this chapter is not to argue against the euro. Any criticism concerning the deficiencies of the single currency is only intended to lay the groundwork for future improvement by giving policy makers available options to handle adverse situations, avoiding faultlines and potential pitfalls. Moreover, as many observers believe, the new 'credibility paradigm' has shed light on aspects neglected by the OCA. According to this paradigm, devaluation is not such a flexible policy instrument as OCA implies and there are also certain limits in correcting demand disturbances occurring in an economy by using the exchange rate instrument (De Grauwe, 2000). However, it is indisputable that the 1990s bequeathed EMU countries with unacceptably high rates of unemployment and a relatively significant proportion of the population living below the poverty line. Such developments have shaken the faith in the ideal of a unified and efficient, but also a 'social EMU', such that in a number of countries the supporters of the EMU could possibly constitute a minority in the near future.

It is of cardinal importance, therefore, to diagnose some of today's problems and sources of conflicts in order to respond in a timely fashion with appropriate policies and measures that can lead to a prosperous EMU, by mitigating or anticipating adverse conditions that could spread euro-pessimism, and even undermine the process of EMU enlargement. It should also be noted that a possible failure to face the problems could also shake the ECB's efforts to establish the euro as an international vehicle currency, let alone the longer-term ambition of turning it into a reserve currency. We may recall that after all the last two decades or so the economies of the major industrialized countries have been characterized by what some central bankers call a period of 'great stability'. The sources of this stability, as Ben Bernanke (for example, 2006) has repeatedly pointed out, may be due to structural changes in the economy, better policy management or simply luck. In any case, should the period of 'great stability' come to an end (especially if it is due to the third mentioned factor) the euro area economies will be faced with even more challenging tasks.

We proceed as follows. Section 7.2 deals with the conflicts arising from the persisting asymmetry of demand shocks, possible unfavourable effects on trade and welfare, lack of national and supranational fiscal stabilizers, low mobility and flexibility of labour and shortage of money stocks for the peripheral countries. Section 7.3 discusses some problems relating to the removal of these obstacles and the pushing of the euro area to high levels of employment and economic activity. Alternative policies are also discussed. Section 7.4 summarizes and concludes.

7.2 Potential sources of conflicts

7.2.1 Asymmetry of demand disturbances

A typical theoretical result is that the asymmetry of demand disturbances in a monetary union shifts the burden of adjustment onto the country in disequilibrium. This point refers to the possibility of disagreements about the goals and methods of monetary policy which, it should be remembered, are now fully implemented by the ECB. The very first requirement to form an OCA lies in the incidence and magnitude of the idiosyncratic demand disturbances which individual countries experience, and also on the speed of adjustment (Eichengreen, 1990, 1992, 1993, 1997; Bayoumi and Eichengreen, 1992a, 1992b). For an open economy, demand disturbances depend also on foreign market fluctuations and changes in imported oil prices, assuming that foreign factors do not provoke a demand shock or, in the case that they do provoke some, that they influence countries symmetrically. Asymmetry in demand disturbances across regions and countries arise mainly from differences in the mix of products they produce. Other things being equal, the product specialization of individual countries, no matter whether it is created by factor endowments or by strategic trade policies, determines both the incidence and magnitude of demand disturbances and so it constitutes a first credible factor in deciding whether a currency area is optimum or not. Brussels officials insist on the ability of the EMU to converge structures of production within the European Union (EU) (European Economy, 1990; Emerson *et al.*, 1992). However, economic theory leaves no doubt that the deeper the market/trade integration, the higher the sectoral specialization and the division of labour (Krugman and Obstfeld, 1994).[1] Furthermore, the greater the difference in the structure of production, the greater the incidence and the magnitude of the demand shocks that individual countries and/or peripheries experience and, thus, the lower their speed of adjustment, if any, in case that the labour markets remain rigid.[2] Eichengreen (1997) provides evidence that the countries at the centre of the EMU (Germany, France, the Netherlands) experience very different supply shocks from those affecting other member states such as Italy, Portugal, Spain, Ireland and Greece.

In the case of multiple countries and currencies, governments are able to use demand management policies to tackle idiosyncratic shocks, namely succeed in adjustment by applying accommodating monetary policies and using the exchange rate instrument to correct external disequilibrium. Currency can depreciate to lower relative prices and underpin demand or it can devalue.

The greater the asymmetric shock, the higher the option value of independent domestic monetary and exchange rate policy. However, EMU, by definition, involves the sacrifice of monetary autonomy, and in the euro area authority for the implementation of a single and non-differentiated monetary policy now belongs to the European Central Bank. As economic integration proceeds and diversity of production structures deepens across Europe, a negative aggregate demand shock is expected to have different, heterogeneous impacts on member states and regions. In this case, the cost of adjustment within the euro area depends upon the size and incidence of asymmetric real shocks, as well as on the efficacy of the alternative adjustment mechanisms, namely, labour market mobility/flexibility and fiscal policies (Obstfeld, 1997). Otherwise, the country hit by a shock must deflate internally by lowering its wages, accepting unemployment and economic recession.

Empirical evidence to date has shown that asymmetries in the EMU between core and peripheral countries are persisting (Bayoumi and Eichengreen, 1992a; Bordo and Jonung 1999; Krueger, 2000; Obstfeld, 2000; Dunn, 2001) and that they coincide with non-synchronized business cycles among member states.[3] A more recent assessment which culminated in 2003 of the case for the UK joining the EMU by HM Treasury was in general agnostic. Regarding the specific issue of business-cycle synchronization, however, the assessment failed to uncover strong evidence in support of such synchronization. Therefore, as the asymmetry of demand shocks raises regional unemployment by destroying industries and jobs, there is a need for monetary accommodation (i.e. an increase in the money supply and lower interest rates) to offset fluctuations and restore growth and employment. For example, in the case where Portugal (or Greece) suffers a permanent fall in exports, output will contract and unemployment will rise as currency depreciation is excluded and wages and prices are rarely flexible enough to react to economic slumps without causing unemployment (Dunn, 2001). The possible refusal of ECB to implement an expansionary monetary policy in order to avoid recession in Portugal had some people being afraid that such an attitude may cause continuing dissatisfaction among the Portuguese and other EMU public.

On the other hand, a decision by the ECB to implement monetary accommodation by lowering the rate of interest, may cause continuing dissatisfaction among the anti-inflationary countries, such as Germany (Feldstein, 1997). Economic disagreement over monetary policy may then cause a general environment distrust among member states and, as a consequence, would very possibly bring political disputes and instability. The ECB, thus, may face pressures that cannot all be satisfied (e.g., see Frieden, 1998).

Therefore, in the case of the net real economic effect being negative, instead of increasing intra-EMU harmony, fostering stability and promoting integration furthermore, the adoption of a single currency may, according to some sceptics, more likely lead, in this case, to increased political conflicts within the EMU, with a number of adverse consequences.

7.2.2 Demand disturbances and trade

Optimistic voices emphasize that, in addition to its other benefits, the establishment of the euro also favours a further increase in the volume of trade among EMU member states and in trade dependency, thereby increasing the levels of welfare (European Community, 1990; Emerson *et al.*, 1992). Some authors' results are optimistic enough to suggest that the volume of trade may be tripled by monetary union participation (Rose and Engel, 2000). The elimination of currency fluctuations within the EMU is expected to mark the end of a period of uncertainty, which is considered to diminish both trade itself and also trade-promoting benefits (McKinnon, 1994). In addition, since the EMU member states enjoy a large volume of trade between themselves, it is to their benefit to abolish national currencies, as the exchange rate policy tool becomes inefficient in tackling unexpected real asymmetric shocks.

On the other hand free trade combined with fixed exchange rates prevent, to a large extent, governments from devising their domestic financial policy for the purpose of preserving domestic stability. With an exchange rate irrevocably fixed and the level of prices of domestically produced goods 'sticky' to an unsupportable level, the loss of competitiveness can possibly lead to a fall in exports and, as a consequence, of trade volume. This way, overall trade both within the EMU and, as a consequence, between the EMU and other trade partners may decrease in the worst-case scenario. For the weakest Mediterranean EMU countries, there may be an increase of trade balance problems in particular. In fact, external deficits for Portugal and Greece at the time that the last joined the euro area were as high (16 per cent and 14 per cent of GDP respectively)[4] as they were in 1990, and in any case higher than they were right after the implementation of convergence policies (around 12–13 per cent in 1992–93 for both countries, see Eurostat, 2001). The deterioration of the external position of the aforementioned countries might be, at least partly, attributed to a loss of competitiveness provoked in turn by a 'hard currency' convergence strategy followed during the 1990s on the road to EMU.[5]

The inefficiency of EMU mechanisms in facing the incidence and magnitude of demand disturbances under a single currency regime may impair production systems and so diminish trade particularly in lagging regions, which otherwise may be able to survive. Trade and, as a consequence, welfare may then also diminish, as an individual member state could not leave its currency free to fall in line with a fall in the value of a foreign currency, such as the dollar, in order to maintain exports. If economic growth in such weak EMU countries (or regions) keeps up with that external balance pressure, an overvalued euro is not such a problem. But if it did not, as the most possible scenario might suggest, an 'expensive' euro might cause a further loss of competitiveness, deepening the initial asymmetric shock.

Moreover, a country, which trades to a large extent with countries outside the EMU, is likely to be affected by large fluctuations in the euro–dollar exchange rate. Such countries are Greece (50 per cent trade with non-EMU countries), Ireland (64 per cent), Finland (65 per cent), while other countries, such as Austria (37 per cent), Benelux (39 per cent) and Portugal (33 per cent), are unlikely to be so affected (Eurostat, New Cronos, as in Bjorksten and Syrjanen (1999). The observed sharp differences, which exist within the EMU area, are large enough for the 'one-size-fits-all' monetary policy to be effective. Thus, the larger the differences, the greater the strains in managing the euro–dollar exchange rate and the greater the political disputes over the appropriate policy.

7.2.3 Responses to labour market rigidities

The view of many analysts is that postponing the idea of a federal, truly unified Europe deprives the EMU of the absolutely necessary, according to OCA theory, option of a strong redistribution of income among European regions and/or member states through a high(er) European budget, as a percentage of GDP. Idiosyncratic shocks, the low mobility of factors of production, stickiness of wages and prices and low levels of economic performance in the so-called peripheral EMU southern countries, seriously obstructing the accommodation of shocks by changing relative prices and costs. Cohen, Lefranc and Saint-Paul (1997) mainly place the blame on the high cost of firing workers, while Abowd, Kramarz, Lemieux and Margolis (1997) emphasize the adverse effects on jobs of a high minimum wage, which negatively affects the growth rates and, as a consequence, the creation of net new jobs. Similarly, Blanchard and Wolfers (1999) point out that labour market rigidities magnify the effects of shocks, although tight macroeconomic policies still remain the number one culprit for the high rate of unemployment in the EMU.[6]

As far as the European periphery in particular is concerned, the available data confirm the aforementioned stories. As Tables 7.1 and 7.2 show, the regulatory framework and employment protection legislation in the EMU is fairly strict by international comparison and in its periphery in particular, with the exception of Ireland. As a consequence, the economies can hardly absorb asymmetric shocks as labour market rigidities get on the way of any adjustment effort.

Tables 7.1 and 7.2 also show that labour flexibility is limited and differs from country to country within the EMU. Given that labour flexibility is a prerequisite as a channel for adjustment in a monetary union, since the exchange rate instrument can no longer serve as an adjustment mechanism, labour unions are expected to react forcefully against any liberalization measures. As Alesina, Spolaore and Wacziarg (1997) correctly emphasize, rather

Table 7.1 Strictness of employment protection legislation (EPL) by international comparisons: qualitative indices

Countries	*Regular & temporary contracts EPL**	
	1990	*1998*
USA	0.2	0.2
Japan	2.9	2.6
Germany	3.6	2.8
France	2.7	3.1
Italy	4.2	3.3
UK	0.5	0.5
Canada	0.6	0.6
Greece	3.6	3.5
Ireland	1.0	1.0
Portugal	4.2	3.7
Spain	3.7	3.2

Note:
* The index EPL ranges from 0 to 6 with higher values representing stricter regulations (OECD, 2001).

Table 7.2 Strictness of employment protection legislation (EPL) by international comparisons: qualitative indices

*Total tax wedge**		*Employer's** social security contributions*		*Net replacement rate****	
1996		1996		1997	
FI	50.3	FI	20.5	FI	103
BE	48.2	BE	25.8	BE	72.0
GE	35.0	GE	16.8	GE	80.0
FR	45.4	FR	30.2	FR	84.0
IT	48.3	IT	31.7	IT	11.0
NL	39.9	NL	7.6	NL	82.0
AT	37.3	AT	19.6	AT	69.0
LU	22.7	LU	11.7	LU	91.0
IR	29.9	IR	10.7	IR	64.0
PT	30.9	PT	19.2	PT	77.0
SP	33.5	SP	23.5	SP	67.0

Notes:
* % of gross labour costs for average production workers. Includes income taxes, employer and employee social security contributions; ** % of gross labour costs for average production workers; *** % of the average earnings of a production worker in the 12th month of unemployment benefit receipt.
Source: OECD data from Bjorksten and Syrjanen (1999).

than alleviating the situation, this may aggravate social tensions and increase political conflict both within and across countries.

As far as the antidote of labour migration – the shorthand for labour market flexibility – is concerned, labour flows of EU nationals remain quite low, around 0.1–0.2 per cent of the destination countries' population (SOPEMI, 1998; Krueger, 2000). Indeed, net EMU-national and non-EMU national migration to EMU has been sharply curtailed since the inauguration of the internal market. The existing social, cultural and language barriers that contribute significantly to the low propensity of workers to migrate away from countries and regions where unemployment exceeds the local natural rate (Obstfeld and Peri, 1998) operate similarly within each country.[7] Krueger (2000) presents evidence confirming that region-to-region migration is more than twice as high in the US as in many European countries and so EU unemployment cannot be solved by immigration. The US absorbs asymmetric shocks by migration while the EU does so by a reduction in the labour force participation rate.[8] It is evident that, in the case of the EMU, labour does not migrate if one member state or region flounders. Under conditions of rigid labour markets, cyclical unemployment turns into structural unemployment.

A generous increase of the EMU budget could partly offset labour market rigidities. At the time of writing, the EMU budget represents only 1.27 per cent of the EMU area's combined GDP, a much lower share than what the Commission itself has proposed in the past (5–7 per cent of GDP) to moderate idiosyncratic business cycles.[9] In the US, the federal budget is four times higher than even those past EMU proposals. Through transferring tax revenues to disadvantaged regions (i.e. federal states), the government subsidizes them through automatic fiscal stabilizers that function as an effective insurance against economic shocks (Sala-i-Martin and Sachs, 1991; Bayoumi and Masson, 1995). The federal government absorbs between one third and one half of each dollar of an asymmetric regional disturbance by reducing tax receipts and by transferring extra-money to the regions, which suffer a shock. That is a government policy with high redistribution and stabilization effects.

In the EMU, the corresponding effects are almost negligible, providing only one half of one per cent reduction per dollar in taxes in the event of an economic shock. As wage flexibility is low, price adjustments very slow and migration limited, demand disturbances are expected to have a severe adverse economic impact on any shock-stricken EMU regions unless a 'generous' 'Brussels budget' did the job of compensating those regions.[10]

In addition, under Maastricht and Amsterdam fiscal restraints, the EMU member states could not have the possibility to use domestic stabilization mechanisms, namely the national fiscal stabilizer (Bayoumi and Eichengreen, 1994a, 1994b). An EMU 'generous' budget, which is today excluded from the whole project, could have alleviated unemployment and regional inequalities, by redistributing fiscal resources to the floundering member states and/or regions. This could be done either with an automatic consequence of a progressive tax and social security system. The redistribution acts as a stabilizer with negative shocks, leading to lower taxation and higher security payments in the region that is adversely affected (Arestis, McCauley and Sawyer, 2001), or even by establishing a central fiscal policy-making authority (Bordo and Jonung, 1999). Without such kind of policy measures, economic prosperity and political stability across Europe might be called into question.

7.2.4 Shortage of money stocks for the peripheral countries

We may assume that member state A experiences a positive demand shock while another member state, B, experiences a negative one. Such shocks may reflect shifts in the preferences of consumers from outside the euro area and therefore changes in the demand for and prices of the given countries' products in international good markets. This is very much the original argument of Mundell (1961). Country's B trade balance will deteriorate and present a deficit while country A's will present a surplus. Let it be assumed that country B is Portugal or Greece and country A is Germany. In this case, Portugal's currency stock will decline as it finances its deficit in the trade balance. As a result, money stock in country A (Germany) increases and its interest rate declines while money stock in Portugal decreases and its interest rate increases. The symmetrical adjustment that takes place is unfavourable for Portugal as it is forced to reduce money supply and accept a permanent recession. The symmetric system could evolve to an asymmetric one, as Germany may absorb the extra inflows by selling government bonds in the money market to avoid an unexpected surge of inflation. It is worth mentioning that Portugal needs extra growth rates in order to reach the average living standards within the EMU region. Assuming that peripheral countries are more vulnerable to shocks due to lower productivity levels, a predominance of traditional sectors, less skilled human capital, and so on, and taking into account that Community money will dry up in the near future, the single currency may bring economic insecurity for weak and vulnerable member states such as Portugal or Greece.

Asymmetry is further enhanced by the variation of monetary transmission mechanisms across the euro area. Countries with a higher reliance on short-term bank credit (the Southern EMU group) would be affected more strongly and rapidly by interest-rate changes than those economies (such as Germany, Belgium, Austria and the Netherlands) that rely more heavily on longer-term finance (Ramaswamy and Sloek 1997).

7.2.5 External imbalances

A large number of theoretical models postulate a causal relationship between shifts in real exchange rates and current account (CA) imbalances. Arghyrou and Chortareas (2006) test this relationship within the EMU area and find it to be substantial in size and subject to non-linear effects. Their analysis identifies two groups of EMU countries since the abolition of European national currencies in 1999: those presenting consistent RER depreciation leading to CA improvement; and those in which appreciation-deterioration are systematically observed. These groups largely correspond to those previous research had identified as respectively belonging to and not belonging to a European Optimum Currency Area. Such findings validate the theoretical arguments concerning the potential costs of participating in a monetary union; suggest that meeting the nominal convergence criteria has come, in some countries, at the cost of growing CA imbalances; and pose important policy-response questions for both national authorities and the ECB. This type of results leads the authors to wonder if in order to avoid further destabilizing polarization within the EMU, it may be optimal for the newly acceding EU countries to supplement the nominal EMU accession criteria with an additional one referring to the balance of the current account. The main focus of the Maastricht criteria is on nominal variables. An effort to meet such criteria can put some strain on other aspects of economic performance and such strains may be reflected in the current account imbalances, which may act as a carpet under which a number of other real imbalances have been swept. According to Arghyrou and Chortareas (2006), more attention has to be paid to the current account position of the accession countries at the time that they join the EMU. At the same time, a number of reforms that enhance factor mobility within the euro area need to proceed faster so that they can allow the economy to adjust more easily. It should be noted that such imbalances are, to some extent, unavoidable given that a number of countries within the euro area are catching up with their more economically advanced partners. From an intertemporal point of view, the faster economic growth in the catching-up countries implies more wealth in the future periods so savings decline while at the same time new investment opportunities emerge. This intensifies the savings–investment imbalance, which is reflected in the current account. Such considerations make Blanchard and Giavazzi (2002) to question the relevance of Feldstein–Horioka in the euro area.

7.3 Are the existing strategies sufficient?

7.3.1 The sceptical view

We begin this section by considering the sceptical view. This is based on the theory of the Optimum Currency Area (OCA), and a focus on the mediocrity of the treaties of Maastricht and Amsterdam where emphasis is exclusively on controlling inflation and reducing public deficits rather than on growth and employment. However, the majority of the authors in the relevant literature, instead of blaming economic policies implemented since 1992, attribute the European disease of unemployment, and the consequent loss of production, to factors such as technology, 'globalization', labour market rigidities and the usual unfounded assumption of generous European welfare states. More specifically, an influential section of academic and political opinion places the blame on three factors:

(a) the nature of the new technologies and, more generally, the new type of development described as 'jobless growth'. Some economists view the unemployment problem as a result of skilled-biased technological change in particular (Lawrence, 1994; Krugman and Obstfeld, 1995; Baldwin and Cain, 1997). It is argued that there is a shift in the demand for skilled workers within industries, which can be explained by skill-biased technological change. As a result, there is a decline in relative wages of the least educated workers, along with increased unemployment of these workers and of the low-skilled in particular.

(b) the inflexibility of the EMU labour market, the high living standards of EMU working people, welfare programmes and firing costs (Bean 1994); and above all high wages, both direct and indirect (in the form of social expenditure). Many of these inflexibilities have to do with institutional regulations (Wyplosz 1997) and are understood as the outcome of political influence by incumbent employees ('insiders'). According to this view, labour market rigidities allow 'insiders' to achieve indirect monopoly power in wage setting. Thus, unemployment levels are considered as a direct result of the powerful political influences exerted by people who already have jobs (Saint-Paul Gilles, 1996, 1997). Conventional wisdom also mentions employment protection legislation and generous welfare benefits in Europe, which preserve rigidities and slow response of wages and prices to demand disturbances and thereby increase unemployment.

(c) the increase of international trade and intensification of international competition, in other words, the effects of the 'globalization'. It is claimed that the imports of products from developing countries with low labour costs undermine the international competitiveness of European products (Wood 1995). As a result, industries close down and unemployment rises, especially that of least educated workers (Baldwin and Cain 1997).

These views, however, cannot be helpful in that they identify problems rather than offering solutions. There are, of course, policy implications, which are either impracticable or of a long-term nature. More short-term policies are paramount and the rest of this section attempts to put forward a number of such policies.

7.3.2 Alternative policies

Relaxation of monetary policy would reduce the level of real interest rates and, therefore, the cost of debt servicing. This would lead to a corresponding increase in the real rate of investment growth and GDP, so that drastic expenditure cuts and high primary fiscal surpluses (i.e. pro-cyclical economic policies), which merely undermine economic development, would no longer be viewed as necessary. Tax revenues would rise following the expansion of the tax base and real GDP could begin to approximate the 'potential output', that is, the 'expanded product' that would be available if we made full use of the forces of production currently being restrained and depressed. This would moderate the level of unemployment, strengthen the balance of current accounts, and stabilize the national currencies in the money markets. By contrast, as long as inflation and the public deficit are dealt with through further cutbacks in consumption and expenditure, the cost of restraining price rises and reducing indebtedness will grow ever more disadvantageous in terms of unemployment, lost output and, ultimately, the process of convergence.

The logic of the 'Stability Accord', decided upon in Dublin (December 1996) and ratified in Amsterdam (June 1997), in effect bans, with the force of police ordinances, any exercise of anti-cyclical economic policy and in its place institutes an absurd dialogue on the place of decimal points in the fiscal deficits.

Further possibilities suggest themselves. One of these is to leave each country to spend on the primary determinants of growth – that is infrastructure, public welfare, services and compensatory measures protecting vulnerable groups – without counting these expenditures within the deficit.[11] Another idea is for the EMU to issue bonds and allow the ECB to buy them. This way, total expenditure that is now feeble will be increased and demand that is now flat will be amplified in the euro area, respecting, at the same time, the 3 per cent sacred budget deficit limit at a member-state level. A third idea could be to allow fiscal stabilizers to operate fully without any limits, and leave member states to decide whether there is any need for further discretionary fiscal expansion. The aforementioned fiscal measures could be combined with some monetary easing by the ECB, as there is plenty of room for an interest rate cut well below today's rate of 2.50 per cent. A rate cut could help to boost exports by weakening the euro and could also expand credit, bolstering private spending and, as a consequence, total demand. In any case, one thing is certain: the rigid 'pact' does not leave enough room for budget deficits to widen enough to fight a recession. In this context, it is worth referring to the proposal of Eichengreen (1997) to transfer funds on the basis of unemployment differentials. Assuming that transfers are capped once the change in unemployment differentials reaches two percentage points, this proposal would require adding to the EMU budget no more than 0.25 per cent of the EMU budget. It is estimated that this project, if applied properly, could compensate about 20 per cent of a region's relative income, after a temporary decline.

7.4 Summary and conclusions

The argument of this chapter may be briefly summarized. In the presence of national asymmetric real shocks, cultural stresses and possible political disputes over policy priorities, the EMU would have to elaborate specific, differentiated and flexible responses both at the euro area level and also at the national level. Taking into account the EMU enlargement and given that most of the Eastern European countries are far behind both in productivity levels and in standards of living, asymmetric shocks are clearly on the cards.[12] A 'broad' Union is now even more vulnerable to demand disturbances and, so, disputes regarding the economic policy mix are expected to appear. Henceforth, the question that arises concerns the appropriate strategy for riding out real peripheral shocks.[13] We have attempted to elaborate on some of the features of such strategy in the final section of this contribution.

Notes

1 Although there has been a common sectoral shift in EU employment towards the service sector, employment in agriculture remains significantly higher in the peripheral EU member states. In manufacturing, employment in Germany, France, UK and Italy is in double-digit numbers (Germany around 30 per cent of total employment) while in Greece, Portugal, Ireland, Denmark, Luxembourg and Belgium employment in manufacturing is around 1–3 per cent (Eurostat Yearbook, 2001). The differences in production structures are, thus, evident and on this ground, member-states are expected to hit by differential shocks.

2 McKinnon (2000) mentions that the composition of output varies from one country to the next, leading member states to experience terms-of-trade shocks differentially. So, the loss of domestic monetary control is expected to make macroeconomic shocks more asymmetric.

3 We may consider GDP growth in a few EMU countries in the year 1999, for example: Ireland 9.80 per cent, Luxembourg 4.0 per cent, Italy 1.40 per cent, Germany 1.60 per cent (Eurostat, 2001). Those different business cycles could be at least partly interpreted as a result of the presence of idiosyncratic shocks, which certainly did not produce the same rate of output growth in all countries and regions.

4 Similarly, Spain's external deficit has worsened from −2.8 per cent of GDP in 1993 to −6.2 per cent in 2000.

5 In addition, Greece's exports to the EU countries had decreased from 60.6 per cent in 1995 to 43.6 per cent in 2000. Therefore, along with the relative decrease of exports, there exists some evidence of trade diversion with the EU member states. It is also worth mentioning that Greece's trade balance deficit has only deteriorated since this time.

6 Peri and Obstfeld (1997), focusing on Italy and Germany, show that regional price-level reactions do little to speed the adjustment to demand disturbances. On the impact of tight macroeconomic policies on the EU unemployment rate see Pelagidis (1998a, 1998b, 1999).

7 For relevant statistical date see Obstfeld and Peri (1998: 12). Alesina, Peroti and Spolaore (1995) also argue that labour mobility in the EU has high utility costs. That means that cultural and linguistic differences make the European currency union very costly and that the optimal size of member states is a function of cultural and linguistic homogeneity.

8 Differences in part-time employment among member states have also contributed to high unemployment in selective EMU countries. Part-time employed as a

percentage of total employment ranges from 39.4 per cent in Netherlands to 6.1 per cent in Greece (Eurostat, 2001). The percentage of persons usually working on Saturday, Sunday, at night or doing shiftwork vary also across member states (from 18.9 per cent in Italy and 16.1 per cent in Austria, to Denmark 7.2 per cent and Portugal 7.9 per cent) (Eurostat, 2001).

9 De Grauwe (2001) agrees that the Community budget is too small to constitute the backbone of risk sharing at the EMU level although he himself recognizes that risk sharing is essential for maintaining cohesion. He, instead, proposes the building of institutions capable of implementing risk sharing through the full integration of financial markets. However, Rose and Engel (2000) find little statistical evidence that international risk sharing is enhanced by membership in a currency union.

10 Obstfeld (1997) argues that a fiscal system favouring regional cohesion interacts with a rigid labour market to discourage mobility. However, as argued in this paper, national fiscal policies across member states are too contractionary to cushion the country or regional downs. In addition, Community Framework Programs are too little to have significant stabilization effects. Therefore, despite the lack of fiscal automatic stabilizers, flexibility of wages and mobility of labour remain at very low levels. As a consequence, it cannot be sustained that there exists a trade-off between labour mobility/flexibility and fiscal stabilization policies.

11 On the benefits of public investment and the process with which public investments through deficit spending promise society the higher rate of return on public sector capital and a correspondingly loftier rate of economic growth, see Aschauer (1998).

12 The differences in productivity among the EMU member states are quite sharp, so that with EU = 1.00, we have: Belgium 1.2, France 1.20, Denmark 1.18, Germany 1.15 and Greece 0.56 and Portugal 0.43. The prospect of enlargement will widen the gap between the developed 'north' and the 'poor south and east', magnifying further the economic and political impacts (European Commission, 1999, from Boldrin and Canova (2000).

13 Alesina, Spolaore and Wacziarg (1997) argue that as trade globalization deepens, the original motivation of a large country to join a Currency Union becomes less important. Large countries normally enjoy the advantages of 'being big', including economies of scale. Under trade globalization Alesina, Spolaore and Wacziarg (1997) argue that one country has no more any incentive to proceed to political integration as it can trade and become economically integrated with the rest of the world. In this context, Alesina, Spolaore and Wacziarg (1997) observe that economic integration goes hand-in-hand with political separatism and not with political integration, as is the case of the EU.

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8

Alternative Fiscal Policy Rules and the Stabilization Problem in EMU: Theory and Simulations

Jorge Uxó and M. Jesús Arroyo

8.1 Objectives and general approach

For European countries, having relinquished their monetary policy autonomy and the possibility of modifying bilateral nominal exchange rates, monetary union has represented a redefinition of the principal instruments associated with stabilization. This has given rise to the *problem of the possible loss of stabilization capacity by EMU economies*.

Indeed, if all these economies experience the same shock (for example, a global deceleration), the single monetary policy could react to bring about a rapid return to equilibrium. The problem arises, however, when the shock is asymmetric: if it only affects some economies, there would be no reaction by the monetary authority (the function of which is to monitor the average economic situation) and the countries in question would take longer to return to normal, generating costs in terms of both employment and income.

This problem is more than a mere theoretical possibility. The empirical studies conducted to test the likelihood of European economies experiencing specific or asymmetric shocks show that such situations cannot be ruled out altogether.[1] And, as Figure 8.1 shows, although the inflation differentials between the member states decreased in the years prior to the establishment of the EMU, this trend ceased in 1999 and there has even been a recent increase in inflation dispersion.[2] There is not even a declining trend in output gap dispersion (Figure 8.2).

Indeed, the problem lies not only in the fact that the nominal interest rate established by the ECB may be inappropriate for all the countries if they are in different cyclical positions, but that, as a result, the *real interest rate* may have a destabilizing effect. The IMF (2004) considers this question, concluding that a change in a country's output gap does not give rise to a change in its real interest rate, in the desired direction, but tends to cause greater disequilibria.

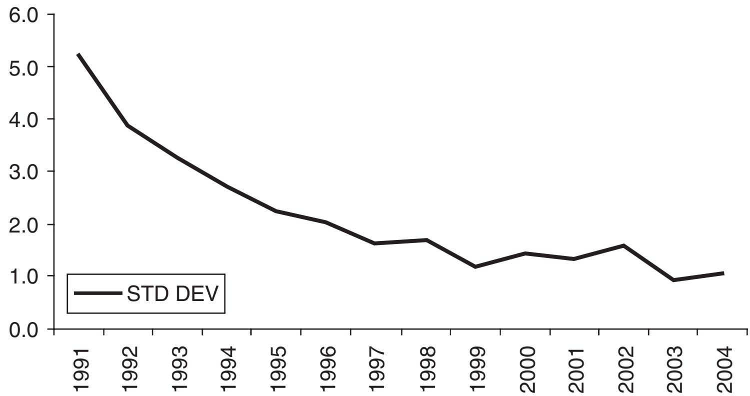

Figure 8.1 Inflation rate dispersion, EMU countries
Source: EUROSTAT.

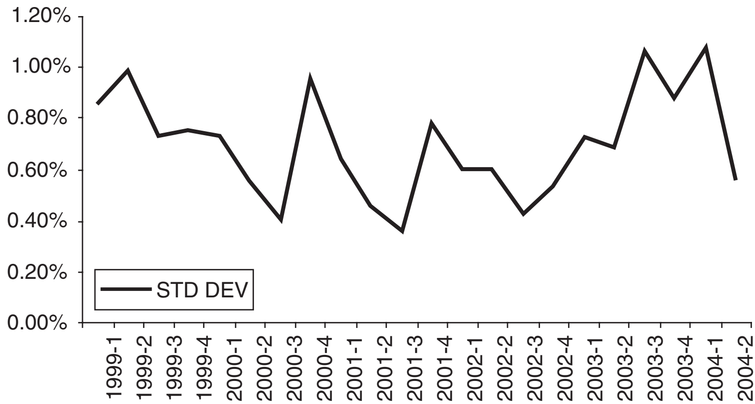

Figure 8.2 Output gap dispersion, EMU countries
Source: EUROSTAT.

> The effect [of the national output gap] on real interest rates has tended to be procyclical, with rising inflation in booming economies, especially Ireland, the Netherlands and Portugal, leading to lower real interest rates, stimulating domestic demand even further. Similarly, in countries experiencing protracted downturns, such as Germany, falling inflation tended to result in relatively high real rates.

These costs, of course, would be lower if monetary union economies had *alternative adjustment mechanisms other than monetary policy*, among which traditional Optimal Monetary Area theory focuses on flexible salaries and geographic mobility. Empirical studies, however, also show that such mechanisms are weak in European economies and that it would be difficult to increase their efficacy in the short term.[3]

In our case, we pay special attention to the stabilization mechanism based on the effect that inflation differentials within the EMU have on the *real exchange rate*. If a country experiences a specific shock, and its inflation rate is no longer the same as that of the union (for instance, being somewhat higher), the resulting variation in the real exchange rate will act as a stabilization mechanism (in this case, the resulting real appreciation would decrease exports to the rest of the EMU, reduce income and, ultimately, moderate inflationary tension).

If it is strong enough, this mechanism will compensate for the lack of an independent monetary policy. However, it may not be strong enough to ensure the stabilization of national economies subject to asymmetric shocks, or to do so quickly enough. Returning to the IMF (2004), it says that

> the effect of inflation differentials on external competitiveness should be stabilising, since higher inflation leads to real appreciation (and vice versa). In practice, however, the stabilising effect of inflation differentials through this channel does not seem to have been particularly strong, although in the specific case of booming countries confronted with declining real interest rates, the real exchange response appears to have increased since EMU was adopted.

Therefore, if this adjustment mechanism proves to be too weak, economic policy should be capable of providing an alternative mechanism enabling national authorities to recover this stabilization capacity. We here consider the possibility of a more active fiscal policy performing this function.

Specifically, our primary objective is to *use a monetary union model to formally analyse whether the introduction of appropriate activist fiscal policy rules could enhance the stabilization capacity of national economies in the EMU*.

Our *basic model* is based on prior work by Galí (1998), Romer (2000) and Aarle, Garretsen and Huart (2004), and comprises two economies (country 1 and country 2) which experience specific supply and demand shocks and have different stabilization policy instruments. One of its prime features is the use of different *rules* to systematize the behaviour of monetary and fiscal authorities. This expression is used here in the sense of the authorities' *reaction function*, and each rule is represented by a simple equation establishing the value that they establish for the economic policy instrument concerned. They are *activist rules* because this value will change according to the evolution of certain variables which are selected as indicators of the state of the economy.

Each monetary policy rule/fiscal policy rule combination will be classified as an *economic policy regime*, and the primary objective is to conclude which of them provides greater stabilization capacity if one of the economies experiences a specific shock.

We shall specifically distinguish the following possible regimes:

1. *Regime I* The two countries apply their monetary policy independently, in both cases following a Taylor Rule.[4] No fiscal policies are implemented. This case would be a simplified representation of the situation before EMU, and is basically used for comparison purposes with the following cases. We will therefore only consider this regime as a starting point for this analysis, and not at one of the possible economic policy options.
2. *Regime II* The two economies form a monetary union and create the ECB, which controls interest rates following the same Taylor rule, but now considering mean inflation values and the output gap. No fiscal policy is implemented, so a comparison between this and the previous case will reveal the costs derived from the establishment of the monetary union in terms of the loss of stabilization capacity.[5]
3. *Regime III* As before, monetary policy is applied by the ECB, but each of the two countries now has an independent fiscal policy, which is applied according to the evolution of some national variables. In this specific regime, the total budgetary balance only deviates from its long-term objective according to changes in the output gap.
4. *Regime IV* This is similar to the previous case, but the fiscal policy rule not only includes the output gap, but also inflation, replicating the Taylor rule applied by the ECB.

As we will see, in Regime I (before the monetary union is formed), if a country experiences a shock the economy will return to the same equilibrium, characterized by the inflation rate targeted by the central bank and potential income. Therefore, the *criterion for deciding whether or not the economy's stabilization capacity grows* in the other three alternative economic policy regimes would be to compare them with this case: it will have suffered if, after the same shock, the economy does not return to equilibrium, or if it takes longer to do so.

The answer to this question will be revealed by a formal analysis of our model. Furthermore, to illustrate the explanation of the processes occurring in each case, we will use *simulation* of the model for different possible values of its parameters. These simulations will be presented in graph form throughout the text.

The chapter is organized as follows. In section 8.2, we discuss the degree to which the formation of the EMU actually reduces the stabilization capacity of the two economies, analysing the model's dynamic properties after a shock. In section 8.3, we will see how the introduction of each of the two fiscal policy rules corrects this problem. Finally, section 8.4 contains our principal conclusions and economic policy recommendations.

8.2 What stabilization capacity is lost when monetary policy is transferred to a single central bank?

Our objective is to show formally that the creation of a monetary union between two countries, thus transferring monetary policy to a single central bank, substantially changes the way in which each of the two economies adjusts to a shock affecting one of them. If we understand the mechanisms involved in this process, we will be better able to justify and compare the effect of the different fiscal policy rules proposed.

We start with an initial equilibrium in which the two economies are at their potential income levels and the inflation rate is that established by the two central banks as the objective of their monetary policy (2 per cent). In this situation, we assume that, in a given period, country 1 suffers a supply shock[6] which increases its inflation rate, and we analyse the dynamic evolution of the two economies from that point, comparing a situation in which they each have their own central bank and another in which monetary policy is centralized.

8.2.1 Regime I: analysis of a supply shock with independent monetary policies

Although in this case the two countries have their own independent monetary policies, applied by their central banks, each economy is affected to a certain extent by the shocks and monetary policy decisions of the other, through trade. Specifically, this spillover effect occurs through variations in the real exchange rate, affecting the competitiveness of both countries: if inflation in country 1 is higher than in country 2, or the currency of country 1 nominally appreciates, there will be income growth in country 2.

We will use the following equations to determine the evolution of inflation and the output gap in the two countries:

$$\dot{P}1_t = \dot{P}1_{t-1} + aOG1_{t-1} + z1_t \tag{8.1}$$

$$OG1_t = -c(r1_t - \bar{r}) - d\dot{RE}_t + g1_t \tag{8.2}$$

$$i1_t = \bar{r} + \dot{P}1_t + \beta(\dot{P}1_t - \dot{P}^{OBJ}) + \gamma OG1_t \tag{8.3}$$

$$r1_t = i1_t - \dot{P}1_t \tag{8.4}$$

$$\dot{P}2_t = \dot{P}2_{t-1} + aOG2_{t-1} + z2_t \tag{8.5}$$

$$OG2_t = -c(r2_t - \bar{r}) + d\dot{RE}_t + g2_t \tag{8.6}$$

$$i2_t = \bar{r} + \dot{P}2_t + \beta(\dot{P}2_t - \dot{P}^{OBJ}) + \gamma\, OG2_t \tag{8.7}$$

$$r2_t = i2_t - \dot{P}2_t \tag{8.8}$$

$$RE_t = \frac{E_t P1_t}{P2_t} \tag{8.9}$$

$$\dot{E}_t = i1_t - i2_t \tag{8.10}$$

Numbers 1 and 2 represent the two economies under consideration. All the parameters are positive and, to simplify, we assume that their value is identical in both countries. This means that there are no structural differences between them, enabling us to isolate the effect of specific shocks in one country on the evolution of macroeconomic variables, our primary interest. For the same reason, we assume that the monetary policy applied by the two central banks follows the same rule, with identical coefficients, although they differ insofar as each of them targets the evolution of its own national variables.

Equations (8.1) and (8.5) show the change in inflation during period t in each of the two economies, where $\dot{p}$ is the rate of inflation, OG the output gap, or percentage deviation of income in relation to its long-term equilibrium level, and z a random variable with zero mean and known variance which represents possible inflationary shocks originating on the supply side of the economy. According to this equation, which can be identified with *accelerationist theory*, if there are no supply shocks the inflation rate remains constant when the economy is at full potential, whereas income deviations from its equilibrium value cause price accelerations (if $OG > 0$) or decelerations (if $OG < 0$). This effect of the output gap on inflation occurs with a delay of one period, meaning that the possible variations in aggregate demand (due to the effect of monetary policy or any other shock, affecting consumer demand for instance) first lead to income variations and only later to changes in inflation.[7] Parameter a represents this effect of the percentage deviation of income from its potential value, on inflation.

Equations (8.2) and (8.6) represent an *IS line* for each of the economies. The level of aggregate demand, and therefore income and the output gap, depend negatively on the value of the real interest rate (r). Let $\bar{r}$ be the real equilibrium interest rate, defined as corresponding to potential income, and let c be the parameter measuring the effect on the output gap of the deviations of the real interest rate from that value.

The effect on one country's income of its trade with the other country is also shown through the variations in the real exchange rate (RE). The magnitude of this effect is determined by parameter d.

In this respect, we define the nominal exchange rate (E) as the number of currency units of country 2 which are equivalent to one unit of the national currency of country 1. Therefore, as equation (8.9) shows, country 1 would suffer a loss of *competitiveness* (real appreciation) if the nominal exchange rate rises or if its inflation rate is higher than that of country 2.[8] Passing this equation (8.9) to growth rates, and replacing it in (8.2) and (8.6) gives us the following:

$$OG1_t = -c(r1_t - \bar{r}) - d(\dot{E}_t + \dot{P}1_t - \dot{P}2_t) + g1_t \tag{8.2b}$$

$$OG2_t = -c(r2_t - \bar{r}) + d(\dot{E}_t + \dot{P}1_t - \dot{P}2_t) + g2_t \tag{8.6b}$$

As for the evolution of the nominal exchange rate, we assume that it is flexible and that it varies according to the differences between the two economies' nominal interests rates (i), as shown in equation (8.10).

In equations (8.2b) and (8.6b), g is a random variable with zero mean and known variance representing the possible demand shocks suffered by the economy at each moment in time.[9]

The model is completed with the determination of interest rates. Equations (8.3) and (8.7) represent the monetary policy applied by each of the central banks to stabilize the country's inflation at around the established target and national income at its potential level. They follow a *Taylor Rule*, and both the real equilibrium interest rate and target inflation rate are the same for both countries. The same occurs with the value of parameters β and γ, representing the reaction of the central banks to the evolution of inflation and the output gap, respectively. Finally, equations (8.4) and (8.8) determine the real interest rate in each country.

Using the terminology coined by Romer (2000), from these equations we can obtain the *aggregate demand equation*, in which the inflation rate[10] and the value of the output gap in the same period are related. Specifically, the aggregate demand curve for country 1 can be obtained by substituting (8.10), (8.4) and (8.3) in (8.2b), and for country 2 by substituting (8.10), (8.8) and (8.7) in (8.6b):

$$OG1_t = \frac{-c\beta(\dot{P}1_t - \dot{P}^{OBJ}) - d(2+\beta)(\dot{P}1_t - \dot{P}2_t) + d\gamma OG2_t + g1_t}{1 + \gamma(c+d)} \tag{8.11}$$

$$OG2_t = \frac{-c\beta(\dot{P}2_t - \dot{P}^{OBJ}) - d(2+\beta)(\dot{P}2_t - \dot{P}1_t) + d\gamma OG1_t + g2_t}{1 + \gamma(c+d)} \tag{8.12}$$

From these equations, we see that, if the situation of the other country is taken as given, the relation established in each economy between its inflation rate and the value of its output gap in a period is derived from two principal effects:

- *Real interest rate effect* When the rate of inflation is above the target established by the central bank, it will increase the real interest rate in an attempt to neutralize inflationist trends by cooling down the economy. A measurement of this effect on the output gap is given by quotient $\frac{-c\beta}{1+\gamma(c+d)}$, which has a negative sign.[11] In other words, as was to be expected, monetary policy helps to stabilise inflation.

- *Real exchange rate effect* If, moreover, the rate of inflation in country 1 is greater than the rate of inflation in country 2, there would be a loss of competitiveness in the inflationist country which would also help to moderate its aggregate demand, and therefore to dampen its inflationist tensions. This second effect on the output gap is given by quotient $\frac{-d(2+\beta)}{1+\gamma(c+d)}$, which also always has a negative sign, again helping to stabilize the economy.

The total effect, therefore, is as required for the economy to become stable at its target inflation rate. In our case, if we start with an equilibrium situation and rises in inflation, both the increase in the real interest rate and real appreciation will lead to a fall in aggregate demand; the subsequent negative output gap would cause a fall in inflation, which would thus approach the desired value. This result is important, because it shows that *for the model to be stable, the slope of the aggregate demand curve must be negative*,[12] and this may not be the case for certain combinations of the value of the parameters in the other economic policy regimes we will be analysing.

The above analysis, however, is still incomplete, because we have assumed a constant situation in the second country, but the variations in the real exchange rate will also affect this economy. For example, in the case we are analysing, the economy of country 2 will experience an expansionary impact on its income as a result of its real depreciation and this will drive up its inflation rate. This will partly moderate[13] the stabilization of the economy of country 1 after suffering the supply, although it will not be completely eliminated. We can see this is we substitute expression (8.12) of the output gap of country 2 in our aggregate demand curve, when we now obtain a new, more complete aggregate demand curve which includes the effects of the changes occurring in country 2:

$$OG1_t = \frac{\begin{array}{c}-c\beta(\dot{P}1_t - \dot{P}^{OBJ}) - d(2+\beta)(1-L)(\dot{P}1_t - \dot{P}2_t)\\ -c\beta L(\dot{P}2_t - \dot{P}^{OBJ}) + g1_t + Lg2_t\end{array}}{1+\gamma[c+d(1-L)]} \tag{8.13}$$

where:

$$L = \frac{d\gamma}{1+\gamma(c+d)} \tag{8.14}$$

The slope of this curve, now we have considered all the effects, continues to be *negative*, since the *real interest rate and real exchange rate effects are strengthened, giving rise to a reduction in the output gap which tends to moderate the*

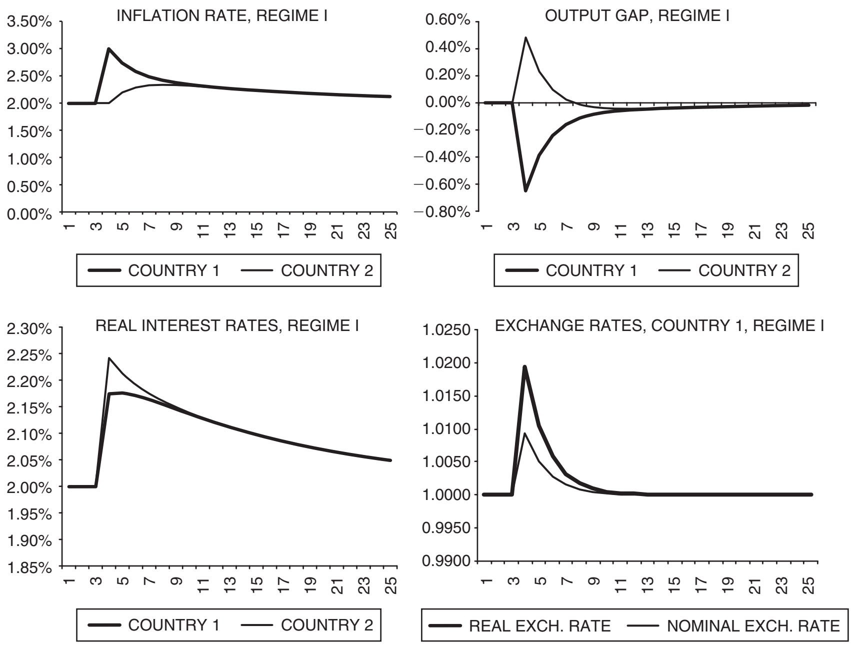

Figure 8.3 Supply shock in one of the EMU economies (Regime I, c = 0,4; d = 0,3)
Source: Authors.

inflation rate and help the economy to approach its initial equilibrium situation:[14]

$$\frac{\Delta OG1_t}{\Delta \dot{P}1_t} = \frac{-c\beta - d(2+\beta)(1-L)}{1+\gamma[c+d(1-L)]} < 0 \qquad (8.15)$$

8.2.2 Value of the parameters and simulation of the model

To illustrate this case better, we have simulated the dynamic evolution of the model's principal variables, based on an initial equilibrium situation and assuming that there is a 1 per cent inflationary shock in country 1. This simulation is shown in Figure 8.3, but before explaining its results, we need to justify the values we have given to the model's parameters (Table 8.1) and the consequences that a change in these values would have for our analysis. We therefore divide the parameters into three groups:

- *Monetary policy rule parameters* We start by including here the change in the nominal interest rate introduced by the central banks when inflation moves off target (β) and when income is at other than its potential value (γ). In both cases, we have given these parameters the value originally

Table 8.1 Value of the model's parameters

Parameter	*Simulated values*
a (response of inflation to output gap)	0.4
c (response of output gap to real interest rate)	0.4
d (response of output gap to real exchange rate)	0.1; 0.2; 0.3
β (response of nominal interest rate to inflation)	0.5
γ (response of nominal interest rate to output gap)	0.5
Equilibrium real interest rate (%)	2
Target inflation rate (%)	2

proposed in Taylor (1993). A change in these parameters, at least over a reasonable period, would not alter the dynamic results of this chapter, although it would affect the speed with which each economy reaches equilibrium. We have also given the equilibrium interest rate the same value as Taylor, 2 per cent, and the inflation target is also established at 2 per cent.

- *Parameters measuring the effect of stabilizing mechanisms on income* These are parameter c, which measures the response of income to a change in the real interest rate, and parameter d, which measures the response of income to changes in the real exchange rate. Their relative value is particularly important because, as we shall see formally later, it will determine whether the economies return to equilibrium or not after a shock. We have therefore established a fixed value for parameter c and later in the chapter we will analyse the sensitivity of our results to changes in parameter d, repeating the simulations with different values.

  With regards to the specific values chosen, we have based them on the calibration performed by Galí (1998) and Aarle, Garretsen and Huart (2004) of models with equations very similar to ours. According to these papers, both parameters will have less than unit values, and a reasonable value for c could be 0.4. However, we insist that should this value change, it would be important to know its value in relation to parameter d. The choice of this value, therefore, does not condition our results, which will always depend on the ratio between c and d.
- *Other structural parameters* The last parameter to be analysed measures the acceleration in inflation when income is at other than its potential level. As in the previous case, based on Galí (1998) and Aarle, Garretsen and Huart (2004), it has been given a value of 0.4. If this parameter were to change value it would not alter the dynamic analysed qualitatively (in particular, the model's stability conditions would be the same) but quantitatively, in the sense that it would change the speed with which, if applicable, equilibrium is reached. But our general conclusions would remain unaltered because the change would be homogeneous in the four economic policy regimes considered.

Having justified the choice of parameter values,[15] we can see that, after the initial shock, the monetary policy rule establishes that the central bank in country 1 should increase the nominal interest rate when inflation rises. This would give rise to the stabilizing effect of the real interest rate, together with the real exchange rate mechanism: with a positive inflation differential, country 1 experiences real appreciation. Ultimately, the output gap will become negative and inflation will start to decline.

In country 2, there will be an initial increase in competitiveness which will have an expansionary effect. As a result, inflation will also rise in the next period, so the country's central bank will also start to apply a restrictive monetary policy. Finally, as we can see from the graphs, the monetary policies applied independently by the two central banks will stabilize both economies at the initial equilibrium.

8.2.3 Regime II: creation of the European Central Bank

In this second case, we analyse how the stabilizing capacity of the above economies changes when country 1 suffers the same supply shock, but now assuming that they form a monetary union – EMU. Monetary policy, therefore, is applied by a central bank – which we will call the ECB – applying a Taylor Rule according to the mean values of the monetary union's inflation and output gap.

This second scenario is contemplated in the following model:

$$\dot{P}1_t = \dot{P}1_{t-1} + aOG1_{t-1} + z1_t \tag{8.13}$$

$$OG1_t = -c(r1_t - \bar{r}) - d\dot{RE}_t + g1_t \tag{8.14}$$

$$r1_t = iU_t - \dot{P}1_t \tag{8.15}$$

$$\dot{P}2_t = \dot{P}2_{t-1} + aOG2_{t-1} + z2_t \tag{8.16}$$

$$OG2_t = -c(r2_t - \bar{r}) + d\dot{RE}_t + g2_t \tag{8.17}$$

$$r2_t = iU_t - \dot{P}2_t \tag{8.18}$$

$$RE_t = \frac{P1_t}{P2_t} \tag{8.19}$$

$$\dot{P}U_t = 0.5\dot{P}1_t + 0.5\dot{P}2_t \tag{8.20}$$

$$OGU_t = 0.5OG1_t + 0.5OG2_t \tag{8.21}$$

$$iU_t = \bar{r} + \dot{P}U_t + \beta(\dot{P}U_t - \dot{P}^{OBJ}) + \gamma\, OGU_t \tag{8.22}$$

Equations (8.13) to (8.15) represent the behaviour of country 1. The first two are identical to the previous case and show the changes in inflation and the output gap. As is shown in equation (8.15) the nominal interest rate is now established by the ECB for the entire union[16] and the real interest rate is determined by the difference between this single interest rate and the economy's real inflation rate. Therefore, the same monetary policy can give rise to different real interest rates in each of the two economies in the monetary union. The following block of equations, (8.16) to (8.18), is equivalent to the former, but for country 2. On the other hand, equation (8.19) is the expression of the real exchange rate, which now only depends on price levels.

Finally, equations (8.20) to (8.22) express the monetary union's behaviour. Both inflation and the output gap are the mean of the two countries, which we assume are of the same size, and the last equation is the Taylor rule.

As in the previous case, we are interested in the expression of the aggregate demand curve, which shows the contemporary relation between the inflation rate and the output gap. As we saw earlier, if a country's inflation rate rises, it will only return to its target level if it involves a reduction in income (smaller output gap). And the greater this effect on the output gap, the greater its stabilizing capacity.

We proceed as before to obtain the aggregate demand curve of country 1, first assuming that the output gap of country 2 remains unchanged, and subsequently including these effects. We start, therefore, by substituting expressions (8.15), (8.19) and (8.22) in expression (8.14) of the output gap:

$$OG1_t = \frac{\begin{array}{c}-0.5c(\beta-1)\dot{P}1_t - d(\dot{P}1_t - \dot{P}2_t) + c\beta\dot{P}^{OBJ} \\ -0.5c(1+\beta)\dot{P}2_t - 0.5c\gamma OG2_t + g1_t\end{array}}{1+0.5c\gamma} \tag{8.23}$$

And performing the same operation for country 2:

$$OG2_t = \frac{\begin{array}{c}-0.5c(\beta-1)\dot{P}2_t + d(\dot{P}1_t - \dot{P}2_t) + c\beta\dot{P}^{OBJ} \\ -0.5c(1+\beta)\dot{P}1_t - 0.5c\gamma OG1_t + g2_t\end{array}}{1+0.5c\gamma} \tag{8.24}$$

The main difference from the case in which each country has its own monetary policy is that, providing $\beta < 1$, which is the case we can consider significant, *the real interest rate mechanism has a destabilizing effect in the EMU*. Indeed, when a supply shock raises inflation in country 1, the EMU's mean inflation rate also rises, although less than proportionally. So even though the ECB increases the nominal interest rate, it will be by less than the growth in inflation in country 1, where the real interest rate will therefore fall instead of increasing as desired. The result is that the income of country 1 will be higher than its potential level, increasing instead of dampening inflationist pressure.[17]

Nevertheless, *the real exchange rate continues to be a stabilizing mechanism*, because inflation in country 1 will be above the inflation rate of country 2.[18] But if the two stabilizing mechanisms previously helped inflation to fall, the effect of the real exchange rate mechanism is now compensated by the destabilizing effect of the real interest rate. Therefore, *in the best case scenario,* *the country suffering from a specific shock will have reduced its stabilizing capacity by joining the monetary union, and could have even completely lost control of its inflation rate*. This will depend on the degree to which the constrictive effect of real appreciation compensates for the expansionary effect of a fall in the real interest rate.

To see this completely, we can substitute equation (8.24) of the output gap of country 2 in equation (8.23), to obtain the country's aggregate demand curve after considering all the effects, as in the following equation (8.25):

$$OG1_t = \frac{[(0.5c-d)(1+c\gamma)-0.5c\beta]\dot{P}1_t + [-(0.5c-d)(1+c\gamma)-0.5c\beta]\dot{P}2_t + c\beta\dot{P}^{OBJ} - 0.5c\gamma g2t + (1+0.5c\gamma)\,g1_t}{1+c\gamma}$$

Likewise, equation (8.26) represents the aggregate demand curve for country 2:

$$OG2_t = \frac{[(0.5c-d)(1+c)-0.5c\beta]\dot{P}2_t + [-(0.5c-d)(1+c\gamma)-0.5c\beta]\dot{P}1_t + c\beta\dot{P}^{OBJ} - 0.5c\gamma g1t + (1+0.5c\gamma)g2_t}{1+c\gamma}$$

As we can see, the condition established in the previous section as necessary for the economy to stabilize after a shock raises its inflation rate, may not always be met. This condition requires the output gap to decline after growth in inflation, and this is only the case *if the value of parameter d is high enough to compensate for the fall in the real interest rate*. Specifically:

$$\frac{\Delta OG1_t}{\Delta \dot{P}1_t} = \frac{(0.5c-d)(1+c\gamma)-0.5c\beta}{1+c\gamma} < 0 \Leftrightarrow d > 0.5c - \frac{0.5c\beta}{1+c\gamma}$$

In fact, this condition is necessary, but not sufficient. To make sure that the model indeed approaches the equilibrium characterized by the rate of inflation before the shock, we must resolve the system formed by differential equations (8.13), (8.16), (8.25) and (8.26), representing the simultaneous evolution of the inflation rate and output gap of each of the two economies. From an analysis of the system's dynamic properties, we can distinguish three possible situations (see Table 8.2):

1. *The stabilizing effect of the real exchange rate is sufficient, and the economy returns to the initial equilibrium ($d > 0.5c$)* We have simulated this case in Figure 8.4, based on an initial equilibrium in which the two economies in the monetary union have an inflation rate of 2 per cent (ECB target) and income is the potential one. After a supply shock drives inflation in

Table 8.2 Economic dynamics after a supply shock (Regime II)

Parameters c and d values	*Other parameters*	*First period*		*Long-term dynamic*
		Changes in OG1 and OG2	*Changes in* OGU	
$\lambda = \frac{d}{0.5c} > 1$	$\beta < -(1-\lambda)(1+c\gamma)$ $\beta > -(1-\lambda)(1+c\gamma)$	$\lvert \Downarrow OG1 \rvert > \lvert \Uparrow OG2 \rvert$ $\Downarrow OG1 > \Downarrow OG2$	$\Downarrow OGU < \Downarrow OG1$	Both economies return to initial equilibrium.
$\lambda = \frac{d}{0.5c} = 1$		$\Downarrow OG1 = \Downarrow OG2$	$\Downarrow OGU = \Downarrow OG1$	Both economies stabilize, but with different inflation rate. UEM inflation rate returns to target.
$\lambda = \frac{d}{0.5c} < 1$	$\beta > (1-\lambda)(1+c\gamma)$ $\beta > (1-\lambda)(1+c\gamma)$	$\Downarrow OG1 < \Downarrow OG2$ $\lvert \Uparrow OG1 \rvert < \lvert \Downarrow OG2 \rvert$	$\Downarrow OGU > \Downarrow OG1$ $\Downarrow OGU$	In both economies the inflation rate departs from target increasingly.

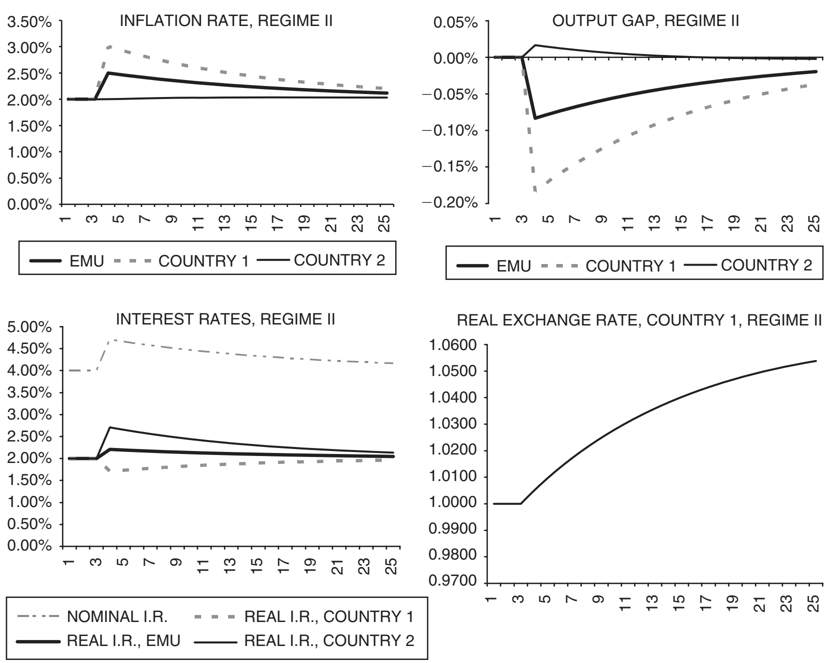

Figure 8.4 Supply shock in one of the EMU economies (Regime II, c = 0,4; d = 0,3)
Source: Authors.

country 1 up to 3 per cent, the ECB increases the nominal interest rate, but not enough, since mean inflation in the union rises only to 2.5 per cent. As a result of this, the real interest rate increases in the EMU but falls in country 1, where an expansionary effect is generated on income. However, since the real exchange rate mechanism is stronger, the inflation differential in relation to country 2 compensates for this growth, and income falls below its potential value. The outcome, therefore, is a fall in inflation in the following period.

Country 2 is also affected by the shock, although in a completely opposite sense. On the one hand, it benefits from the competitiveness gained from higher inflation in country 1, but at the same time its real interest rate will rise with the ECB's nominal rate, since its inflation rate remains unaltered as yet. However, for the value of β that we are considering, this second effect is weaker and income will rise, the output gap will be positive and inflation will tend to grow in the following period.

To discover what will occur in the EMU, we have to compare the absolute value of the effect of the inflationary shock in country 1 on the output gap of country 1 (recessive) and the output gap of country 2 (expansionary). According to expressions (8.25) and (8.26), we see that the effect on OG1[19] will be stronger, so the EMU will have a negative output gap and the mean rate of inflation will fall, although less than the inflation rate of country 1. As we shall see in the next case, this is important because, since the supply shock has driven this country's inflation further up, it also requires a more powerful corrective measure to return to the initial situation.[20]

In the following periods, as we shall see in the figures, the ECB will make downward adjustments to the interest rate, bringing the real interest rate closer to its equilibrium value as inflation is corrected. This monetary policy will ensure that the two EMU economies will return to their equilibrium situation.

However, *even in this case in which the single monetary policy is capable of stabilizing the two economies when there is a specific shock in one of them, there will be a decrease in the stabilizing capacity of economic policy*. Indeed, as Figure 8.5 shows, the effects of the rise in inflation are more persistent and the economy takes longer to return to its initial equilibrium, because if in the previous case the adjustment was derived from the *sum* of the effects of the exchange and interest rates, it now results from the *difference* between the two mechanisms, which are compensated.

2. *The real exchange rate partly compensates the destabilising effect of the real interest rate, but the economy finally stabilises with an inflation rate greater than its original value ($d = 0.5c$)* If we return to the previous initial situation and simulate the same supply shock, but with the value of parameter d equal to half parameter c, the EMU economies will experience a dynamic evolution as simulated in Figure 8.6. As we can see, the process starts in the same way as before: the rise in inflation leads the ECB to increase

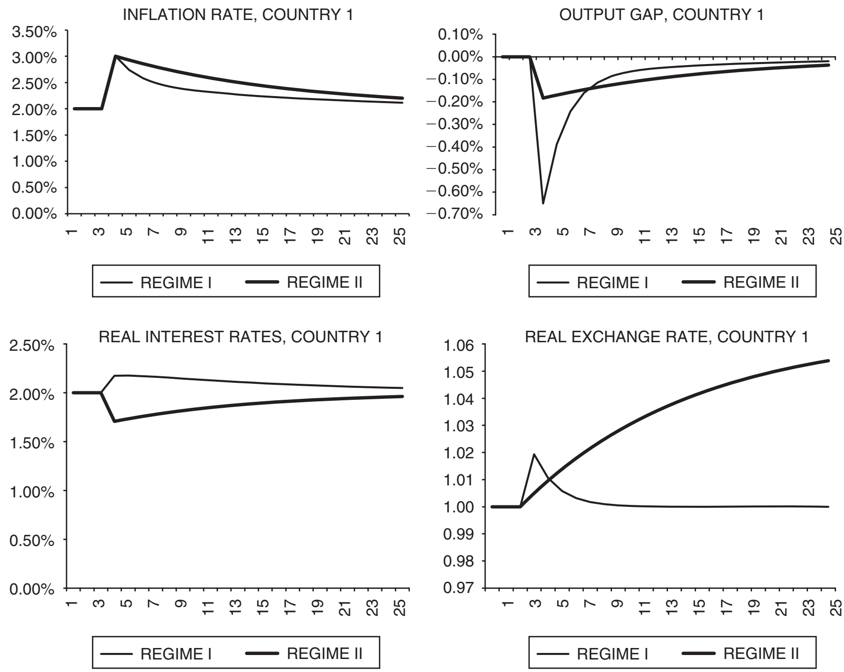

Figure 8.5 Supply shock in one of the EMU economies (comparison between Regime I and Regime II; c = 0,4; d = 0,3)
Source: Authors.

the nominal interest rate, but in such a way as to increase the mean real interest rate for the union and for country 2, but not for country 1. The most important difference, however, is that once we consider the effect of the real exchange rate, the output gap is reduced in both country 1 and country 2, whereas before it tended to grow in the latter,[21] and the decrease is the same in both of them.[22] If we observe the union's mean values, this will result in the output gap diminishing by the same amount as in country 1.[23] In the following period, therefore, *inflation will fall by the same degree in the two economies*. But since we start with different inflation rates, the fact that monetary policy equally lowers the inflation rate in both countries will eventually lead to an equilibrium situation in which income is at its full potential value and the mean EMU inflation rate is 2 per cent (so the ECB will not leave the interest rate unaltered), but in which inflation will stabilize at 2.5 per cent in country 1 and at 1.5 per cent in country 2. In other words, *a transient inflationist shock would have a permanent effect for each of the EMU economies, but not for the mean*.

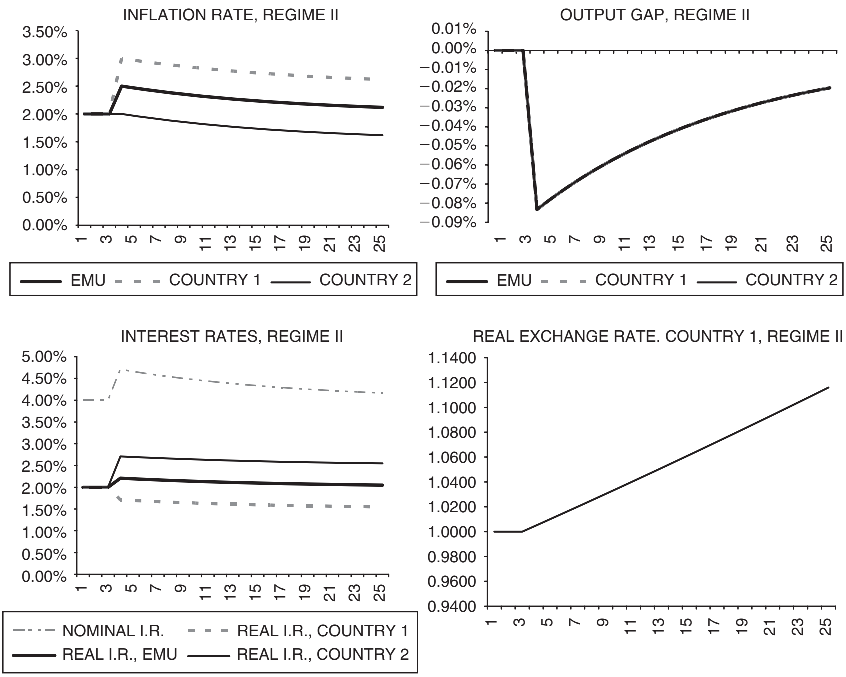

Figure 8.6 Supply shock in one of the EMU economies (Regime II; c = 0,4; d = 0,2)
Source: Authors.

As we can also see from the figures, in the new equilibrium country 1 will have a lower than equilibrium interest rate, whereas in country 2 it will be higher. The expansionary and recessive effects of these differences, however, will be precisely compensated by the inflation differential between the two economies (real appreciation for country 1 and real depreciation for country 2).

3. *The destabilizing effect of the real interest rate is stronger than the stabilizing effect of the real exchange rate, and the economy affected by the shock will register growing inflation rates and fail to stabilize ($d < 0.5c$)* Of the three cases considered, this is evidently the one with the worst outcome. To see why this occurs, we can start as before with an initial equilibrium, followed by a 1 per cent inflation shock in country 1. The resulting dynamics are shown in Figure 8.7, and we can see that the most important difference is related to the relative strength of the real interest and real exchange rate mechanisms. As in the previous two situations, the rise in inflation leads to a lower real interest rate in country 1, even though the ECB increases the nominal interest rate, but the constrictive effect of the real exchange rate is no longer sufficient to compensate for it.[24] In the country in which

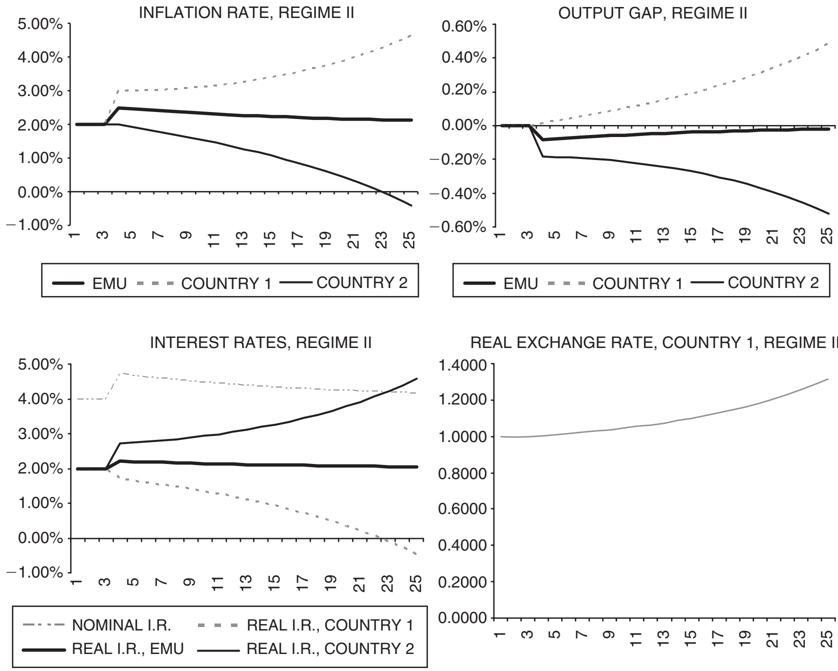

Figure 8.7 Supply shock in one of the EMU economies (Regime II; c = 0,4; d = 0,1)
Source: Authors.

inflation has risen, therefore, income will not fall but grow, and there will be further inflation acceleration in the following periods. Finally, although the mean EMU inflation rate will stabilize, this will never be the case for the two member economies. We can say, then, that *if parameters c and d reach these values and there is a specific shock in one of the EMU economies, the application of the single monetary policy will generate a diverging dynamic, instead of helping to stabilize the member economies*.

8.2.4 Conclusion: the need for alternative adjustment mechanisms

The analysis given in this section clearly shows that when a country relinquishes its own monetary policy and faces a different situation from the rest of the monetary union members, its stabilizing capacity is diminished. In the best of cases, this means that the shocks which make it deviate from the equilibrium will have longer-lasting effects, but they could even be permanent or generate a dynamic leading to a growing acceleration or deceleration of inflation.

This problem arises from the loss of one of the adjustment mechanisms available to economies for absorbing shocks: the real interest rate. In fact, its effect becomes destabilizing, and it is only compensated if the adjustment mechanism derived from the real exchange rate is strong enough. We would have to know the precise value of the two effects in the specific case of the EMU to define the most likely scenario, but our analysis shows that small changes in the values of these parameters have a significant impact on the dynamics of the economies.

Therefore, from the economic policy perspective it would appear to be both reasonable and necessary to establish alternative mechanisms to reinforce the effect of the real exchange rate and compensate for the problems derived from an inadequate evolution of the real interest rate. In our opinion, this mechanism could be fiscal policy, so in the following section we consider how different alternative fiscal rules could help to solve the stabilization problem in the EMU.

8.3 Can an active fiscal policy help stabilize the national economies in the EMU? An examination of two alternative rules

To analyse the role of fiscal policy in a monetary union, we use the same method as before, representing the decisions of the authorities through activist rules similar to those used for monetary policy and assessing how the economy's stabilizing capacity changes when it faces the same supply shock in country 1.

A fiscal policy rule, or reaction function of the fiscal authorities, is defined as a simple equation in which a variable representing the sign of fiscal policy (normally the total budgetary balance, the primary balance or one of these two cyclically adjusted balances, whatever the purpose of the analysis) depends upon different variables representing the state of the economy (normally, the output gap, inflation or, in certain cases, public debt[25]).

Although fiscal rules have been less developed in the literature than monetary rules,[26] their use for analysing fiscal policy has advantages similar to those described for monetary policy. From a theoretical viewpoint, they enable us to systematically compare the effects on the economy of different alternative fiscal authority behaviour, or to discuss issues related to policy mix using a homogeneous method for analysing the two instruments – this applies to our work. From a more empirical perspective, the econometric estimation of the rules which have in fact been applied by tax authorities in different countries or periods, enable us to compare and evaluate their fiscal policies (by comparing them with the best fiscal rules obtained in the theoretical analysis, for instance).

In this section, we will be formulating and comparing the effects of two alternative fiscal policy rules on our model:

- *Fiscal policy rule based on the output gap* This rule is as proposed by Taylor (2000); the government establishes a budgetary balance target (SPT^{OBJ}) and deviates from it exclusively depending on the country's output gap. Specifically, when the economy is expansionary and the output gap is positive, a restrictive fiscal policy is applied and the budgetary balance increases. On the other hand, if the demand weakens and the output gap is negative, the policy becomes more expansionary in relation to the long term and the budgetary balance is reduced. This fiscal policy reaction could theoretically apply both to the role of automatic stabilisers and also to systematic discretionary behaviour by the authorities aimed at increasing the stabilizing capacity of fiscal policy.
- *Fiscal policy rule based on the output gap and inflation* The main change to this new version of the fiscal policy rule is that we consider that national tax authorities are also explicitly concerned with the stability of prices and that they therefore alter the budgetary balance in relation to long-term equilibrium according to the evolution not only of the output gap, but also of the inflation rate. Ultimately, this means that the fiscal policy rule adopts the same form as the Taylor rule for monetary policy. In our opinions, there are reasons for believing that this may be reasonable fiscal authority behaviour. In Spain, for instance, a restrictive fiscal policy has been applied since the EMU was created in order to counter arrest the fall in the real interest rate derived from ECB monetary policy, and this behaviour is justified by the differential inflation that the country has suffered throughout this period.[27]

Below, we obtain the model's equations when we include each of the two alternative rules, followed by an analysis of the model's dynamics in the three cases we are considering, according to the relative value of parameters c and d.

8.3.1 Regime III: the model's equations when a fiscal rule based on the output gap is applied

When we introduce the behaviour of the tax authorities, the model is formed by the following equations:

$$\dot{P}1_t = \dot{P}1_{t-1} + aOG1_{t-1} + z1_t \tag{8.27}$$

$$OG1_t = -c(r1_t - \bar{r}) - d\,\dot{R}E_t - e\,SPT1_t + g1_t \tag{8.28}$$

$$r1_t = \dot{i}U_t - \dot{P}1_t \tag{8.29}$$

$$SPT1_t = SPT^{OBJ} + f\,OG1_t \tag{8.30}$$

$$\dot{P}2_t = \dot{P}2_{t-1} + aOG2_{t-1} + z2_t \tag{8.31}$$

$$OG2_t = -c(r2_t - \bar{r}) + d\,\dot{R}E_t - e\,SPT2_t + g2_t \tag{8.32}$$

$$r2_t = iU_t - \dot{P}2_t \tag{8.33}$$

$$SPT2_t = SPT^{OBJ} + f\,OG2_t \tag{8.34}$$

$$RE_t = \frac{P1_t}{P2_t} \tag{8.35}$$

$$\dot{P}U_t = 0.5\dot{P}1_t + 0.5\dot{P}2_t \tag{8.36}$$

$$OGU_t = 0.5OG1_t + 0.5OG2_t \tag{8.37}$$

$$iU_t = \bar{r} + \dot{P}U_t + \beta(\dot{P}U_t - \dot{P}^{OBJ}) + \gamma\,OGU_t \tag{8.38}$$

This is basically the same model as in Regime II, but it now includes the fiscal policy rules of the two countries (equations (8.30) and (8.34)). SPT is the current budgetary balance of a period and SPT^{OBJ} is the value established by the authorities when the economy is at its potential level. To maintain the criterion that the only difference between these economies is the shocks suffered by each of them, we will assume that this value is the same for both authorities and equal to 0 per cent.[28] On the other hand, f is a positive parameter measuring the budget's response to changes in the cyclic position of the economy. In our simulations, it has a reference value of 0.5, which is the value proposed by Taylor (2000) based on the data for the United States and also coincides with the European Commission's mean estimation of the cyclical sensitivity of the EU budget.[29]

The second change in the model is in equation IS, since it has to reflect the direct effect of the changes in the budgetary balance on disposable income and, therefore, on the production level. This is represented by parameter e. Like parameters c and d, which measured the effect of the other two adjustment mechanisms on income, we will see that the model's dynamics after the shock may depend on the relative values of c, d and e. We will therefore analyse which cases may occur and simulate the model with different values of parameter e.[30]

The aggregate demand curve of country 1 can be obtained, as in the previous cases, by substituting equations (8.29), (8.30), (8.35) and (8.38) in (8.28):[31]

$$OG1_t = \frac{\begin{array}{c}-0.5c(\beta-1)\dot{P}1_t - d(\dot{P}1_t - \dot{P}2_t) + c\beta\dot{P}^{OBJ} - 0.5c(1+\beta)\dot{P}2_t \\ -\,0.5c\gamma OG2_t - e\,SPT^{OBJ} + g1_t\end{array}}{1 + 0.5c\gamma + ef} \tag{8.39}$$

And performing the same operation for country 2:

$$OG2_t = \frac{\begin{array}{l}-0.5c(\beta-1)\dot{P}2_t + d(\dot{P}1_t - \dot{P}2_t) + c\beta\dot{P}^{OBJ} - 0.5c(1+\beta)\dot{P}1_t \\ -0.5c\gamma OG1_t - e\,SPT^{OBJ} + g2_t\end{array}}{1 + 0.5c\gamma + ef} \quad (8.40)$$

If we compare equation (8.39) with the aggregate demand before the introduction of the fiscal policy rule (equation (8.37)), we see that the most important difference arises from the appearance of a new adjustment mechanism that we will call *budgetary balance effect. With the rule being considered, this mechanism weakens the efficacy of the real exchange rate even further,* since the fiscal authorities will apply an expansionary policy if the output gap decreases, limiting the fall in income. But in the case of a supply shock, this reduction in demand is precisely what is needed to contain inflationary tension. Analytically, this is shown by the highest denominator value.

The analysis can be completed by substituting the output gap equation of country 2 in that of country 1, and vice versa, to again obtain the aggregate demand equations but now contemplating all the effects. The result would be as follows:

$$OG1_t = A\dot{P}1_t + B\dot{P}2_t + D(c\beta\,\dot{P}^{OBJ} - e\,SPT^{OBJ}) + Eg1_t + Fg2_t \quad (8.41)$$

$$OG2_t = A\dot{P}2_t + B\dot{P}1_t + D(c\beta\,\dot{P}^{OBJ} - e\,SPT^{OBJ}) + Eg2_t + Fg1_t \quad (8.42)$$

where:

$$A = \frac{(0.5c-d)(1+c\gamma+ef) - 0.5c\beta(1+ef)}{1+c\gamma+ef(2+c\gamma+ef)} \quad (8.43)$$

$$B = \frac{-(0.5c-d)(1+c\gamma+ef) - 0.5c\beta(1+ef)}{1+c\gamma+ef(2+c\gamma+ef)} \quad (8.44)$$

$$D = \frac{1+ef}{1+c\gamma+ef(2+c\gamma+ef)} \quad (8.45)$$

$$E = \frac{1+0.5c\gamma+ef}{1+c\gamma+ef(2+c\gamma+ef)} \quad (8.46)$$

$$F = \frac{-0.5c\gamma}{1+c\gamma+ef(2+c\gamma+ef)} \quad (8.47)$$

Based on these equations, in section 8.3.3 we will analyse the dynamics of the economy coupled with the case in which the alternative fiscal policy rule is adopted.

8.3.2 Regime IV: model's equations when a fiscal rule based on both the output gap and inflation is applied

The model is now expressed by the same equations as in Regime III, except for the two equations referring to the fiscal policy rule, (8.30) and (8.34), which are replaced by the following:

$$SPT1_t = SPT^{OBJ} + f\,OG1_t + h(\dot{P}1_t - \dot{P}^{OBJ}) \tag{8.48}$$

$$SPT2_t = SPT^{OBJ} + f\,OG2_t + h(\dot{P}2_t - \dot{P}^{OBJ}) \tag{8.49}$$

Together with the term representing the authorities' reactions to output gap variations, this rule contains an additional term expressing the changes occurring in fiscal policy when the country's inflation rate exceeds the target value. The magnitude of these changes depends on parameter h, which is also positive, because if the economy suffers from inflationist tensions, the government will apply a restrictive fiscal policy and raise the budgetary balance. To maintain the parallelism with monetary policy, we have taken a value of this parameter equal to f (that is, 0.5) as the basic scenario for our simulations.

Performing the same operations as in the previous cases, we first obtain the aggregate demand curves of country 1 and country 2, taking the other country's output gap as given, in order to simply identify the action of the budgetary balance effect in this case. These equations are identified as (8.50) and (8.51):

$$OG1_t = \frac{\begin{array}{c}-0.5c(\beta-1)\dot{P}1_t - d(\dot{P}1_t - \dot{P}2_t) + c\beta\dot{P}^{OBJ} - 0.5c(1+\beta)\dot{P}2_t \\ -0.5c\gamma OG2_t - e\,SPT^{OBJ} - eh(\dot{P}1_t - \dot{P}^{OBJ}) + g1_t\end{array}}{1 + 0.5c\gamma + ef} \tag{8.50}$$

$$OG2_t = \frac{\begin{array}{c}-0.5c(\beta-1)\dot{P}2_t + d(\dot{P}1_t - \dot{P}2_t) + c\beta\dot{P}^{OBJ} - 0.5c(1+\beta)\dot{P}1_t \\ -0.5c\gamma OG1_t - e\,SPT^{OBJ} - eh(\dot{P}2_t - \dot{P}^{OBJ}) + g2_t\end{array}}{1 + 0.5c\gamma + ef} \tag{8.51}$$

With the new rule, the budgetary balance becomes a stabilizing mechanism when the economy suffers an inflationary shock, because the inflation rate is precisely one of the rule's arguments. Therefore, *when inflation grows, the authorities will apply a restrictive fiscal policy, reinforcing the impact of the real exchange rate mechanism and further neutralizing the destabilizing effect of the real interest rate.*[32] Analytically, this is represented in term ($\frac{-eh}{1+0.5c\gamma+ef}$), which is negative.

And if, as before, we substitute each country's output gap in the other country's aggregate demand expression, we also obtain the final output gap equations with all the effects taken into account:

$$OG1_t = A'\dot{P}1_t + B'\dot{P}2_t + D'\dot{P}^{OBJ} + E'SPT^{OBJ} + Eg1_t + Fg2_t \quad (8.52)$$

$$OG2_t = A'\dot{P}2_t + B'\dot{P}1_t + D'\dot{P}^{OBJ} + E'SPT^{OBJ} + Eg2_t + Fg1_t \quad (8.53)$$

where:

$$A' = \frac{(0.5c - d)(1 + c\gamma + ef) - 0.5c\beta(1 + ef) - eh(1 + 0.5c\gamma + ef)}{1 + c\gamma + ef(2 + c\gamma + ef)} \quad (8.54)$$

$$B' = \frac{-(0.5c - d)(1 + c\gamma + ef) - 0.5c\beta(1 + ef) + 0.5c\gamma eh}{1 + c\gamma + ef(2 + c\gamma + ef)} \quad (8.55)$$

$$D' = \frac{(c\beta + eh)(1 + ef)}{1 + c\gamma + ef(2 + c\gamma + ef)} \quad (8.56)$$

$$E' = \frac{-e(1 + ef)}{1 + c\gamma + ef(2 + c\gamma + ef)} \quad (8.57)$$

8.3.3 Comparative dynamic analysis of a supply shock with the two fiscal policy rules

The purpose of this section is to analyse how the dynamics of the three cases considered in our analysis of Regime II change when we consider the use of fiscal policy. In particular, we want to know whether, in the cases in which the economy did not return to equilibrium, it does so now that we consider the effect of fiscal rules, or whether, in the cases where the economy stabilised at the target rate of inflation, this process is now faster.

We will support our reasoning with simulations of the model,[33] for which we will use the same parameter values as in Regime I and II, plus the values shown on Table 8.3 in the case of new parameters related to fiscal policy:

Table 8.3 Value of fiscal policy parameters

Parameter	*Simulated values*
f (response of budgetary balance to output gap)	0.5
h (response of budgetary balance to inflation)	0.5
Equilibrium budgetary balance (%)	0
e (response of output gap to budgetary balance)	0.3;0.7

8.3.3.1 First case: d > 0.5c

In this situation, we had seen that the force of the effect derived from the real exchange rate was sufficient to compensate for the destabilizing effect of the real interest rate. We also saw, however, that the effects of the specific supply shock on inflation would last longer when monetary policy is applied by the ECB that when it is applied separately by each country. Could the introduction of a fiscal policy rule correct this situation?

We have simulated this case for country 1 in Figure 8.8, representing the dynamic evolution of the economy in the three regimes being compared. Firstly, as we can see, the tendency to return to equilibrium is maintained whichever fiscal policy rule is applied, since the effect of inflation growth on the output gap of country 1 remains unaltered, and is negative.[34] The inflation increase is therefore compensated in the following periods.

However, there are differences in the speed with which equilibrium is reached depending on the fiscal rule applied. When the authorities make budgetary decisions based solely on the output gap, fiscal policy becomes

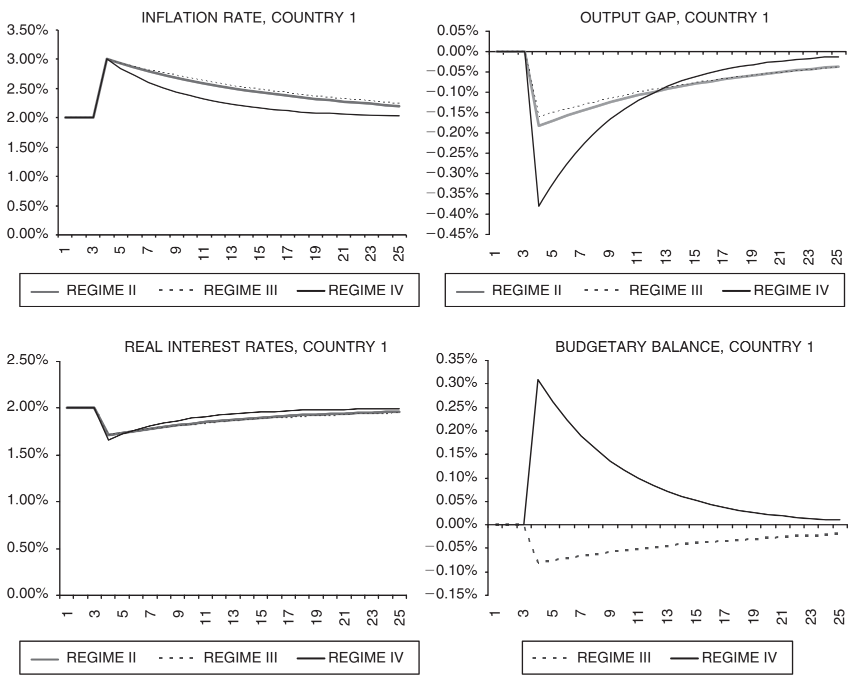

Figure 8.8 Supply shock in one of the EMU economies (comparison between Regimes II, III and IV; c = 0,4; d = 0,3; e = 0,7)
Source: Authors.

expansionary when real appreciation generates a negative output gap, thus limiting the efficacy of the adjustment. On the other hand, when fiscal policy also takes inflation into account, it becomes restrictive, reinforcing the effect of the real exchange rate. In this first case, therefore, *Regime IV would obtain the best results from the perspective of stabilizing inflation, although certainly at the cost of a greater reduction in income in the periods following the shock.*

8.3.3.2 Second case: d = 0.5c

When we took this value of parameter d in Regime II, the real exchange rate mechanism was still strong enough to prevent an inflationary spiral from occurring in country 1, but not strong enough to reduce inflation rapidly enough to reach equilibrium at the same time as the EMU mean. Consequently, when the latter reached an inflation rate of 2 per cent and the ECB ceased to modify the interest rate, the inflation rate in country 1 was still 2.5 per cent and stabilized at this value.

The results do not change if we now consider the case of the first fiscal rule (Figure 8.9). The effect on OG1 continues to be negative,[35] but so is the

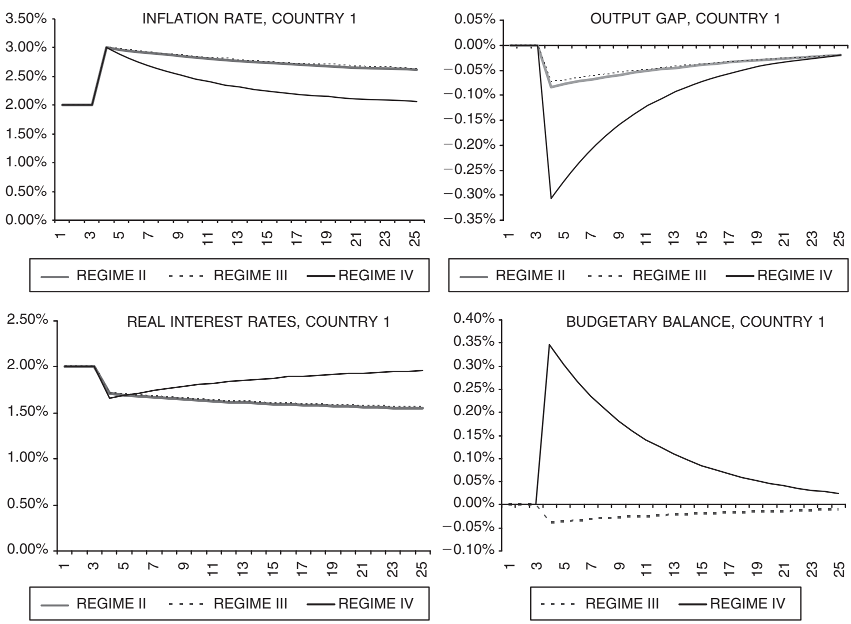

Figure 8.9 Supply shock in one of the EMU economies (comparison between Regimes II, III and IV; c = 0,4; d = 0,2; e = 0,7)
Source: Authors.

effect on OG2; and according to expressions (8.43) and (8.44), this reduction in the output gap is identical in both countries, so the situation is the same as when only monetary policy was applied.

The problem is solved, however, when the fiscal policy rule adopted also takes the rate of inflation into account. Since it increases in country 1, but not in country 2, fiscal policy is more restrictive in the country affected by the shock.[36] Income (and inflation), therefore, is further reduced in this country than in the EMU in general, which is what is needed for the economy to stabilize. *Once again, we see that Regime IV has the best results from the stabilizing capacity perspective.*

8.3.3.3 Third case: $d < 0.5c$

This is the most important case, because in the previous section we saw that the real exchange rate was not sufficient to compensate the destabilizing effects of the real interest rate derived from the ECB's monetary policy, and after a transient shock there was a growing inflation rate in the country where it occurred, and growing deflation in the other economy.

Application of the first fiscal policy rule partly reduces this inflationist spiral in country 1, because the budgetary balance would increase with the output gap, reinforcing the effect (stabilizing) of the exchange rate and helping to compensate for the effect (destabilizing) of the interest rate. However, as the expressions confirm, it would not be sufficient, because either the output gap continues to grow in country 1 (Figure 8.10) or it decreases less than in country 2.

On the other hand, *in Regime IV, if the fiscal authorities' reaction to growing inflation (measured by parameter h) is decisive enough, and this change in the budgetary balance has a strong enough impact on income (which depends on parameter d) equilibrium could also be reached in this case*, because the adjustment made through the budgetary balance would compensate for the relative weakness of the real exchange rate mechanism.

The condition for this to occur is for $eh > c - 2d$: when this is the case, expression (8.54) becomes negative (the output gap of country 1 is reduced) and greater in absolute values than expression (8.55), which represents the evolution of the output gap in country 2, which also becomes negative. Consequently, inflation falls both in the monetary union and in country 1, although the reduction is greater in the latter, and the national economies return to equilibrium (Figure 8.10).

The only case in which this does not occur is when $eh < c - 2d$, when neither of the two fiscal rules proposed could solve the problem of stabilizing national economies in a monetary union (Figure 8.11).

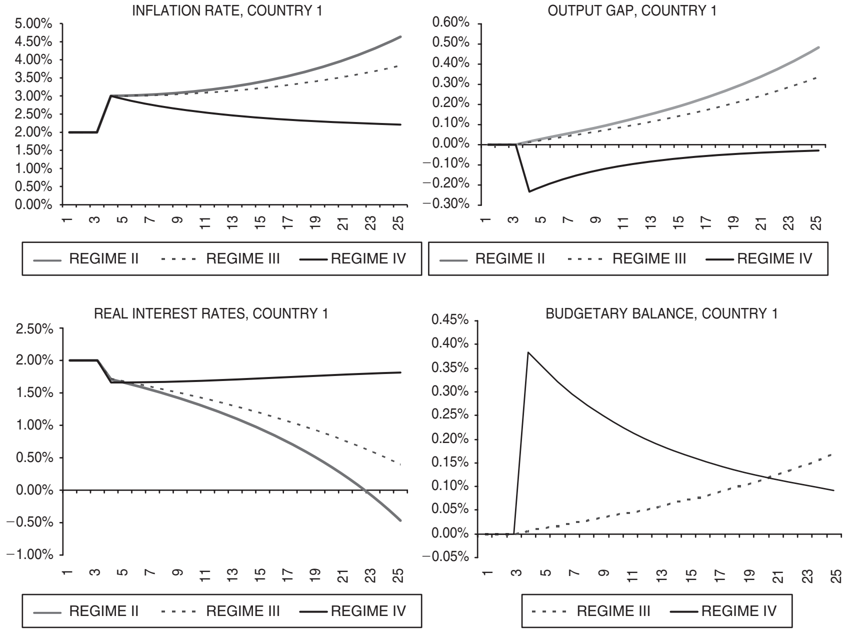

Figure 8.10 Supply shock in one of the EMU economies (comparison between Regimes II, III and IV; c = 0,4; d = 0,1; e = 0,7)
Source: Authors.

8.4 Conclusions

The idea that a centralized monetary policy should go hand in hand with a greater capacity of national authorities to actively apply a fiscal policy based on their own cyclical circumstances (which may differ from those of the union) is shared by an important part of the literature aimed at analysing stabilization policy in the EMU. In practice, however, this proposal faces a dual paradox.

In the first place, the last two decades have witnessed the dwindling trust of economists – particularly academics – in the capacity of fiscal policy to effectively counter fluctuations in demand and contribute to greater macroeconomic stability. This distrust is due to both theoretical and more institutional reasons, and the result has been that in discussions concerning stabilization policy, monetary policy has played not only a preferential, but often an exclusive role.[37] Secondly, although this situation has improved with the reform of March 2005, the Stability and Growth Pact may be a limited framework for the use of active fiscal policies, especially if the idea is to supplement the effect of automatic stabilizers with other discretionary measures.

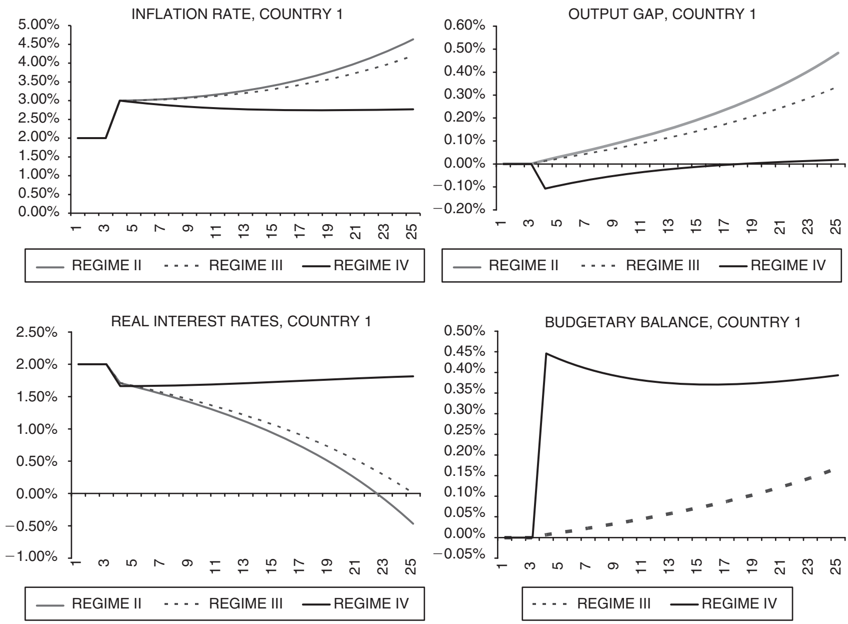

Figure 8.11 Supply shock in one of the EMU economies (comparison between Regimes II, III and IV; c = 0,4; d = 0,1; e = 0,3)
Source: Authors.

Table 8.4 Economic dynamics after a supply shock (Regime III)

Parameters c and d values	*Other parameters*	First period		*Long-term dynamic*
$\lambda = \dfrac{d}{0.5c} > 1$	$\beta < -\dfrac{(1-\lambda)(1+c\gamma+ef)}{1+ef}$	$\lvert \Downarrow OG1\rvert > \lvert \Uparrow OG2\rvert$	$\Downarrow OGU < \Downarrow OG1$	Both economies return to initial equilibrium.
	$\beta > -\dfrac{(1-\lambda)(1+c\gamma+ef)}{1+ef}$	$\Downarrow OG1 > \Downarrow OG2$		
$\lambda = \dfrac{d}{0.5c} = 1$		$\Downarrow OG1 = \Downarrow OG2$	$\Downarrow OGU = \Downarrow OG1$	Both economies stabilize, but with different inflation rate. UEM inflation rate returns to target.
$\lambda = \dfrac{d}{0.5c} < 1$	$\beta > \dfrac{(1-\lambda)(1+c\gamma+ef)}{1+ef}$	$\Downarrow OG1 < \Downarrow OG2$	$\Downarrow OGU > \Downarrow OG1$	In both economies the inflation rate departs from target increasingly.
	$\beta < \dfrac{(1-\lambda)(1+c\gamma+ef)}{1+ef}$	$\lvert \Uparrow OG1\rvert < \lvert \Downarrow OG2\rvert$	$\Downarrow OGU$	

Table 8.5 Economic dynamics after a supply shock (Regime IV)

Parameters c and d values		*Other parameters*	*First period*		*Long-term dynamic*
$\lambda = \dfrac{d}{0.5c} > 1$		$\beta < \dfrac{-(1-\lambda)(1+c\gamma+ef)+\gamma eh}{1+ef}$	$\lvert \Downarrow OG1 \rvert > \Uparrow OG2 \rvert$	$\Downarrow OGU < \Downarrow OG1$	Both economies return to initial equilibrium
		$\beta > \dfrac{-(1-\lambda)(1+c\gamma+ef)+\gamma eh}{1+ef}$	$\Downarrow OG1 > \Downarrow OG2$		
$\lambda = \dfrac{d}{0.5c} = 1$		$\beta < \dfrac{\gamma eh}{1+ef}$	$\lvert \Downarrow OG1 \rvert > \Uparrow OG2 \rvert$		
		$\beta > \dfrac{\gamma eh}{1+ef}$	$\Downarrow OG1 > \Downarrow OG2$		
$\lambda = \dfrac{d}{0.5c} < 1$		$eh > c - 2d$	$\Downarrow OG1 > \Downarrow OG2$		
	$eh < c - 2d$	$\beta > \dfrac{-(1-\lambda)(1+c\gamma+ef)+\gamma eh}{1+ef}$	$\Downarrow OG1 < \Downarrow OG2$ $\lvert \Downarrow OG1 \rvert < \lvert \Downarrow OG2 \rvert$	$\Downarrow OGU > \Downarrow OG1$ $\Downarrow OGU$	In both economies the inflation rate departs from target increasingly.
		$\beta < \dfrac{-(1-\lambda)(1+c\gamma+ef)+\gamma eh}{1+ef}$			

In this chapter, we have attempted to argue the need to consider this active use of fiscal policy through a model with two countries forming a monetary union and using the fiscal policy rule concept in the same way as the monetary policy rule concept which is of more widespread use in the literature. The principal conclusions we have reached are as follows:

- The creation of a monetary union, if it is not supplemented by the use of other economic policy instruments such as fiscal policy, involves the national economies concerned relinquishing stabilizing capacity. When there is no longer an independent monetary policy in each country, a specific shock in one of the economies, depending on the relative effect of the real interest rate and the real exchange rate on income, can either result in taking longer to return to the initial equilibrium or in a divergent dynamic of this equilibrium.[38]
- The national authorities' management of an active fiscal policy increases their stabilizing capacity, but it is also important to design an appropriate fiscal policy to be applied.
- In the cases in which there is no return to equilibrium after the shock in Regime II, the fiscal policy rule based on both the output gap and inflation provides the best results and is capable of resolving the situation.
- In the cases in which equilibrium is reached with the two alternative rules, the explicit consideration of the inflation rate in budgetary decisions also eliminates the impact of the inflation shock sooner, although at the cost of greater income variations. The choice of one or the other rule, therefore, would here depend on the welfare costs associated to income fluctuations and the rate of inflation variations.

In our opinion, these arguments are solid enough to be in favour of the greater use of an active fiscal policy by EMU governments, although we are also aware of the practical difficulties this could involve. The empirical evidence, however, clearly shows that fiscal policy is an effective way of influencing short-term demand, and a rejection of its use can only be explained by reasons such as a lack of confidence in the political management of the budget, time lags or the fear that a lack of coordination between the national authorities could harm the price stability objective pursued by the ECB for the entire euro area. We believe, however, that these reasons should not be sufficient to directly reject the only instrument left for national authorities to stabilize their economies in a monetary union. Even if they are taken into consideration, this decision would be too risky in the present context. Our considerations open two possible pathways for progressing in relation to fiscal policy: (i) *to design institutional mechanisms* ensuring a correct application of budgetary policy without in fact suppressing it,[39] and (ii) *to design fiscal policy reaction functions or rules*, along the lines suggested in this chapter, the systematic application of which would have acceptable results from the perspective of income and inflation stability.

Notes

1 A classic paper in this respect is Bayoumi and Eichengreen (1993). Subsequent debates have focused, however, on the possibility of deeper economic integration either favouring the productive specialisation of European economies (increasing the likelihood of an asymmetric shock even further) or generating a tendency towards closer approximation of productive structures.
2 The three factors primarily explaining these differentials are the different reaction to common shocks (oil prices and euro exchange rate), cyclical differences and the Balassa–Samuelson effect.
3 Mongelli (2002) provides an overview of this empirical literature.
4 Taylor (1993). According to this rule, the central bank adjusts the nominal interest rate in relation to its 'neutral' or equilibrium value, according to the evolution of inflation and income.
5 Obviously, these costs could be compensated with other benefits, which the economic literature usually establishes in terms of greater nominal stability and possible growth in potential income. Our objective is not to consider these overall effects, but only to analyse a possible alternative economic policy to improve the possible problem of short-term stabilisation.
6 Our principal results would remain unaltered if we were to analyse the effects of a demand shock.
7 Romer (2000) shows that this is a good approximation to reality.
8 Logically, the opposite would be occurring in country 2.
9 To simplify the analysis, we nevertheless assume here that there are no demand shocks.
10 Not the price level, as in the aggregate demand curve of traditional macroeconomic models.
11 Since the monetary policy rule also depends on the evolution of the output gap, this expression not only contains the central bank's reaction to changes in inflation (numerator), but also its reaction to all the changes in the output gap (denominator), either due to the action initially taken by the monetary authorities or because of the change in the country's competitiveness. The increase in the real interest rate would therefore be less than if γ was zero.
12 Otherwise, the rise in inflation would be followed by increased income, a positive output gap and a new rise in inflation, which would therefore move further away from the target established by the central bank.
13 In expression (8.11) we see that the increase in $OG2_t$ has a positive impact on $OG1_t$. The magnitude of this effect is given by quotient $d\gamma/1+\gamma(c+d)$.
14 The speed with which inflation returns to its initial equilibrium rate depends positively on parameters c, β and d, and negatively on parameter γ.
15 Figure 8.1 only shows the case in which $c = 0.4$ and $d = 0.3$. The model's dynamics remain unaltered for any other similar parameter value.
16 The monetary union's mean values are represented by the letter U.

17 This destabilizing effect will be determined by the term $\frac{-0.5c(\beta-1)}{1+0.5c\gamma}$.

18 Still assuming that the output gap of country 2 remains unaltered, this is represented by $\frac{-d}{1+0.5c\gamma}$.

19 This is so because $\left|\frac{\Delta OG1_t}{\Delta \dot{P}1_t}\right| - \left|\frac{\Delta OG2_t}{\Delta \dot{P}2_t}\right| = \frac{c\beta}{1+c\gamma} > 0$.

20 If β reaches higher values, the output gap may also decrease in country 2, because the effect of the real interest rate will be stronger than the effect of the real exchange rate. This would reduce mean inflation even further, but in any case less than in country 1, as shown in the previous note. It would therefore remain unaltered and equilibrium would eventually be reached in the two economies.

21 Since the value of parameter d has been reduced, the effect of the real exchange rate is weaker, and the restrictive effect of the increase in the real interest rate predominates in country 2.

22 Indeed, if we consider that d = 0.5c, it follows that $\frac{\Delta OG1_t}{\Delta \dot{p}1_t} = \frac{\Delta OG2_t}{\Delta \dot{p}2_t}$.

23 The reduction was greater in the previous case.

24 In this third scenario there would be one specific case when $0.5c > d > 0.5c - \frac{0.5c\beta}{1+c\gamma}$. In this situation, the output gap of country 1 would decrease in the period in which the shock occurs, but less than in country 2. Therefore, inflation would be corrected to a smaller degree in the country than for the mean, and the single monetary policy would eventually become too expansionary for the situation in country 1. Finally, after a period in which inflation is reduced, it would start to accelerate in the same way as in the simulation we have described in the text, in which $d < 0.5c - \frac{0.5c\beta}{1+c\gamma}$, and the dynamic is there equivalent in the mean term.

25 The presence of public debt in the fiscal rule is justified by the tax authorities' concern for the long-term sustainability of public finance. For the latter to be guaranteed, the tax authorities have to increase the primary balance when debt increases. Since in this case we are interested in the short-term stabilization of the economy, we will not take this problem explicitly into account, although the magnitude of the deficit increases do not compromise long-term stabilization of the debt.

26 There are, however, articles estimating fiscal rules to represent the behaviour of different authorities or to analyse their possible effects on the economy. Some examples of the former are Galí and Perotti (2003), OECD (2003) or IMF (2004); and for the latter, Taylor (1995 and 2000) and Aarle, Garretsen and Huart (2004). We have estimated the fiscal rule followed by EMU countries in the last 20 years in García Serrador, Arroyo, Mínguez and Uxó (2005).

27 Buti and Martínez Mongay (2005), for instance, refer to the fiscal policy being applied in Spain as follows: 'Is there enough fiscal tightening? With credit growing above 15 per cent, coupled with high households' indebtedness and a *large and persistent inflation differential*, risks seem to be on the downside. With a view to preventing economic imbalances, in particular *overheating*, from deepening further, *fiscal policy should be tightened*' (the underlining is ours).

28 We establish this value according to the Stability and Growth Pact's requirement for 'long-term equilibrium or superavit'. We do not adventure an opinion, however, on whether this is the best possible option.

29 In the dynamic analysis, changes in this parameter primarily affect the speed at which equilibrium is reached, if the system is stable, but not the qualitative results.

30 According to the European Commission's QUEST model, a 1 per cent increase in public spending involves an increase of from 0.5 to 0.7 percentage points in the GDP, depending on the country concerned.

31 Assuming for now that *OG*2 remains constant.
32 The output gap certainly continues to appear as one of the fiscal rule's arguments, and this partly limits this restrictive fiscal policy. However, providing parameter f does not have a very high, unrealistic value, the growth in inflation will be greater than the reduction in the output gap, so this stabilizing effect of the budgetary balance will prevail.
33 Tables 8.4 and 8.5 show details of all the possible cases which could occur with different combinations of parameter values. The text and the graphs, however, only refer to the general cases of greatest interest.
34 This effect is represented in expressions (8.43) and (8.54).
35 Although less than in Regime II, due to the expansionary fiscal policy being applied.
36 See expressions (8.54) and (8.55).
37 For a clear exposition of arguments against this negative view on fiscal policy, see Arestis and Sawyer (2003) and Blinder (2004).
38 Although we have always analysed a supply shock, the overall results remain unaltered if a demand shock is considered.
39 For a paper in this line see EEAG (2003).

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9
On the Minskyan Business Cycle

Korkut A. Erturk

9.1 Introduction

Minsky's seminal contribution was to underscore the importance of speculation in economic activity. Emphasizing that a firm's investment decision is inherently a speculative one, he reintroduced asset prices into the Keynesian theory of investment. Any decision to acquire real capital assets, as he was keen to emphasize, bequeathes the firm a certain liability structure that shapes its balance sheet for a long time to come. This liability structure is either validated or contradicted by future events, with possibly dire consequences since firms' expected returns might never be realized. Yet, despite this emphasis on the speculative character of investment decisions, Minsky paid little attention to asset price speculation *per se*, ignoring asset price bubbles and their macroeconomic effects.

From a point of view of the history of thought, Minsky can be seen to have revived a good part of Keynes' analysis in the *Treatise* (Kregel 1992) that was eclipsed by the *General Theory*. But, at the same time, he not only ignored the role played by asset price speculation in Keynes' analysis of the business cycle in the *Treatise*, but also generally refrained from crediting this work as the source of his 'two-price' theory. In Keynes' famous *QJE* article (Keynes 1937a), which Minsky extensively referenced throughout his work, Keynes talked about how people in financial markets tend to fall back on convention in forming expectations about an uncertain future, and emphasized how valuations can change drastically and violently because panic and doubt have a life of their own close to the surface. In the *Treatise*, the changing size of the *bear position* was the very index of what was brewing under the surface, of what he called the 'other view'. It provided a convenient setting for analysing the macroeconomic effects of asset prices the preponderance of market opinion held to be misaligned (Erturk 2006). This was the thread of the argument in the *Treatise* that was overlooked by Minsky, either because his views were formed during the era of financial regulation, when speculation 'could do no harm as bubbles on a steady stream of enterprise', or, perhaps, because he just wanted to stay clear of the acrimonious debates that broke out between Keynes and his critics about the role of the rate of interest after the publication of the *General Theory*. Whatever might have been Minsky's real reason, we neither can know nor does it matter that we do. What, however, is worthwhile is to discuss the importance of the missing part of the analysis from the *Treatise* for Minsky's own account of how a business cycle expansion comes to an end. The point of the chapter is to make that connection.

The essential insight Minsky drew from Keynes was that optimistic expectations about the future create a margin, reflected in higher asset prices, which makes it possible for borrowers to access finance in the present. In other words, the capitalized expected future earnings work as the collateral against which firms can borrow in financial markets or from banks. But the value of long-lived assets cannot be assessed on any firm basis as they are highly sensitive to the degree of confidence markets have about certain states of the world coming to pass in the future. This means that any sustained shortfall in economic performance in relation to the level of expectations that are already capitalized in asset prices is susceptible to engendering the view that asset prices are *excessive*. Once the view that asset prices are excessive takes hold in financial markets, higher asset prices cease to be a stimulant and turn into a drag on the economy. Initially debt-led, the economy becomes debt-burdened.

In this chapter, I suggest that Keynes' views on the alternation of the 'bull' and 'bear' sentiments and asset price speculation over the business cycle can provide a satisfactory explanation for two of Minsky's central propositions in relation to business cycle turning points that have often been found to be less than fully persuasive in the way they have been expounded: (i) that financial fragility increases gradually over the expansion; and (ii) that the interest rate sooner or later increases setting off a downward spiral bringing the expansion to an end.[1] The gist of the said argument from the *Treatise* says that the rise of the bear position during late expansion impairs the ability of the banking system to accommodate rising levels of economic activity and is, thus, the real culprit behind the eventual rise in interest rates during a business cycle expansion. This is typically caused not because fear of inflation, or some other extraneous consideration, forces the central bank to curtail credit to the system, but, rather, because financial sentiment shifts for the worse and asset prices all of a sudden begin to look excessive.

The following discussion is organized in to five sections. In section 9.2 we give a brief overview of the conceptual structure of the argument in the *Treatise*, and section 9.3 discusses the role asset price speculation plays over the business cycle. Then we draw out some of the theoretical implications of the argument in the *Treatise* with respect to the conditions under which speculation can be both stabilizing and destabilizing. Section 9.5 situates Minsky's contribution in the historical context of the marginalization of the two-price theory in the *Treatise* as it has become increasingly overshadowed by the theoretical developments following the *General Theory*. The last section includes a few concluding comments.

9.2 Structure of the argument in the *Treatise*

Keynes' main contention in his *A Tract on Monetary Reform* was that price fluctuations over a business cycle were characterized by systematic changes in the demand for real money balances rather than by exogenous shifts in the money supply. That was why any attempt on the part of monetary authorities to keep the money supply steady would fail to achieve price stability (*CW*, IV: 69). Instead, the more effective policy, in Keynes' view, had to aim at changing the money supply to compensate for the systemic shifts taking place in the demand for real money balances over the credit cycle. If changes in desired money balances had a systemic character, this also meant that the excess of investment over savings could correspond to a fall in demand for money in relation to supply as well. In other words, the dual of the difference between investment and savings did not just have to be an increased supply of money, as Wicksell laid out, but could also come about by a fall in the demand for money balances through dis-hoarding. Likewise, periods of excess savings would be characterized either by increased monetary hoarding or by decreasing money supply, or by some combination of the two. The disaggregation of money demand by the type of agent and transaction in the *Treatise* was thus motivated in part by Keynes' desire to analyze changes in hoarding over the credit cycle.

Keynes' second insight was that in a credit cycle expansion, or the transition from one position of equilibrium to a higher one in the sense of the quantity theory of money, the prices of capital goods varied systematically in relation to those of consumer goods. Later revived by Minsky, this view held that the prices of capital goods are determined in financial markets by profit expectations that are reflected – though not always accurately as we shall see – in securities prices, while consumer goods prices are determined by the relative magnitude of consumer demand in relation to the available supply. Thus, the very *modus operandi* of monetary expansion involved changes in the relative values of capital and consumer goods, and that is why the Classical Dichotomy, Keynes held, was not viable.[2]

Finally, in the *Treatise*, Keynes then linked expected changes in securities prices over the credit cycle to changes in net hoarding – his first innovation – through the variations in the stock demand for financial assets, by what he called the 'state of bearishness'. For instance, a period of early expansion is typically characterized in his view by excess investment, expected increases in asset prices and falling state of bearishness, and thus net dis-hoarding. This makes it all the more easier for banks to accommodate a rising level of activity without having to raise the rate of interest. In this approach, speculation about asset price expectations is an integral part of the investment–savings nexus, where changes in the state of bearishness has a direct *quantity* effect on the relative size of inactive balances without necessarily causing a change in the rate of interest or asset prices in general.

9.3 Asset price speculation in the *Treatise*

In the *Treatise*, monetary circulation is divided into industrial and financial parts, associated, respectively, with the circulation of goods and services and that of titles to financial wealth. The amount of money in industrial circulation is closely related to the level of output and expenditures. Financial circulation, by contrast, reflects primarily the size of the bear position, referring to those who choose to keep their resources in liquid form, having sold securities short. Keynes took the volume of *cash* deposits as a rough measure of the size of industrial circulation and *savings* deposits as that of the financial circulation.[3]

The desire to remain more, or less, liquid is, of course, not independent of the actual changes in security prices. The fall (rise) in security prices in relation to the short-term rate of interest can partially offset the bearish (bullish) sentiment, thus the actual increase (decrease) in the volume of savings deposits also depends on the extent of the fall in securities prices. This implies that, '[t]here will be a level of security prices which on the average opinion just balances the bullishness [or bearishness], so that the volume of savings deposits is unchanged' (*CW*, V: 224). If security prices fall (rise) beyond this point, then the savings deposits might actually decrease (increase).

In the *Treatise*, Keynes defines four types of speculative markets in connection with different configurations of the bear position (*CW*, V: 226). These typically correspond to different phases of the business cycle. The first involves a decreasing bear position, i.e., a decreasing volume of savings deposits, at a time of rising security prices. Keynes calls this a 'bull market with a consensus of opinion' and distinguishes it from a 'bull market with a difference of opinion' where the bear position is increasing at a time when security prices are also rising. In the former case, which typically holds during early expansion, the preponderance of market opinion holds that security prices have not risen sufficiently, while in the latter case, corresponding normally to late expansion, an ever-rising segment of the market thinks that security prices have risen more than sufficiently. The third case, which corresponds to early recession, is a 'bear market with a consensus', and again Keynes distinguishes this from a 'bear market with a division of opinion'. The former involves a rising bear position, i.e., an increasing volume of saving deposits, at a time of falling security prices and the latter a decreasing bear position when security prices are still falling. In the former, the predominant market opinion is that security prices have not fallen sufficiently and that they have fallen more than sufficiently in the latter.

From the point of view of an orthodox theory of finance, it makes no sense to say that security prices have increased or decreased more, or less, than *sufficiently* if no new information has emerged at a given point in time. For, if securities are thought to be undervalued, then arbitrageurs would continue to buy them until their prices are bid up to a level that is no longer considered low. Likewise, if securities are thought to be overvalued, again, arbitrage would bring their value down to a level consistent with what is considered to be their 'true' value. Thus, at a given point in time, with an unchanged information set, the prevailing asset prices must be the best estimates of fundamental values.[4]

However, Keynes' approach in the *Treatise* is consistent with the modern 'noise trader' (or the so-called *behavioural*) approach to finance, which holds that *riskless* arbitrage is not effective in relation to the prices of shares or bonds as a whole and severely limited even when it comes to the relative prices of individual assets (Shleifer and Summers 1990; Shleifer and Vishny 1997). According to this view, even when it is assumed that arbitrageurs know what fundamental values are, they face no *riskless* arbitrage opportunities when actual prices deviate from their true values. For with a finite time horizon, an arbitrageur faces two kinds of risk: when s/he, say, sells overvalued assets short it is possible that by the time s/he is supposed to liquidate his/her position (i) the economy can grow so rapidly that the true values increase, or, more importantly, (ii) asset prices might be even more overpriced. In both cases, the arbitrageur would be experiencing losses. Thus, the fear of loss would limit the initial positions the arbitrageurs take and thus prevent them from driving prices down in any significant way. Moreover, if we drop the assumption that arbitrageurs know what the true values are, the risk of loss they face is higher, and the compensatory shift in demand for the undervalued securities smaller.

In a vein very similar to the modern behavioural approach, in the *Treatise*, Keynes remarks that when prices deviate from their 'true' values no automatic mechanism exists in the short run to check their deviation. *Opinion*, or what we would today call *noise* (Black 1986), moves prices. 'If everyone agrees that securities are worth more, and if everyone is a "bull" in the sense of preferring securities at a rising price to increasing his savings deposits, there is no limit to the rise in price of securities and no effective check arises from a shortage of money' (*CW*, V: 229). However, as prices continue to rise, a 'bear' position begins to develop, and that is what can eventually check the rise in prices. '... [I]n proportion as the prevailing opinion comes to seem unreasonable to more cautious people, the "other view" will tend to develop, with the result of an increase in the "bear" position...' (*CW*, V: 228–9).

In Keynes' discussion in the *Treatise*, the rise of the bear position at a time when security prices are rising plays an important role in explaining the turning point of a business cycle expansion. In his view, 'it is astonishing... how large a change in the earnings bill can be looked after by the banking system without an apparent breach in its principles and traditions' (*CW*, V: 272). Yet, the banking system's ability to accommodate a rising level of production is typically impaired at some point during a business cycle expansion. That happens typically not because the banking sector is held back by the central bank or faces some intrinsic difficulty, but because the financial sentiment falters. The trigger can have a myriad of immediate causes but the underlying reason is almost invariably the fact that the actual performance of profits, though they might still be rising, falls short of the high expectations that underlie asset prices. As the view that the market might be overvalued begins to take hold, the bear position develops, and '... the tendency of the financial circulation to increase, on the top of the increase in the industrial circulation ... break[s] the back of the banking system and cause it at long last to impose a rate of interest, which is not only fully equal to the natural rate but, very likely in the changed circumstances, well above it' (*CW*, V: 272).

9.4 'Beauty contest' and asset price bubbles

Ever since Friedman (1953) argued that destabilizing speculation would be unprofitable, and, thus, unsustainable in the long run, the mainstream view among economists have assumed that speculation as a rule could not be destabilizing. Asset price bubbles were considered highly unlikely, if not impossible, in a 'normally' functioning market.

The intuition behind Friedman's argument rested on a simple view of arbitrage, in which the market comprises smart traders who know the true values and misinformed noise traders. If securities are undervalued, as the argument goes, then the smart traders would continue to buy them until their prices are bid up to their true value. Likewise, if securities are overvalued, smart traders would sell them, bringing their price down to their true value. Indeed, under these conditions, speculation is always stabilizing and profitable. Misinformed noise traders create riskless arbitrage opportunities that smart traders profit from, while making losses themselves. In other words, this implies that the rate of current price change is a function of the difference between the current price and the expected future price, which is by assumption equal to *true* value. In simple terms:

$$\frac{dP}{dt} = j(P^e - P), \tag{9.1}$$

where, P^e, the future expected price, is assumed to be constant ($P^e = \overline{P}$) and equal to the *true* value, and j is the adjustment coefficient indicating the speed with which traders respond to changes in current price. When

$$P > P^e \quad \text{then} \quad \frac{dP}{dt} < 0$$

$$\text{and} \quad P < P^e \quad \text{then} \quad \frac{dP}{dt} > 0.$$

The time path of price is given by,

$$P(t) = P(0)e^{-jt} + P^e,$$

which clearly cannot be unstable, since the stability condition $j > 0$ is always satisfied because the speed of adjustment is positive by definition.

Undoubtedly, the assumption that smart traders or speculators know with certainty what the true value is exceedingly unrealistic. But, even under this strong assumption, it does not necessarily follow that the deviation of the current price of an asset from its true value creates a riskless arbitrage opportunity. As mentioned above, the speculator who sells overvalued assets short can find that by the time s/he is supposed to close his/her position, the true value has increased, or, that the assets in question have become even more overpriced.[5] In both situations, the speculators who have sold securities short would be making losses. Even if the true value is known, it does not follow that it would be equal to the expected future price. Thus, because the fear of making losses would cause smart traders to limit the initial positions they take in an over or undervalued asset, the current price might not smoothly adjust to its true value. Needless to say, if we drop the assumption that speculators know what the true value is, the risk of loss they perceive is likely to be higher, and the compensatory shift in demand for undervalued assets smaller. That is why the modern *behavioural* approach to finance holds that the effect of arbitrage can be severely limited.

This also takes us very close to a world described in Keynes' (1936: ch. 12) famous beauty contest analogy, where speculators base their expectations of future asset prices not only on what they think the true value is, but, more importantly, on what they think the average opinion about the average opinion is. In other words, *noise* (Black 1986) is at least as important as information about true values in causing asset price changes, rendering the resale price uncertain. Uncertainty about the future resale price means that traders lack a terminal value from which to backwardize, which in turn implies that they must not only form higher-order expectations (i.e., on what others think others think) but also decide how much weight to assign them relative to what they themselves think the true value is (Hirota and Sunder 2003). Since no direct information exists on others' higher-order expectations, traders have to infer that from market trends, i.e., the magnitude and direction of changes in current price.

For instance, if a trader observes that the price of an asset (or an asset group) which s/he thinks is already overvalued is still rising in price, s/he is led to surmise that either her/his opinion about the true value is wrong or that the price increase indicates a bubble, i.e., a self-sustained rise in price on account of noise trading driven by the average opinion thinking that the average opinion thinks the price will keep on rising. In either case, the current price changes are likely to gain in importance in how the trader forms his/her expectation about the future price. The current change in price becomes either a proxy for the higher-order expectations or a corrective on opinions about the true value, or, some combination of both.

If so, the crucial variable that determines whether speculation is stabilizing or not very much depends on the relative weight traders assign to their higher-order expectations (i.e., what they think others think others think) relative to their own assessment of what the true value is. To the extent that they do, they become more responsive to the current price change in forming their expectations about the future price. In Kaldor's (1939) formulation, whether speculation is stabilizing or not in this setting depends on the elasticity of future price expectations with respect to present price changes.[6]

If indeed the expected future price can be thought to comprise two parts, then we can write:

$$P^e = \overline{P} + \sigma \frac{dP}{dt}, \tag{9.2}$$

where $\overline{P}$ is what the true value is believed to be (and is assumed constant for simplicity), and σ is the coefficient of elasticity for expectation of elasticity of the future price with respect to the current change in price.

Plugging (9.2) into (9.1) gives:

$$\frac{dP}{dt} = j[\overline{P} + \sigma \frac{dP}{dt} - P],$$

and rearranging we get:

$$\frac{dP}{dt} + \frac{j}{1 - \sigma j} P = \frac{j}{1 - \sigma j} \overline{P}$$

which, in turn, yields the following time path of price:

$$P(t) = [P(0) - \overline{P}] e^{\frac{-j}{1-\sigma j} t} + \overline{P}$$

The stability condition, $\sigma < \frac{1}{j}$, shows that stability depends upon both the elasticity of expectations and the reaction speed. If the reaction speed is assumed to be instantaneous ($j = 1$), a less than unitary elasticity of expectations ($\sigma < 1$) ensures stability as Kaldor argued. In other words, destabilizing speculation – and an asset price bubble – requires that traders revise their expected future price proportionally more than the change in current price. However, the lower is the reaction speed ($j < 1$), the greater is the extent to which the threshold value of σ exceeds unity.

It is highly plausible that both the reaction speed (j) and the elasticity of expectations (σ) might respond to changes in market opinion as to the degree to which asset prices are overvalued. As remarked above, if a trader observes that the actual price is well above what s/he thinks the true value is and still rising, s/he either begins to lose confidence in his/her own opinion on what is reasonable or thinks that asset price increases have acquired the character of a bubble. In either case, an increasing number of traders who might think alike will either leave the market or become much more responsive to current price movements in forming expectations about the future price – either *naïvely* as noise traders or *smartly* as speculators are presumed to do. In this setting, unlike what Friedman foresaw, successful (*read* rational) speculators are those who engage in 'trend' speculation, where they act like noise traders themselves in the short run, trying to feed the bubble rather than help deflate it (De Long *et al.*, 1990).[7] Because the successful speculative strategy entails jumping on the bandwagon of noise traders and knowing when to get off while the rest rides on, this might also imply a rising reaction speed. Thus, any sustained trend of a current price increase from what the market opinion generally holds to be the true value, whatever the cause, is likely to raise both the elasticity of expectations and the reaction speed. While this does not explain how prices become misaligned initially, it suggests speculation can become destabilizing once price deviations exceed in size and duration a certain threshold.

In a similar manner, Keynes' discussion on how asset prices behave over the business cycle, in his *Treatise*, seems to presuppose that speculation can be both stabilizing and destabilizing, depending upon the phase of the cycle. As discussed in the previous section, Keynes argues that agents form expectations about the trend value of asset prices and the weighted average of these opinions tend to shift over the course of a business cycle expansion, which are then reflected in the changing size of the bear position in the economy. He stylistically divides the expansion phase of a business cycle into two parts, where the preponderance of market opinion holds that asset prices are alternately undervalued and overvalued during the early and late periods of the cycle. The latter period owes its existence, and is prolonged in duration, to the extent that the banking system transfers the *bear* funds (the bank deposits of those who have sold securities short) to those who still have a *bullish* sentiment that asset prices will continue to rise. In other words, while asset prices are rising in both periods, their increase is driven in the former by *fundamentals* and in the latter by *speculation*. By implication, while speculation is stabilizing in the former period it becomes destabilizing during late expansion, giving rise to a bubble.

Thus, Keynes' argument in the *Treatise* implies that the elasticity of expectations can vary endogenously over the business cycle. When traders observe that the actual price is well above what they think the true value is and that it is still rising, they not only infer that higher-order expectations are at work but also, in increasing numbers, assign greater weight to them (what they think others think others think) over their own opinion. They begin either to lose confidence in their own judgement of what is reasonable or to think that asset price increases have acquired the character of a bubble. In either case, they become increasingly responsive to changes in current price in forming expectations about the future price. That, in other words, implies a *regime* shift from inelastic to elastic expectations as traders begin to discount their own opinions in forming expectations about the future price.

Keynes' discussion of the trade cycle in the *Treatise* presupposes a regime shift of this sort. During the upswing, actual profits cannot increase at an increasing rate, while asset prices will often do so. Thus, sooner or later, optimistic expectations, and thus the asset prices that they underlie, outstrip the actual performance of profits. The latter, though still rising, eventually falls short of the former, but the bullish sentiment tends to persist. Thus, what eventually 'breaks the back of the banking system', causing the rate of interest to rise, is the development of the 'other view' which holds that asset prices have become excessive.

9.5 Debate on the two-price theory

Robertson (1931) objected to Keynes' employment of two separate principles to determine, respectively, the investment and consumer goods prices in his *Treatise*. He argued that Keynes could insulate the price level of new investment goods from changes in the flow of savings only because he was assuming that over-saving was associated with hoarding and under-saving with dis-hoarding. This argument was only partially true in part because it misspecified the real issue of contention between them. The very logic of the Quantity Equation as an accounting identity, as Wicksell laid bare, requires that a reduction in monetary income (over-saving) involves a decreased monetary circulation. This can come about either through a fall in the total quantity of money or increased hoarding, or some combination of the two. Thus, if the quantity of total money is not decreasing, over-saving has to be associated with an increase in net hoarding, and thus a fall in the overall velocity for the broad money supply. Otherwise, over-saving and thus a fall in monetary income could not have occurred.[8] So, there was something to Robertson's objection. But, the really contentious issue in his criticism was whether or not this increase in inactive balances (hoarding) would also translate into excess demand for financial assets. If it did, as Robertson seems to have argued, then, clearly the price of securities (and thus that of new investment goods) could not be determined independently of savings – as Keynes had done. Thus, Keynes' 'two-price' theory was (or should have been) the central issue in this debate.

In his rebuttal of Robertson, Keynes argued that a situation of over-savings involves windfall losses for a class of entrepreneurs who would be forced to liquidate a part of their asset positions in order to be able to meet their current financial obligations that can no longer be covered by sale proceeds

(*CW*, XIII: 219–36). Thus, the increased demand for financial assets, if indeed inactive balances caused that, would be balanced by the increased supply coming from those entrepreneurs running down their reserves of financial assets to compensate for their windfall losses. In other words, the increase of wealth savers experience at the end of the period would be matched by the decrease of wealth experienced by entrepreneurs facing windfall losses. The prices of financial assets would then remain basically unchanged, provided that the state of bearishness of savers is not significantly different from that of entrepreneurs. While this argument is plausible, it might have detracted attention from the real issue.

For Keynes' stronger argument is, of course, the broader justification for his 'two-price' theory, which he also restated in his rebuttal (*CW*, XIII: 220). In the language of modern finance theory, this can perhaps be put more succinctly: The price of an asset is determined solely by its expected future price, independently of its current flows of supply and demand, if these flows are dwarfed by speculative stocks that are *very* large. Thus, the impact of 'outside' supply and demand on the current price can be only indirect, through its influence, if any, on the expected future price of the asset in question.[9] In a nutshell, this was the gist of Keynes' argument in justification of his 'two-price' theory. Already in the *Treatise*, Keynes had made a distinction between the decision to save in the sense of non-consumption, and the decision about how to dispose of what is not consumed, and remarked that the main consideration in making the latter decision is the current and expected future asset prices, which also influenced how all financial wealth was held. Because the marginal increase in financial wealth, equal to current savings used to purchase securities, was 'trifling' in magnitude compared to the total stock of wealth, expectations about the future asset prices were much more important than the marginal increase in the demand for financial assets. The way he put it, the 'excess bearish' factor, an inverse index of the stock demand for securities, reflected the public's demand for inactive balances (saving deposits) given their expectations (and degree of their confidence in them) about future asset prices, and the current asset prices changed accordingly to the extent the banking sector chose not to accommodate the changes in the public's demand for saving deposits (inactive balances). In other words, with a given banking sector policy, future asset price expectations governed the current prices of securities (and thus those of investment goods), reflecting in part profit expectations in the real economy along with the other considerations summarized under Keynes' famous 'beauty contest' analogy discussed above.

The 'finance' debate that broke out after the publication of the *General Theory* was essentially a continuation of the disagreement Robertson had with Keynes in 1931. It again involved two separate issues – one about consistency in macro accounting, and the other on economic behaviour – that were entangled together, and the former continued to detract attention from the more important disagreement with respect to the latter involving Keynes' 'two-price' theory. As Keynes redefined investment and savings in the *General Theory*, insisting that they were separate but always equal, agreement first had to be reached on expressing 'investment–savings' disequilibrium in terms of a discrepancy between *intended* and *actual* magnitudes, with all the attending confusion about what *intended* savings meant. Then, the focus of the debate again became the monetary corollary of the discrepancy between investment and savings.

In 1931, the issue was the connection between excess savings and increased hoarding (i.e., in the absence of an endogenous fall in the money supply); after the *General Theory*, it became a debate about what was the corollary of an increase in 'intended' investment. A rise in the money supply was ruled out by assumption and 'dis-hoarding' had an immediate price effect by definition. Thus, this time around, the whole debate could only be framed from the 'money demand' side and focused on the pressure an increase in planned expenditures would exert on the interest rate. In his exchanges with his critics, including Robertson among others, Keynes (1937a, 1937b, 1937c, 1938) had to concede that a rise in planned investment would also raise the demand for money prior to its execution, and, thus, all other things being equal, the interest rate. He emphasized banks' overdraft facilities to argue that this effect on the interest rate would not amount to much in practice. Decades later, in another round of 'finance' debate an article by Asimakopulos (1983) set off, it was in a similar vein accepted that additional bank finance would be required until the multiplier process worked itself out, generating enough savings to equal the higher level of investment (Chick 1983, 1997).

The effect of these rounds of 'finance' debates was to link the increased 'planned' expenditures to a prospective increase in the money supply or the interest rate, without, however, bringing into the forefront the more important issue about economic behaviour. If anything, this preoccupation with the accounting problem alone had the effect of placing undue emphasis on the so-called finance demand as a separate motivation to hold money, which appears to have weakened the essential aspect of Keynes' 'two-price' theory. In Davidson's (1978) well-known incorporation of the idea into the IS-LM model, an increase in planned investment not only shifts up the IS schedule but the LM schedule as well, causing the interest rate to go up faster and sooner whenever the level of activity rose. Of course, the verbal explanation of why the interest rate rises was very different than Robertson's 'loanable funds' account, but the end result was the same in obliterating whatever remained intact from what Hicks' called Keynes' 'special theory'.[10]

9.6 Conclusion

As it evolved after the *General Theory*, Keynesian theory had strayed so far from the two-price theory that Minsky (1975) had to re-establish that Keynes was essentially about 'an investment theory of fluctuations in real demand and a financial theory of fluctuations in real investment' (p. 57). Restating the two-price theory, Minsky re-emphasized that changing views about the future exert their influence on the present through their impact on the current asset prices, reflecting the expected profitability of producing investment goods. But, at the same time, Minsky paid little attention to asset price speculation and its macroeconomic effects, and left untouched that part of Keynes' analysis in the *Treatise* about how self-sustained biases in asset prices affect financial sentiment in financial markets over the business cycle.

The point of this chapter has been to argue that what Minsky overlooked in the *Treatise* is of importance for his argument, in that Keynes' account of how financial sentiment shifts over the cycle in this work can help to provide a satisfactory explanation of the turning point of a Minskyan business cycle expansion. Just as in Minsky's account, the expansion in the *Treatise* begins with optimistic expectations enabling firms to capitalize their expected earnings in financial markets and thereby finance their investment expenditures. During the upswing, the actual increase in profits validates the higher asset prices, spurring them to increase further. But, unlike asset prices, actual profits cannot increase at an increasing rate in the course of an expansion. Thus, the rise in profits increasingly lags behind the upward movement in asset prices. As economic performance begins to fall short of the level of expectations that are capitalized in asset values, the view that asset prices are excessive begins to take hold in financial markets and the bear position gains strength. This is the point at which higher asset prices tend to become a drag on the economy rather than a stimulant, and the pressure on the banking system to raise the interest rate begins to grow. Thus, what ultimately impairs the ability of the banking system to accommodate a rising level of economic activity is the fact that at some point during an expansion the financial sentiment falters, and that is why sooner or later the interest rate rises as Minsky insisted that it does.

Notes

1 See, among others, Lavoie (1986, 1992: 199).
2 After the *General Theory*, this idea all but disappeared as macroeconomics came to be associated with one-commodity models even among Keynesians (Leijonhufvud, 1968: 23).
3 Keynes maintained that saving deposits would typically be held in the form of 'deposit accounts' (which corresponds to time deposits in the US) and while cash deposits would take the form of 'current accounts' (checking or demand deposits in the US).
4 The more elaborate justification of this position is based on 'the efficient market hypothesis', which has gained currency among economists after Samuelson's (1965) 'proof' that in a market that is *efficient* in appropriating all available

information stock prices should exhibit a random walk and Fama's (1965) demonstration that they almost actually do. But neither proposition is considered valid any longer in the finance literature. Empirically, it is shown that stock prices do not exhibit random walk, and theoretically it is shown that *unforeseeable* prices are neither necessary nor sufficient for *rationally* determined stock prices. See, among others, Lo and MacKinlay (1999), Bossaerts (2002) and Shleifer (2000).

5 Shleifer and Summers (1990) call these, respectively, the *fundamental value* and the *noise trader* risk.

6 See also Hicks (1946: 205–6).

7 In the modern finance literature on asset price bubbles the emphasis, until recently, was on rational traders' risk aversion which was thought to prevent them from eliminating noise-driven price movements. However, the focus has been shifting to 'trend' speculation as the winning strategy for speculators, a fact well known to market participants all along (Soros 1987; Temin and Voth 2004).

8 In his haste to make the point that excess savings and increased hoarding were not one and the same, Keynes appears to have caused confusion by insisting that over-saving had no particular relation to increased inactive balances unless the banking sector chose to supply a higher amount of saving deposits, without, however, indicating that what he took as his *default* case was an endogenous fall in the supply of money. Though, technically, excess savings can be associated with neither a fall in the money supply nor increased net hoarding in a given period if 'non-GDP' transactions increase inordinately relative to those on the currently produced output, but this cannot be generally the case.

9 Ironically, the 'efficient market hypothesis', which the detractors of Keynes were quick to embrace, also presupposes that the current asset prices are solely determined by their expected future prices independently of outside supply and demand.

10 While Hicks (1937) arguably stood Keynes' GT on its head in his famous review article, he also appears to have identified accurately what was unique about his theory. This was, in his opinion, the notion that an increase in expenditures and income did not necessarily put an upward pressure on the interest rate. Hicks called this Keynes' 'special theory', and distinguished it from the GT which in his view was closer to orthodoxy since Keynes' argument there implied that – as his IS/LM formulation he believed made evident – an increase in expenditure led to a rise in the interest rate, all other things being equal (p. 152). The 'special theory' Hicks was referring to is but the essential feature of the 'two-price' theory, whereby asset prices are determined independently of investment and saving flows.

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10

Minsky's Vision and its Relationship with *The General Theory*

Elisabetta De Antoni

10.1 Introduction

Minsky is generally considered to be one of the main exponents of the Post Keynesian School (King 2002). He himself presented his theory as an authentic interpretation/a legitimate extension of *The General Theory.*[1] Minsky's theory flows into his financial instability hypothesis, according to which a financially advanced economy is structurally unstable,[2] tending to move through a sequence of an expansion, a speculative boom and a financial crisis followed by a debt deflation and a deep depression. Minsky's up-to-dateness consists precisely in his placing finance and financial instability at the centre of his analysis.

The financial instability hypothesis – a hypothesis that, as we have just stated, Minsky attributes to Keynes – is at the same time 'an investment theory of the business cycle and a financial theory of investment' (Minsky 1978: 30). From the former point of view, it is a theory which identifies investment as the primary cause of income fluctuations (Minsky 1986: 171).[3] From the latter point of view, it is a theory which focuses on the ways in which investment is financed and on the perceived risks connected to indebtedness.

Starting from these presuppositions, sections 10.2 and 10.3 will examine, respectively, Minsky's investment and business cycle theory. Section 10.4 will examine the recent applications of Minsky's financial instability hypothesis to the real world. Section 10.5 will bring to light the assumptions implicit in Minsky's theory. These assumptions imply the existence of profound differences between Minsky's financial instability hypothesis and *The General Theory*. The former, therefore, cannot be considered as an authentic interpretation/a legitimate extension of the latter. Minsky deals with a vibrant economy with upward instability, naturally inclined to overinvestment and overindebtedness. *The General Theory*, by contrast, deals with a depressed economy, tending to chronic underinvestment and thus to high and long-lasting unemployment. These conclusions are summarized in section 10.6.

10.2 Minsky's financial theory of investment

According to Minsky, the basic characteristic of a capitalist economy is the existence of two prices:[4] the (more volatile and uncertain) price of capital assets and the price of current production. Belonging to both categories, investment has the function of aligning the two prices. By so doing, however, it attracts uncertainty, passing it on to the rest of the economy.

Figure 10.1 depicts the two prices at the core of Minsky's analysis with the broken lines, which appear to be similar to those in Tobin's q theory of investment.[5] The broken horizontal line P_k gives both the price of capital assets and the demand price for investment goods. Capital assets are valuable because they are a source of expected profits which – depending upon the scarcity of capital and therefore on expected demand instead of on the marginal productivity of capital – are prone to a high degree of uncertainty. The price of capital assets is thus equal to the present value PV of these expected profits Π_e; by analogy, it also represents the demand price for investment goods. The rising broken curve P_i gives the supply price of investment goods, similar to the price of current production. It consists of the technologically determined cost (which, given productive capacity, from a certain point curves upwards) plus the interest on the short-run financing required by the production of investment goods plus the mark-up. The intersection between the broken demand price horizontal line P_k and the broken supply price curve P_i determines the level I_n of investments in Figure 10.1. This level can be called 'notional' because firms do not yet know if and how it can be funded.

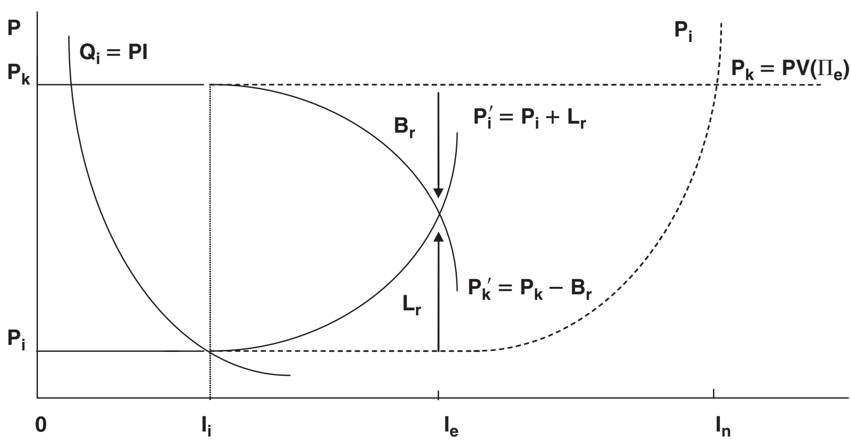

Figure 10.1 The determination of investment

After firms have identified the profitable opportunities for investment (I_n in Figure 10.1) whose present value $P_k = PV(\Pi_e)$ is higher than the cost P_i, they must decide how to finance the purchase of new machinery. To this end, they must first foresee the internal funds (gross profits minus taxes and debt commitments) that they will be able to accumulate during the gestation period 'between the decision to invest and the completion of investment' (Minsky 1986: 185). The difference between the value of profitable investments and the expected internal funds will give the extent of external funds (loans, bonds or equities financing) demanded by firms at the moment of purchase. In Minsky's view, the supply of funds aligns itself with the demand.

The above financial considerations are represented by the solid lines in Figure 10.1. The equilateral hyperbola $Q_i = PI$ gives the combinations of P and I compatible with the internal funds Q_i that the firms foresee accumulating during the gestation period of investment. The intersection between the equilateral hyperbola Q_i and the supply price curve P_i gives the level of investment – I_i in Figure 10.1 – that can be financed with the expected internal funds. For investment levels greater than I_i, firms will have to resort to indebtedness. Indebtedness in its turn involves the risk – a borrower's risk (B_r) for firms and a lender's risk (L_r) for their financiers – that expectations may be wrong and that, once installed, investment generates profits which are less than debt commitments. *Ceteris paribus*, this risk increases with debt commitments and therefore with indebtedness.

For investment levels greater than the one that can be internally funded, i.e. greater than I_i in Figure 10.1, the curve of the demand price for investment goods and the curve of their supply price must be adjusted for the increasing risks related to indebtedness. The result is again represented by the solid lines in Figure 10.1. The borrower's risk-adjusted demand price curve, shown as $P'_k = P_k - B_r$ in Figure 10.1, is obtained by subtracting the borrower's risk B_r from the original demand price P_k. To quote Minsky (1986: 190): 'Borrower's risk shows up in a declining demand price for capital assets. It is not reflected in any financing charges; it mirrors the view that increased exposure to default will be worthwhile only if there is a compensating potential capital gain.' The risk-adjusted supply price curve, shown as $P'_i = P_i + L_r$ in Figure 10.1, is obtained by adding the lender's risk L_r to the original supply price P_i. To quote Minsky again (1986: 192): 'The supply schedule of investment goods rises after some output. However, lender's risk imparts a rising thrust to the supply conditions for capital assets independent of technological-supply conditions. This rising thrust takes a concrete form in the financing conditions that bankers set. In loan and bond contracts, lender's risk is expressed in higher stated interest rates, in terms to maturity, and in covenants and codicils.'

The intersection between the solid line of the borrower's risk-adjusted demand price P'_k and the solid line of the lender's risk-adjusted supply

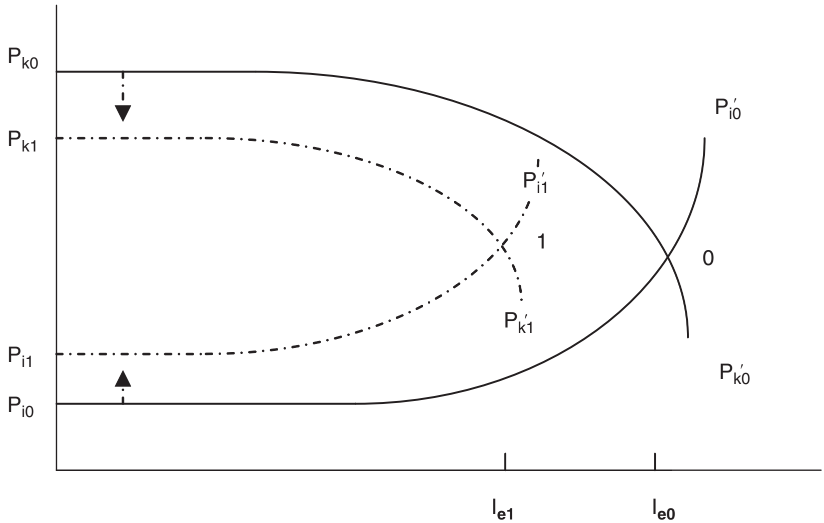

Figure 10.2 The effect on investments of an increase in interest rates

price P_i' determines the effective level of investments, I_e in Figure 10.1. The excess of effective investments I_e over internally financed investments I_i shows the level of indebtedness. The gap between the original demand price $P_k = PV(\Pi_e)$ and the original supply price P_i, corresponding to I_e, gives the safety margins required by firms and their financiers *vis-à-vis* the risks related to indebtedness.[6] Together with the capitalization factor[7] used to calculate the original demand price $P_k = PV(\Pi_e)$, these safety margins are the channel through which uncertainty influences investment decisions.

In order to analyse the implications of the preceding analysis, let us see what happens if the rate of interest increases. The initial situation is represented by the solid lines in Figure 10.2. Following Minsky (1986: 195), the long-term rate of interest is used to actualize expected profits; it therefore negatively affects the original demand price for investment $P_k = PV(\Pi_e)$. The short-run rate of interest represents a cost for the producers of investment goods and thus positively affects the original supply price of investment. In the presence of a general increase in interest rates, the original (and consequently the adjusted) demand price for investment falls as long as long-term interest rates increase, while the original (and consequently the adjusted) supply price of investment rises as short-term interest rates rise. As shown by the shift from the solid to the broken lines in Figure 10.2, the overall effect is a fall in effective investments from I_{e0} to I_{e1}.[8]

To sum up, Minsky's analysis confirms the traditional negative relationship between investments and the rate of interest. Its novel feature is that this relationship remains in the background. Minsky's 'financial' theory of investment is a theory inspired by Keynes (Minsky 1972) which focuses on the ways in which investment is financed and on the risks connected to indebtedness. Dominating the scene are expectations about the fulfilment of debt commitments and the degree of confidence in these expectations.

10.3 Minsky's business cycle theory

Minsky totally rejects the 'crutch' represented by the concept of equilibrium. Firstly, he questions the tendency towards a long-run general equilibrium reintroduced by the Neoclassical Synthesis (Patinkin 1956). Insofar as wage and price deflation is associated with a fall in profits, it decreases firms' ability to fulfil inherited debt commitments and consequently jeopardizes the robustness of the financial system, with possible depressive effects on long-term expectations and investments.[9] Secondly, Minsky also questions the less ambitious concept of short-run equilibrium. This is a constantly changing equilibrium that the system can reach only by chance and momentarily. Instead of speaking of equilibrium or disequilibrium, Minsky – like Joan Robinson (1971) – argues in terms of states of tranquillity, which nurtures disequilibrating forces bound to gain strength over time.[10]

Specifically, Minsky's starting point is that 'Stability – or tranquillity – is destabilising' (Minsky 1975: 127; Minsky 1978: 37), and that 'the fundamental instability is upward' (Minsky 1975: 165; 1986: 119–220). A period of tranquillity (in which the financial system is robust and there are no major shocks, so that profits are systematically greater than debt commitments) increases the confidence of firms and financial intermediaries and consequently decreases both the value placed upon liquidity (and thus the discount rate used to calculate the present value of expected profits) and the borrower's and lender's risks. Consequently, in Figure 10.1, the price of capital assets $P_k = PV(\Pi_e)$ increases and the desired safety margins decrease. The result is an increase in effective investment financed by indebtedness (Minsky 1986: 183) whereby tranquillity evolves into an expansion.

The just-mentioned increase in investments triggers a deviation-amplifying mechanism based on the interdependence between investments and profits. Let us consider the initial link of this interdependence, the one from investments to profits. Minsky adopts a conception *à la* Levy-Kalecki-Kaldor according to which income distribution mirrors the level and composition of aggregate demand rather than input productivity. At the aggregate level, the rise in investments provokes an income expansion which turns into a rise in profits.[11] As we shall see, this rise in profits further increases investments.

The link from profits to investments is shown in Figure 10.3. The initial situation is represented by the solid lines. Initially, following Minsky (1986:

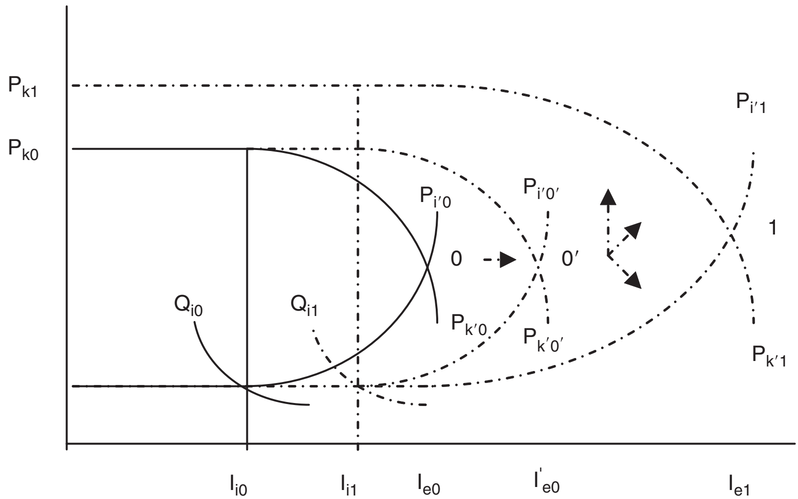

Figure 10.3 The effects on investments of an unexpected increase in profits

193–4), the increase in profits gives rise to an increase in the available internal funds Q_i, thereby causing a rightward shift of the equilateral hyperbola $Q_i = PI$, of the level of internally financed investments I_i, and of the borrower's and lender's risks starting from I_i. As shown by point 0′, the result is an internally funded increase in effective investments (from I_{e0} to I'_{e0}). This, however, is not the end of the story. By increasing the level of profits expected after the installation of the investment goods Π_e, the rise in current profits has two further effects. First, it increases the original demand price for investment goods $P_k = PV(\Pi_e)$. Secondly, it increases confidence in the future fulfilment of debt commitments, thus reducing the borrower's and lender's risks.[12] The result of both the effects is a further increase in effective investment (from I'_{e0} to I_{e1} in Figure 10.3) that this time is financed by indebtedness.

As a consequence of the deviation-amplifying mechanisms resulting from the interdependence between profits and investments, the initial expansion turns into an investment boom. As shown in Figure 10.3, the increasing investments are associated with increasing indebtedness. Moreover, any given amount of indebtedness is now associated with lower safety margins. Economic growth thus gives rise to a more fragile financial system.[13] As far as financial fragility is concerned, Minsky's account goes beyond Figure 10.3. Amid the boom's general euphoria, firms' debt commitments increase more rapidly than profits, and eventually rise above them. Given the expectation of a future bonanza, firms – with the consent of their financiers – start financing the principal by indebtedness (speculative financing) and also interest payments (ultra-speculative or Ponzi financing). The fulfilment of debt commitments is no longer mainly based on profits but, respectively, on the rolling over or the increase in indebtedness. From being initially robust the financial system thus becomes fragile.

As if this were not enough, the persistence of the boom inevitably ends up by creating either bottlenecks in the financial system or inflationary pressures in the goods market that push the central bank in a deflationary direction. In both cases, the result is an increase in the rate of interest.[14] The rise in the interest rate brings the boom to an end, turning the investment–profit–investment link into a downward spiral. The unexpected increase in the cost of funds is thus associated with the unexpected fall in (the already insufficient) profits. Given the fragility of the financial system, fulfilment of inherited debt commitments would require an increase in indebtedness. This solution, however, is neither desirable nor possible because the confidence underlying indebtedness fades away. We thus come to the financial crisis: firms are no longer able to fulfil their debt commitments in the normal way, i.e. by profits or indebtedness (Minsky, 1982b).

As a consequence of the crisis, the primary aim of firms (shared by their financiers) is to fulfil inherited debt commitments rather than financing new investments. The only way to achieve the new target is to sell assets, which after the boom are mainly illiquid assets. The fall in asset prices reduces the net wealth of firms and financial intermediaries; this in its turn reinforces the need to squeeze indebtedness by selling assets. Asset prices thus fall precipitously. The fall of capital asset prices strengthens the fall of investments and profits, and vice versa. The financial crisis thus turns into a debt deflation, which, in Minsky's framework, is an asset price as well as a profit deflation (Minsky, 1992). Debt deflation will eventually make the fulfilment of debt commitments impossible. The consequence will be a wave of bankruptcies which in its turn will end in a deep depression.

Destruction, however, is creative. Only hedge units (units able to fulfill debt commitments by profits) survive. Under these circumstances, a phase of tranquillity will suffice to reactivate the sequence just described. According to Minsky's financial instability hypothesis, the system will again experience an expansion, a speculative boom, a financial crisis and a debt deflation, along with a deep depression. On turning to the real world, Minsky finds confirmation of his analysis. The financial instability of the US economy, which he had previously denounced (Minsky, 1963), surfaced in the mid-1960s, giving rise to the crises of 1966, 1970, 1974–5, 1979, and 1982 (Minsky, 1986). Financial instability had, however, also characterized the periods preceding the two world wars. This confirms that financial crises are systemic and not idiosyncratic (Minsky, 1991). Looking ahead, Minsky (1982a) wonders whether 'It' can happen again. 'It' is the Great Depression and Minsky's answer is affirmative.

10.4 The applications of Minsky's financial instability hypothesis to the real world

Minsky's analysis has been utilized recently to interpret important instability episodes, which are generally related to situations of upward instability. As we have seen, during his life, Minsky himself saw a confirmation of his analysis in the numerous financial crises experienced by the American economy. Some authors extend Minsky's preoccupations with the financial stability of the USA to the present. Together with other economists of the Levy Economics Institute, Godley, Izurieta and Zezza (2004) focus on the financial imbalances currently characterizing the American economy. Given the heavy indebtedness of the private sector and the large government and external deficits, the maintenance of satisfactory growth in the medium term will require a consistent devaluation of the dollar. This will be coupled with a fall in the domestic absorption of goods and services which will impart a deflationary impulse to the rest of the world.

Sawyer (2001) criticizes the European single currency from a Minskyan perspective. Minsky's approach would have implied rather different policy arrangements for the European monetary union. The primary task assigned to the European Central Bank would have been financial (rather than price) stability. The importance of lender of last resort interventions in aborting and containing debt deflations (and therefore the thrust towards deep depressions) would have been recognized instead of being ignored. The role of fiscal policy in ensuring financial stability and in supporting the economy would have been recognized, instead of subordinating fiscal to monetary policy in controlling inflation. The scope of fiscal policy would have been expanded through the institution of a European federal budget instead of being limited through the introduction of constraints on national government budgets. The deflationary impacts of fiscal constraints that led to the recent loosening of the Growth and Stability Pact would have been recognized in advance of their taking place.

Minsky's financial instability theory was mainly developed in the context of a closed economy. Its extension to the open economy, however, gave rise to stimulating interpretations of the crisis that took place in Southeast Asia in 1997–98. According to Arestis and Glickman (2002), the possibility of borrowing abroad fuels both the upward instability and the tendency towards financial fragility of open, liberalized, developing economies. In the absence of capital controls – and especially if interest rates are low in the major financial centres – liquid funds will switch into these economies, reinforcing their upward instability. Through the increase in domestic deposits and in domestic security prices, capital inflows will also stimulate both the availability of credit and the propensity to borrow, strengthening the tendency towards a higher degree of indebtedness. In addition, units which borrow abroad will have to fulfil their debt commitments in foreign currency and thus will also become vulnerable to movements in the exchange rate. The increase in indebtedness, together with the denomination in foreign currency of part of it, will stimulate the tendency towards financial fragility. The economy will thus become prone: (i) to a crisis that is domestic in origin but impacts on its external situation (a '*d to e*' crisis); (ii) to a crisis that is external in origin but impacts upon its domestic situation (a '*e to d*' crisis); and (iii) to deviation-amplifying interactions between (i) and (ii).

The '*d to e*' crisis is essentially the one described in section 10.3. Once more, however, the openness of the economy accentuates the problems. When the crisis evolves into a debt deflation and a big depression, a flight towards liquidity will break out. Some investors will seek to diversify the now larger liquidity by shifting into other currencies. Others will act in anticipation of behaviour of this kind. The domestic currency will be sold heavily and this will trigger an exchange rate crisis. The devaluation will increase the difficulties of the units with debt commitments in foreign currency and cash receipts in domestic currency, thus intensifying the crisis.

The opening of the economy introduces also the possibility of an '*e to d*' crisis. Capital inflow sustains the domestic exchange rate and thus worsens the current account. As the ratio between foreign indebtedness and foreign reserves grows, speculators may begin to doubt the ability of the state to support the currency and may move, possibly on a massive scale, against the currency concerned. As a consequence of the devaluation, units with debt commitments in foreign currency and cash receipts in domestic currency will experience more difficulties in fulfilling their debt commitments. Capital outflow will imply a decrease in domestic deposits as well as the sale of domestic assets and thus the fall in their prices. As a consequence, the rolling over of domestic debts will also become more difficult. The devaluation can thus trigger a financial crisis. Under the pressures emanating from the international financial system, during both the '*d to e*' and the '*e to d*' crises, the central bank will raise interest rates in order to bolster the exchange rate. In an open economy, monetary policy thus ends up accentuating the debt-deflation processes instead of mitigating them as Minsky suggested.

According to Arestis and Glickman (2002), the crisis experienced in Southeast Asia in 1997–98 is an '*e to d*' crisis. Its distinctive characteristic is that the crisis experienced by the various countries coincided with the spread of financial liberalization processes. Financial liberalization sweeps away the rules and conventions which previously governed the financial system, speeding up the process by which debt ratios rise. It also weakens the barrier of financial conservatism which, in Minsky's view, acts to contain speculative behaviours. From a Minskyan perspective, the connection between liberalization, financial instability and financial crises is thus perfectly understandable. As Minsky claimed, controls on domestic financial systems and on capital movements preserve the stability of the financial system.

Kregel (2001) also offers a Minskyan interpretation of the Asian financial crisis. Both directly, and also through its effects on the exchange rates, a rise in foreign interest rates increases the debt commitments in the indebted developing countries. Whether this greater fragility turns into instability and crises will depend upon the willingness of foreign banks to extend foreign currency lending. If foreign banks are unwilling to do so, the 'normal functioning' of the financial system will be compromised. The result will be a Minskyan debt-deflation process. Firms and banks will try to liquidate their stocks of goods and assets in order to fulfil their debt commitments and reduce their debts. The consequent fall in the price of their products, in the price of their assets and in the value of the domestic currency, however, will further diminish their ability to fulfil debt commitments and to reduce debts.

Mistaking the crisis for a traditional balance of payments crisis, the IMF required a reduction in government expenditure and tight monetary targets. This, however, was the opposite of what was required from the point of view of avoiding a Minskyan debt-deflation crisis. A slowdown in domestic demand could only decrease the cash receipts of firms, while the increase in interest rates could only increase their financing costs. A more reasonable response would have been to attempt to slow down the withdrawal of foreign lending and to ease the conditions of payment. At the same time, expansionary monetary and fiscal policies should have been adopted in order to reinforce the financial system and hinder debt deflation.

Arestis (2001) compares the Southeast Asian crises of 1997–98 with the crises of the period 1977–96. All these crises have some features in common. They were preceded by a process of financial deregulation that prompted a climate of euphoria and speculation. However, those of 1997–98 were currency speculative-induced crises while those of 1977–96 were balance of payments speculative-induced crises. The crisis of 1997–98 was triggered by the devaluation caused by the reversal of capital flows as a result of the rise of the ratio between foreign indebtedness and foreign reserves. The origin of the crises of the period 1977–96 was, instead, the balance of payments deficit due to an unsustainable speculative consumption boom. In any case, both kinds of crises are perfectly understandable from a Minskyan perspective.

The frequency and the enormous costs of financial crises point to the need for a reform of the international financial system. The massive increase in the volume of foreign exchange transactions over recent years, relative to the volume of international trade, implies that the financial transactions influenced by differential interest rates and by expected exchange rate movements have grown relative to transactions related to international trade. According to Sawyer (2001), this is not unconnected with the higher volatility of exchange rates observed in the post-Bretton Woods era. In the presence of foreign indebtedness, exchange rate volatility can threaten the calculations of either the lender or the borrower, thereby increasing financial instability. On this basis, Sawyer (2001) suggests: (i) measures to reduce international financial flows not related to trade or to foreign direct investment, for instance the introduction of a Tobin tax; (ii) the regulation of global financial institutions; (iii) the institution of an international lender of last resort; and (iv) the international coordination of domestic and exchange rate policies.

10.5 The implicit assumptions of Minsky's financial instability hypothesis

Minsky's financial instability hypothesis is the result of implicit assumptions that at first sight are anything but evident. Between the lines, in many cases Minsky seems conscious of them. This may even be the reason why he prefers to speak of a financial instability 'hypothesis' rather than of a financial instability 'theory'. Whatever the case may be, these implicit assumptions are crucial for his financial instability hypothesis. As we shall see, in their absence tranquillity may not turn into an expansion, expansion may not turn into a boom, and the boom may not give rise to a fragile financial system.

To start with, let us return to the investment function. To the 'normal' case described in Figure 10.1 and referred to thus far, Minsky adds the two 'extreme' cases shown in Figure 10.4 (Minsky 1975: 127; Minsky 1986: 195). Case A is the case of 'present value reversal'. Profit expectations, Π_e, are so depressed that the original demand price curve for investment goods, $P_k = PV(\Pi_e)$, lies below the original supply price curve P_i. There are no profitable opportunities to invest. Regardless of the availability of funds, firms do not invest. Case B is the one in which firms associate investments with an increasing risk that profits are lower than expected and even negative.[15] The result is a risk-adjusted demand price curve for investment goods, P'_k, which slopes sharply downwards from the outset. Its intersection with the

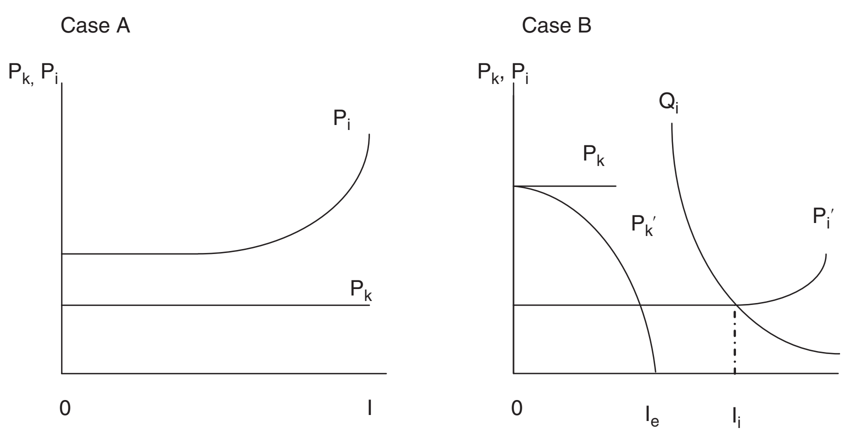

Figure 10.4 Minsky's two 'extreme' cases

adjusted supply price curve P'_i gives rise to effective investments, I_e, smaller than the ones that can be internally financed, I_i. The excess of internal funds over the value of effective investments is used to reduce indebtedness or to accumulate financial assets.

What then characterizes the two 'extreme' cases? In Minsky's 'normal' case shown in Figure 10.1, investments are constrained by the financial risks connected to indebtedness, i.e. the risk that profits will fall below debt commitments. In the two 'extreme' cases shown in Figure 10.4, by contrast, investments are constrained by their insufficient profitability (Case A) or by the economic risk of low or even negative profits (Case B). Moreover, Minsky refers the two extreme cases (Minsky 1975: 115; 1986: 195) to the 'situations after a crisis', i.e. to the contractionary phase of the cycle. He then, implicitly, considers the expansionary phase of the cycle as 'normal'. Minsky is thus referring to a vibrant and optimistic economy in which profitable investment opportunities and confidence abound, an economy with upward instability naturally inclined to overinvestment and overindebtedness. As we shall see, if he had referred to a stagnant economy with depressed or highly risky profit expectations, his financial instability hypothesis would not have held.

Let us assume that the 'after crisis' debt deflation and deep depression evolve into a situation of tranquillity in which the investment function is the one shown in Case A of Figure 10.4. According to Minsky, tranquillity increases the level of confidence, giving rise to a wealth reallocation from money to the alternative assets. Under these circumstances, the price of capital assets P_k – by analogy equal to the original demand price for investment goods – increases.[16] In Case A of Figure 10.4, however, there is no reason why P_k should necessarily rise above P_i and thus make investments profitable. If P_k continued to lie below P_i, however, its increase would not stimulate investments. As a consequence, tranquillity would not turn into an expansion.

Let us now assume that tranquillity is instead associated with the investment function shown in Case B of Figure 10.4. This time, the rise in the original demand price for investment goods P_k (and consequently in the adjusted demand price P'_k) succeeds in stimulating investments. Tranquillity thus turns into an expansion. Contrary to what Minsky claims, however, this expansion does not evolve into a boom. In Case B of Figure 10.4, effective investments do not depend upon internal funds and thus on profits. While investments continue to create profits, profits do not stimulate any more investments.[17] The interdependence between investments and profits thus dissolves. As a consequence, the deviation-amplifying mechanisms that, according to Minsky, should transform expansion into a boom stop working.

To sum up, if the investment function were the one shown in Cases A or B of Figure 10.4, tranquillity would not turn into an expansion, and expansion would not turn into a boom. In both cases, Minsky's financial instability hypothesis would not hold. For unexplained and mysterious reasons, Minsky assumes that during the phase of tranquillity the investment function returns to being the 'normal' one shown in Figure 10.1. Even then, however, the relationship envisaged by Minsky between investments on the one hand and profits and indebtedness on the other seems questionable.[18]

Following Minsky, let us assume that tranquillity stimulates the original demand price for investment goods enough to restore the 'normal' situation shown in Figure 10.1. Starting from this assumption, let us focus on the relationship between investments and profits. In Figure 10.1, Minsky takes expected internal funds Q, and therefore profits, as given independently of the level of investments. Under these circumstances, higher investments inevitably imply higher indebtedness. In his subsequent works, Minsky realizes that this approach holds only for the individual firm. At the aggregate level, profits – and thus internal funds – increase with investments.

In some passages (Minsky 1975: 114, 1980, 1986: 193–4), Minsky attempts to incorporate this phenomenon into his investment function. Firstly, he claims that, even if investments generate an equal amount of profits, profits must cover overheads and ancillary expenses, financial commitments and so on. The remaining internal funds Q_i are thus lower than the investments generating them (Minsky 1986: 153). Minsky's conclusion is that investments are only partially able to self-finance themselves; thus, they inevitably require indebtedness. Secondly, and above all, Minsky assumes that internal funds generated by investments are not used to reduce their external financing, but are automatically reinvested.[19] In Figure 10.3, for instance, the increase in the available internal funds causes a rightward shift of the equilateral hyperbola Q_i, turning into an equivalent internally funded increase in effective investments from I_{e0} to I'_{e0}. The assumption that profits are automatically reinvested, however, is not necessarily true. If internal funds were used to reduce external funding instead of being reinvested, however, the interdependence between profits and investments would dissolve. As in Case B of Figure 10.4, expansion would not turn into a boom.

Let us now consider the relationship between investments and indebtedness. In Figure 10.3, the increase in profits does not only cause an internally funded increase in effective investments from I_{e0} to I'_{e0}. By increasing the profits expected after the installation of the investment goods Π_e, the rise in current profits on the one hand increases the original demand price for investment goods $P_k = PV(\Pi_e)$ and on the other increases confidence in the future fulfilment of debt commitments, thus reducing the borrower's and lender's risks. The result is a further – this time debt financed – increase in effective investment from I'_{e0} to I_{e1} in Figure 10.3. Minsky is thus *implicitly* assuming that the increase in profits is perceived as permanent. Without this assumption indebtedness would not rise. Insofar as profits are reinvested, the interdependence between profits and investments would keep generating a boom. If the increase in profits is not perceived as permanent, however, this boom would be internally financed and consequently would not lead to any financial fragility.

Following Minsky, let us continue to assume that financial fragility increases during the boom. Specifically, let us assume that debt commitments increase more rapidly than profits. In this case, internal funds (gross profits minus taxes and debt commitments) fall. According to Figure 10.3, this has depressive effects on investments. The increase in financial fragility thus triggers a deviation-counteracting mechanism that hinders the boom. Minsky does not even take it into account.

10.6 Conclusions

Minsky's implicit assumptions bring to light the unexplored core of his vision. He considers as normal an economy with unutilized resources and plenty of profitable investment opportunities. In this economy, firms use all their profits and borrow in order to invest. Investment is limited by the risks connected to indebtedness, not by an insufficient or risky profitability of investments. Any increase in profits is not merely reinvested. Because it is perceived as permanent, it improves profit expectations and confidence, thus stimulating externally financed investments. If this is true, however, Minsky's financial instability hypothesis is not an interpretation/a legitimate extension of *The General Theory*. Minsky deals with a vibrant economy with upward instability, naturally inclined to overinvestment and overindebtedness. *The General Theory*, by contrast, is concerned with a depressed economy, tending to chronic underinvestment and thus to high and long-lasting unemployment.

Despite these differences, the basic vision is the same in each case. Consider, for instance, the importance attributed to uncertainty and accumulation, the rejection of the assumption of individual and collective rationality, the crucial role assigned to institutions and so on. On this basis, the financial instability hypothesis and *The General Theory* may be considered to be two faces of the same coin; however, they are two faces that look in opposite directions. From this perspective, Minsky may be considered to have extended the economics of *The General Theory* to a vibrant and euphoric economy, making it even more general and modern. If Keynes had observed the US economy of the last fifteen years, he too might have begun to worry about upward instability. On the other hand, Minsky's upward instability seems totally foreign to today's European economies.

Notes

1 Specifically, Minsky refers to Keynes (1936) and Keynes (1937). See Minsky (1975, 1977). In Minsky's re-reading, Keynes lived through the experience of the Great Depression. He thus dwelled upon the particular case of an economy which, as a

consequence of a financial crisis followed by a debt deflation, fell into a deep and long-lasting depression. According to Minsky, however, Keynes considered the Great Depression to be only an extreme case. Despite not developing it, Keynes had in mind a cyclical perspective: 'The evidence that it is legitimate to interpret *The General Theory* as dealing with an economy that is cyclical by reason of its essential institutions is spread throughout the volume. References to cyclical phenomena occur not only in chapter 22 of *The General Theory*, 'Notes on the Trade Cycle', which explicitly deals with business cycles, and in the rebuttal to Viner in The Quarterly Journal of Economics of February 1937, but throughout his book. When *The General Theory* is read from the perspective that the subject matter is a sophisticated capitalist economy, whose past and whose future entail business cycles, the ratifying references for an interpretation within a cyclical context are everywhere evident'(Minsky 1975: 58).

2 On this important aspect, see Vercelli (2001). According to Vercelli, Minsky had in mind a system whose structure and whose dynamic behaviour endogenously change with the passing of time. Keynes, by contrast, referred to a short-run unemployment equilibrium destined to fluctuate whenever current views about the future change.

3 According to Minsky, the role of consumption is minor and mainly consists in its multiplier effects.

4 On this, see Kregel (1992).

5 See, for instance, Tobin and Brainard (1977).

6 If realized profits prove to be less than expected, safety margins will increase firms' capacity to meet debt commitments and bank's capacity to absorb losses. They consequently increase the robustness of the financial system, meaning its capacity to absorb the shocks under normal functioning conditions (i. e. without implying the sale of assets). If realized profits prove to be equal to or greater than those expected, safety margins will represent a compensation to firms and their financiers *vis-à-vis* their respective risks.

7 To quote Minsky (1986: 183): 'As sketched in the previous section, the quantity of money, the value placed upon liquidity, and the income and liquidity characteristics of the various capital and financial assets lead to the set of prices of capital and financial assets.' According to Minsky, the value placed on liquidity is positively related to the level of uncertainty.

8 In Figure 10.2, the level of investments I_i (from which borrower's and lender's risks start) that can be financed by the given internal funds Q_i falls if the original supply price P_i increases. The increase in interest rates thus reduces both internally and externally financed investments.

9 In line with the experience of 1929–33 and the 'true' thought of Keynes, the fall in prices might thus accentuate unemployment instead of reabsorbing it (Minsky 1975, 1978, 1986).

10 More generally, according to Minsky, every state nurtures the forces destined to change it.

11 Aggregate saving S is the sum of workers' saving (S_w) and capitalists' saving (S_c), equal in its turn to the difference between capitalists's profits (Π) and capitalists' consumption (Cc). This means that $S = S_w + (\Pi - C_c)$. By substituting into the goods market equilibrium condition, $S = I + DF + NX$, and rearranging, we get: $\Pi = I + DF + NX + C_c - S_w$. In clearing the goods market, income fluctuations align profits Π to the sum of investments I, government deficit DF, net exports NX and capitalists' consumption C_c net of workers' savings S_w.

12 Obviously, the fall in the lender's risk (L_r) turns into a decrease in the lenders' risk adjusted supply price (P_i') only if the financing contract allows the lender to modify the terms of the financing (see Minsky, 1986: 194).
13 As shown in Figure 10.3, the increase in indebtedness and the decrease in safety margins are the result of the assumption that any unexpected increase in current profits is perceived as permanent.
14 Minsky (1978: 45) puts it as follows: 'However, the internal workings of the banking mechanism or Central Bank action to constrain inflation will result in the supply of finance being less than infinitely elastic leading to a rapid increase in short-term interest rates.' The increase in short-term interest rates is followed by the increase in long-term interest rates.
15 Minsky refers this case to an individual firm characterized by a high sensitivity of borrower's risk to investments. Yet, how can investments imply a borrower's risk if they do not imply any borrowing?
16 Minsky also admits (but does not take into account) the possibility of liquidity trap, a situation in which the increase in confidence does not imply any wealth reallocation from money to the alternative assets and thus any rise in P_k.
17 As we have seen, the increase in profits is used to reduce indebtedness or to accumulate financial assets.
18 On this, see Lavoie and Seccareccia (2001).
19 Quoting Minsky (1975: 114), for instance: 'In the case illustrated the improvement of realized profits . . . reinforces the willingness of firms and bankers to debt-finance further increases in investment'.

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11

Towards a Spatial Keynesian Economics

William Mitchell and James Juniper

11.1 Introduction

What would a Post Keynesian economist see as being the appropriate macroeconomic policy goals of the state? If we polled macroeconomists of all ideological persuasions, and asked them to outline the major macroeconomic policy objectives then the following consensus would probably emerge: (a) full employment; (b) price stability; (c) a robustly sustainable rate of economic growth; and (d) maintaining an equilibrium balance of payments. While these goals are so general that they lack clarity and are regularly used by different economists in ways that do not permit meaningful dialogue, we can use them to motivate our discussion.

In this chapter we support (a) and (b) but contest (c) and (d). We argue that many Post Keynesians have been seduced by orthodox conceptions of a market-based capitalism with commodity currencies and as a consequence have accepted propositions that have no application in a fiat-currency monetary capitalism. Section 11.2 outlines our conception of the desirable macroeconomic policy aims for a progressive government based on the power the state enjoys in a modern monetary economy. Section 11.3 argues that the possibilities available to the state with fiat currency are typically misunderstood by both neoclassical supply-siders and many Post Keynesians alike. A 'progressive' policy approach must use this power to create employment buffer stocks to achieve price stability rather than using unemployment buffers (as in the 'NAIRU' approach).

An employment buffer stock approach defines full employment in terms of the provision of a certain number of jobs specified in terms of hours worked (to match the preferences of the willing labour force), some of which will be delivered via an unconditional (and infinite) fixed-wage offer of state employment to anyone who wishes to take advantage of the offer. While this offer constitutes the minimum state intervention required, further public infrastructure investment or public service employment strategies can be introduced.

We also consider the 'deficit-dove' approach to fiscal policy, which underpins much of Post Keynesian macroeconomics, to be untenable and unjustified. Moreover, much of the 'open economy' analysis, which is also accepted by many Post Keynesians, has no application in the 'modern money' paradigm.

In section 11.4, the argument is extended to justify a Spatial Keynesian approach to macroeconomic analysis (Mitchell and Carlson, 2005), albeit departing from the conventional Keynesian regional policy approach that dominated the early postwar period. Concluding remarks follow.

11.2 Goals of macroeconomic policy

11.2.1 Full employment

What do we mean by full employment? We define full employment in terms of a number of jobs rather than a rate of unemployment relative to the inflation rate. Following the Second World War, the problem that had to be addressed by governments was how to translate the full employed war economy with extensive civil controls into a fully employed peacetime model.

The first major statement addressing this problem came in Beveridge's (1944) *Full Employment in a Free Society*. Consistent with the emerging Keynesian orthodoxy, unemployment was constructed as a systemic failure to provide enough jobs and the focus moved away from the personal characteristics of the unemployed and prevailing wage levels. Full employment was defined as an excess of vacancies at living wages over unemployed persons. Beveridge (1944: 123–35) said: 'The ultimate responsibility for seeing that outlay as a whole, taking public and private outlay together, is sufficient to set up a demand for all the labour seeking employment, must be taken by the State.' The emphasis was on jobs. Inflation control was not a major issue although most governments listed it as a policy target.

11.2.2 Price stability

In the 1950s, economists focused on the irreducible minimum rate of unemployment (see Bancroft, 1950; Dunlop, 1950), which soon gave way to the unemployment and inflation trade-off debate. Full employment as a sufficiency of jobs was further undermined by the expectations-augmented Phillips curve of Friedman (1968) and Phelps (1967), which spearheaded the resurgence of pre-Keynesian macroeconomics. Friedman's (1968: 60) Natural Rate Hypothesis (NRH) alleged there was 'no long-run, stable trade-off between inflation and unemployment'. Full employment prevailed with a natural rate of unemployment unless there were errors in interpreting price signals. This left little or no room for discretionary management of aggregate demand. A related concept emerged – the non-accelerating inflation rate of unemployment (NAIRU) (Modigliani and Papademos, 1975). In practical terms the two concepts equally undermine the pursuit of full employment defined as a sufficiency of jobs.

Various theoretical structures can support the conclusion that unemployment above a certain level will be associated with declining rates of inflation. It can arise within simple excess demand models, as in Modigliani and Papademos (1975), or in Marxist-inspired conflict-theory models of inflation (Rowthorn, 1977). In either case there is some (cyclically-invariant) unemployment rate at which price inflation stabilizes (see Mitchell, 1987 for discussion of the cyclical invariance assumption). With the NAIRU concept (or its Marxist equivalent) dominant, full employment as initially conceived was abandoned.

11.2.3 Importance of social settlements

Defining full employment in terms of an adequacy of employment opportunities invokes a spatial dimension if we introduce another policy priority – the sustainability of social settlements. It seems reasonable that Post Keynesians would place more emphasis on the importance of local communities as the building blocks of society than their neoclassical counterparts, who privilege notions of comparative and competitive advantage. The resilience and richness of communities, which in turn is predicated on the depth and strength of social networks, should be an intrinsic design element in a spatially-oriented macroeconomic policy whose aims extend beyond a concern with aggregate outcomes. An approach of this kind departs markedly from the pursuits of those who would merely supplement the Schumpeterian Post-National Workfare State (SPWS) with policies to promote 'social capital' (see Fine, 2001).

Motivation is provided by evidence that differentials in regional employment growth rates and regional unemployment rates have persisted in most countries since the early 1990s. In Australia, for example, despite relatively robust economic growth since the 1991 recession, which might have promoted convergence in regional labour market outcomes, spatial disparities in unemployment and employment growth have widened (see Mitchell and Bill, 2005).

Geographers such as Jessop (1999) chart the development of the SPWS in advanced industrial economies driven by transformations in production technology and neo-liberal political strategies. The characteristics of these developments include a 'hollowing-out' of the national state in favour of regional devolution and supranational political forms (for example, NAFTA and the EU), the development of new forms of governmentality (facilitative, catalytic, involving partnerships with NGOs and private sector agencies), and a displacement of Keynesian welfare states with systems promoting international competitive advantage, often at the expense of declining 'old industrial areas'.

Keynesians typically argue that regional employment varies with the changing distribution of industries across space and that the impact of aggregate factors is largely uniform within those industries (see Arestis and Sawyer, 2004). However, even after controlling for industry composition, low growth regions experience stagnant labour conditions and negative shocks endure for a long time (see Mitchell and Bill, 2005). Neoclassical explanations for poor rates of convergence in regional outcomes tend to focus on wage differentials, low labour mobility and related structural impediments. Mitchell and Bill (2005) refute these claims and demonstrate that employment growth differentials and regional job accessibility strongly determine the health of regional labour markets.

There is strong evidence from various countries suggesting that low rates of job accessibility combine with patterns of local interactions (Durlauf, 2003) to isolate the long-term joblessness. In this regard, the emerging literature on social interaction and dependence among economic agents (Glaeser *et al.*, 1996; Jensen *et al.*, 2003) and spatial spillovers (Anselin, 2003) is relevant to Post Keynesians who want to design full employment strategies (Mitchell and Bill, 2005). These effects are compounded by agglomeration effects within industrial districts, which seem to be driven by 'local information spillovers' (Topa, 2001) and capital accumulation processes (Audretsch and Feldman, 1996). Regional spillovers are most likely to exist in regions tightly linked by interregional migration, commuting and trade (Niehbuhr, 2001). These spillover effects ensure that local shocks spread to neighbouring regions (Molho, 1995). Topa (2001) argues that neighbourhood stratification and widening inequalities accompany these endogenous spatial dependencies.

11.2.4 Environmental sustainability

Full employment and the continuity and health of the social settlement are necessary conditions for achieving economic and social sustainability, which is the overarching aim. However, they are not sufficient conditions. Without a balance being achieved between these elements and the natural (physical) environment, the macroeconomic situation is unsustainable. Thus, a forward-looking Post Keynesian macroeconomics requires economic activity to be in balance with the natural environment. There are two aspects of this concept of 'sustainability' that are relevant to macroeconomic policy design: (i) the level of production (and consumption) must be consistent with the demands of the physical environment; and (ii) locally- or community-based production should be encouraged.

11.3 The role of the state in Post Keynesian macroeconomics

11.3.1 Mediation between competing classes

In the context of the policy goals outlined in section 11.2, we construct the state as providing mediation between conflicting classes – workers and capitalists – and thus firmly situate our understanding of the dynamics of power in the modern monetary system within the authority relationships (classes) defined by property ownership. The two sides of property ownership (owning or not) generate specific and conflicting 'class interests' and the structure of political relations emerges from this conflict. The fiscal power of the state is to be seen within this context. The non-government sector in general requires an operative fiscal presence of the type we describe below.

11.3.2 Government as issuer of fiat currency and sectoral balances

This section summarizes the recent work of Mitchell and Mosler (2002, 2006) (see also Mitchell, 1998; Wray, 1998). Modern monetary economies use fiat currencies with flexible exchange rates. The currency is the only unit acceptable for payment of taxes and other financial demands by the government. The currency supply monopoly presents the government with options it would not otherwise have under alternative currency arrangements.

Figure 11.1 sketches the essential structural relations between government and non-government. First, Treasury and Central Bank operations are combined because 'within government' transactions are of no importance to understanding the 'vertical' relationship between government and non-government. Secondly, the private domestic and foreign sectors are consolidated as non-government with no loss of analytical insight.

Basic national income accounting indicates that the government deficit (surplus) equals the non-government surplus (deficit). Cumulative government deficit spending is required in order for the non-government sector to accumulate aggregate net savings of financial assets. Net government spending is required to accommodate any net desire to save by the non-government sector. Recognising that currency plus reserves (the monetary base) plus outstanding government securities constitutes net financial assets of the non-government sector, the fact that non-government is dependent upon the government to provide funds for both its desired net savings and payment of taxes to the government becomes a matter of accounting.

Government surpluses have two negative effects for the private sector: (a) they reduce private disposable income; and (b) they reduce the private holdings of financial assets (money or bonds). The decreasing levels of net savings 'financing' the government surplus increasingly leverage the private sector and the deteriorating debt to income ratios eventually see the system succumb to ongoing demand-draining fiscal drag through a slowdown in real activity.

11.3.3 Vertical and horizontal relationships in a monetary economy

The government is never inherently revenue-constrained. Government typically spends by crediting private bank accounts at the central bank.

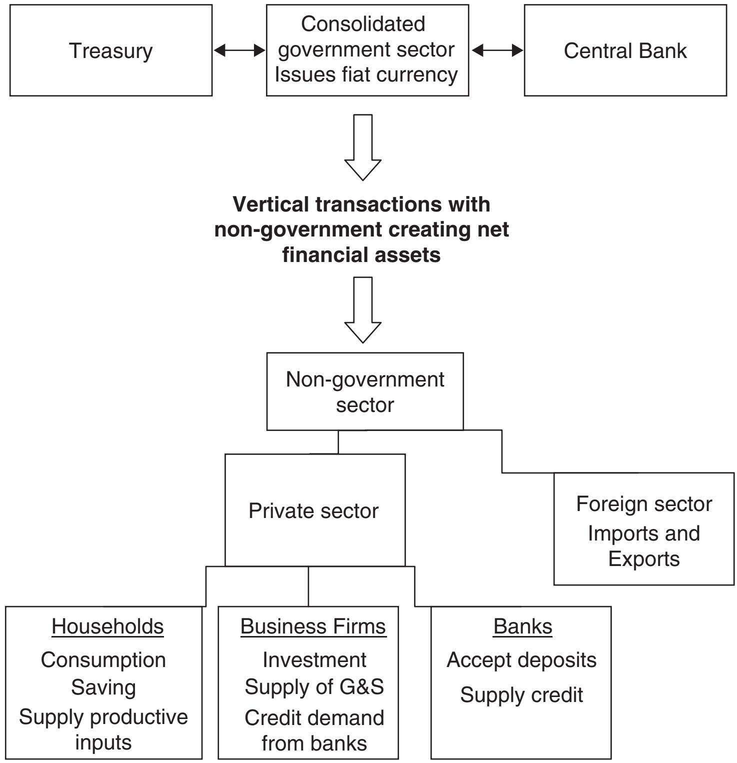

Figure 11.1 Government and non-government structure

Operationally, this process is independent of any prior revenue. Such 'spending' does not diminish any government asset or government's ability to spend further. Alternatively, when taxation is paid by private sector cheques (or bank transfers) that are drawn on private accounts in member banks, the central bank debits a private sector bank account. No real resources are transferred to government and its ability to spend is independent of the debiting of private bank accounts.

Figure 11.2 provides the juxtaposition between vertical and horizontal relationships in the economy. Vertical arrows depict transactions between government and non-government and horizontal arrows depict transactions between agents within the non-government sector. The government impacts on the stock of accumulated financial assets in the non-government sector and their composition. The government deficit (treasury operation) determines the cumulative stock of financial assets in the private sector. Central bank decisions then determine the composition of this stock in terms of

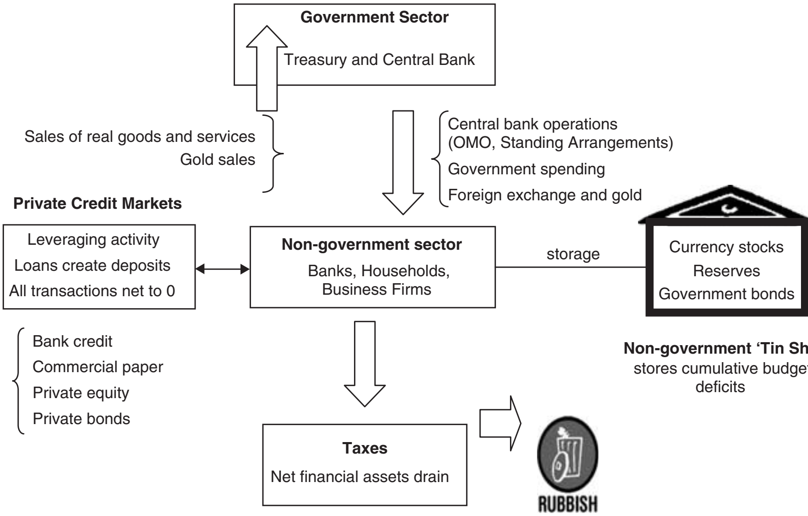

Figure 11.2 Vertical and horizontal macroeconomic relations

notes and coins (cash), bank reserves (clearing balances) and government bonds.

Taxes lie at the bottom of the 'exogenous vertical chain' (and are 'scrapped') as they reduce balances in private bank accounts. The government doesn't 'get anything' – the reductions are accounted for but 'go nowhere'. The concept of a fiat-issuing government 'saving' in its own currency is nonsensical. It is erroneous to think that when governments run surpluses the funds are stored and can be 'spent' in the future.

The private credit markets represent relationships (depicted by horizontal arrows) and 'house' credit leveraging activity by commercial banks, business firms, and households (including foreigners), which Post Keynesians term endogenous circuits of money. But, crucially, horizontal transactions do not create net financial assets – all assets created are matched by a liability of equivalent magnitude and net to zero.

Figure 11.2 also shows the 'Non-government Tin Shed' which stores fiat currency stocks, bank reserves and government bonds which reflect cumulative budget deficits. Following our earlier discussion, any payment flows from government to non-government that do not 'finance' the taxation liabilities remain in the non-government sector as cash, reserves or bonds. The private leveraging activity, which nets to zero, is not an 'operative' part of 'Tin Shed' stores of currency, reserves or government bonds. The commercial banks do not need reserves to generate credit, contrary to standard textbook representation.

11.3.4 The flawed government budget constraint framework

Mainstream macroeconomics errs by blurring the differences between household budgets and the government budget. This errant analogy is advanced by the government budget constraint (GBC) framework that is a standard exposition in most macroeconomics textbooks. While the GBC is just an *ex post* accounting identity, mainstream economists consider it an *ex ante* financial constraint on government spending.

The GBC leads us to believe that unless government wants to 'print money' and cause inflation it has to raise taxes or sell bonds to get 'money' in order to spend. But households use the currency and must finance their spending, *ex ante*, whereas government issues the currency and necessarily spends first before it can subsequently debit private accounts, should it so desire.

11.3.5 Government debt sets interest rate

The GBC myth is expressed in erroneous discussion about 'debt monetization' that frequently dominates the policy chapters in macroeconomic textbooks. Debt monetization allegedly occurs when the central bank buys government bonds directly from the treasury. In return, the central bank 'prints money' to facilitate government spending and inevitably leads to inflation. So, logically, the government sells bonds to the public to 'finance' net spending. In reality the central bank has no option but to 'monetize' any outstanding or newly issued federal debt. As long it desires to maintain a target short-term interest rate, the size of its purchases and sales of government debt are not discretionary.

The central bank administers the risk-free interest rate and is not subject to direct market forces. While the funds that the government spends do not 'come from' anywhere and taxes collected do not 'go anywhere', there are substantial liquidity impacts from net government positions. Government spending and central bank purchases of government securities add liquidity and taxation and sales of government securities drain liquidity. These transactions influence the daily cash position of the system which on any one day can be in surplus or deficit. The system cash position bears on the central bank's ability to maintain their desired interest rate and influences its use of open market operations.

Fiscal deficits result in system-wide cash surpluses, after spending and portfolio adjustments have occurred. When commercial banks try to loan these excess funds, downward pressure is put on the cash rate. Exchanges between commercial clearing accounts do not change the system-wide position. So the central bank must 'drain' the surplus liquidity by selling government debt to maintain control over the interest rate.

The central bank's lack of control over reserves underscores the impossibility of debt monetization. If the central bank purchased securities directly from the treasury which then spent the money, its spending would manifest as excess bank reserves. The central bank would be forced to sell an equal amount of securities to support the target interest rate. The central bank would act only as an intermediary between treasury and the public. No monetization would occur. So government debt functions as interest rate support and not as a source of funds.

Within this framework we can also see why financial crowding-out, inherent in standard IS-LM analysis used by many Post Keynesians, is impossible. In an accounting sense, the 'money' that is used to buy bonds (that is regarded as 'financing government spending') is the same 'money' (in aggregate) that government spent. Nugent (2003) says that 'in other words, deficit spending creates the new funds to buy the newly issued securities'. So government securities function to 'offset operating factors that add reserves', the largest 'operating factor' being net spending by treasury. In this sense, the purchase (or sale) of bonds by (to) non-government alter the distribution of assets in the 'Tin Shed'.

Thus it is nonsensical to think that government spending rations finite 'savings' which could alternatively finance private investment. Nugent (2003) says 'that in Japan, with the highest public debt ever recorded, and repeated downgrades, the Japanese government issues treasury bills at .0001%! If deficits really caused high interest rates, Japan would have shut down long ago!'

What if the government sold no securities? The 'penalty' for the government that doesn't pay interest on reserves would be a Japan-like zero interest rate rather than their target cash rate. If a default support rate is paid, the interest rate would converge on that support rate. Any economic ramifications (like inflation or currency depreciation) would be due to lower interest rates rather than any notion of monetization.

Ultimately, private agents may refuse to hold any more cash or bonds. The private sector at the micro level can only dispense with unwanted cash balances in the absence of government paper by increasing their consumption levels. Given the current tax structure, this reduced desire to net save would generate a private expansion and reduce the deficit, eventually restoring the portfolio balance at higher private employment levels with lower required budget deficits. Whether this generates inflation depends upon the ability of the economy to expand real output to meet rising nominal demand. The size of the budget deficit doesn't compromise that and the government would have no desire to expand the economy beyond its real limit.

11.3.6 State money implies possibility of unemployment

If government spending is not revenue-constrained, then what function is served by taxation? Taxation promotes offers from private individuals to government of goods and services in return for the necessary funds to extinguish the tax liabilities. So taxes create unemployment (people seeking paid work) in the non-government sector and allow a transfer of real goods and services from that sector to the government sector, to facilitate its economic and social programmes. Government spending provides the funds necessary to pay the tax liabilities and thus provides the paid work which eliminates the unemployment created by the taxes.

Thus, it is the introduction of 'State Money' (government taxing and spending) into a non-monetary economics that raises the spectre of involuntary unemployment. As a matter of accounting, for aggregate output to be sold, total spending must equal total income. Involuntary unemployment is idle labour offered for sale with no buyers at current prices (wages). Unemployment occurs when the private sector, in aggregate, desires to earn the monetary unit of account, but doesn't desire to spend all it earns, and net government spending is insufficient to accommodate the tax liabilities and the private desire to net save.

As a result, involuntary inventory accumulation among sellers of goods and services translates into decreased output and employment. In this situation, nominal (or real) wage cuts *per se* do not clear the labour market, unless those cuts somehow eliminate the private sector desire to net save, and thereby increase spending. The basis of demand-deficient unemployment is at all times inadequate net government spending, given the private spending decisions in force at any particular time.

Post Keynesians appear united in the contention that unemployment reflects a systemic failure in aggregate demand. Post Keynesians also concur that government intervention is required to close the spending gap. Significant differences emerge, however, when we get down to the detail of how the government should close that gap and what supporting mechanisms are required to sustain full employment. There are two broad approaches: (a) generalized expansion predominantly driven by investment together with mechanisms whereby individual nations can manage structural imbalances between trading nations; and (b) spatially-targeted expansion with buffer employment stocks. Section 11.4 compares and contrasts these approaches.

11.3.7 Opposition to Chartalist macroeconomics

There are two camps in economics that oppose our conception of macroeconomic analysis: (i) the orthodox monetarists/rational expectations/new classical schools which eschew government debt and advocate balanced or surplus budgets. Their wrong-minded logic has imposed extremely high macroeconomic costs in terms of lost growth and high unemployment since the mid-1970s; and (ii) the progressive 'deficit-doves' (for example, Glynn, 1997) who correctly believe that federal net spending stimulates employment, but fail to understand the essentials of modern money. They erroneously consider that net spending is 'financed' by debt-issuance and then construct the viability of any particular fiscal stance through a comparison between the respective levels of national debt and national wealth.

They also decompose deficit into structural and cyclical components, believing this to be a meaningful distinction (Eisner, 1989). They tend to propose balanced budgets over the business cycle rather than on a year-to-year basis (Glynn, 1997). This argument is often supported by the fallacious household/business analogy that justifies growth in debt in terms of asset building which underpins future rates of return. Many Post Keynesians fall prey to this logic (for example, Palley, 1996). While comfortable with using deficit spending to increase economic activity, they adopt a conservative logic bounded by stable movements in the debt to GDP ratio (see Bispham, 1988; Glynn, 1997). However, Glynn (1997: 226–7) claims that 'financial markets, the ultimate arbiters of such matters, may look simply at the size of the deficit . . . [and that] . . . given the experience of the past twenty years it would be difficult to convince that increased deficits at the beginning of the expansionary programme would be rapidly scaled down as the private sector took up the main thrust of expansion. There seems little alternative to financing through taxation most of an expansionary programme'. Further, Glynn (1997: 224) says 'it is misleading to treat them (interest rates) as entirely exogenous. It is likely that beyond a certain level, a higher deficit will lead financial markets to exact a higher real-interest rate.'

In terms of our previous analysis, it is clear that the two camps, whatever their differences on the role of government in relation to creating full employment, fail at the most fundamental level to understand the macroeconomics of a modern monetary economy. They fail to understand the priority of government spending and misconstrue the role of debt issuance as interest rate maintenance.

11.4 Current 'progressive' approaches to unemployment

11.4.1 Introduction

All Post Keynesians agree that the orthodox unemployment buffer stock approach (NAIRU) to inflation control is costly and unacceptable. The neoliberal solution to the resulting unemployment is to pursue supply-side policies (labour market deregulation, welfare state retrenchment, privatization, and public–private partnerships) to give the economy 'room' to expand without cost pressures emerging. Post Keynesians, in general, reject this strategy because the sacrifice ratios are high and the distributional implications (the creation of an underclass and working poor and the loss of essential services) are unsavoury.

However, there is no alternative consensus. Some Post Keynesians, closely following the policy recommendations of Keynes himself, advocate what we will term 'generalized expansion', where the government ensures that spending is sufficient to purchase all available output. In essence, this policy purchases at market prices or provides incentives to profit-seekers to create private employment expansion. Typically, public and private capital formation is targeted. This strategy ignores the role for a buffer employment stock policy, which allows the government to guarantee full employment using automatic stabilizers by purchasing at fixed prices. The buffer stock approach also distributes jobs across geographic space thus underpinning a regional safety net.

11.4.2 Generalized expansion

Typically, Post Keynesians advocate generalized fiscal and monetary expansion mediated by incomes policy and controlled investment as a solution to unemployment (Ramsay, 2002–3; Seccareccia, 1999; Kadmos and O'Hara, 2000; Sawyer, 2003, 2005). Davidson (1994: 79), representing the mainstream Post Keynesian approach, writes 'Government fiscal policy is conceived as the balancing wheel, exogenously increasing aggregate demand whenever private sector spending falls short of a full employment level of effective demand and reducing demand if aggregate demand exceeds the full employment level.'

However, (indiscriminate) expansion in isolation is unlikely to lead to employment opportunities for the most disadvantaged members of society and does not incorporate an explicit counter-inflation mechanism. It also fails to address the spatial labour market disparities. Arestis and Sawyer (2004: 11, 18) argue correctly that 'the industrial structure of a region and... variations in productive capacity as well as in aggregate demand of the region... [drive these disparities and conclude]... in terms of policy implications, appropriate demand policies are required to stimulate investment and underpin full employment.' But how can we be sure that the investment will provide jobs in failing regions? Upon what basis are the most disadvantaged workers with skills that are unlikely to match those required by new technologies going to be included in the 'generalized expansion'? Where is the inflation anchor?

11.4.3 Buffer employment stocks and spatial Keynesianism

The state can resolve demand gaps which cause unemployment in two distinct ways: (i) by increasing net spending via purchasing goods and services and/or labour at market prices as explained in the previous sub-section; and/or (ii) by using its currency issuance power to provide a fixed-wage job to all those who are unable to find a job elsewhere. This employment buffer stock approach is termed the Job Guarantee (JG) (see Mitchell, 1998; Wray, 1998). The JG is an effective strategy for a fiat-currency issuing government to pursue to ensure that work is available at a liveable wage to all who wish to work but who cannot find market sector employment (including in the regular public sector). The government would become 'an employer of last resort' and provide a buffer stock of jobs that are available upon demand.

The JG differs from a Keynesian expansion because it represents the minimum stimulus (the cost of hiring unemployed workers) required to achieve full employment rather than relying on market spending and multipliers. The JG also provides an inherent inflation anchor missing in the generalized Keynesian approach (Mitchell, 1998). Clearly, and emphatically, a mixture of (i) and (ii) is likely to be optimal although (i) alone is not preferred.

The JG is juxtaposed with the NAIRU approach which accompanied a regime shift in macroeconomic policy in the 1970s. The NAIRU approach is exemplified by tight monetary policy that targets low inflation, using unemployment as a policy tool rather than a target. The countries that avoided high unemployment in the 1970s maintained a 'sector... which effectively functions as an employer of last resort, which absorbs the shocks which occur from time to time, and more generally makes employment available to the less skilled, the less qualified' (Ormerod, 1994: 203).

The JG absorbs and hence minimizes the real costs of private sector demand swings. When private employment declines (expands), the JG pool automatically increases (decreases) and full employment is retained. The JG wage rate set at minimum award levels does not interfere with the private wage structure.

Kadmos and O'Hara (2000: 10–12) criticize the focus on government consumption of low-skilled services by JG advocates. They claim the leading sectors rely on information, knowledge, communications and networking. They advocate a boost to public infrastructure investment which enhances the profitability of private sector investment, in addition to contributing to aggregate demand and employment. Clearly, if a political will exists to construct public infrastructure then employment levels will rise subject to real resource availability. This is independent of the need for a JG. Yet, the JG should be accompanied by social wage spending to increase employment in education, health care and the like (Mitchell, 1988). But sole reliance on public sector investment to achieve full employment would create considerable economic inflexibility. The ebb and flow of the private sector would not be readily accommodated and an increasing likelihood of inflation would result (Forstater, 2000).

Crucially, public investment is unlikely to benefit the most disadvantaged workers in the economy. The JG is explicitly designed to provide opportunities for them. By way of example, during the golden age in Australia (1945–75), when public capital formation and social wage expenditure was strong, full employment was only achieved because the public sector (implicitly) provided a JG for low-skilled workers. This experience is shared across all advanced economies. Further, the JG does not replace social security payments to persons unable to work because of illness, disability, or parenting and caring responsibilities.

Kadmos and O'Hara (2000) and Seccareccia (1999) also claim that the low-wage service JG employment produces skills which are of little benefit to the private sector (also Sawyer, 2003). Kadmos and O'Hara (2000) allege that in a tightening labour market with structural unemployment, firms drive up wages to retain skilled staff, thereby maintaining unemployment in the context of wage/wage inflation. But structural unemployment is itself a loaded term because it ignores the fact that firms adjust hiring standards across the business cycle and offer training slots as part of their recruitment strategies when labour markets tighten (Thurow, 1976). Certain individuals are excluded from job/training offers by discriminating firms because they are deemed to possess 'undesirable' personal characteristics although discrimination reduces as activity increases. But progressives should question why these discriminative practices occur rather than perpetuating the idea that there are 'structural' labour market impediments.

The JG redresses this discrimination that many wrongly label as structural unemployment. Further, via regionally-based job creation programmes, the JG can also productively employ all workers who cannot find a private employer. The JG also does not preclude training initiatives (see Mitchell, 1988). Appropriately structured training within a paid employment context helps overcome the 'churning' of unemployed through training programmes, workfare and other schemes under current neo-liberal policies. Specific skills are usually more efficiently taught on the job.

The JG is thus designed to ensure that the lowest-skilled and least experienced workers are able to find employment. The JG is a full employment policy and should be judged on those terms. It does not presume that JG jobs will suit all skills. For some skilled workers who become unemployed in a downturn the income loss implied would be significant. Yet Seccareccia (1999) acknowledges that a fully employed economy with the JG workers paid minimum wages represents a Pareto improvement, when compared to the current unemployment.

But Seccareccia (1999) also argues that in a low-wage regime, government employers may choose to replace some current public sector employees with those paid at the minimum wage, thereby reducing their costs of employment. These cost-minimizing strategies are not specific to a JG implementation and are available to most employers.

While environmental constraints militate against generalized Keynesian expansion, JG proponents emphasize the regional dispersion of unemployment. Higher output levels are required to increase employment, but the composition of output remains a pivotal policy issue. JG jobs would be designed to support local community development and advance environmental sustainability. JG workers could participate in many community-based, socially beneficial activities that have intergenerational payoffs, including urban renewal projects, community and personal care, and environmental schemes such as reforestation, sand dune stabilization, and river valley and erosion control. Most of this labour-intensive work requires very little capital equipment and training (Mitchell, 1988). We denote this form of spatially targeted employment policy as Spatial Keynesianism, in contrast to the bluntness of orthodox Keynesian tools which fail to account for the spatial distribution of social disadvantage.

11.4.4 Balance of payments constraints

Some Post Keynesian economists focus on alleged 'stop–go' constraints on growth emerging from current account constraints (Davidson, 1994). The alleged constraint is often used to justify contractionary policies. This made sense under fixed exchange rates because the current account influenced central bank reserves and made domestic expansion dependent on the defence of the external parity. Under floating exchange rates the constraint is not binding and domestic policy can pursue full employment targets, leaving the exchange rate to absorb any adjustment. In claiming that flexible exchange rates are a 'liberal notion', Ramsay (2002–3: 275) demonstrates his misunderstanding of the options facing a government in a fiat currency economy, which are difficult to construct as being liberal. The neo-liberal practice denial of these options has resulted in persistent unemployment.

Given the monetary perspective in section 11.3, there are strong grounds for doubting the relevance of Post Keynesian and Post Kaleckian analysis to a floating exchange rate world. In effect, the analysis indirectly ratifies the erroneous notion of government-budget constraints, through the medium of the external constraint (Dow, 1988). Regional policy interventions are then privileged to the extent that they alleviate rather than aggravate this external constraint, which requires the promotion of extra-regional export activity (McCombie and Richardson, 1987).

We would argue that under flexible exchange rates these 'sustainability' concerns are no longer applicable. Balance of payments considerations should not be allowed to get in the way of deficit spending to achieve full employment. A current account deficit merely indicates that foreigners desire to accumulate financial assets denominated in the domestic currency and are willing to ship more real goods and services (in aggregate) than they receive in return to accomplish this desire. Exports represent a real cost to any domestic economy and are therefore not in themselves virtuous. While the desires of the foreign sector may change over time a fiat-issuing sovereign government should not determine its net spending decisions (aimed at maintaining full employment) with reference to any particular foreign balance.

11.4.5 New regionalist supply-siders

The persistently high unemployment rates observed since the mid-1970s in many OECD countries has motivated 'solutions' that purport to steer a course between the 'extremes' of Keynesianism and neo-liberalism. These so-called progressive Third Way movements include new ideas about space which attract the label of New Regionalism (NR). While NR has appealed to many progressive economists, its characterization of unemployment, albeit somewhat blurred, is hard to distinguish from the NAIRU approach (Lovering, 1999; Peck, 2001; Cook, Dodds and Mitchell (CDM), 2003). NR has adopted the individualistic and market-based constructs inherent in neoliberalism, and rendered unemployment as an individual problem – the ultimate 'privatization'. NR proposes a series of 'solutions' or separate policy agendas that build on these individualistic explanations for unemployment and accepts the litany of myths used to justify the damaging macroeconomic policy stances now common in OECD countries. By failing to ask the correct questions, these 'solutions' then appear, on first blush, to have (undeserved) plausibility.

NR emerged in the mid-1980s and was driven largely by case studies documenting economic successes in California (Silicon Valley) and some European regions (such as Baden Württemberg and Emilia Romagna). Lovering (1999: 380) says that NR consists of a series of ideas comprising: '(1) the historico-empirical claim that "the region" is becoming the "crucible" of economic development; and (2) the normative bias that "the region" should be the prime focus of economic policy'. Scott and Storper (1989) argued that regions have displaced nation-states as sites of successful economic organization, allegedly, because of changing technological and organization dimensions of production and the downfall of 'Fordism' as a production mode (Storper, 1995). Following the deindustrialization of many regions (the decline of Fordism in NR jargon), 'many small firms began to adopt a system of flexible specialization as a means of dealing with the uncertainty engendered by the fragmentation of formerly secure and stable mass markets' (Danson, 2000: 857).

NR advocates argue that regional spaces provide the best platform to achieve flexible economies of scope that are required to adjust to increasingly unstable markets. These socio-spatial processes involve localized knowledge creation, the rise of inter-firm (rather than intra-firm) relationships, collaborative value-adding chains, the development of highly supportive localized institutions and training of highly skilled labour (Lovering, 1999; Ohmae, 1995). These dynamics require firms to locate in clusters, often grouped by new associational typologies (for example, the use of creative talent or untraded flows of tacit knowledge) rather than by a traditional economic sector such as steel. The new post-Fordist production modes emphasize new knowledge-intensive activities encouraging local participative systems (Sassen, 1994). By achieving critical mass of local collaborators, a region could be dynamic and globally competitive (Castells, 1997; Cooke and Morgan, 1998).

Most of these claims are based on induction of regional 'successes' without regard for the specific cultural or institutional contexts, and lack any coherent unifying theoretical underpinning. Lovering (1999: 384) concludes that NR is 'a set of stories about how *parts* of the regional economy *might* work, placed next to a set of policy ideas which *might* just be useful in *some* cases'.

It is also doubtful whether some of the examples used to advance NR actually represent 'proof' of NR claims. For example, Staber (1996) argues that Baden Württemberg does not fit the NR model; Markusen (1996) criticizes the applicability of the term to Silicon Valley; and Jones and MacLeod (2002) and Lovering (1999) challenge empirical claims concerning UK regions. As an example, Lovering (1999: 382) cautions

> If one factor has to be singled out as the key influence on Wales' recent economic development ... it is not foreign investment, the new-found flexibility of the labour force, the development of clusters and networks of interdependencies or any of the other features so often seized upon as an indication that the Welsh economy has successfully 'globalized'. Something else has been at work which is more important than any of these, and it is a something which is almost entirely ignored in New Regionalist thought... It is the national (British) state.

While many criticisms can be levelled at NR, its major weakness is that it perpetuates the notion that regions can entirely escape the vicissitudes of the national business cycle through reliance on a combination of foreign direct investment and export revenue. It thus supports neo-liberal claims that fiscal and monetary policy is impotent and, in turn, it constructs mass unemployment as an individual phenomenon. While highlighting local initiative (for example, Henton *et al.*, 1997), NR fails to understand that in a constrained macro-economy the scale of job creation required dwarfs the capacity of local schemes. NR thus fails to develop a full employment policy framework (Ohmae, 1995; Danson, 2000; CDM, 2001; Lovering, 1999). By ignoring the fact that mass unemployment demonstrated the unwillingness of the central government to spend sufficient amounts of currency given the non-government sector's propensity to save, the neo-liberal position is left unchallenged and is actually reinforced and a new style of Say's Law emerges with claims that post-Fordist economies need to focus on 'supply-side architectures'.

11.5 Conclusion

The Chartalist perspective on the monetary system is adopted here as the basis of a Spatial Keynesian policy framework to achieve the objectives of full employment, price stability and environmental sustainability. This policy agenda stands opposed to both the neo-liberal, supply-side policies of the 'new regionalism', and Keynesian policies of generalized expansion, especially those muted by unnecessary concerns about either the sustainability of public sector debt or the resilience of the balance of payments situation. Throughout, we have highlighted the activist role of the state in issuing fiat currency, targeting interest rates, and setting the deficit to appropriate levels under the auspices of a Job Guarantee scheme designed to achieve full employment through the provision of regionally targeted jobs remunerated at the minimum wage.

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12

Monetary Shocks and Real Exchange Rate Dynamics*

Daniela Federici and Sergio Santoro

12.1 Introduction

The highly influential contribution of Obstfeld and Rogoff's *Redux* model (1995) essentially initiated a new line of research that reflects the attempt to integrate nominal rigidities and imperfect competition into a dynamic general equilibrium framework within an intertemporal optimization approach. Since then, several theoretical models have been developed, extending the Obstfeld–Rogoff seminal model in order to address a number of macroeconomic issues; this new literature is commonly called 'New Open Economy Macroeconomics' (hereafter NOEM).[1]

Although the theory in the spirit of NOEM is developing very rapidly, the empirical validity of the predictions of such a framework has been treated as a side issue. More recently, a number of empirical investigations making use of calibration procedures have been conducted. These exercises can be broadly divided in two categories: a first group of authors[2] compare the unconditional moments generated by their calibrated models[3] with those observed in the data. Nevertheless, as Lane (2001) points out, 'it is widely accepted that the unconditional variances of nominal and real exchange rates are infected by considerable market noise that is unrelated to macroeconomic fundamentals'. A second approach has been developed using an alternative method, which consists in deriving the impulse response functions to a predetermined macroeconomic shock, generated by a VAR approach, of the relevant variables.[4] For example, Senay (1998) follows this procedure to simulate the effects of various types of shocks, under different degrees of good and financial markets integration, within the sticky-price intertemporal framework.[5]

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A more complex analysis is carried out by Kollmann (2001), who calibrates a dynamic open economy model with both price and wage stickiness. He applies both methodologies described above: on the one hand, he compares the unconditional moments of his calibrated model to those observed for the G7 in the post-Bretton Woods period; on the other hand, he evaluates the reaction of the exchange rates to one per cent shocks to money, foreign real interest rate, productivity, and foreign price level.

All these contributions share a common weakness: the calibration of the model's parameters is based on the estimates of previous studies and derived within different theoretical frameworks. It should be noted that the results could be misleading.

It would be preferable to estimate the parameters directly in the model considered, in order to have a more reliable indication of their values; this methodology could be helpful also to assess the overall consistency of the NOEM approach with reality. Ghironi (2000) and Bergin (2003) have taken steps in this direction: the former develops a NOEM model and estimates it using a single equation approach;[6] the latter estimates a structural general equilibrium model of a small open economy. Some parameters in Bergin's approach are calibrated exogenously and some estimated.[7] The author obtains encouraging results in favour of the NOEM approach, and uses his empirical methodology to compare some competing versions of this new literature.

The present chapter moves in the same direction. Its aim is to take a step in the direction of bringing the NOEM approach to data. In particular, the novel features of our approach are the following:

(a) we estimate a simultaneous equations model derived from the consumer's first-order conditions which owes much to the contribution by Chari *et al.* (2000a, 2000b);
(b) our methodology permits us to estimate all of the structural parameters;
(c) we adopt a two-country approach, more widely considered in the theoretical literature, and we do not impose any *a priori* symmetry on the parameters.

It is worth mentioning the fact that we are going to estimate only the consumers' side of the model; since a typical feature of the NOEM approach is the introduction of a staggered price setting behaviour on the firms' side, this chapter cannot be considered a proper test of the NOEM empirical validity. However, we are going to build a first block in estimating the demand side of the model and leave for future research the design and estimation of the production side, also taking into account that there is no consensus on how the firms' behaviour should be modelled.[8]

Moreover, we will use the estimated equations to simulate the response of the RER to a monetary shock, in order to assess its empirical plausibility.

The model is estimated with quarterly data for Italy and an aggregate formed by the other G7 countries (in what follows, we will refer to the G6 aggregate) over the period 1978:1–1998:1[9] by a FIML procedure.

The rest of the chapter is organized as follows: in section 12.2 we summarize the main features of the Chari, Kehoe and McGrattan model; the derivation of our model, starting from the consumer's first-order conditions obtained in Chari *et al.* (2000a, 2000b), is given in section 12.3; the estimation results and the RER dynamics generated by a monetary shock, are discussed in sections 12.4–12.6; section 12.7 concludes, while the Appendix deals with the linearization procedures followed to derive the econometric model.

12.2 The theoretical model

The model we use for estimation is actually derived from the consumer's first-order conditions of the model presented in Chari *et al.* (2000a), which we will outline in this section.

This is a dynamic general equilibrium model with an infinite number of consumers. In each period t, the economy faces one of the finitely many events, s_t; the set of the states of events occurred up to period t is denoted with $s^t = (s_0, s_1, \ldots, s_t)$. There are two countries, Home and Foreign; each country is inhabited by three types of agents: consumers, intermediate goods producers, and final goods producers.

There are complete contingent markets, where consumers can sell and purchase one-period contingent nominal bonds denominated in the home currency; $B(s^{t+1})$ denotes the home consumer's holdings of this bond, which pays one unit of the home currency if the particular event s_{t+1} occurs. The price in s^t of one unit of home currency in an abstract unit of account is $Q(s^t)$; therefore, the price of $B(s^{t+1})$ in units of the home currency in period t and state s^t, is given by $Q(s^{t+1})/Q(s^t)$. In what follows, we will refer to this price as $Q(s^{t+1}/s^t)$.

In each period t, the representative home consumer chooses (after the realization of the event s_t) his allocations in order to maximize the intertemporal utility function:

$$\sum_{t=0}^{\infty} \sum_{s^t} \beta^t \pi(s^t) U(c(s^t), l(s^t), M(s^t)/P(s^t)), \tag{12.1}$$

where $c(s^t)$, $l(s^t)$, $M(s^t)$, and $P(s^t)$ represent respectively consumption, labour supply, nominal money balances and consumer price index (CPI), all evaluated at time t, while $\pi(s^t)$ is the probability of the states s^t, and β is the subjective discount factor. In the optimization process, the consumer faces the flow budget constraint:

$$P(s^t)c(s^t) + M(s^t) + \sum_{s_{t+1}} Q(s^{t+1}/s^t)B(s^{t+1}) \\ \leq P(s^t)w(s^t)l(s^t) + M(s^{t-1}) + B(s^t) + \Pi(s^t) + T(s^t), \tag{12.2}$$

where $w(s^t)$, $\Pi(s^t)$, and $T(s^t)$ denote the real wage, the profits and the transfers of home currency, respectively. Maximizing Eq. (12.1) subject to Eq. (12.2), we obtain the consumer's first-order conditions:[10]

$$-\frac{U_l(s^t)}{U_c(s^t)} = w(s^t), \tag{12.3}$$

$$\frac{U_m(s^t)}{P(s^t)} - \frac{U_c(s^t)}{P(s^t)} + \beta \sum_{s_{t+1}} \pi(s^{t+1}/s^t)\frac{U_c(s^{t+1})}{P(s^{t+1})} = 0, \tag{12.4}$$

$$Q(s^t/s^{t-1}) = \beta\pi(s^t/s^{t-1})\frac{U_c(s^t)}{U_c(s^{t-1})}\frac{P(s^{t-1})}{P(s^t)}, \tag{12.5}$$

where $U_c(s^t)$, $U_l(s^t)$ and $U_m(s^t)$ represent the derivatives of the utility function with respect to its arguments. The Foreign consumer's first-order conditions are derived analogously; thus, the correspondent of (12.5) in the Foreign country is:[11]

$$Q^*(s^t/s^{t-1}) = \beta\pi(s^t/s^{t-1})\frac{U_c^*(s^t)}{U_c^*(s^{t-1})}\frac{e(s^{t-1})}{e(s^t)}\frac{P^*(s^{t-1})}{P^*(s^t)}, \tag{12.6}$$

where $e(s^t)$ is the nominal exchange rate at time t. Note that the price of contingent bonds is equal across countries, given the assumption of perfect integration of financial markets; then, we can equate the second members of Eq. (12.5) and Eq. (12.6), obtaining:

$$\frac{U_c(s^t)}{U_c(s^{t-1})}\frac{P(s^{t-1})}{P(s^t)} = \frac{U_c^*(s^t)}{U_c^*(s^{t-1})}\frac{e(s^{t-1})}{e(s^t)}\frac{P^*(s^{t-1})}{P^*(s^t)}.$$

Iterating backwards, we get:

$$\frac{U_c(s^t)}{U_c(s^0)}\frac{P(s^0)}{P(s^t)} = \frac{U_c^*(s^t)}{U_c^*(s^0)}\frac{e(s^0)}{e(s^t)}\frac{P^*(s^0)}{P^*(s^t)}. \tag{12.7}$$

Denoting the RER with $q(s^t)$,[12] Eq. (12.7) can be rewritten as:

$$q(s^t) = k\frac{U_c^*(s^t)}{U_c(s^t)}, \tag{12.8}$$

where the constant k is equal to $e(s^0)P^*(s^0)/P(s^0)$. Eq. (12.8) states that the RER dynamics are driven by the marginal utility of consumption in the two countries: this is a crucial result for our purposes, because it will allow us to analyze the RER response to a monetary shock estimating only the parameters included in the consumer's first-order conditions.

Let us note that the precise mathematical form of eqs. (12.3)–(12.5) depends upon the specification of the utility function in period t; in Chari *et al.* (2000b), the authors propose a few different versions of $U(s^t)$, among which we choose the following:

$$U(s^t) = \frac{1}{1-\sigma}\left[\left(\omega c(s^t)^{\frac{\eta-1}{\eta}} + (1-\omega)m(s^t)^{\frac{\eta-1}{\eta}}\right)^{\frac{\eta}{\eta-1}}(1-l(s^t))^{\psi}\right]^{\frac{1}{1-\sigma}}, \tag{12.9}$$

where $\omega \in [0, 1]$. Eq. (12.9) is non-separable in consumption and leisure, and can deal with a drawback of the ordinary consumption–leisure separable preferences: in fact, as Lane (2001) points out, 'a potential criticism of this assumption is that it is incompatible with a balanced growth path if trend technical progress is confined to the market sector: as a country grows richer, labour supply continually declines, converging to a situation in which labour supply is zero'.[13] Instead eq. (12.9) is consistent with a balanced growth path.

12.3 The econometric model

In this section we develop the econometric model, starting from eqs. (12.3)–(12.5) and their foreign counterparts. As stressed in the Introduction, the most important new features that we took into account are the following:

(a) we drop perfect symmetry hypothesis across countries;
(b) we introduce real money balances directly in the utility function;
(c) we estimate the structural parameters.

At this first stage, we focus our attention on the consumers' behaviour derived from utility maximization, neglecting the producers' first-order conditions; as outlined in the Introduction to this chapter, the design and estimation of the production side is left as future research. Moreover, as show in the previous section, the RER dynamics depends on the parameters included in the consumer's first-order conditions.

However, we are aware that our analysis should be extended to the production side; we will take this further step in future work.

12.3.1 The equations of the model

If the Home representative consumer maximizes the utility function (12.9), subject to the intertemporal budget constraint (12.2), the first-order conditions are:[14]

$$
\begin{aligned}
w(s^t) &= \frac{\psi}{\omega}\frac{c(s^t)}{(1-l(s^t))}\left(\omega c(s^t)^{\frac{\eta-1}{\eta}} + (1-\omega)m(s^t)^{\frac{\eta-1}{\eta}}\right),\\
m(s^t) &= c(s^t)\left(\frac{1-\omega}{\omega}\frac{1+r(s^t)}{r(s)^t}\right)^{\eta},\\
Q(s^t/s^{t-1}) &= \beta\pi(s^t/s^{t-1})\frac{U_c(s^t)}{U_c(s^{t-1})}\frac{P(s^{t-1})}{P(s^t)}.
\end{aligned}
$$

Putting together the consumer's first-order conditions in the two countries, and the corresponding budget constraints, we obtain:

$$w(s^t) = \frac{\psi}{\omega}\frac{c(s^t)}{(1-l(s^t))}\left(\omega c(s^t)^{\frac{\eta-1}{\eta}} + (1-\omega)m(s^t)^{\frac{\eta-1}{\eta}}\right), \quad (12.10)$$

$$w^*(s^t) = \frac{\psi}{\omega}\frac{c^*(s^t)}{(1-l^*(s^t))}\left(\omega c^*(s^t)^{\frac{\eta-1}{\eta}} + (1-\omega)m^*(s^t)^{\frac{\eta-1}{\eta}}\right), \quad (12.11)$$

$$m(s^t) = c(s^t)\left(\frac{1-\omega}{\omega}\frac{1+r(s^t)}{r(s)^t}\right)^{\eta}, \quad (12.12)$$

$$m^*(s^t) = c^*(s^t)\left(\frac{1-\omega}{\omega}\frac{1+r^*(s^t)}{r^*(s)^t}\right)^{\eta}, \quad (12.13)$$

$$Q(s^t/s^{t-1}) = \beta\pi(s^t/s^{t-1})\frac{U_c(s^t)}{U_c(s^{t-1})}\frac{P(s^{t-1})}{P(s^t)}, \quad (12.14)$$

$$Q^*(s^t/s^{t-1}) = \beta\pi(s^t/s^{t-1})\frac{U_c^*(s^t)}{U_c^*(s^{t-1})}\frac{P^*(s^{t-1})}{P^*(s^t)}\frac{e(s^{t-1})}{e(s^t)}, \quad (12.15)$$

$$
\begin{aligned}
&P(s^t)c(s^t) + \Delta M(s^t) + \sum_{s_{t+1}} Q(s^{t+1}/s^t)B(s^{t+1})\\
&\quad = P(s^t)w(s^t)l(s^t) + B(s^t) + \Pi(s^t) + T(s^t), \quad (12.16)
\end{aligned}
$$

$$
\begin{aligned}
&P^*(s^t)c^*(s^t) + \Delta M^*(s^t) + \sum_{s_{t+1}} Q(s^{t+1}/s^t)B^*(s^{t+1})/e(s^t)\\
&\quad = P^*(s^t)w^*(s^t)l^*(s^t) + B^*(s^t) + \Pi^*(s^t) + T^*(s^t), \quad (12.17)
\end{aligned}
$$

where the variables denoted with an asterisk are referred to the G6 countries.

Note that (12.12) has been obtained from (12.4) taking into account that the nominal interest rate $r(s^t)$ is defined as follow:

$$\frac{1}{1+r(s^t)} \equiv \sum_{s_{t+1}} Q(s^{t+1}/s^t) = \sum_{s_{t+1}} \beta\pi(s^{t+1}/s^t)\frac{U_c(s^{t+1})}{U_c(s^t)}\frac{P(s^t)}{P(s^{t+1})},$$

where the last equality derives from (12.5). Substituting the above relation into (12.4) leads to the real money demand equation:

$$\frac{U_m(s^t)}{U_c(s^t)} = \frac{r(s^t)}{1+r(s^t)}$$

which is exactly (12.12), when the utility function (12.9) is used. This implies that the parameter η can be interpreted as the elasticity of the real money demand with respect to the nominal interest rate.

Financial markets are perfectly integrated; thus, arbitrage implies that the price of contingent bonds is the same in both countries (when expressed in the same currency). This result allows us to equate the second members of (12.14) and (12.15), obtaining the relation:

$$q(s^t)\frac{U(s^t)}{U(s^{t-1})}\frac{c(s^{t-1})\left(\omega c(s^{t-1})^{\frac{\eta-1}{\eta}} + (1-\omega)m(s^{t-1})^{\frac{\eta-1}{\eta}}\right)}{c(s^t)\left(\omega c(s^t)^{\frac{\eta-1}{\eta}} + (1-\omega)m(s^t)^{\frac{\eta-1}{\eta}}\right)}$$

$$= q(s^{t-1})\frac{U^*(s^t)}{U^*(s^{t-1})}\frac{c^*(s^{t-1})\left(\omega c^*(s^{t-1})^{\frac{\eta-1}{\eta}} + (1-\omega)m^*(s^{t-1})^{\frac{\eta-1}{\eta}}\right)}{c^*(s^t)\left(\omega c^*(s^t)^{\frac{\eta-1}{\eta}} + (1-\omega)m^*(s^t)^{\frac{\eta-1}{\eta}}\right)},$$

where $q(s^t) = e(s^t)P^*(s^t)/P(s^t)$ is the RER.

We assume that the Italian interest rate is determined by the interest rate that prevails in the rest of the world;[15] it seems a reasonable hypothesis, if we take into account that the weight of the Italian capital market in the global financial context is negligible. Thus, in our model $r(s^t)$ will be endogenous,[16] while $r^*(s^t)$ will be exogenous; the relation between these two variables is expressed by the following uncovered interest parity (UIP) condition:

$$r(s^t) - (P(s^t) - P(s^{t-1})) = r^*(s^t) - (P^*(s^t) - P^*(s^{t-1})) + \gamma,$$

in which γ is an additive constant. For notational simplicity, from now on we indicate the period t value of a variable x as x_t, instead of $x(s^t)$; let assume that the only source of income is labour. Therefore, the model can be rewritten as follows:

$$l_t w_t = \frac{\psi}{\omega} c_t^{1/\eta}\left(\omega c_t^{\frac{\eta-1}{\eta}} + (1-\omega)m_t^{\frac{\eta-1}{\eta}}\right), \qquad (12.18)$$

$$l_t^* w_t^* = \frac{\psi}{\omega} c_t^{*1/\eta} \left(\omega c_t^{*\frac{\eta-1}{\eta}} + (1-\omega) m_t^{*\frac{\eta-1}{\eta}} \right), \tag{12.19}$$

$$m_t = c_t \left(\frac{1-\omega}{\omega} \frac{1+r_t}{r_t} \right)^{\eta}, \tag{12.20}$$

$$m_t^* = c_t^* \left(\frac{1-\omega}{\omega} \frac{1+r_t^*}{r_t^*} \right)^{\eta}, \tag{12.21}$$

$$q_t \frac{U_t}{U_{t-1}} \frac{c_{t-1}^{1/\eta} \left(\omega c_{t-1}^{\frac{\eta-1}{\eta}} + (1-\omega) m_{t-1}^{\frac{\eta-1}{\eta}} \right)}{c_t^{1/\eta} \left(\omega c_t^{\frac{\eta-1}{\eta}} + (1-\omega) m_t^{\frac{\eta-1}{\eta}} \right)}$$

$$= q_{t-1} \frac{U_t^*}{U_{t-1}^*} \frac{c_{t-1}^{*1/\eta} \left(\omega c_{t-1}^{*\frac{\eta}{\eta-1}} + (1-\omega) m_{t-1}^{*\frac{\eta-1}{\eta}} \right)}{c_t^{*1/\eta} \left(\omega c_t^{*\frac{\eta-1}{\eta}} + (1-\omega) m_t^{*\frac{\eta-1}{\eta}} \right)}, \tag{12.22}$$

$$r_t - (P_t - P_{t-1}) = r_t^* - (P_t^* - P_{t-1}^*) + \gamma, \tag{12.23}$$

$$P_t c_t + \Delta M_t + \sum_{s^{t+1}} Q_{t+1} B_{t+1} - B_t = P_t w_t l_t, \tag{12.24}$$

$$P_t^* c_t^* + \Delta M_t^* + \sum_{s^{t+1}} Q_{t+1} B_{t+1}^* / e_t - B_t^* = P_t^* w_t^* l_t^*. \tag{12.25}$$

Notice that we replaced the term $(1 - l_t)$ with $(1/l_t)$, in order to make the mathematical treatment of the model easier; this change can be done without losing any information: in fact, both terms are decreasing in l_t. The equations (12.18)–(12.22) are non-linear in the variables, and this non-linearity can make the estimation process very complicated; thus, we log-linearize the model (see the Appendix) and we end up with the following equations:

$$\log c_t = -\chi \left(\frac{\eta(\omega+\mu)}{\eta\omega+\mu} \right) + \left(\frac{\eta(\omega+\mu)}{\eta\omega+\mu} \right) (\log l_t + \log w_t) - \frac{\mu(\eta-1)}{\eta\omega+\mu} \log m_t + v_{1t}, \tag{12.26}$$

$$\log c_t^* = -\chi^* \left(\frac{\eta^*(\omega^*+\mu^*)}{\eta^*\omega^*+\mu^*} \right) + \left(\frac{\eta^*(\omega^*+\mu^*)}{\eta^*\omega^*+\mu^*} \right) (\log l_t^* + \log w_t^*)$$
$$- \frac{\mu^*(\eta^*-1)}{\eta^*\omega^*+\mu^*} \log m_t^* + v_{2t}, \tag{12.27}$$

$$\log l_t = \chi - \left(\frac{\eta+\mu}{\omega+\mu}\right)\left[\log\left(\frac{1-\omega}{\omega}\right) + \log\left(\frac{1+\bar{r}}{\bar{r}}\right) + \frac{\bar{r}}{\bar{r}(1+\bar{r})}\right] - \log w_t - \left(\frac{\eta+\mu}{\omega+\mu}\right) r_t + \log m_t + v_{3t}, \tag{12.28}$$

$$\log l_t^* = \chi^* - \left(\frac{\eta^*+\mu^*}{\omega^*+\mu^*}\right)\left[\log\left(\frac{1-\omega^*}{\omega^*}\right) + \log\left(\frac{1+\overline{r^*}}{\overline{r^*}}\right) + \frac{\overline{r^*}}{\overline{r^*}(1+\overline{r^*})}\right] - \log w_t^* - \left(\frac{\eta^*+\mu^*}{\omega^*+\mu^*}\right) r_t^* + \log m_t^* + v_{4t}, \tag{12.29}$$

$$\Delta \log q_t = \left(\frac{1-\eta^*\sigma^*}{\eta^*-1}\right)\left(\frac{\eta^*\omega^*+\mu^*}{\eta^*(\omega^*+\mu^*)}\right)\Delta \log c_t^* - \left(\frac{1-\eta\sigma}{\eta-1}\right)\left(\frac{\eta\omega+\mu}{\eta(\omega+\mu)}\right) * \Delta \log c_t + \frac{1-\eta^*\sigma^*}{\eta^*}\frac{\mu^*}{\omega^*+\mu^*}\Delta \log m_t^* - \frac{1-\eta\sigma}{\eta}\frac{\mu}{\omega+\mu}\Delta \log m_t - \psi^*(1-\sigma^*)\Delta \log l_t^* + \psi(1-\sigma)\Delta \log l_t + v_{5t}, \tag{12.30}$$

$$r_t - (P_t - P_{t-1}) = r_t^* - (P_t^* - P_{t-1}^*) + \gamma + v_{6t}, \tag{12.31}$$

$$[\Gamma(\overline{\log c}) - e^{\overline{\log m}}(\overline{\Delta \log m} + \overline{\Delta \log P})] + e^{\overline{\log c}} \log c_t + e^{\overline{\log m}}(\overline{\Delta \log m} + \overline{\Delta \log P}) \log m_t + e^{\overline{\log m}} \Delta \log m_t + e^{\overline{\log m}} \Delta \log P_t + B'_{t+1} = \Gamma(\overline{\log w} + \overline{\log l}) + e^{\overline{\log w} + \overline{\log l}}(\log w_t + \log l_t), \tag{12.32}$$

$$[\Gamma(\overline{\log c^*}) - e^{\overline{\log m^*}}\left(\overline{\Delta \log m^*} + \overline{\Delta \log P^*}\right)] + e^{\overline{\log c^*}} \log c_t^* + e^{\overline{\log m^*}}(\overline{\Delta \log m^*} + \overline{\Delta \log P^*}) \log m_t^* + e^{\overline{\log m^*}} \Delta \log m_t^* + e^{\overline{\log m^*}} \Delta \log P_t^* + B^{*'}_{t+1} = \Gamma(\overline{\log w^*} + \overline{\log l^*}) + e^{\overline{\log w^*} + \overline{\log l^*}}(\log w_t^* + \log l_t^*), \tag{12.33}$$

in which $\bar{x}$ denotes the sample mean of the variable x_t, B'_{t+1} and $B^{*'}_{t+1}$ represent the change (between period t and period $t+1$) in the consumer's holdings of bonds in Italy and in the G6, respectively, and where:

$\chi \quad = \log \frac{\psi}{\omega} + \log(\omega+\mu) + \frac{\mu}{\omega+\mu}\frac{\eta-1}{\eta}(\overline{\log c} - \overline{\log m})$,

$\chi^* \quad = \log \frac{\psi}{\omega} + \log(\omega+\mu^*) + \frac{\mu^*}{\omega+\mu^*}\frac{\eta-1}{\eta}(\overline{\log c^*} - \overline{\log m^*})$,

$\mu \quad = (1-\omega)e^{\frac{\eta-1}{\eta}(\overline{\log m} - \overline{\log c})}$,

$\mu^* \quad = (1-\omega)e^{\frac{\eta-1}{\eta}(\overline{\log m^*} - \overline{\log c^*})}$,

$\Gamma(\overline{\log x}) \quad = e^{\overline{\log x}} - e^{\overline{\log x}}\overline{\log x}.$

Note that the loglinearization has been done around the sample mean; this is motivated by the technical difficulties of analytically deriving the steady state. In fact, the recursive algorithm developed in Chari *et al.* (2000b) to obtain the steady-state values is based on the original version of the model; adapting this procedure to our system goes beyond the scope of this chapter. However, even if the linearization about the steady state is more appropriate, the linearization about sample means may be used for a preliminary screening of the model.[17]

Before showing the estimation results, we state a few preliminary observations about the system (12.26)–(12.33):

- the endogenous variables of the model are $\log c_t$, $\log c_t^*$, $\log m_t$, $\log m_t^*$, $\log l_t$, $\log l_t^*$, $\log q_t$, r_t;
- the structural parameters of the G6 are denoted with an asterisk, and we assume that the parameter values are different across countries.[18] This hypothesis will be tested in the next section;
- the first six equations are stochastic, and for this reason a serially incorrelated error term is included in each of these,[19] while the budget constraints are identities;
- the real money balances dynamic paths, in the absence of shocks, are endogenously determined by the intertemporal budget constraints. It can be justified assuming that monetary policy reacts to current economic conditions matching the demand for liquidity expressed by the agents. If either government supplies an amount of money different from what is expected by the consumers, the system experiences a monetary shock.

Moreover, let us notice that consumption is expressed as a function of labour income and real money balances;[20] taking into account that the optimal money holdings depend on the interest rate,[21] and that the only source of income is supposed to be labour, imply that consumption is determined by income and the interest rate. Analogously, labour depends on the real wage, the interest rate, and the real money balances.

12.4 Estimation results

The model (12.26)–(12.33) was estimated by a Full Information Maximum Likelihood (FIML) procedure.[22] In our estimation, the two countries have been Italy and the G6. We used OECD-IFS quarterly data from 1978:1 to 1998:1.

12.4.1 Parameter estimates

In Table 12.1 we report the point estimates of the structural parameters, the asymptotic standard errors and the t-ratios.

Table 12.1 Parameter estimates

Parameter	*Point estimates*	*Standard error*	t-*ratio*
η	0.09558	0.01159	8.25
η^*	0.05988	0.01329	4.51
σ	2.80501	0.20199	13.89
σ^*	1.49892	0.07132	21.02
ψ	0.73142	0.00304	240.79
ψ^*	0.93938	0.00767	122.46
ω	0.98269	0.0015	657.22
ω^*	0.79279	0.09995	7.93
γ	−0.00008	0.00129	0.06

Note that the term '*t*-ratio' simply denotes the ratio of a parameter estimate to the estimate of its asymptotic standard error, and does not imply that this ratio has a Student's *t*-distribution. In fact, for a sufficiently large sample, the maximum likelihood estimates have an asymptotic normal distribution and, consequently, the *t*-ratio has a standardized normal distribution; in Table 12.1 the *t*-ratio is calculated to test the null hypothesis that each parameter is equal to zero. Thus, any parameter is significantly different from zero at the 5% level if its *t*-ratio is outside the interval ±1.96, and significantly different from zero at the 1% level if its *t*-ratio is outside the interval ±2.58.

The empirical results are, on the whole, quite satisfactory.

With the exception of the estimate of γ, which is not statistically discernible from zero, all parameters have statistical significance at the 1% level and their signs are as theory would lead one to expect. The fact that γ is not significantly different from zero would seem to suggest that, over the sample period, the real interest rates have not been significantly different across countries, which is a plausible result.

Moreover, the magnitude of the parameter estimates are consistent with the theory. The estimates of ω and ω^* lie within the range (0,1),[23] which is a necessary condition for the utility function (12.9) to make sense from an economic point of view.[24] The result implies that both consumption and real money balances enter directly the utility function, in contrast with the hypothesis made in Chari *et al.* (2000b), where a qualitative analysis on the RER volatility is carried out under the simplifying assumption $\omega = \omega^* = 1$. Besides, η and η^* are both positive, as required by the theory; note that their values (0.09558 and 0.05988, respectively) are much smaller than the values presented in Chari *et al.* (2000a) (0.39). This discrepancy could be due to the approach suggested by Chari, Kehoe, and McGrattan. They run a quarterly single-equation regression of a money demand function with consumption and interest rate[25] instead of a simultaneous multiple-equation estimation. Their approach cannot take into account some relevant interactions among the variables of the system, thus overvaluing the importance of the relations

Table 12.2 Tests on the overall validity of the model

	Likelihood ratio	*Carter–Nagar*
Statistic's value	2095.1	2790
Critical value at the 1% level	120.6	21.7
Degrees of freedom	87	9
Null hypothesis:		
Model' s restrictions are	accepted	rejected

considered. In the case of η, the direct impact of an interest rate change on the real money balances could be overestimated, because the indirect effect of the interest rate on the money demand via its effect on consumption is not explicitly modelled.

The estimated values of the curvature parameters (σ and σ^*) are much lower than those set in Chari *et al.* (2000a), where $\sigma = \sigma^* = 6$. As shown by the authors, this choice was critical for generating a high degree of volatility of the RER; hence, the smoother curvature obtained in our estimation could be a cause of the mild volatility observed in the simulation performed in section 12.6.

Finally, also the remaining parameters (ψ and ψ^*) are all positive and in line with what theory would suggest are plausible magnitudes.

12.4.2 Tests on the overall validity of the model

In Table 12.2, we report the results of both likelihood ratio (LR) and Carter–Nagar (C–N) statistics, which are the most commonly used tests to evaluate the overall validity of a simultaneous-equation model. The LR statistics, which is distributed according to the chi-square distribution, provides a test of whether or not the over-identifying restrictions are consistent with the data for the FIML estimator. This test, however, is unlikely to be valid for a sample of the size usually available for a macroeconomic study.

The chi-square value of the LR at 2095.1 being much larger that the critical value of 120.6 at the 1% level leads to rejection of the model's over-identifying restrictions.

The C–N statistic of the estimated model implies that the hypothesis that the over-identified model is not consistent with the data can be rejected.

12.4.3 Wald test

In the specification of the econometric model, we supposed that the structural parameters were different across countries, we now verify the validity of this assumption by using the Wald test, which has the null hypothesis that several parameters' linear functions are jointly equal to zero. In our case, these functions are given by the difference of the parameter values across countries. The value of the statistic (917.133) exceeds the critical value at

Table 12.3 Wald test

Parameters' function	*Point estimates*	*Standard error*	*t-ratio*
$\eta - \eta^*$	0.03666	0.02067	1.77
$\sigma - \sigma^*$	1.14358	0.20523	5.57
$\psi - \psi^*$	−0.20859	0.00846	24.65
$\omega - \omega^*$	0.18161	0.09238	1.97

Table 12.4 Eigenvalues of the model

	Eigenvalue	*Damping period*
λ_1	0.98576	1.042
λ_2	0.77230	1.298

the 1% level (13.3). This finding implies that the hypothesis that the two countries share the same set of structural parameters must be rejected.

In Table 12.3 we show the t-ratio for each parameter's difference; note that only one out of four ($\eta - \eta^*$) is not significantly different from zero, while two are different from zero at the 1% level, and one at the 5% level.

12.5 Stability analysis

The local stability properties of the model, given the estimates of the parameters listed in Table 12.1, can be analyzed by studying the eigenvalues of the model (12.26)–(12.33) that as illustrated above has been log-linearized around the sample means.[26] It should be noted that this exercise is not very informative, from an economic point of view; in fact, its purpose should be to determine the dynamic behaviour of the model in the neighbourhood of the steady state. To do so, the non-linear model (12.18)–(12.25) should have been linearized around the steady state, while we linearized it about the sample means.

In Table 12.4 we report the two eigenvalues of the system (12.26)–(12.33) and the corresponding damping period. The damping period is an indication of the time required for the system to return to the equilibrium after a shock. We can observe that the system is fully stable in the neighbourhood of the sample means, because both eigenvalues have absolute values smaller than one.[27]

12.6 Simulation results

In this section, we use the estimated model to carry out both static and dynamic simulations.[28] The static case is equivalent to calculating 'forecasts'

Table 12.5 RMSE of the in-sample static simulation

Variable	*Root mean square error*
$\log c_t$	0.13576
$\log c_t^*$	0.07947
$\log m_t$	0.08251
$\log m_t^*$	0.07350
$\log l_t$	0.08818
$\log l_t^*$	0.10124
$\log q_t$	0.16532
r_t	0.01300

of the endogenous variables for each observation in the sample period by letting the predetermined variables take on their actual values. In the dynamic forecasts the values of all lagged endogenous variables for the first period are the observed values, but for all later forecasts the lagged endogenous variables have the values forecasted by the model for the previous period.

12.6.1 Static simulation

To study the model's success for individual variables, we calculated the root mean squared errors (RMSE) for an in-sample static simulation; the results are reported in Table 12.5.

It should be remembered that the variables (except r_t) are expressed in logarithms, consequently the RMSE give the average error as a proportion of the actual level of the endogenous variables.[29] The in-sample predictive performance of the model was good, as indicated by the root mean square errors of the endogenous variables in single-period. All RMSE are quite small, indicating that the model can replicate the dynamics observed in the data; only three variables have errors greater than 10 per cent.

12.6.2 Dynamic simulation

In this section we carry out an out-of-sample dynamic simulation, in order to evaluate the RER's reaction to a monetary shock implied by our model. To begin with, we forecasted the benchmark dynamic paths of the model, supposing that the system experiences no shocks; we set the initial value of each variable equal to the corresponding sample mean, assuming that the exogenous variables grow at the same growth rate observed over the sample.

Afterwards, we repeated the same exercise assuming that, in the first period of the simulation, a 1% monetary shock takes place in Italy. We computed this shock taking into account that, in model (12.26)–(12.33), the dynamic path of real monetary balances in Italy is determined by the intertemporal budget constraint (12.32); therefore, we add in that equation a dummy variable that is equal to 0.01 in the first period, and to zero in all the others. The shock can be interpreted as an unexpected increase in money supply, which endows the agents with an additional amount of wealth; therefore, they are induced to change their optimal allocations.

To analyse the RER's reaction to a monetary shock, we subtracted the values of $\log q_t$ obtained in the without-shock forecast from those obtained in the with-shock forecast, thus deriving the effect of the shock in terms of q_t's percentage deviation from the benchmark dynamics. We plotted these percentage deviations for each period t in Figure 12.1. It shows that the shock determines, on impact, a depreciation of the RER, followed by a slow re-appreciation; after the 25th quarter following the shock, the dynamics of the two simulations are exactly the same. These findings are consistent with the predictions of the NOEM theoretical literature,[30] and with the results obtained using calibration procedures.[31] Our results are also compatible with the evidence for Italy presented in Lee and Chinn (1998), who study the effects of money and productivity shocks on the real exchange rate using a structural VAR approach.

Our findings differ from the results reported in Bergin (2003), who carries out a similar exercise for Canada. In our case, the impact depreciation of the RER induced by the shock (0.4 per cent) is much smaller than Bergin's (2.5 per cent). This may be due to the specification of the utility function we considered. As Lane (2001) argues, the assumption of consumption-leisure nonseparability in the utility function can have 'the effect of mitigating the impact of monetary shocks on the real exchange rate'. It also reflects how the predictions of the new open economy model appear to be sensitive to the specification of the microfoundations.

It must be admitted that the exogeneity of variables like the price indexes inhibits some potentially relevant feedback effects. To consider the production side of the economy will be the next step.

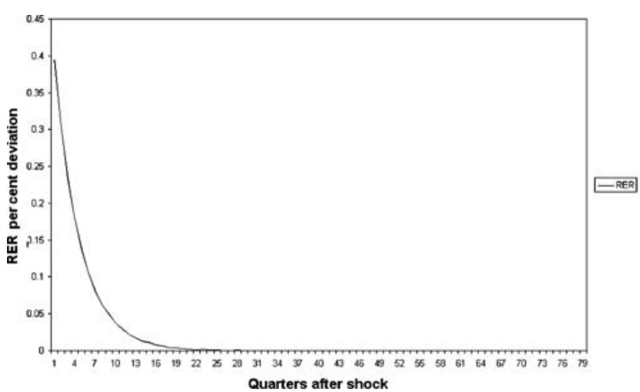

Figure 12.1 RER's reaction to a monetary shock

12.7 Conclusion

Although the NOEM theory is developing very rapidly, few papers at present have attempted to test the empirical relevance of this new literature. The purpose of our exercise was to estimate directly the structural parameters of a model inspired by NOEM. We used a FIML procedure to estimate a two-country model (Italy and G6) derived from the consumer's first-order conditions. Several interesting results have emerged. The model was found to perform quite well and the findings were encouraging. The majority of the parameter estimates were found to have plausible values and the model appears to be locally asymptotically stable.

Beyond the interest in specifying and estimating the model, we were interested in analysing how monetary shocks affects the dynamics of the real exchange rate. Our exercise was able to reproduce the basic empirical findings of the existing evidence obtained either via calibration or VAR procedures.

Nevertheless, it would be interesting to extend this work to include the producers' behaviour in the system, in order to provide better-fitting empirical results and to highlight the role of monetary and real shocks in explaining the variability of the real exchange rate. This will be the next step of our research.

Appendix

To log-linearize model (12.18)–(12.22) we follow a two-step procedure:

- we take natural logarithms of both members of Eqs. (12.18)–(12.22). This first step does not completely solve our problem, because there are still the terms $\log \frac{1+r_t}{r_r}$, $\log \frac{1+r_t^*}{r_r^*}$, $\log(\omega c_t^{\frac{\eta-1}{\eta}} + (1-\omega) m_t^{\frac{\eta-1}{\eta}})$, and $\log(\omega c_t^{*\frac{\eta-1}{\eta}} + (1-\omega) m_t^{*\frac{\eta-1}{\eta}})$, which are neither linear, nor log-linear;
- we take a first-order Taylor series expansion about the sample means of $\log c_t$, $\log m_t$, $\log c_t^*$, $\log m_t^*$, r and r_t^*. As a result, Eqs. (12.18)–(12.22) become log-linear in c_t, m_t, l_t, c_t^*, m_t^*, l_t^*, but linear in r_t and r_t^*; this is a standard feature of economic models, and is due to the nature of the interest rate, which is already a rate of change.

Let us consider for example Eq. (12.18):

$$l_t w_t = \frac{\psi}{\omega} c_t^{1/\eta} (\omega c_t^{\frac{\eta-1}{\eta}} + (1-\omega) m_t^{\frac{\eta-1}{\eta}});$$

and take natural logarithms of both members, obtaining:

$$\log l_t + \log w_t = \log \frac{\psi}{\omega} + \frac{1}{\eta} \log c_t + \log(\omega c_t^{\frac{\eta-1}{\eta}} + (1-\omega) m_t^{\frac{\eta-1}{\eta}}). \qquad (12.34)$$

Then we have to linearize the term $\log(\omega c_t^{\frac{\eta-1}{\eta}} + (1-\omega) m_t^{\frac{\eta-1}{\eta}})$. By multiplying and dividing the argument of the logarithm by $c_t^{\frac{\eta-1}{\eta}}$ we get

$$\log(\omega c_t^{\frac{\eta-1}{\eta}} + (1-\omega) m_t^{\frac{\eta-1}{\eta}}) = \frac{\eta-1}{\eta}\log c_t + \log\left(\omega + (1-\omega)\left(\frac{m_t}{c_t}\right)^{\frac{\eta-1}{\eta}}\right). \quad (12.35)$$

To linearize the last term in the right member of eq. (12.35), we take a first-order Taylor series expansion about the sample means of $\log m_t$ and $\log c_t$:[32]

$$\log\left(\omega + (1-\omega)\left(\frac{m_t}{c_t}\right)^{\frac{\eta-1}{\eta}}\right) = \log\left(\omega + (1-\omega) e^{\left(\frac{\eta-1}{\eta}\right)(\log m_t - \log c_t)}\right)$$

$$\approx \log\left(\omega + (1-\omega) e^{\left(\frac{\eta-1}{\eta}\right)(\overline{\log m} - \overline{\log c})}\right) + \frac{(1-\omega) e^{\left(\frac{\eta-1}{\eta}\right)(\overline{\log m} - \overline{\log c})}}{\omega + (1-\omega) e^{\left(\frac{\eta-1}{\eta}\right)(\overline{\log m} - \overline{\log c})}}$$

$$\left(\frac{\eta-1}{\eta}\right)[(\log m_t - \overline{\log m}) - (\log c_t - \overline{\log c})]. \quad (12.36)$$

Let us define μ as

$$\mu = (1-\omega) e^{\left(\frac{\eta-1}{\eta}\right)(\overline{\log m} - \overline{\log c})}.$$

Rearranging (12.36) we obtain

$$\log\left(\omega + (1-\omega)\left(\frac{m_t}{c_t}\right)^{\frac{\eta-1}{\eta}}\right) \approx \log(\omega + \mu) + \frac{\mu}{\omega + \mu}\left(\frac{\eta-1}{\eta}\right)$$
$$* [(\log m_t - \overline{\log m}) - (\log c_t - \overline{\log c})]. \quad (12.37)$$

Substituting eq. (12.37) in the second member of eq. (12.35), and, in turn, eq. (12.35) in eq. (12.34), we get

$$\log l_t + \log w_t = \log\frac{\psi}{\omega} + \frac{1}{\eta}\log c_t + \frac{\eta-1}{\eta}\log c_t + \log(\omega+\mu)$$
$$+ \frac{\mu}{\omega+\mu}\left(\frac{\eta-1}{\eta}\right) * [(\log m_t - \overline{\log m}) - (\log c_t - \overline{\log c})].$$

Defining χ as:

$$\chi = \log\frac{\psi}{\omega} + \log(\omega+\mu) + \frac{\mu}{\omega+\mu}\frac{\eta-1}{\eta}(\overline{\log c} - \overline{\log m}),$$

and solving for $\log c_t$, we derive Eq. (12.38):

$$\log c_t = -\chi\left(\frac{\eta(\omega+\mu)}{\eta\omega+\mu}\right) + \left(\frac{\eta(\omega+\mu)}{\eta\omega+\mu}\right)(\log l_t + \log w_t) - \frac{\mu(\eta-1)}{\eta\omega+\mu}\log m_t, \tag{12.38}$$

Similarly we obtain:

$$\log c_t^* = -\chi^*\left(\frac{\eta(\omega+\mu^*)}{\eta\omega+\mu^*}\right) + \left(\frac{\eta(\omega+\mu^*)}{\eta\omega+\mu^*}\right)(\log l_t^* + \log w_t^*) - \frac{\mu^*(\eta-1)}{\eta\omega+\mu^*}\log m_t^*, \tag{12.39}$$

$$\begin{aligned}\log l_t &= \chi - \left(\frac{\eta+\mu}{\omega+\mu}\right)\left[\log\left(\frac{1-\omega}{\omega}\right) + \log\left(\frac{1+\bar{r}}{\bar{r}}\right) + \frac{\bar{r}}{\bar{r}(1+\bar{r})}\right] \\ &\quad - \log w_t - \left(\frac{\eta+\mu}{\omega+\mu}\right) r_t + \log m_t,\end{aligned} \tag{12.40}$$

$$\begin{aligned}\log l_t^* &= \chi^* - \left(\frac{\eta+\mu^*}{\omega+\mu^*}\right)\left[\log\left(\frac{1-\omega}{\omega}\right) + \log\left(\frac{1+\overline{r^*}}{\overline{r^*}}\right) + \frac{\overline{r^*}}{\overline{r^*}(1+\overline{r^*})}\right] \\ &\quad - \log w_t^* - \left(\frac{\eta+\mu^*}{\omega+\mu^*}\right) r_t^* + \log m_t^*,\end{aligned} \tag{12.41}$$

$$\begin{aligned}\Delta\log q_t &= \left(\frac{1-\eta\sigma}{\eta-1}\right)\left[\left(\frac{\eta\omega+\mu^*}{\eta(\omega+\mu^*)}\right)\Delta\log c_t^* - \left(\frac{\eta\omega+\mu}{\eta(\omega+\mu)}\right)\Delta\log c_t\right] \\ &\quad + \frac{1-\eta\sigma}{\eta}\left[\frac{\mu^*}{\omega+\mu^*}\Delta\log m_t^* - \frac{\mu}{\omega+\mu}\Delta\log m_t\right] - \psi(1-\sigma)^* \\ &\quad [\Delta\log l_t^* - \Delta\log l_t],\end{aligned} \tag{12.42}$$

$$r_t - (P_t - P_{t-1}) = r_t^* - (P_t^* - P_{t-1}^*) + \gamma, \tag{12.43}$$

$$P_t c_t + \Delta M_t + \sum_{s^{t+1}} Q_{t+1} B_{t+1} - B_t = P_t w_t l_t, \tag{12.44}$$

$$P_t^* c_t^* + \Delta M_t^* + \sum_{s^{t+1}} Q_{t+1} B_{t+1}^*/e_t - B_t^* = P_t^* w_t^* l_t^*, \tag{12.45}$$

To obtain (12.40), we substituted the value of c_t from (12.20) into (12.18), then loglinearized the resulting expression.

To estimate the model (12.38)–(12.45) the budget constraints (12.44)–(12.45) need to be modified. First, they are specified in nominal terms, while the other six equations are specified in real terms, so we deflated (12.44) and

(12.45) by P_t and P_t^*, respectively. Secondly, we loglinearize them since they are linear in the levels of c_t, m_t, l_t, c_t^*, m_t^*, l_t^*, while the equations (12.38)–(12.43) are linear in the logs of these variables. In addition, we take into account that any variable x_t can be written as $e^{\log x_t}$, which, in turn, can be approximated by taking a first-order Taylor series expansion about the sample mean $\overline{\log x}$.

Notes

1 For recent reviews of the NOEM, see Lane (2001) and Sarno (2001).
2 See e.g. Betts and Devereux (2000) and Bergin and Feenstra (1999).
3 They build the moments generating a random sample of shocks, and compute the corresponding variances and means of some crucial variables.
4 Especially the nominal and real exchange rates.
5 See also Eichenbaum and Evans (1995), Betts and Devereux (1997).
6 An innovation introduced by Ghironi (2000) is that he adopts an overlapping generation structure in order to properly define the steady state, abandoning the mainstream assumption of a representative agent.
7 The estimation could be biased by the choice of calibration values.
8 For example, there are many recent papers claiming that staggered prices *à la* Calvo have difficulties in explaining some features of inflation and output dynamics, see Mankiw and Reis (2002) and Woodford (2001).
9 The length of the sample considered is justified by the introduction of the euro.
10 For the formal derivation of (12.3)–(12.5), see Chari *et al.* (2000b).
11 The Foreign country's variables are indexed with an asterisk.
12 The RER is defined as $q(s^t) = e(s^t)P^*(s^t)/P(s^t)$.
13 For a technical discussion of the homogeneity conditions that a utility function has to meet in order to be compatible with a balanced growth path, see Chari *et al.* (2000b).
14 See Chari *et al.* (2000b).
15 We consider the G6 as an approximation of the rest of the world.
16 The other seven endogenous variables are $c(s^t)$, $m(s^t)$, $l(s^t)$, $c^*(s^t)$, $m^*(s^t)$, $l^*(s^t)$ (the instrumental variables of the consumers in the two countries), and $q(s^t)$.
17 See Gandolfo (1981).
18 On the contrary, Chari *et al.* (2000a) suppose that perfect symmetry across countries holds.
19 These stochastic error terms are denoted with v_{kt}, where $k = 1, \ldots, 6$.
20 See eq. (12.26) and eq. (12.27).
21 See eq. (12.20) and eq. (12.21).
22 Clifford Wymer's program RESIMUL (version 2001), which allows for nonlinear restrictions on the parameters within and across equations, was used to estimate the model.
23 It should be noted that this result has been achieved without imposing any functional restriction on the parameters' values during the estimation procedure.
24 The confidence intervals for ω and ω^* can be calculated to show that neither 0 nor 1 are included in them.
25 Remember that, as shown in the previous section, η can be interpreted as the elasticity of the real money demand with respect to the nominal interest rate.

26 The stability properties of the model are studied using the program CONTINEST, developed by Clifford Wymer (2001 version).
27 Remember that, given k eigenvalues, a difference equation system is stable if $|\lambda_i| < 1$, $i = 1, \ldots, k$. See Gandolfo (1997).
28 The simulations are obtained using the program PREDIC, developed by Clifford Wymer (2001 version).
29 In other words, if $\log c_t$ has a RMSE of 0.13576, it means that the average difference between the forecasted and the actual values of $\log c_t$ is equal to 0.13576, and, consequently, that, on average, the proportional change between the forecasted and the actual values of c_t is 13.576 per cent.
30 See, e.g. Betts and Devereux (2000).
31 See Kollmann (2001, Figure 1).
32 According to the procedure developed by Bergstrom and Wymer (1976).

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13

Macroeconomic Risk Evaluation of International Reserves in Venezuela*

Carolina Pagliacci and Elizabeth Ochoa

13.1 Introduction

In the World Bank Conference 'Liquid Reserves and Debt' in 1999, Alan Greenspan pointed out that it would be desirable if policy makers incorporated in their analysis of international reserves the risks associated with the occurrence of stochastic shocks, as is usually done in the evaluation of other financial assets. The rationale for this assessment is that when the occurrence of shocks is neglected, biases in the decision-making process may arise, and wrong decisions can be costly for the economy.

Recently, the concepts of 'value at risk' and 'managing risk' have been popularized, but few applications have been developed to macroeconomic variables. Among those that have been advanced, Kilian and Manganelli (2003) propose a tool for 'risk management' that measures risk on inflation forecasts as the expected deviations of inflation from its target rate. This risk measure is then used to interpret historic Federal Reserve decisions, considering the same set of information available to the authorities at each point in time.[1]

Following a similar reasoning to that adopted by Kilian and Manganelli (2003), this chapter tries to generate a methodology for evaluating the risks associated with the performance of international reserves, based on the idea that reserves are related to other macro variables through a reduced form model of the economy (such as a small-scale macroeconomic model). When external shocks hit the economy, joint probability distributions of reserves and related macro variables arise, which allow the application of any form of risk measurement. In particular, if policy makers reveal their preference for a certain range of international reserves or other related macro variables,

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risk can simply be defined as the probability of not achieving these preferred sets of values. In this way, given any probability distribution of interest, we can attach an operational risk measure, and evaluate its evolution through time.

To study the risks that stem from the (direct or indirect) management of international reserves, we focus on the analysis of four indicators: the forecast path of both international reserves and inflation, the likelihood of a currency crisis, and an indicator of optimality of reserves. These indicators are selected because they synthesize the two main areas of concerns of central bankers. On one hand, inflation is typically a policy objective, and although it is not directly caused or explained by reserve changes, it is indirectly affected by the exchange rate policy and the structure of the economy. On the other hand, the probability of an external crisis behaves as an early signalling indicator for a currency crisis, and, related to the existence of these crises, the indicator of *suboptimality* summarizes how well insured a country is against them.

The model of the economy that summarizes the time-dependent relationships among variables focuses on the Venezuelan external sector, which is basically described by the path of the nominal exchange rate and the main components of the balance of payments: oil exports, imports and private capital movements.

Since the Venezuelan economy has experienced several kinds of exchange rate regimes in the last twenty years, directly modelling the nominal exchange rate is not a straightforward task, especially during the periods of exchange rate controls. We overcome this difficulty by resorting the definition of 'exchange market pressure'. This concept, although not new in the literature,[2] has been used recently to predict currency crises through logit or probit models. García and Soto (2004), Edwards (2004), Berg and Pattillo (1999) and Sachs, Tornell and Velasco (1996) are examples of empirical models on external crises. In this chapter we model the determinants of the exchange market pressure with two explicit purposes: (i) to explain the behaviour of the nominal exchange rate independently of the exchange rate regime and (ii) to compute the probability of an external crisis.

One of the most important the empirical determinants of exchange market pressure is the level of international reserves, since it this represents a broad measure of external vulnerability. Models like Sachs, Tornell and Velasco (1996) and Sims (2001) provide theoretical background to explain the negative relationship between international reserves and external crises. In Sachs, Tornell and Velasco (1996) agents observe the level of international reserves to determine whether capital outflows of the economy can occur without causing a balance of payments crisis. The lesson from this model is that when a country faces weak fundamentals, the probability of occurrence of a crisis due to self-fulfilling prophecies is higher if the level of reserves is low. In the same line of reasoning, Sims (2001), in a stylized model of a small economy, shows that explosive paths of prices (i.e., the exchange rate) can be ruled out if the Central Bank commits to maintain enough reserves to back up the quantity of money in the economy.

In the estimated model for the Venezuelan economy, we do find that exchange market pressure is partially explained by the level of international reserves. The fact that reserves relate inversely to exchange market pressure, and this one proportionally to the probability of a crisis, implies that reductions in reserves increase the likelihood of a crisis and might translate either into further losses of reserves or to depreciations of the domestic currency. This makes reserves crucial, not only in terms of their use, but also for their consequences on economic stability.

The main components of the balance of payments, especially imports and private capital movements, are estimated using standards arguments proposed in the literature.[3] Given the expected behaviour of balance of payment flows and a Central Bank policy rule, future levels of reserves are determined.

The complete model allows the computation of forecasts for international reserves and the probability of a crisis. Simulating stochastic shocks in the exogenous variables of the model, we can retrieve probability distributions on these variables. Establishing policy makers' preferences on them, defines risk as the chances of missing the desired accumulation of reserves or of facing extremely high possibilities for an external collapse.

To assess the degree of optimality of forecasted international reserves requires imposing a definition of 'optimal reserves'. Empirically, there are several grounds for which countries rationalize the accumulation of foreign reserves.[4] Theoretically, reserves are mostly treated as an inventory and optimal reserves must minimize the costs associated.[5] In this chapter we follow a variation developed by García and Soto (2004) in which optimal reserves minimize the expected costs, and the probability of a crisis depends upon the behaviour of several macroeconomic variables – among them, the ratio of foreign debt to reserves. Additionally, we compare optimal reserves to forecasted reserves in order to asses to what extent optimality is achieved. Risk arises when, according to the preferences of policy makers, *suboptimality* exceeds established thresholds.

The suggested measures of risks have the attribute of conveying all the relevant information from different sources of uncertainty, and of changing through time according to the state of the economy. These characteristics endow policy makers with sufficient information, not only to achieve a proper assessment of the nature of risks faced, but also to compare different policy regimes on the basis of the risks implied. These comparisons can be done since risk arises from the context of a macroeconomic model that describes the response of the economy to diverse types and magnitudes of shocks.

This chapter is structured as follows: first, we present a stylized version of the external sector of the Venezuelan economy, and, then, the estimation of the main relationships of the model (this latter part can be skipped if the reader is only interested in the layout and application of the methodology). Thirdly, we present the operational definition of risk, and propose the indicators over which this measure is computed. Finally, we apply the methodology described to analyse the accumulation of reserves in year 2006, and draw the main conclusions.

13.2 Stylized model of the external sector

In this section, we present a basic theoretical model that summarizes the main characteristics of the external sector using the concept of exchange market pressure. This simplified representation allows us to highlight the endogenous relationship between variables and the structure of the estimation model described in the next section. Although the resulting system of differential equations with rational expectations is not solved in the chapter, qualitative dynamic paths for the nominal exchange rate and international reserves could be easily derived.

To model the nominal exchange rate, we use the concept of exchange market pressure, which is a measure that increases its value when an excess of demand of foreign currency (US dollar) occurs. Since this excess of demand of dollars is reflected either in a depreciation of the domestic currency or in an increase of the amount of dollars sold by the Central Bank to the market, then the exchange market pressure (*EMP*) can be measured as: $EMP \equiv g\left(\frac{\dot{E}}{E}, \frac{V}{R}\right)$, where E is defined as the nominal exchange rate (domestic currency per dollar) and V/R is the ratio of net Central Bank sales of dollars to international reserves. Measuring the exchange market activity in this way allows comparing moments with identical exchange market pressure, independent of the existing exchange rate regime.

All those factors that potentially cause a higher demand of the foreign currency can be interpreted as determinants of the exchange market pressure. In particular, we are interested in stressing that the level of reserves has a negative relationship with the exchange market pressure. Intuitively this accounts for the fact that when the Central Bank has a big enough stock of reserves, it is more capable of facing speculative attacks to the domestic currency. This intuition translates in the first equation of the model:

$$EMP = f_0(R; G_0) \tag{13.1}$$

where G_0 represents all fundamental variables that are exogenous to the model and $f_{0R} < 0$ is the partial derivative of the function with respect to the level of reserves.

Using the definition of exchange market pressure, we can obtain the movement equation for the nominal exchange rate:

$$\dot{E} = f_1(EMP, E, V, R) \tag{13.2}$$

where $f_{1EMP} > 0,\ f_{1E} > 0,\ f_{1V} < 0,\ f_{1R} > 0$. Note that in this case, for a given value of exchange market pressure, a lower ratio of Central Bank net sales to reserves causes a higher depreciation of the domestic currency.

To complete the external sector model, it is necessary to describe the behaviour of the main components of the balance of payments. The imports of goods and services (M) can be modelled as:

$$M = f_2(E; G_2) \tag{13.3}$$

Since imports depend upon the real income and real exchange rate, G_2 contains the levels of domestic and foreign prices, and real income, which are determined outside the model. It is the case that $f_{2E} < 0$.

Private capital inflows (K) are assumed to be inversely related to the expected depreciation of the domestic currency, since the anticipation of a loss in domestic assets causes a reallocation of the agents' portfolios to foreign currency. These capital flows are as well explained by other exogenous variables such as the domestic and foreign interest rate and the sovereign risk, all of which are considered in G_3.

$$K = f_3(\dot{E}^e; G_3) \tag{13.4}$$

In order to characterize the path of international reserves, we incorporate to the model a Central Bank policy rule that indicates how much of the demand of foreign currency will be supplied to the market.[6] Since this (private) demand of foreign currency is basically explained by the imports of goods and services and capital outflows, the policy rule can be simply expressed as:

$$V = \phi_1 M - \phi_2 K \tag{13.5}$$

where $\phi_1, \phi_2 \geq 0$ are the policy parameters chosen by the Central Bank according to the existing exchange rate regime. For example $\phi_1 < 1$ implies that the Central Bank is partially financing the demand of imports, while $\phi_2 < 1$ might reflect the fact that during exchange rate controls, the Central Bank does not explicitly allocate foreign currency to the desired level of capital transactions, although some degree of capital outflows might take place.

Finally, the change in international reserves is described by:

$$\dot{R} = G_4 - V \tag{13.6}$$

where G_4 includes all net inflows of foreign currency to the economy not directly modelled. In the case of the Venezuelan economy this inflows are mainly represented by oil exports.

13.3 Model estimation

All equations are estimated using quarterly data for the period 1988:4–2004:2. Since this time period contains episodes of exchange rate control,[7] the differentiation between the dual (or parallel) and the official exchange rate market is addressed whenever is relevant for estimation purposes. In general, the working strategy consisted in the estimation of linear equations using Generalized Instrumental Variables (GIV) or Generalized Method of Moments (GMM) since endogeneity of variables was taken into account. Prior to the estimation of the models, Augmented Dickey-Fuller tests were performed on the data.

13.3.1 Exchange market pressure

One of the most important parts of the external model is the description of the determinants of the nominal exchange rate. As mentioned earlier, this description is undertaken indirectly through the estimation of an equation for exchange market pressure. The empirical definition of exchange market pressure is:

$$EMP_t = \frac{1}{\sigma_{dlep}} DL[EP_t] + \frac{1}{\sigma_{vr}} L[V_t - R_{t-1}] \tag{13.7}$$

where σ_{dlep} is the standard deviation of the log-variation of the nominal exchange rate (EP) and σ_{vr} is the standard deviation of the logarithm of the ratio of Central Bank net sales to reserves, $L\left(\frac{V}{R}\right)$. During periods of exchange rate control, EP refers to nominal exchange rate in the parallel or dual market. For the sample: $\sigma_{dlep} = 0.12$ and $\sigma_{vr} = 1.42$.

The literature generally uses the relative variations of international reserves as the indicator that captures quantities adjustments in the exchange rate market. This is generally correct when Central Banks modify their stock of reserves by buying or selling foreign currency to the market through a process of bargaining. For the Venezuelan case, this is not always true since the Central Bank can increase its stock of reserves by receiving dollars from the oil state company. These transactions are mandatory by law and do not involve any bargaining over the price of the currency. Therefore, the variable used in our definition is the Central Bank net sales of dollars, which strictly refers to transactions where the price of the currency arises from a process of bargaining between private agents and the Central Bank.

The theoretical grounds for the estimation of the exchange market pressure are found in the literature of currency crises.[8] Reserves are introduced as an explanatory variable in relation to the stock of outstanding public foreign debt. Other variables that try to capture the state of fundamentals are also included, such as the misalignment of the real exchange rate and the amount of money supply generated by the government, the oil state company and the Central Bank (public sector). Additionally, the misalignment of terms of trade respect to its long term trend is used as a proxy for oil windfalls (or shortfalls).[9] The estimation is summarized in Table 13.1.

Coefficient signs are consistent with the predictions of the theory: an appreciation of the real exchange rate below its long-term trend, a relative increase in money supply, and a reduction in the ratio of reserves to public foreign debt (net worth of the economy) will tend to increase the demand of foreign currency and therefore, the exchange market pressure. Additionally, when an oil windfall occurs with a depreciated real exchange rate, i.e. the relative price of oil exports is above its long-term trend, the exchange market pressure rises reflecting that agents try to reallocate this transitory income in foreign currency.

Since the determinants of the exchange market pressure are relevant for the behaviour of the nominal exchange rate, we can conclude that any factor that will drive the demand of foreign currency upwards without an increase in the Central Bank supply (sales), will cause a depreciation of the domestic currency.

Table 13.1 Exchange market pressure estimation

		Dependent variable: EMP Method: GLS II Q 1989–II Q 2004		
Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob.*
C	−1.850	0.164	−11.307	0.000
EMP(−1)	−0.419	0.028	−14.906	0.000
MLER(−1)	−1.417	0.415	−3.411	0.001
MPS_GDP(−1)	6.623	1.061	6.240	0.000
D[R_FD(−1)]	−12.172	1.518	−8.019	0.000
DUM_DEP*MLTT	0.931	0.411	2.269	0.027
DUM_C94	4.184	0.153	27.337	0.000
		Weighted statistics		
R-squared	0.994	Mean dependent var		0.972
Adjusted R-squared	0.993	S.D. dependent var		16.253
		Unweighted statistics		
R-squared	0.581	Mean dependent var		−0.640
Adjusted R-squared	0.534	S.D. dependent var		1.347

Weighting: EMP(−1)*MLER(−1)
Variables: EMP: exchange market pressure; MLER: misalignment of real exchange rate; MPS_GDP: ratio of public sector money supply to GDP; R_FD: ratio of international reserves to foreign debt; MLTT: misalignment of terms of trade; DUM_DEP: dummy that takes value 1 when MLER > 0; DUM_C94: dummy that takes value 1 for the beginning of the 1994 exchange rate control;
D[.]: refers to the first difference operator.

13.3.2 Imports

In its simplest form, imports are expressed as a function of the real exchange rate and real income. A new explanatory variable is added to the analysis: the relative gap between the parallel and the official nominal exchange rate during exchange rate controls. This variable intends to capture the fact that during controls there is an incentive to import more due to the subsidy the government provides when assigning foreign currency at the official price, which is always lower than the one quoted in the parallel or dual market. Estimation results are summarized in Table 13.2.

Estimated coefficients show that the demand for imports is inelastic to its price but very elastic to income, indicating that the response of imports to the economic cycle is significant. Also, an increase of the nominal exchange rate gap during controls in 1 per cent will increase imports in 0.2 per cent, showing that imports do respond to the subsidy created by the exchange rate control.

13.3.3 Private capital inflows

Since this variable is not directly defined in the external sector statistics, it is constructed as the sum of the balance of the capital account and 'errors and omissions', minus the foreign debt flows from the public sector. As portfolio decision theory would indicate, capital inflows are a function of the expected return of foreign assets, i.e. the expected depreciation of the nominal exchange rate, the return of domestic assets and the risk imputed to those returns.[10] Three additional variables are incorporated in the estimation: the public foreign debt to reserves ratio, as a measure of the degree of

Table 13.2 Imports estimation

Dependent Variable: DL[M] Method: GMM II Q 1989–II Q 2004				
Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob.*
C	−0.016	0.015	−1.049	0.299
DL[GDPR]	2.019	1.076	1.876	0.066
DL[ER(−1)]	−0.559	0.173	−3.225	0.002
GPE(−1)	0.208	0.119	1.747	0.086
DUM_POL	−0.147	0.061	−2.403	0.020
R-squared	0.520	Mean dependent var		0.004
Adjusted R-squared	0.486	S.D. dependent var		0.195

Instruments: C DL[GDPR(−1)] DL[ER(−1)] GPE(−1) DUM_POL
Variables: GDPR: real GDP; ER: real exchange rate; GPE: relative gap between the parallel and the official nominal exchange rate; DUM_POL: dummy that takes value 1 for II and III Q 2002, due to political events; DL[.]: refers to the log difference operator.

external vulnerability of the economy, the misalignment of terms of trade and the change in the gap between the parallel and the official exchange rate. As in the estimation of the exchange market pressure, the misalignment in terms of trade captures the impact of transitory aggregate income due to oil price variations. The change in the exchange rate gap, when expressed as the difference between depreciations in the parallel and the official market, allows the researcher to test for the response of capital inflows to both markets.

According to the estimation results (shown in Table 13.3), an increase in sovereign risk, external vulnerability, and oil windfalls, cause capital outflows. It is also found that capital movements respond to the behaviour of both the parallel and the official exchange rate, indicating that outflows are financed in both markets.[11]

To complete the external sector representation of the economy, we model the behaviour of other crucial variables such as growth, inflation and the stance of public policies, which are measured through the level of government expenditures and money supply. These equations jointly solved with other auxiliary regressions for the trend variables, conform the complete dynamic system used to forecast macroeconomic conditions.

Table 13.3 Net capital private inflows estimation

Dependent variable: K (millions of US dollars) Method: GMM I Q 1994–II Q 2004				
Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob.*
C	1,973.51	534.78	3.690	0.001
@TREND	−56.05	10.07	−5.565	0.000
D[RISK(−1)]	−676.06	161.23	−4.193	0.000
D[DI(−1)]	77.08	20.81	3.703	0.001
D[FD_R(−1)]	−638.10	263.49	−2.422	0.022
DL[E(1)]	−7,242.58	3,086.63	−2.346	0.026
D[GPE]	−3,826.89	1,632.46	−2.344	0.026
MLTT	−2,640.63	643.03	−4.107	0.000
R-squared	0.405	Mean dependent var		−762
Adjusted R-squared	0.262	S.D. dependent var		1,589

Instruments: C @TREND D[RISK(−1)] D[DI(−1)] D[FD_R(−1)] D[R]
V DUM_CC DUM_POL D[GPE(−1)] MLTT
Variables: K: net private capital inflows; RISK: sovereign risk; DI: domestic interest rate; FD_R: ratio of foreign debt to international reserves; E: nominal official exchange rate; GPE: gap between the parallel and the official nominal exchange rate; MLTT: misalignment of terms of trade; V: Central Bank net sales of dollars; R: international reserves; DUM_CC: dummy that takes value 1 for starting and ending periods of exchange rate controls; DUM_POL: dummy that takes value 1 for political events in 2002; D[.]: refers to the first difference operator; DL[.]: refers to the log difference operator.

13.4 A methodology for measuring risk

In this section, we present our operational definition of risk. Then we propose four indicators to summarize information related to the management of international reserves, and measure risk over their probability distributions.

13.4.1 Operational definition of risk

To provide an operational definition of risk, we need two elements: the probability distribution of variables over which preferences are established and decision makers' preferences.

Most of the variables which policy makers analyse, decide upon or commit to, come from complex relationships with other variables, that is to say, they can be understood as the set of endogenous variables of a small-scale macroeconomic model, such as the one presented in the previous section. This idea allows us to introduce a more general representation of the model, and to retrieve probability distribution of these endogenous variables.

Define *Y* and *X* as the set of endogenous and exogenous variables respectively. Divide the endogenous variables according to their nature: variables that come from an economic definition (*YD*); variables to be estimated through a functional relationship (*YF*); and state variables that come from a first-order differential equation or movement equation (*YS*). The preceding model can then be represented as a system of difference equations:

$$YD_t = \phi(YD_{t-1}, YF_t, YS_t, X_t) \tag{13.8}$$

$$YS_t = YS_{t-1} + A\ YD_t + B\ YF_t + C\ X_t \tag{13.9}$$

$$YF_t = D\ YF_{t-1} + \sum_{i=-1}^{1} E_i Y_{t-i} + \sum_{i=0}^{1} F_i X_{t-i} \tag{13.10}$$

where *A*, *B*, *C*, *D*, *E*, and *F* are matrices of coefficients, some of which are estimated (*D*, *E* and *F*) and $\phi(.)$ refers to a non-linear function.

The exogenous variables of the model are considered to be random. These variables are: the relative change in oil prices, in oil export quantities, and in public foreign debt, and the absolute change in country risk. We assume that each of them can be characterized by a Beta probability distribution with parameters α and β. We select the Beta distribution since it is continuous, has a finite support and can be shaped easily according to the maximum, minimum and mode expected. This versatility of the Beta distribution allows incorporating both objective and subjective information available into the generating process of these exogenous variables. As a consequence, the retrieved probability distribution of endogenous variables will be efficient since they also contain all the information available on the shocks that are expected to hit the economy for the forecast horizon.

The realizations of each of the exogenous variables can be ordered in a matrix of dimension (N, T), N being the number of simulations or scenarios and T the forecasting horizon:

$$X = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1T} \\ \vdots & \vdots & \dots & \vdots \\ x_{N1} & x_{N2} & \dots & x_{NT} \end{bmatrix} \tag{13.11}$$

where $X \sim$ *i.i.d. Beta* (α, β).

When incorporating the realizations of the exogenous random variables into the model, we similarly obtain a matrix of realizations for each of the endogenous variables,[12] such that:

$$Y = \begin{bmatrix} y_{11} & y_{12} & \dots & y_{1T} \\ \vdots & \vdots & \dots & \vdots \\ y_{N1} & y_{N2} & \dots & y_{NT} \end{bmatrix} \tag{13.12}$$

where each column of the matrix describes the probability distribution for the variable in period t, which evolves through time according to the relations of the model. Notice that each column can also be understood as a marginal probability density function that is retrieved from the joint density function of all endogenous variables of the model.

Therefore, for any endogenous variable y and any forecast period $t = 1, \dots, T$, we can describe a sequence of empirical probability distributions $\{F_1(y), F_2(y), \dots, F_T(y)\}$. Moreover, we can also define any sequence of values of an endogenous variable $\{y_1^\lambda, y_2^\lambda, \dots, y_{T'}^\lambda\}$ such that $F_t(y_t^\lambda) \equiv \Pr(Y_t \le y_t^\lambda) = \lambda$ for $\lambda \in (0,1)$, or define a probability interval $(y_T^{\lambda_0}, y_T^{\lambda_1})$ such that $\Pr(y_T^{\lambda_0} \le Y_t \le y_T^{\lambda_1}) = \lambda_1 - \lambda_0$ for $\lambda_0 < \lambda_1$.

Policy makers and in particular Central Bankers, usually describe their policies in terms of achieving a certain range of these endogenous variables, typically inflation or growth. Sometimes commitments are not explicitly recognized, but monitoring of variables is undertaken respect to a *reference interval*. In these sense, we might generalize that decision makers indeed have preferences over these variables in such a way that they only care about the fact that variables end up in their target or reference zone. That is, we base all our work on the assumption that decision makers can always tell their preferences, dividing the support of the variable in question into two sets of values: the preferred ones and the undesirable outcomes. Although this might sound a very restrictive theoretical assumption, in practice, decision makers are willing to reveal their preferred values or outcomes (at least, most of the times).[13]

The above assumption is formalized by saying that policy makers can reveal preferences on any endogenous variable Y, in such a way that for values $(\underline{y}, \bar{y})$ and (y_0, y_1), $y_0 \succ y_0$ if $y_1 \in (-\infty, \underline{y})$ *or* $y_1 \in (\bar{y}, \infty)$ and $y_0 \,\phi\, y_1$. Therefore, risk can be defined as the probability of obtaining outcomes outside the range of preferred values:

$$Risk_t^F(Y) = F_t(\underline{y}) + 1 - F_t(\overline{y}) \tag{13.13}$$

where $F_t(\underline{y})$ is usually referred as the downside risk and $1 - F_t(\bar{y})$ as the upside risk of the variable.[14]

Alternatively, when there is an explicit management variable over which decisions might be taken, it could be useful to redefine risk as a conditional probability distribution, since it becomes more appealing for interpretation purposes:

$$Risk_t^F(Y) = \begin{cases} \Pr(Y_t \leq \underline{y}/Z_t \leq z^*) + \Pr(Y_t \geq \overline{y}/Z_t \leq z^*) \\ \Pr(Y_t \leq \underline{y}/Z_t \geq z^*) + \Pr(Y_t \geq \overline{y}/Z_t \geq z^*) \end{cases} \tag{13.14}$$

where Z is the decision variable and z^* divides the support of Z into two mutually exclusive sets.

13.4.2 International reserves and inflation

The most intuitive and simple measure of risk of international reserves is given by the changes its probability distribution suffers through time. To observe these changes we construct a 'fan chart', which is a summarized representation of all the information contained in the probability distributions of reserves. If we choose λ, in such a way that λ = 0,05 ; 0,1; ...; 0.95, we can obtain different sequences of international reserves $\{r_1^\lambda, r_2^\lambda, \ldots, r_T^\lambda,\}$. In matrix form, the 'fan chart' of international reserves can be written as:

$$FC_r = \begin{bmatrix} r_0 & r_1^{0.05} & r_2^{0.05} & \cdots & r_T^{0.05} \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ r_0 & r_1^{0.95} & r_2^{0.95} & \cdots & r_T^{0.95} \end{bmatrix} \tag{13.15}$$

Using the probability distribution of reserves for a given time period, we measure $Risk_t^F(R) = F_t(\underline{r}) + 1 - F_t(\bar{r})$, for any forecast period and for preferred values belonging to the interval $(\underline{r}, \bar{r})$.

However, preferences on international reserves are usually indirect, i.e. they are based on the relationship that reserves have with other more crucial macro variables, such as inflation. If this is the case, then risk can be redefined as the probability that inflation exceeds its target zone, conditional on a variation or level of reserves. This procedure would only imply a 'reshaping' of our definition of risk, which will reduce to:

$$Risk_t^F(PI) = \begin{cases} \Pr(PI_t \leq \underline{pi}/R_t \leq r^*) + \Pr(PI_t \geq \overline{pi}/R_t \leq r^*) \\ \Pr(PI_t \leq \underline{pi}/R_t \geq r^*) + \Pr(PI_t \geq \overline{pi}/R_t \geq r^*) \end{cases} \tag{13.16}$$

where r^* is a cut-off value for the support of international reserves.[15] The advantage of this definition of risk is that highlights the intuition built in the model: when comparing the magnitude of conditional probabilities we can infer which values of reserves levels or variation have a higher associated risk in terms of inflation.[16]

13.4.3 Probability of an external crisis

According to the reviewed literature, the levels and variations of international reserves affect agents' perception about the external vulnerability of the economy, which triggers agents' response in the foreign exchange market and directly influences the likelihood of an external crisis. Therefore, any policy decision about the management of international reserves might have a direct impact on the likelihood of a crisis that needs to be evaluated in the context of the future performance of the economy. A notion of risk arises when the tolerance of policy makers to the likelihood of a crisis trespasses a given threshold, given all possible future probability crisis scenarios.

For particular realizations of external shocks, the forecasted path for the probability of a crisis (PC) is described by the sequence $\{pc_1, pc_2, \ldots, pc_T\}$. Similarly to the way information on reserves is organized, we can compute a 'fan chart' for the probability of an external crisis to directly evaluate the changes in its probability distribution through time:

$$FC_{pc} = \begin{bmatrix} pc_0 & pc_1^{0.05} & pc_2^{0.05} & \cdots & pc_T^{0.05} \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ pc_0 & pc_1^{0.95} & pc_2^{0.95} & \cdots & pc_T^{0.95} \end{bmatrix} \tag{13.17}$$

Given a particular time probability distribution of PC, we quantify risk simply as $Risk_t^F(PC) = 1 - F_t(\overline{pc})$, considering that only an upper threshold value $\overline{pc}$ is relevant for the analysis. Also we can compute, conditional on a level or variation of reserves, the chances that the crisis probability will exceed this threshold:

$$Risk_t^F(PC) = \begin{cases} \Pr\left(PC_t \geq \overline{pc}/R_t \leq r^*\right) \\ \Pr\left(PC_t \geq \overline{pc}/R_t \geq r^*\right) \end{cases} \tag{13.18}$$

In the estimated model, since the external market pressure is negatively related to the level of international reserves (see Table 13.1), high (low) levels of reserves will tend to have associated low (high) levels of external market pressure, and therefore a low (high) probability of an external crisis. In short, the correlation between reserves and crisis probability is negative, and the upside risk of the chance of a crisis is slim, when reserves are high enough.

To estimate the probability of an external crisis, we depart from the standard procedure described in the literature. In particular, we do not compute the probability of a crisis through the estimation of a logit or a probit model,[17] but directly define it as the empirical probability of observing a particular exchange market pressure. For more information on this procedure (see Appendix 1).

13.4.4 Optimality of international reserves

Since decisions on international reserves typically affect their level, policy makers are interested in answering if such levels are optimal or adequate for the economy conditions. To make this evaluation is necessary to define the concept of 'optimal reserves' according to a loss/utility function suitable for decision makers.

We chose to compute optimal reserves following García and Soto (2004) since it combines a very stylized optimization problem with the estimation of a crisis probability in a macroeconomic context. According to their work, optimal reserves (R^*) are the result of the following minimization problem:

$$R_t^* = \arg\min_R [PC_t C + (1 - PC_t)\varphi_t R_t] \tag{13.19}$$

where PC is the probability of a crisis, C the expected cost of a crisis measured in millions of dollars, φ_t the opportunity cost of international reserves and R international reserves also expressed in millions of US dollars. For more information on the estimation of optimal reserves, see Appendix 2.

Once having estimated a level of optimal reserves from given values of a crisis probability, a level of forecasted international reserves and a stock of foreign debt, we can define a sequence $\{d_1, d_2, \ldots, d_T\}$ such that $d_t = \frac{R_t - R_t^*}{R_t}$, which indicates the proportion of the forecasted reserves in excess (or deficit) to the counterfactual optimal level. We can regard this variable (D) as a measure of *suboptimality*, which policy makers might look at to assess how costly the forecasted path of reserves is. Since for each time period there exists a probability distribution of relative distances, we can also evaluate the time change of such distributions by constructing a 'fan chart':

$$FC_d = \begin{bmatrix} d_0 & d_1^{0.05} & d_2^{0.05} & \cdots & d_T^{0.05} \\ \vdots & \vdots & \vdots & \ldots & \vdots \\ d_0 & d_1^{0.95} & d_2^{0.95} & \cdots & d_T^{0.95} \end{bmatrix} \tag{13.20}$$

Likewise, having preferences on the variable D, summarized in threshold values $(\underline{d}, \overline{d})$, we can define risk as $Risk_t^F(D) = F_t(\underline{d}) + 1 - F_t(\overline{d})$, or as:

$$Risk_t^F(D) = \begin{cases} \Pr(D_t \le \underline{d}/R_t \le r^*) + \Pr(D_t \ge \overline{d}/R_t \le r^*) \\ \Pr(D_t \le \underline{d}/R_t \ge r^*) + \Pr(D_t \ge \overline{d}/R_t \ge r^*) \end{cases} \tag{13.21}$$

13.5 An application of the methodology

In this section we simulate the performance of the Venezuelan economy for the second half of 2005 and the whole of 2006, subject to quarterly stochastic external shocks. On the basis of these forecasts, we measure the risks

Table 13.4 Assumptions for the probability distributions of external shocks

	Average oil prices (US$ per barreil)	*Average change oil exports (t.b.d.)*	*Variation foreign debt (%)*	*Sovereign risk (p.p.)*
MIN	40.0	0	–0.1	2.0
MODA	46.6	200	1.5	4.0
MAX	54.0	480	4.0	6.0

associated with the expected changes in international reserves and interpret them. In particular, we run 1,000 simulations or scenarios from which we construct the different probability distributions of variables.

The assumptions to calibrate the Beta probability distributions of shocks are summarized in Table 13.4.

These assumptions, although not necessarily adjusted to policy makers' expectations, suggest that for the most likely scenarios, oil prices will be similar to the average prices in 2005, foreign debt will grow at a moderate rate, while the sovereign risk will tend to fall slightly throughout the year.[18]

The policy rule is calibrated in such a way that the actual variation of international reserves (in 2004 and the first semester of 2005) matches the prediction of the model. We additionally impose that the proportion of imports financed by the Central Bank be greater than the proportion of capital outflows.[19]

Given the above probability distributions of shocks, the general outlook for the external sector is an important accumulation of international reserves, especially during 2006, and a progressive increase of the exchange market pressure, mainly due to the accumulation of distortions associated to the appreciation of the real exchange rate. Detailed results of the principal variables for the external sector of the economy are presented in Appendix 3.

To summarize the consequences of the forecasted performance of international reserves in terms of risks, we classify the scenarios (realizations) of international reserves at the end of 2006 as either *moderate* or *high accumulation*, depending upon whether the scenario belongs to the upper or bottom half of the probability distribution of reserves.[20] We assume that policy makers prefer inflation rates below 18 per cent (the observed inflation rate in 2004), a probability of an external crisis under 0.20, and a measure of *suboptimality* lower than 20 per cent. The computed risks are shown in Table 13.5.

In terms of inflation, a higher risk is associated with the moderate accumulation of international reserves basically because higher rates of inflation occur when the depreciation of the nominal exchange rate in the parallel market is larger, i.e. when the exchange market pressure is more significant.[21] On the other hand, for a high accumulation of international reserves, the risks of observing external crisis probabilities greater than 0.2 are null, due

Table 13.5 Risks associated to international reserves in 2006

	Moderate accumulation	*High accumulation*
Pr (PI > 0.18/ΔR)	**0.88**	0.27
Pr (PC > 0.2/ΔR)	**0.75**	0.00
Pr (D < −0.2 & D > 0.2/ΔR)	0.61	**0.76**
Pr (D > 0.2/ΔR)	0.32	0.52
Pr (D < −0.2/ΔR)	0.30	0.24

to the positive association between the crisis probability and the exchange market pressure. However, the risk of *suboptimality* is greater when the accumulation of reserves is high, and it is fundamentally caused by the excessive hording of reserves. For a moderate accumulation of reserves, risks are equally split between cases of excessive and deficient reserves.

These results lead us to conclude that under the selected probability distributions of shocks and policy rule, decisions on reserves accumulation might cause a trade-off between the upside risk of inflation and the upside risk of optimality. That is to say, deciding to allow a larger accumulation of international reserves reduces the risk of observing high inflation and external crisis probabilities, but attempts to increase the risk of accumulating excessive reserves, which by definition is costly for the economy.

However different the probability distributions of shocks, an alternative policy rule or a different stance of the fiscal and monetary policy might change the trade-off of risks just explained. For example, suppose that the policy rule for reserve management is such that the financing of imports and capital outflows is smaller. Recall also that according to the model, the fiscal and monetary policies are expansionary with elevated oil prices. On one hand, high oil prices and the new policy rule could explain a larger accumulation of reserves that would tend to reduce pressures on the exchange rate market, but on the other hand, the loose stance of the fiscal and monetary policy would induce high inflation and growth in the economy (at least in the short run).[22] In this type of scenario, a high accumulation of reserves could be associated with an important upside risk of inflation but a small upside risk in the probability of an external crisis. In other words, in contrast to the results of the simulations, in this example there would be a trade-off between inflation and the probability of an external crisis that could be explained by the selection of a diverse policy rule and different probability distributions of external shocks.

All the above suggests that the ultimate decision to accumulate a given quantity of international reserves will depend on decision makers' preferences of facing different types of risks.

13.6 Conclusions

Policy makers generally do not take the effects of stochastic shocks into account in their analysis of international reserves. Such misperceptions of uncertainty could introduce a bias in their decision-making process, which can be costly for the economy. In this chapter we show that, given an operational measure of risk and taking into account the effects of these shocks, we are able to evaluate different types of risks related to the management of international reserves.

These risks are measured on the expected probability distributions of inflation, external crisis probability, and the degree of optimality of forecasted reserves. Since these probability distributions are generated from a dynamic model of the economy, they are not only time dependent, but also provide important insights regarding the effects of reserves on the economy. Also, since the probability distributions of shocks may incorporate both objective and subjective information available, the resulting risk measures can be considered efficient.

The nature of the risks policy makers might face depends upon several factors, including the structure of the model of the economy, the preferences of policy makers, and the probability distributions of shocks. It follows from the simulations for the Venezuelan economy for 2006 that varying the accumulation of reserves causes a trade-off between the upside risk of inflation and the upside risk of optimality. Under a different probability distribution of shocks and policy rule, there could instead be a trade-off between the upside risk of the crisis probability and the upside risk of inflation.

The interesting lesson from these examples is that reserve management decisions will depend, to some extent, upon which type of risks policy makers or society desire to bear, but these decisions will ultimately be constrained by the structure of external shocks that hit the economy.

Additionally, the specification of a policy rule for the participation of the Central Bank in the exchange rate market allows a comparison of the implicit risks in different policy regimes. This exercise, although not shown in this chapter, could provide additional insights to understand the consequences of decisions, especially in the context of exchange rate controls.

Appendix 1: Estimation of the probability of an external crisis

The probability of an external or currency crisis depends on the behaviour of the exchange market pressure, since this variable summarizes the direct consequences of agents' demand for and supply of foreign currency. More specifically, the probability of a crisis is a monotonic increasing function of the exchange market pressure since high levels of pressure can imply the depletion of international reserves, an extreme depreciation of the domestic currency, or a combination of both events.

Using the historical information of the exchange market pressure (*EMP*), we define its empirical c.d.f. as $F(emp) \equiv \Pr(EMP \leq emp)$. Since $F(emp)$ is also a monotonic increasing function of the exchange market pressure, then it can be directly interpreted as the probability of an external crisis. Because the empirical c.d.f. of the exchange rate pressure is not sufficiently smooth, we calibrate a logit function to fit it. Operationally, the calibration consists in minimizing the vertical distances between the two distribution functions such that:

$$\min_{\gamma,\delta} \sum_{ipe} [F_{\text{lg}}(\gamma\ emp - \delta) - F(emp)]^2 \quad \text{(A13.1.1)}$$

where $F_{\text{lg}}(\gamma emp - \delta) = \frac{e^{(\gamma emp - \delta)}}{1+e^{(\gamma emp - \delta)}}$, is the c.d.f. of a logistic function and $F(emp)$ is the empirical c.d.f.. The quadratic minimization function in (A13.1.1) results from the application of the measure of discrepancy proposed by Anderson and Darling, which belongs to family of Cramer–von Mises measures of discrepancy. The general quadratic measure of discrepancy is given by $\sum [F_{\text{lg}}(x) - F(x)]^2 \psi(x) dF_{\text{lg}}(x)$, where $\psi(x) = \{F_{\text{lg}}(x)[1 - F_{\text{lg}}(x)]\}^{-1}$, according to Anderson and Darling. Since for the logistic function $f_{\text{lg}}(x) = F_{\text{lg}}(x)\lfloor 1 - F_{\text{lg}}(x) \rfloor$, this measure reduces to the one proposed in expression (A13.1.1). The estimated values of the parameters are $\gamma = 2.94$ and $\delta = -1.98$.

Finally, we can define the probability of an external crisis as $pc_t = F_{\text{lg}}(\hat{\gamma}\ emp_t - \hat{\delta})$. It is important to mention that the rationale for this procedure is to avoid imposing ad hoc thresholds for the exchange market pressure in order to construct the binary variable typically used to estimate logit and probit models of crises, and to avoid discarding statistical valuable information contained in the variable. However, it can be argued that when using empirical c.d.f. of the exchange market pressure, the interpretation of this probability might be slightly different to the one used in standard procedures. In particular, we could theoretically define a crisis as the occurrence of an extreme event in the exchange rate market, that in practice is equivalent to or worse than the worse crisis experienced during the time period considered.

Appendix 2: Estimation of optimal reserves

For computational purposes, we estimate the expected cost of a crisis as the average gap between the real GDP (measured in dollars) and its long-term trend, across different currency crises years in Venezuela, as in Ben Bassat and Gottlieb (1992). These crises refer to those that occurred in 1983, 1986 and 1994, which registered the highest values for the exchange market pressure (*EMP*). The estimated average value of a crisis ranges between \$2,000 and

\$3,000 million depending upon the values of the exchange rate used. The opportunity cost of reserves is theoretically defined as the difference between the marginal return of capital and the return of reserves, as pointed out in Ben Bassat and Gottlieb (1992). Empirically, we proxy this cost as the difference between the return of the public foreign Venezuelan debt and the return of US Treasury Bills.

Assuming that the expected cost of a crisis is invariable to the level of reserves, solving the first-order condition for the level of optimal reserves, we obtain:

$$R_t^* = \left(\frac{\partial PC_t}{\partial R}\right)^{-1}(1 - PC_t) + \frac{C}{\varphi_t} \tag{A13.2.1}$$

where $\frac{\partial PC}{\partial R}$ refers to the rate of change of the probability of a crisis when reserves are marginally increased. Acknowledging the fact that according to our model the probability of a crisis is increasing in the exchange market pressure (*EMP*), and this one is inversely related to international reserves, we can write:

$$\begin{aligned} \frac{\partial PC_t}{\partial R} &= F_{\mathrm{lg}}(\hat{\gamma}\ emp_t - \hat{\delta})[1 - F_{\mathrm{lg}}(\hat{\gamma}\ emp_t - \hat{\delta})]\frac{\partial EMP_t}{\partial R} < 0 \\ \frac{\partial EMP_t}{\partial R} &= g(\overset{-}{R}, \overset{+}{FD}) < 0 \end{aligned} \tag{A13.2.2}$$

where $\frac{\partial EMP}{\partial R}$ is the rate of change of the exchange market pressure with respect to reserves. The expression $g(\overset{-}{R}, \overset{+}{FD})$ denotes that the stock of outstanding foreign debt (*FD*), and the stock of reserves (*R*) are arguments of the function that defines the rate of change of market pressure with respect to reserves (see *EMP* estimation in Table 13.1). According to the estimated model, this derivative is negative and becomes smaller as an increase in international reserves, or a reduction in foreign debt, occurs. That is, a reduced ratio of foreign debt to reserves will drive a more significant reduction in the exchange market pressure per unit of additional reserves.

To ensure a local minimum to the function $F = PC_t\,C + (1 - PC_t)\varphi_t R_t$, the second-order condition needs to satisfy that:

$$\frac{\partial^2 F}{\partial R^2} = (C - \varphi R)\frac{\partial^2 PC}{\partial R^2} - 2\varphi\frac{\partial PC}{\partial R} > 0 \tag{A13.2.3}$$

which holds when $(C - \varphi R) > 0$ and $\frac{\partial^2 PC}{\partial R^2} > 0$ if and only if $pc < 0.5$; or when $(C - \varphi R) < 0$ and $\frac{\partial^2 PC}{\partial R^2} < 0$ if and only if $pc > 0.5$.

Table 13.6 Forecasts for the external sector

Variables	*GPE*		*Annual ER variation*		*FD/R*	
2004	26.3		2.6		110.9	
			λ–Percentiles			
Lambda λ	*2005*	*2006*	*2005*	*2006*	*2005*	*2006*
0.05	29.3	25.8	1.3	−20.3	88.3	60.6
0.25	31.5	37.1	1.8	−17.6	91.2	66.7
0.50	32.9	43.8	2.2	−15.4	93.2	71.0
0.75	34.2	49.4	2.6	−12.3	95.2	75.1
0.95	36.4	57.0	3.2	−7.7	98.6	82.1

Variables: GPE: gap between the parallel and the official nominal exchange rate; ER: real exchange rate; FD_R: ratio of foreign debt to reserves.

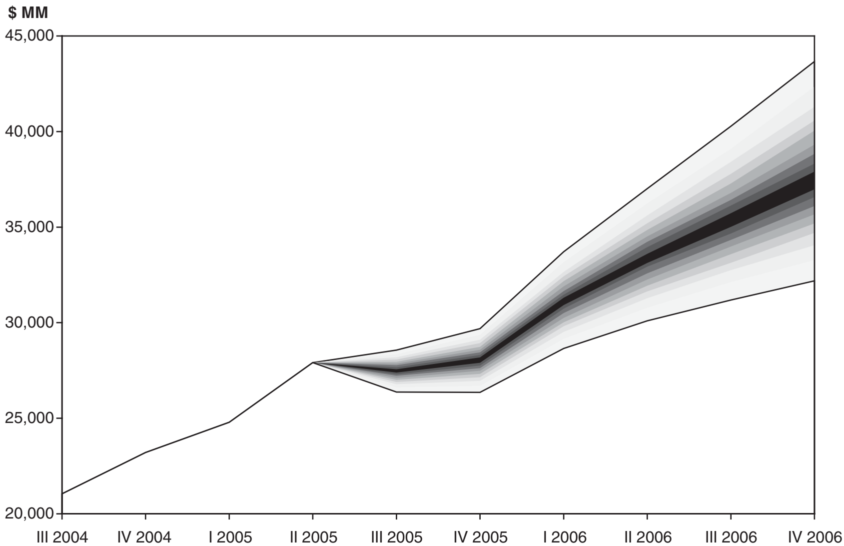

Figure 13.1 Fan chart of forecasted international reserves

Appendix 3: Results for the external sector and fan charts

These forecasts suggest that the high oil prices combined with the parameter values assigned to the policy rule explain an important accumulation of reserves in 2005 that continues in 2006, which has improved the ratio of foreign debt to reserves.[23] On the other hand, the lack of depreciation of the official exchange rate (recall that Venezuela is under an exchange rate control since 2003) tends to deteriorate part of the external sector, in terms of increasing gaps between the parallel and the official nominal exchange rate,

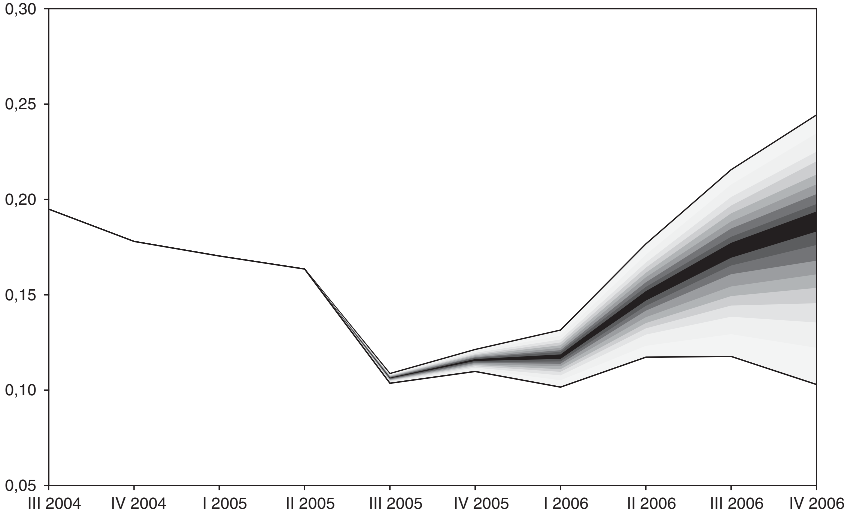

Figure 13.2 Fan chart of forecasted inflation

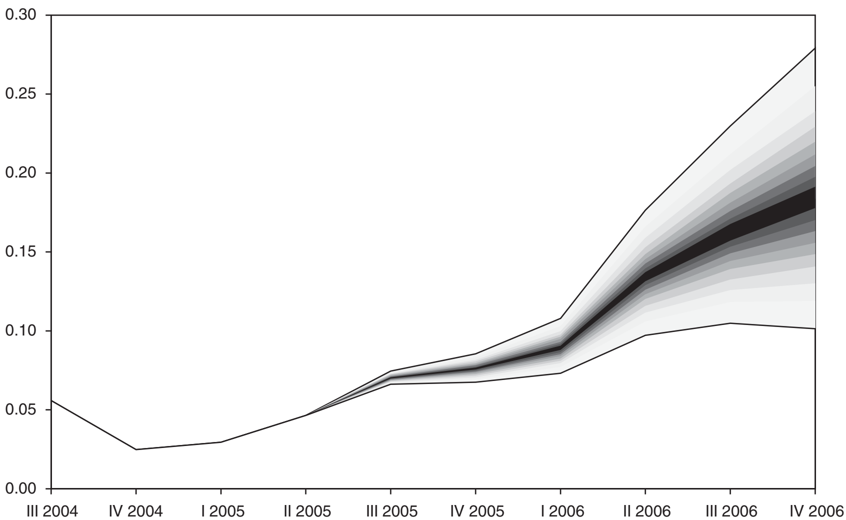

Figure 13.3 Fan chart of forecasted probability of a crisis

and significant appreciations of the real exchange rate. This real appreciation has a direct impact on imports, which increase on average by around 12 per cent for 2006, and on capital outflows. The reduction in the ratio of foreign debt to reserves with respect to 2004 for all scenarios tends to compensate for the negative accumulation of distortions in terms of relative prices (the

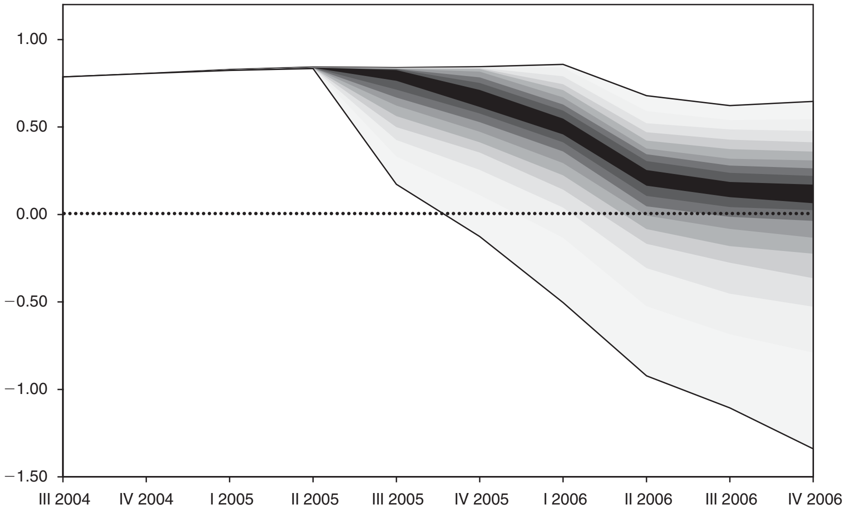

Figure 13.4 Fan chart of forecasted indicator of reserve optimality

official versus the parallel exchange rate) and prevents the exchange market pressure to excessively grow over time. The graphic representations of the different 'fan charts' proposed are shown in Figures 13.1, 13.2, 13.3 and 13.4.

Notes

1 Garcia and Rigobón (2004) also apply risk analysis to the problem of debt management. We found out about this paper after a first version of this document was written. Lewis (2004) reproduces Garcia and Rigobón (2004) for Jamaica.
2 Among the first references to the concept of exchange market pressure are Girton and Roper (1977) and Weymark (1995).
3 For a survey on capital flow determinants see Rigobón (2004).
4 A detailed explanation of different rules used by countries to explain reserve accumulation is given in Beaufort and Kapteyn (2001).
5 See, for example, Frenkel and Jovanovic (1981).
6 It is important to notice that, according to the institutional arrangement in Venezuela, the state oil company has to sell all its foreign currency from the oil business to the Central Bank. As a consequence, the Central Bank participates in the exchange rate market on a daily basis, supplying at least half of the foreign currency traded between private agents.
7 Periods of exchange rate control: 1994–1996 and 2003 to the present.
8 References to this topic are Sachs, Tornell and Velasco (1996), Sims (2001), García and Soto (2004) and Edwards (2004).
9 Terms of trade are defined as the relative price of oil exports in terms of imports. The long-term trend is estimated with a Hodrick–Prescott filter.

10 Sovereign risk is empirically approximated by the difference between the return of Venezuelan debt in foreign markets minus the return of US T-bills.
11 It is interesting to note that the response of capital outflows to depreciations of the exchange rate is similar in both markets, i.e. around $3,500 million for an exchange rate variation of 100 per cent.
12 The solution of our system of difference equations was solved by the Gauss–Siedel method provided in E-views.
13 Another totally different discussion that we are going to avoid is whether or not these values can be achieved or which instruments are the most suitable for this purpose.
14 Although no formal considerations will be further made, it is important to note that this definition suggests that individuals could rank probability distributions according to their risk, and that the notion of second-order stochastic dominance is compatible with this one.
15 Note that the support of international reserves can be divided in as many mutually exclusive regions as desired for analytical purposes.
16 Risk can be computed in terms of other variables, such as growth. The election of the variable will depend on policy maker preferences and on the structure of the estimated model.
17 See García and Soto (2004) as an example of the standard procedure for the estimation of the probability of a crisis.
18 In the model, the probability distributions of external shocks are expressed as quarterly variations of the variables. Realizations of these variables for the forecast period (six quarters) are identical and independently generated across quarters, implying that the variables in levels, i.e. oil prices, oil quantities, sovereign risk and foreign debt, are all random walks.
19 The calibrated parameters for the rule are 88 per cent for imports, and 65 per cent for capital outflows.
20 We make r^* equal to the median of the probability distribution of reserves.
21 Recall that the ratio of foreign debt to reserves determines the exchange market pressure. In these high inflation equilibria the economy ends up with relatively low reserves, large real exchange rate appreciations and important exchange market pressures.
22 This assumes that the higher levels of inflation are mostly explained by the fiscal expenditure and money supply effects, while the exchange market pressure is basically dominated by the foreign debt to reserves ratio effect.
23 It is important to emphasize that the rate of accumulation of international reserves depends heavily on the magnitude of the oil shocks, which are sized according to the combination of objective and subjective expectations.

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14
World Bank Trade Models and the Doha Debate*

Rudi von Arnim and Lance Taylor

14.1 Introduction

As this chapter is being written, the World Trade Organization's 149 members are engaged in the 9th world round of multilateral trade negotiations, the first following the WTO's creation in 1994. In December 2005 the nations' trade representatives hurried to Hong Kong, where the 6th Ministerial Conference was supposed to pave the way – at least two-thirds – towards an agreement. While the 5th Ministerial Conference in Cancun in 2003 unmistakably failed, Hong Kong did not, although it fell far short of what the trade and development community considers a success. Over the course of the first few months of 2006, negotiations in Geneva and member countries continued in order to avoid failure, which is expected to come about if an agreement is not found before President Bush's 'fast track' negotiating power expires at the end of the calendar year 2006.

At this point, the manifold negotiating positions can be briefly summarized in three major blocks, representing the trade interests that fuel the debate: First, the developed world aims to maintain its traditionally high levels of protection for agricultural production while demanding improved market access in developing countries for manufacturing as well as service exports. Secondly, large developing countries such as India, Brazil,[1] and Argentina hope to reach an agreement that allows protection as well as developmentalist policies in exactly those sectors, while demanding substantial reductions in developed countries' agricultural tariffs and subsidies. Thirdly, the poorest countries, often with small economies heavily dependent on aid and a few primary commodity exports, defend not only preferential trade agreements but furthermore need policy space to promote exports and economic diversification, while demanding special protection against increased import competition.[2]

* Research support from Oxfam GB is gratefully acknowledged.

Amidst this politically and historically fraught debate economists wield a powerful technical weapon in the form of global computable general equilibrium (CGE) models. The numbers these models produce often dominate public discourse. In this chapter we provide a review and critique of their standard building blocks. We focus on the ubiquitous Armington trade specification as in the World Bank's LINKAGE-model and publications associated with Purdue's Global Trade Analysis Project (GTAP).[3] We underline our analysis with a stylized two-region model tied together in a Social Accounting Matrix (SAM).

The chapter is organized as follows. First, we set out our accounting framework and data followed by an overview of the analytics. We then discuss the many possibilities and problems presented by a CGE trade model. The former relate to causality assumptions, which cover wide swathes of macroeconomic theory; the latter include an upward bias in simulated welfare outcomes due to tariff reduction from (1) the interaction of the government deficit and the Armington structure and (2) the magnitude of the trade elasticities that the World Bank typically adopts. In a third section, we outline the differences and similarities between our version and 'standard' models, both to motivate our simulation strategy as well as to highlight limitations of the Bank's approach. Lastly, we discuss simulation results and conclude.

14.2 An Armington–Godley SAM

In this section we present the SAM and data with a couple of peculiarities stemming from the Armington specification and Wynne Godley's (1996) treatment of international payment flows. Before jumping into rows and columns, a word is in order about the former.[4] Paul Armington (1969) wrote his influential article about 'A Theory of Demand for Products Distinguished by Place of Production' at the IMF. His work built on the common assumption in the empirical trade literature that there is imperfect substitution between imports and domestic products, allowing him to set up a specification avoiding complete specialization in a multi-country world. Global trade then becomes easy to model. An important simplifying assumption is that, usually, 'the standard model specification adds up Armington demand across domestic agents and the Armington decomposition between domestic and aggregate import demand … at the national level, not at the individual agent level'.[5]

Looking at a SAM clarifies the approach.

Figure 14.1 shows a symbolic one-sector flow matrix of an open economy with Armington trade. The accounting satisfies the usual restrictions of double entry bookkeeping. First, row sums and column sums are equal, so that at any point in time the 'agents' satisfy their budget constraint along the column – i.e., that the government's expenditure in column 4 cannot exceed

		1 **Costs**	2 **Armington**	3 **Priv**	4 **Gov**	5 **Foreign**	6 **Inv**	7 **Bonds**	8 **CA**	9
A	Domestic Supply	$-PX$	PX							**0**
B	Composite Supply	aZX		ZC	ZG	ZE	ZI			**ZA**
C	Factor Income	wL								**QV**
D		rK								
E	Government Income	$a_f teZ'X$	$teZ'M_A$	ZT						$\mathbf{Y_G}$
F	Foreign Income	$a_f eZ'X$	$eZ'M_A$							$\mathbf{Y_F}$
G	FoF-Private			S_P			$-ZI$	$-B$		**0**
H	FoF-Gov				S_G			B	$e\Delta'$	**0**
I	FoF-Foreign					S_F			$-e\Delta'$	**0**
J		**0**	**ZA**	**QV**	$\mathbf{Y_G}$	$\mathbf{Y_F}$	**0**	**0**	**0**	

Figure 14.1 A symbolic one-sector flow matrix of an open economy with Armington trade

its income in row E. Secondly, entries along rows are valued at the same price. Thirdly, row entries variously comprise sources of incomes, decompositions of demand, or flows of funds. Fourthly, columns represent cost decompositions, budget constraints, or translation flows from one row to another.

In Figure 14.1 specifically, Rows A through F present demand decompositions, uses of production and sources of incomes, followed in G through I by the flows-of-funds accounts of households, the government, and the foreign 'sector', respectively.

Columns 1 and 2 and the balancing rows A and B show how Armington accounting deviates from standard bookkeeping: The value of domestic output PX (price P and quantity X), is disaggregated into its cost components down column 1: summed domestic and imported intermediates $(a_f e\tau Z' + aZ)X$ plus tariffs and value added.[6] After a sign switch between cells A1 and A2, in column 2 PX and 'final' imports at tariff-ridden prices fold into an Armington value aggregate or composite supply ZA (with price Z and quantity A). The mysteriously created substance A is what everybody spends money on along row B: domestic intermediates, private and public consumption, and investment.

The remainder of the SAM is business as usual. Households spend their income on consumption (B3), pay lump-sum taxes (E3) and save a portion (G3). Savings, in turn, are used to finance investment (G6) and buy government bonds (G7). The government, on the other hand, supports at least a part of its expenditure (B4) by negative government savings (H4), which are funded by treasury bond sales (H7, the flip-side of G7) and a foreign aid inflow. As this SAM is essentially a micro-matrix – there is no financial market with different assets and their potentially different returns – a current account deficit is offset by an exactly equal amount of capital (or aid) inflow in the government's flows of funds. Aid is financed by foreign savings, two items offsetting each other in the foreign flows-of-funds row I.[7]

Such a crude treatment of international financial markets and the resulting capital account is not very compelling, but LINKAGE perceives the world economy as ruled by *trade*, rather than *money*.

Next we can include the other region into the analysis. In order to keep the number of rows and columns at a minimum we assume away the government and investment (see Figure 14.2 for the SAM). Without the government, the private sector is the only agent that can borrow in order to finance a current account deficit. Accordingly, (economy-wide) savings in cell D3 would be negative and balanced by an equal capital inflow in D5, which in turn is equal to the foreign deficit. While this is a considerable simplification – together with the government we have dispensed with tariffs and other policy instruments – our purpose here is to clarify the accounting links between the two regions.

As above, the top part of the table shows supply and income rows (A–D), followed by the international rows (E–G). From left to right, the table presents the developing region in columns 1–6 and the developed region in columns 7–12. Rows A and B and columns 1 and 2 tell the Armington story, here without factor disaggregation and imported intermediates.

The international rows E–G illustrate bilateral trade accounting *à la* Godley. Whereas exports and savings balance with imports to foreign income in the one-region SAM above, these quantities are now transferred from one region to another through the 'conversion column' that separates the two.

Exports of the poor country in cell B4, *ZE*, provide an example. In B4, they enter as a use of supply, but are 'flipped' by a sign change down to the international row F, and subsequently converted to foreign currency[8] before adding to foreign supply in F8. One region's imports are the other region's exports and vice versa. Export–import accounting then produces the current account, which given macroeconomic balance has to be equal to aid or capital flows, which cross the border in row G. The developed country features positive savings in cell D9, offset by the capital outflow Δ', which

		1 **Costs**	2 **Arm**	3 **Priv**	4 **Exp**	5 **For**	6 **SUM**	**XR**	7 **Costs**	8 **Arm**	9 **Priv**	10 **Exp**	11 **For**	12 **SUM**
A	Output	−PX	PX				**0**		−P′X′	P′X′				**0**
B	Supply	aZX		ZC	ZE		**ZA**		a′Z′X′		Z′C′	Z′E′		**Z′A′**
C	Income	QV					**QV**		Q′V′					**Q′V′**
D	FoF			S		eΔ′	**0**				S′		−Δ′	**0**
E			eZ′E′					**−e←**				−Z′E′		
F	Foreign				−ZE			**→ −1/e**		(Z/e)E				
G						−eΔ′		**−e←**					Δ′	
H	**SUM**	**0**	**ZA**	**QV**	**0**	**0**			**0**	**Z′A′**	**Q′V′**	**0**	**0**	

Figure 14.2 A symbolic SAM for two regions

is first carried into the international accounts (G11) and after conversion reappears as the deficit-balancing inflow in D5.

Lastly, we take a look at the data.[9] We extend the symbolic 2-region, 1-sector SAM of the previous paragraphs to a numerical, 2-region, 2-sector SAM in Figure 14.3. Disaggregating production into an agricultural and an industrial good emphasizes structural differences between the two regions. The upper part, rows A through O show Sub-Saharan Africa (SSA) and the lower part (A′ – O′) the rest of the world (ROW), our proxy for the rich countries.

The first four rows and columns in each part take up the Armington business described above, followed by the various agents' accounts, here inclusive of an investment column as well as the government and its treasury bonds which balance flows of funds between private and public hands. Policy instruments such as tariff revenues, subsidies and taxes appear at the right spots. In row F (and F′), output subsidies and, presumably, tariffs on intermediates add to a negative number. Tariffs on Armington imports are accounted for in F3 and F4 and their ROW counterparts. The data can be readily understood, based on a combination of the SAMs in Figures 14.1 and 14.2. Substituting numbers for symbols, however, reveals a couple of simplifying assumptions: (1) All government expenditures are on services, which are subsumed into the industrial sector; (2) all investment originates in the industrial sector; and (3) *all* African imported intermediates come from ROW.

Another important point is that imports and exports in fact are separated in intra- and extra-regional quantities, a distinction especially important for Africa for the reasons just mentioned. Notice, however, that such detail does not go well with publishing conventions, meaning trade flows are disaggregated in a bilateral trade matrix between the two regions *but not shown here* – so that ROW's export total vastly exceeds SSA's import total. In other words, the international rows are not mere Godley-flips across, but a portion of ROW's (and SSA's) exports are rerouted back into the region's imports.

Having built an accounting framework, from Armington to Godley to the numbers, we can now take a preliminary look at what these data tell us. The most obvious difference is that the SAM entries for the rest of the world (ROW) are overwhelmingly larger than those for Sub-Saharan Africa (SSA). Other distinctive features are a roughly tenfold per capita income differential between ROW and SSA, an agricultural consumption share of African consumers twice as high as that in the North, and high extra-regional industrial import shares in the South, exemplifying a dependent economy. See Figure 14.4 for a summary. The data stylize trade between a large, developed region with an affluent population and a smaller, underdeveloped, and poor region.

In the next section, we introduce behavioural functions and discuss the most important aspects of model structure.

	Costs		Armington								
SSA	**Agr**	**Ind**	**Agr**	**Ind**	**Priv**	**Gov**	**Exp**	**Inv**	**Bonds**	**Aid**	**SUM**
Dom(Agr)	−129.6		129.6								**0**
Dom(Ind)		−517.5		517.5							**0**
Arm(Agr)	35.8	7.3			78.8		14.3				**136.2**
Arm(Ind)	29.0	197.8			152.6	53.8	65.2	59.2			**557.6**
Factor-Inc.	60.6	279.0									**339.6**
Gov-Inc.	−2.8	−6.6	1.7	8.6	41.3						**42.2**
FoF:Priv					66.8			−59.2	−7.6		**0**
FoF:Gov						−11.6			7.6	4.1	**0**
Imp(Agr)	2.4	0.7	4.9								**8.0**
Imp(Ind)	4.6	39.3		31.5							**75.4**
Exp(Agr)							−14.3				**−14.3**
Exp(Ind)							−65.2				**−65.2**
CA										−4.1	
SUM	0	0	136.2	557.6	339.5	42.2	0	0	0	0	
ROW	**Agr**	**Ind**	**Agr**	**Ind**	**Priv**	**Gov**	**Exp**	**Inv**	**Bonds**	**Aid**	**SUM**
Dom(Agr)	−4728.2		4728.2								**0**
Dom(Ind)		−48771.7		48771.7							**0**
Arm(Agr)	1419.5	516.4			2585.3		538.6				**5059.8**
Arm(Ind)	1070.5	18852.9			15196.0	4291.9	5645.0	6461.0			**51517.3**
Factor-Inc.	2042.7	27439.8									**29482.5**
Gov-Inc.	−117.5	−1192.9	51.0	315.4	4489.4						**3545.4**
FoF:Priv					7211.8			−6461.0	−750.6		**0**
FoF:Gov						−746.6			750.6	−4.1	**0**
E(Agr)							−538.6				**−538.6**
E(Ind)							−5645.0				**−5645.0**
M(Agr)	206.9	92.9	280.6								**580.4**
M(Ind)	106.1	3062.6		2430.6							**5599.3**
CA										4.1	
SUM	0	0	5059.8	51517.7	29482.5	3545.3	0	0	0	0	

Figure 14.3 A numerical SAM for two regions

Sub-Saharan Africa							
Macro Balance							
Investment	Savings	Gov-Sp	Gov-Y	Exports	Imports		
59.2	−66.8	+53.8	−42.2	+79.47	−83.53	(−0.05)	
Ratio to GDP							
Investment	Savings	Gov-Sp	Gov-Y	Exports	Imports	CA	Def
17%	20%	16%	12%	23%	25%	1%	3%
Statistics				Industrial Import Shares			
Per Capita Income		Agricultural Cons.-Share		*Extra-regional*		*Fixed intermediates (extra)*	
$470		34%		90%		52%	
'Rest of the World'							
Macro Balance							
Investment	Savings	Gov-Sp	Gov-Y	Exports	Imports		
6461	−7211.8	+4291.9	−3545.4	+6183.9	−6179.8	(−0.25)	
Ratio to GDP							
Investment	Savings	Gov-Sp	Gov-Y	Exports	Imports	CA	Def
22%	24%	15%	12%	21%	21%	0%	0%
Statistics				Industrial Import Share			
Per Capita Income		Agricultural Cons.-Share		*Intra-regional*		*Fixed intermediates (intra)*	
$5150		14.5%		99%		53%	

Figure 14.4 Summary statistics for the two regions

14.3 The model

To avoid cluttering subscripts and enhance intuition, we discuss a one-sector model from the developing country's perspective. No important result requires a higher level of disaggregation.[10] Three prices have to be determined: the 'price of value-added' Q from factor costs, the price P of domestic output, and the 'Armington' price Z of composite supply. The first is a constant elasticity of substitution (CES) aggregate of wage and profit rates, which can be interpreted as the cost function dual to a CES production function for unit value-added.[11] The domestic price level follows from the cost decomposition in column 1 in Figure 14.2. Finally, Z is another CES aggregate, in this case of the domestic price and the import price $e\tau Z'$ (the tariff-ridden foreign Armington price in domestic currency).

$$Q = (\alpha w^{1-\sigma} + \beta r^{1-\sigma})^{\frac{1}{1-\sigma}} \tag{14.1}$$

$$P = aZ + a_f e\tau Z' + Q\frac{V}{X} \tag{14.2}$$

$$Z = (\chi P^{1-\theta} + \delta[e\tau Z']^{1-\theta})^{\frac{1}{1-\theta}} \tag{14.3}$$

Equation 14.3 implies that domestic supply – the aggregate of domestic product and imports – is 'produced' into the Armington quantity A by a dual CES production function. The underlying rationale is that (say) foreign and domestic cars are distinct products but can be aggregated into a national 'car pool'. Stanford (1992) gives careful consideration to the plausibility of the Armington specifications. On the surface, they appear to provide a simple, operational model structure for trade. However, national product differentiation ignores the fact that characteristics of products are mostly determined by firms, not countries. A Toyota manufactured in Japan is identical to the same model made in the US, and the Toyota Group itself decides how much international trade to undertake. In other words, much trade is intra-firm, for which the Armington setup is beside the point.

The introduction of the Armington price also appears to provide a convenient solution to the well-known price over-determination problem in an open economy model. Domestic prices cannot be determined from the cost side and at the same time be world prices 'marked-up' by a tariff factor. An Armington price blends the two determining relationships and provides flexibility between domestic and import prices in an otherwise over-determined system. However, to allow the domestic price to vary subject to its cost function, a LINKAGE-style model also must include specific factor inputs with endogenous prices in each sector. Our specification avoids such clutter by including an exchange rate variable explicitly so we can focus on macro price changes.

In more detail, (14.2) shows that P incorporates costs of domestic and imported material inputs (valued at their respective prices P and $e\tau Z'$) and value-added. The last term on the right asks for a scaling factor to relate real value-added and domestic product. Given the Leontief assumption that output is proportional to inputs, it turns out to be

$$\frac{V}{X} = \upsilon = 1 - a - a_f e\tau. \tag{14.4}$$

Combining this 'Johansen' (1960) equation with (14.2) and (14.3) shows that P depends only on parameters, the exchange rate e, and components of the value-added price Q. Domestic prices largely follow factor costs, an assumption shared by both classical economists and Keynes. In any reasonable model, factor prices move only slowly, if at all, and so, consequently, do goods prices. Looked at from this perspective, the Armington construct has two purposes.

One is to 'solve' the over-determination problem of domestic and international prices. This is feasible in (14.1)–(14.4) if the exchange rate can vary to allow the price system to respond to quantity shocks. Because LINKAGE does not incorporate an exchange rate variable it has to use endogenous sector-specific rents, quasi-rents, etc. to attain the same result.[12] The other goal is to insert neoclassical price flexibility into a model otherwise 'naturally' suited for price-rigid analysis. After all, the quantity adjustment prevalent in a world with rigid prices does not fit the World Bank's ideology.

Turning to the demand side, intermediates – both domestic and imported – are non-competitive with levels determined by fixed coefficient demand functions. Factor–output ratios and demand shares for domestic product and imports in Armington composite supply are governed by Shephard's lemma which from standard microeconomics determines conditional demand functions as partial derivatives of the cost function with respect to factor prices.

For example, labour demand bears an inverse relationship to the real wage rate, and, making use of the scaling ratio υ, becomes

$$\frac{\partial Q}{\partial w} = \frac{L}{V} = \alpha\left(\frac{Q}{w}\right)^{\sigma} \Rightarrow \frac{L}{X} = \alpha\upsilon\left(\frac{Q}{w}\right)^{\sigma} \tag{14.5}$$

The labour share follows immediately as

$$\frac{wL}{QV} = \alpha w^{1-\sigma} Q^{\sigma-1} \tag{14.6}$$

The derivatives of (14.3) with respect to the domestic price and the import price give the respective demand ratios

$$\frac{\partial Z}{\partial P} = \frac{X}{A} = \chi\left(\frac{Z}{P}\right)^{\theta} \tag{14.7}$$

$$\frac{\partial Z}{\partial e\tau Z'} = \frac{E'}{A} = \delta\left(\frac{Z}{e\tau Z'}\right)^{\theta} \tag{14.8}$$

Consumption demand in the multi-sector setting must be determined by some complete system of demand equations such as the linear expenditure system (LES), in which sectoral consumption levels above a subsistence basket rise with income according to Engel elasticities. In our one-sector example, consumption from the household columns in the SAM is

$$ZC = QV - ZT - S_P \tag{14.9}$$

With government expenditure fixed in nominal terms and investment either predetermined or savings-driven, we arrive at the material balance

$$A = \left(1 - a\chi\left(\frac{Z}{P}\right)^{\theta}\right)^{-1} D_{fin} \tag{14.10}$$

where $D_{fin} = (C + G + I + E)$ is real final demand and the term in brackets is the Leontief inverse augmented by equation (14.6) in order to substitute for X.

We set savings in Kaldorian fashion to the sum of savings out of profit and wage income

$$S_P = s_r - (s_r - s_w)\alpha Q^{\sigma-1} w^{1-\sigma} \tag{14.11}$$

so that $\frac{\Delta s}{\Delta w} < 0$ with $\sigma < 1$. LINKAGE unrealistically sets $S_w = S_r = S$.

Finally, the World Bank attaches huge importance to its policy metric of choice: 'welfare gains' as quantified by 'little triangle' calculations of how reducing (say) a tariff will shift the economy toward a Pareto-optimal allocation. While 'increasing welfare' is a precious goal of many economists (and even trade negotiators) it might be helpful to recall what it means in the context of a micro/trade-driven computable model – nothing more than a standard calculation of the change in expenditure, *given utility*, between pre- and post-reform price systems.[13]

The assumption of constant utility presupposes that changes in real spending apart from those induced by price movements do *not* enter into orthodox computations of areas of triangles. In the following two sections we show, first, how these estimated welfare changes are biased by macroeconomic 'income effects' in Armington-type CGE solutions and, secondly, why the World Bank reports *only* such a welfare measure.

14.4 The 'Armington effect'

The model in the previous section is not very different from our computer-based version, which features three different sectors, intra- and extra-regional trade, and more policy instruments. Nor, aside from having 100-odd equations instead of more than 50,000, does our computer model differ much in structure from the World Bank's LINKAGE. How such a machine behaves is seen best in computer simulations as discussed below.

Before proceeding to the numbers, however, we take up a hitherto unobserved (to our knowledge) artifact we call the 'Armington effect'. Armington models are already subject to conceptual criticism due to their peculiar definition of national products and emphasis on flexible price adjustment. Here we add a more substantive argument: Armington builds in a real consumption crunch following tariff removal if the government deficit is exogenous. In other words, real income changes and little triangle welfare calculations of the effects of tariff revisions become meaningless. This effect attenuates with a higher Armington elasticity of substitution, which may help explain why the Bank prefers high elasticities in its simulations.

Consider a (further) simplified one-country economy. No intermediate inputs are required, so that $QV = PX$. Households do not save, and as usual the government deficit is balanced by the foreign aid inflow $e\Delta'$.[14] The Armington effect becomes apparent in the consumption response to tariff changes. Consider the consumption column – with $S_P = 0$, $ZC = PX - ZT$, or equivalently in real terms

$$C = \frac{P}{Z}X - T \tag{14.12}$$

where consumption increases with a rise in the relative price ratio P/Z induced by a falling composite supply price and decreases with a rise in taxes.

Look at the latter effect first: suppose, as in LINKAGE-style models, that the government controls its deficit such that a loss of tariff revenue is counteracted by an equal increase in lump-sum taxes T. From column 3 and row C with fixed nominal spending and (negative) saving, T must increase by an amount equal to the revenue decrease $\frac{eZ'E'}{Z}$ after tariff removal.

How does the relative price change affect consumption? The Armington price Z falls with a lower tariff, whereas the assumption $QV = PX$ renders P stable as long as factor prices do not change. Consequently, P/Z rises and spurs consumption – but by how much? The change in the composite supply price following tariff reduction is

$$\frac{\partial Z}{\partial t} = -\frac{\delta e Z'}{Z^2}\left[\frac{Z}{e\tau Z'}\right]^{\theta}. \tag{14.13}$$

To first order, the total shift in C depends on the relative size of these two effects. With some manipulation one can show that the consumption reduction from the tax increase (in absolute terms) is always greater than the consumption gain from a higher price ratio: $\left|\frac{eZ'E'}{Z}\right| > \frac{\delta e Z'}{Z^2}\left[\frac{Z}{e\tau Z'}\right]^{\theta} PX$

$$E' > \delta \frac{PX}{ZA} E'. \tag{14.14}$$

The price effect on the right-hand side of (14.14) is stronger, the higher is the Armington elasticity θ. That is, in (14.12) the fall in Z following tariff reduction is greater, but still cannot fully offset the impact of a higher lump-sum tax.

Intuitively, it seems clear that if tariff reduction causes a real consumption loss, then a lower subsidy is likely to induce a gain. In an applied simulation with many countries, many policy instruments, and strong cross-border interactions, it is impossible to think through the results in detail. But our simulations below confirm the present interpretation of the interaction of liberalization and fiscal policy.

14.5 Balance and closures

Macroeconomic balance is the sum of the internal private balance, the public balance, and the foreign balance. In the identity below, discrepancies between investment and savings or government spending and revenue are offset by the external balance between exports and imports, the latter nominal aggregate *ZM* here as the sum of intermediate and Armington imports valued at domestic supply prices.

$$[ZI - S] + [ZG - Y_G] + [ZE - ZM] = 0 \tag{14.15}$$

How is overall balance attained? A plethora of causality assumptions and combinations exists, even within the few equations above. We focus on two sets, one we call the Bank's closure and the other an Absorption closure. The former replicates the key assumptions the World Bank usually employs, among them savings-driven investment, a predetermined trade balance, fixed (or full) employment, and adept fiscal programming that guarantees a fixed fiscal deficit. The absorption closure stands as our Keynesian response to all of the above. Besides the age-old income adjustment in the balance of payments, it features predetermined investment, an endogenous government deficit, and the possibility of varying employment.

The Bank's closure works along the lines of the ancient elasticities approach to the balance of payments (as extended by fiscal effects discussed above and illustrated below). The government deficit, the current account, and employment levels are exogenous. In simulations, these variables are set in stone at their base year levels. Consistent with neoclassical theory, adjustment is allegedly carried out by variation of prices.

As will be seen, however, price changes are often over-ruled by macro-level forces. If the fiscal deficit is predetermined, the government is not able to finance expenditure by increased borrowing. Tariff and subsidy rates are simulation parameters so that the only variable that can adjust in the government balance is the household consumption tax. In the private balance, investment is driven by savings and, lastly, the exchange rate varies so that the current account stays constant. With regard to factor markets, full employment rules.

Now consider the government's balance. With fixed nominal spending and a constant deficit the government's budget constraint cannot budge. Consequently, revenue along the relevant row in a SAM row has to be constant as well. As tariffs are a policy instrument, taxes have to be endogenous.

$$\overline{ZG} + \overline{S_G} = \overline{Y_G} = ZT + etZ'E' \tag{14.16}$$

In the government's flows of funds

$$\overline{S_G} + B + e\Delta' = 0. \tag{14.17}$$

The foreign capital inflow $e\Delta'$ finances the current account deficit, and in that sense is determined by trade flows. The only adjusting variable to satisfy this accounting constraint is *B*, the amount of treasury bonds sold to households. The government finances its deficit by a combination of foreign aid (on which it doesn't have an influence) and domestic debt.

Household income is equal to value added. Its budget constraint is the sum of expenditures along the relevant column, and its flows of funds are

$$S_P - ZI - B = 0 \tag{14.18}$$

Households happily buy bonds *B* up to the amount the government requires them to, and channel the rest of their savings into investment. Higher government debt crowds out private *ZI* as in neoclassical growth models. Direct tax revenue *ZT* is endogenous and increases after tariff liberalization. The Armington effect described above kicks in and consumption is crowded out.

In the foreign balance the exchange rate in our model is endogenous. As noted above, Bank models instead include myriad Armington and domestic prices moving against one another to guarantee balanced trade with a predetermined current account. Either way, with higher trade elasticities there will be weakened Armington fiscal effects, increased welfare gains, and less aggressive devaluation with its hefty repercussions on economic performance.

Finally, with constant employment L the labour–wage relationship from (14.5) above becomes

$$\frac{w}{Q} = \alpha\nu\left(\frac{\overline{L}}{X}\right)^{-\frac{1}{\sigma}} \tag{14.19}$$

so that the real wage adjusts in order to clear the labour market.

In principle, the Bank's closure rests firmly on neoclassical theory. Price adjustment prevails and ensures a smooth functioning of the economy, supported by the constancy of various macroeconomic indicators. However, this fairly standard story is heavily influenced by the fiscal Armington effects discussed above. If trade elasticities are not high enough to counteract the negative tax effect, it is in fact the strongest quantity change and thus drives simulation results. Lurking behind the scenes is the constant deficit assumption – which has not a bit of theoretical or empirical backing, but stands rather as a normative proposition. Looking at the 'Armington/fiscal closure' from this perspective should shed some doubt about the validity of the World Bank's arguments in the Doha debate.

Our (Keynesian) absorption closure presents the natural antithesis to the Bank. In all macroeconomic balances, causality assumptions are reversed: The deficit is endogenous. Fixing the exchange rate leaves the current account as an adjusting variable. It permits macroeconomic 'absorption' of shifting import and export quantities, instead of an 'elastic' adjustment of trade flows to international prices. In the private balance, investment is predetermined by investors' long-term expectations and animal spirits rather than by available savings that are automatically channeled into physical investment. Lastly, we abandon the full employment assumption. Employment levels of labour can vary, and the wage rate is fixed. As in the Bank's closure, workers can freely move from sector to sector, but may end up under- or over-employed depending on effective demand.

Let's consider again the fiscal balance. Fixed nominal spending and an endogenous deficit build the budget constraint, as taxes are a function of income and tariffs remain a policy instrument.

$$ZG + S_G = Y_G = ZT(QV) + etZ'E' \tag{14.20}$$

The government deficit adjusts to finance expenditure and absorbs the revenue reduction when tariffs are cut. Government borrowing moves up and down in any functioning economy, even when it is hypothetically constrained by IMF conditionalities or Maastricht accords. Letting it play its proper role in a model simulation is simple common sense.

The governments' flow of funds is

$$S_G + B + e\Delta' = 0 \tag{14.21}$$

where S_G now follows from the expenditure column. Otherwise, as above, the government finances its deficit by aid and bonds sold.

For the private sector that implies B given in the flows of funds, and, in Keynesian fashion, nominal investment predetermined. Savings then adjust to finance that investment, physical as well as portfolio,

$$S_P - \overline{ZI} - B = 0. \tag{14.22}$$

The overwhelming impact of tax increases in the Bank's closure disappears. However, fiscal effects are still important: tariff removal increases the budget deficit and, through the multiplier and in combination with relative price changes, induces a consumption (and import) splurge, the latter unconstrained if the foreign deficit is allowed to vary. The demand increase triggers positive employment changes. Prices change little, as they are bound by the fixed macro-prices w, r and e. We discuss below in more detail how subsidy removal has 'Keynesian' effects. First, however, we summarize differences and similarities between our model and LINKAGE, and how we bring the equations above to work.

14.6 A similar computable model with a different simulation strategy

In this part we present an alternative to the World Bank in the form of a table-top two-region and three-sector CGE model which represents Sub-Saharan Africa and the Rest of the World. It stylizes the CGE approach to trade and is capable of providing policy insights with regard to the Doha process. To allow for a critique of LINKAGE, our framework is based on broadly the same assumptions and theoretical constructs. When non-Bank (and arguably more plausible) assumptions about trade liberalization are made, the predicted outcomes are radically different.

We begin with a few comparisons of the models. Ours is static, and computes one-off effects of liberalization and other perturbations to the data built into the base-year SAM. The Bank's model is also essentially static, but it is run over a number of periods ('years') to generate a simulacrum of dynamic change. For example, tariffs are usually phased out over several years to leave room for adjustments in domestic policies as well as agents' behaviour.

More importantly, the World Bank stipulates that an increasing export/output ratio (say, in response to liberalization with the positive export response that is built into Bank models) raises a sector's labour productivity according to a pre-set elasticity. This idea is as old as trade theory: When autarchy breaks down in a Ricardian world in which comparative advantage determines trade patterns, the ensuing shift toward specialization has positive productivity effects. While most economists agree that such things can happen, it is by no means undisputed that a sector-level productivity response to higher exports is important in practice. LINKAGE's treatment of this issue is mechanical and *ad hoc*, so we chose not to pursue it.

Perhaps the key difference between the Bank's and our model is size. The former is on the order of 50,000 equations, impressive but not helpful in understanding and explaining the core working mechanisms. Heavy simplification implies that we aggregate sectors, factors and regions: We use three sectors (agriculture, manufactures and services), not 57, two factors (labour and capital), not five, and two regions (Sub-Saharan Africa and the rest of the world) instead of 87 as in LINKAGE. As discussed above, our choice of regions stylizes trade between a large, rich and a smaller, poor region and directly addresses the Doha process with its focus on development concerns as well as the pivotal area of negotiations, agriculture vs. non-agricultural market access (NAMA).

Trade flows are classified into regional non-competitive intermediate imports and imperfectly competitive final imports, the former determined by fixed coefficients Leontief demand functions and the latter by relative prices, coming from the derivative of the Armington price function with respect to the price of the imported component of composite supply.

Two other important aspects are interrelated: closure assumptions and the treatment of the exchange rate, which is disingenuous in the World Bank's model. 'Exchange rate adjustment' in LINKAGE is a metaphor for thousands of individual price adjustments which are impossible to think through in detail. Our specification incorporates the exchange rate explicitly. The Bank's hidden and our visible exchange rates are supposed to accommodate changes in trade flows such that the current account remains constant. How realistic is that? The underlying assumption is that any other forces potentially driving the exchange rate – such as political factors, institutions and capital flows – do not play a role. The prevailing current account and exchange rate between the USA and China are just one example where this is clearly not the case. Our closure rules, discussed in the next section, allow for a more complete analysis.

Furthermore, there is no space whatsoever for unemployment in the standard version of LINKAGE. Bank models can address issues of employment (or shifts in the trade balance), but usually the modelling department chooses not to do so. Contrary to the World Bank, we report and compare simulation results both with and without a full-employment assumption. Not only employment, but also the current account and the government balance are important indicators of macroeconomic performance. The World Bank freezes these three major variables out of the analysis and focuses almost exclusively on its 'welfare' metrics. In contrast, our simulation strategy encompasses both the Neoclassical and the Keynesian configurations described in the previous section.[15]

The World Bank usually compares a model's results under complete liberalization with some 'likely' Doha scenario which would take into account political realities, the current state of the negotiations, and the principles underlying them. The developing world would presumably allow more non-agricultural market access for firms from the North, and the developed world would lower agricultural protection by removing subsidies for agro-exporters as well as tariffs on imports. We compare Full Liberalization with such a Likely Doha outcome, while exploring the model's working by discussing a variety of simulations with a single tariff or subsidy removal.

Sensitivity analysis is another important dimension. CGE models are fed a banquet of parameters that at best come from econometric analysis, but often from prior belief and (more or less) educated judgments on the part of the modeller. It is indispensable to investigate the effects of changes of parameters on results and the model's policy recommendations. Parameter values derived from a mixture of econometrics – itself often not to be trusted – and a modeller's considered opinions could quickly render conclusions irrelevant if they are not robust to 'reasonable' changes.

The most important – and controversial – parameters in LINKAGE/GTAP-style trade models are the Armington elasticities. The World Bank has been criticized for using elasticity values that are 'too high'. Higher elasticities improve the responsiveness of trade flows to price changes, which in turn requires less adjustment in other macroeconomic variables. We will focus on Armington elasticity values.[16]

Limiting the analysis to 'only' three liberalization scenarios, two closure rules and, say, three different regimes of trade elasticities already gives us a wide range of combinations to discuss. The difference between our and the World Bank's modelling strategies becomes obvious. Instead of including scores of regions and sectors we attempt to describe broad patterns of results from different theoretical perspectives.

14.7 Results

In this section we delve into the various simulations and explain how different configurations affect results. Maybe the key result is that causality assumptions determine simulation outcomes. In order to get a feel for the model before radically removing tariffs and assuming more or less likely Doha scenarios we carefully examine several single tariff reductions under different closure assumptions.

14.7.1 Some initial comparative statics

The baseline configuration features trade elasticities of a lower average magnitude with stronger econometric support than the ones commonly used in LINKAGE or GTAP. Completely removing, in a first exercise, the external agricultural tariff in the developing region – the tariff SSA applies to agricultural imports from ROW – and applying the Bank's closure rules has small, negative effects on welfare in SSA. While composite supply prices decline somewhat with the lowered tariff, the key adjustment – in the form of a contraction – takes place in value added.

Why does real value added decline? The change in relative prices due to the tariff decrease increases SSA demand for agricultural imports. In this particular simulation, real imports rise by more than 14 per cent, whereas the average change in trade flows hovers at about one per cent. Domestic agriculture faces an adverse shift in demand. Real output in SSA agriculture declines, because the adverse demand shock is not neutralized by a positive shift in export demand. As we will see in other simulations this problem disappears with higher trade elasticities. In the present case, relative price changes induce demand shifts that translate into negative GDP growth.

The contraction of value added is a consequence of the core fiscal adjustment (noted repeatedly above) in the Bank's closure. The SSA government is constrained to borrow constant amounts from the private sector and ROW but receives less tariff revenue due to liberalization. Its only possible recourse in a LINKAGE world is to raise taxes on household income to balance its flow of funds – but raising taxes crowds out private consumption. Two effects contribute to a decrease in welfare: the decline in value added tightens the private sector budget constraint and consequently diminished consumption levels are further stifled by increased taxes. The welfare losses are small – a third of a percentage point – and other macroeconomic performance indicators – employment, current account, fiscal deficit – are constant by assumption.

Tracing through a similar exercise exemplifies how adjustment works in the absorption closure. This time we look at the effects of removing SSA's tariff on industrial imports. Again, trade elasticities are assumed to be 'normal'.

Macro causality now runs along Keynesian lines, with quantities instead of prices doing the adjusting. The wage, profit, and exchange rates are fixed and the current account and government deficit are endogenous. As before, relative supply prices change with the change in (one) tariff. The difference with the previous story is that domestic output is not forced to contract if the export response lacks strength. In fact, because the foreign deficit is free to rise, neither exports nor GDP need move to balance an import surge.

The simulation results are clear: the current account worsens tremendously with rising imports resulting from the shift in the relative prices of domestic and foreign manufactures. In order to satisfy its flow-of-funds constraint and match the loss in tariff revenue, the government (now free to borrow more from the private sector while holding income taxes constant) increases its deficit spending. With a (foreign and public) deficit-financed demand boost, factor employment and GDP follow suit. On the one hand, such private consumption growth translates directly into welfare increases, but, on the other hand, SSA might very well face chronic indebtedness, debt crises, capital flight, and political instability in the not too distant future.

14.7.2 How the government's 'fiscal responsibility' drives simulation outcomes

The implication is that closure assumptions have a huge impact on results. To see how the assumptions on the public balance in particular drive simulation outcomes, it is important to understand the different effects from subsidy and tariff removal. In the Bank's closure, the former leads to lower taxes and higher consumption, whereas the latters triggers tax increases and thus has detrimental welfare effects. In the absorption closure, the results are the opposite (but not a bit less unconventional): Subsidy elimination triggers a heavy contraction of demand as the government *saves* the funds it previously spent on subsidies to reduce its deficit. Tariff liberalization, on the other hand, leads to deterioration in current account and public deficit, but improvements in employment, output, and welfare.

A full liberalization, under either closure, is simply the sum of these two effects. Consider the Bank's closure first. The leftmost bars in Figure 14.5 show the welfare results with reasonable elasticities in both SSA and ROW, the dashed line indicates the average Armington elasticity. SSA loses slightly more than half a percentage point of GDP, ROW gains circa 3 per cent. If our base year data had featured higher subsidy and lower tariff rates,

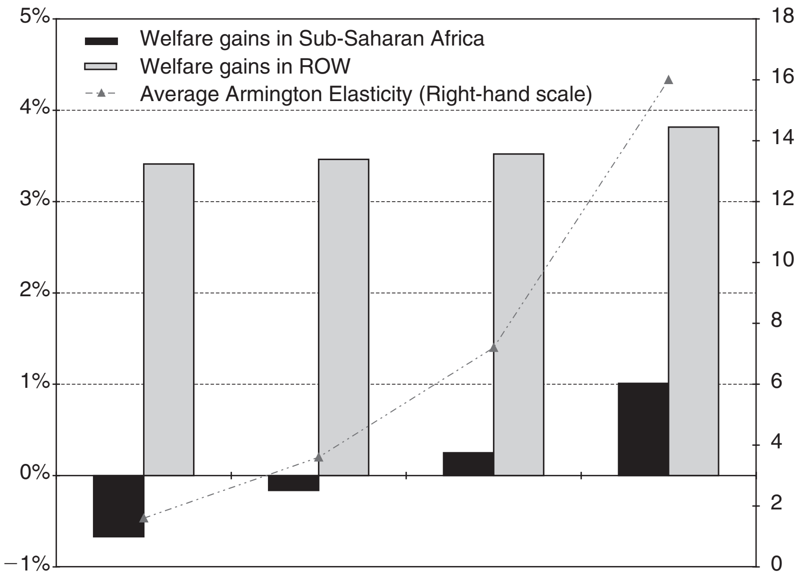

Figure 14.5 Welfare changes relative to GDP: full liberalization in the Bank's closure with different Armington elasticities

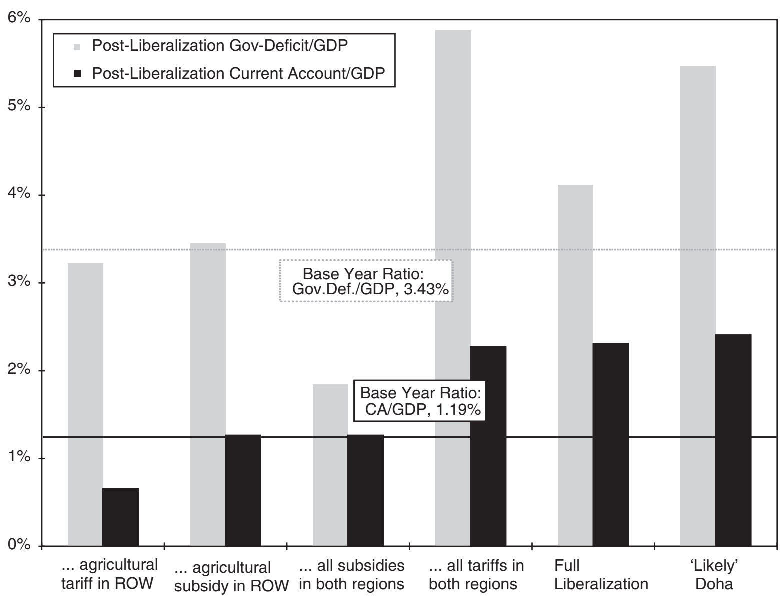

Figure 14.6 Selected indicators for Sub-Saharan macro performance relative to GDP absorption closure

Sub-Saharan Africa could have very well shown higher – i.e. positive – welfare gains. ROW's welfare gains are due to the fact that subsidies were high.

Note how crucial the size of the Armington trade elasticities is. The simulations discussed thus far were all based on 'normal' elasticities, meaning that they average around 1.5 – a reasonable mid-point of a range supported by empirical research. It is obvious that a policy conclusion to the effect that 'SSA should not liberalize because simulations show a negative welfare change of a third of a percentage point' is meaningless because such a small change could be bigger in magnitude and/or have a different sign depending on the complex interaction of all parameters, base-year data, and functional and closure related assumptions. However, Figure 14.5 clearly shows the positive relationship in such a model between the magnitude of Armington elasticities and welfare effects in the small, dependent region.

Under the absorption closure, full liberalization of tariffs and subsidies brings about the worst of both, at least for the developing region: Foreign and public deficit rise, and consumption, output and employment fall. The benefits from lower import prices are too low relative to the contraction due to subsidy removal, but, on the other hand, the deficit-lowering effects of the latter are not high enough to improve the public balances. As subsidies play a more important role in ROW, the deficit decreases. Still, global real output diminishes.

Finally, we can briefly discuss a likely Doha scenario[17] – briefly, because we see the same principles at work as in the examples discussed so far. In the Bank's closure, ROW's consumers experience welfare gains, rooted in increased consumption following tax decreases, which in turn are 'financed' by subsidy removal. With the SSA–liberalization scenario focused on tariffs, and trade elasticities in a reasonable range, welfare decreases following the tax-induced consumption crunch.

Unsurprisingly, the Bank's closure shows results where macroeconomic performance is more stable overall. Unsurprising, because most indicators policy makers pay attention to are held constant. Still, welfare depends on the specific simulation scenarios, and it is in fact rather straightforward to see negative welfare changes due to a consumption crowding-out.

Equally unsurprisingly, the Keynesian closure shows relatively volatile macro-behaviour. Employment, output, current account, and public deficit changes have strong spillover effects onto economic activity. The multiplier effect from a higher government deficit and income gains from import adjustments have positive welfare effects, but, as discussed above, they pose great risks for an increasingly vulnerable economy.

14.8 Conclusions

What is the World Bank's model supposed to do? A World Bank modeller, or a faithful neoclassical theorist, might answer that LINKAGE is supposed to show distributional changes, mainly of factor returns and sectoral output ratios. What industry in what country contracts or expands, post-liberalization? Such a question lends itself to the beautifully simple body of microeconomic theory. Trade-offs left and right, marginal pricing and substitution abound. As relative prices change, fully informed, homogenous and rational agents adjust behaviour such that each individual's utility is maximized and resources are fully employed. Moreover, the theorist might argue that 'in the long run' or 'on average' or 'in such an equilibrium' trade is balanced and the government will not run a deficit, justifying the constancy of these indicators. She might say that a trade – and therefore micro – model is ill-suited to analyse macroeconomic variables such as the current account and unemployment. In fact, the key to understand LINKAGE's limitations is that no effort is spared to maintain its appearance as a micro-model, whereas we would argue that it implicitly does macro. The focus on welfare measures as the single variable indicating success or failure further underlines this wrong emphasis.

We might answer the question what LINKAGE is supposed to do with the assertion that it serves a purpose, providing arguments for powerful political interests behind the free-trade agenda. A list of points support such a conclusion: (1) The specific closure commonly chosen for LINKAGE limits macroeconomic risks of trade liberalization by holding employment, current account and the public deficit constant; (2) The Armington trade specification increases welfare gains 'behind the scenes', where (3) the exchange rate is also hidden, so that devaluation effects cannot be analysed. Our final conclusion has to be that developing countries would be ill advised to follow the radical recommendations of the World Bank's liberalization strategy insofar as it rests on results from the LINKAGE model.

Notes

1. In 2004, India and Brazil joined the United States, the EU and Australia to form the core negotiating group of the Five Interested Parties (FIPs).
2. For fairly comprehensive overviews of the Doha issues and negotiations, see http://www.ictsd.org/ or http://www.fao.org/trade/policy_en.asp.
3. On LINKAGE, see www.worldbank.org and follow Data & Research > Prospects > Products > Global Models. For GTAP, see http://www.gtap.agecon.purdue.edu/
4. We discuss the technical details of the Armington specification in more detail below, which will lead as well into a critique. Here we rather stick to the concept and its advantages.
5. Van der Mensbrugghe (2005: footnote 20).
6. Variables and parameters with a prime originate from abroad or, so that $a_f e\tau Z'X$ are 'Leontief' intermediate imports, proportional to output and valued at tariff-ridden, currency-converted *foreign* prices $e\tau Z'$.
7. We use the symbol $e\Delta'$ to denote the current account/aid-flows, which will become more reasonable below, where Δ' is the current account of the developed region,

which then is converted to domestic home country currency via the exchange rate *e*.

8 In more complete accounting, as in our simulated model discussed below, the trade flows are not merely currency converted, but furthermore marked-up by tariffs and disaggregated into intra- and extra-regional exports and imports.

9 The source of our data is GTAP 5, which neither fully incorporates the Uruguay Round implementation period nor deals in any way with preferential trade agreements (as GTAP 6 does). The most recent version is a more precise and detailed dataset, and all recent CGE-estimates of welfare gains from liberalization make use of it, but we argue that using GTAP 5 does not put limits to our results. We provide a critique of the models' theoretical foundations, and do not want to participate in a discussion about the precise magnitude – 0.5 per cent or 1.3 per cent of GDP – of welfare estimates. GTAP 5 serves our purposes as a base year dataset that depicts trade between a rich and a poor region, with strongly differing economic structures and characteristics – a point we highlight further below. We used GTAP 5 because it was available in the public domain. Changes were made only to average applied tariff rates, based on recent World Bank publications that make use of the GTAP 6 dataset. See World Bank Working Paper 3616, Anderson *et al.* (2005: Table 1).

10 We abstract from export and output subsidies, bringing these policy instruments back into the picture in the simulation analysis.

11 We do not model the production side explicitly. As shown below, product is determined from the demand side – which in turn follows from the dual CES–price function.

12 That is, the cost function for value-added takes the form $Q = Q(w, r, \rho)$ where ρ is the endogenous 'rent' of a specific factor.

13 The World Bank usually reports the more conservative welfare measure, Equivalent Variation, which compares expenditures at pre-reform prices. Consumer- and producer-surplus 'triangles' in the standard diagram fall in between Equivalent and Compensating Variation. In the simulations discussed below, we chose to report the average of Equivalent and Compensating Variation.

14 In Figure 14.1, we assume that no intermediates are required, and investment as well as private savings are zero. These assumptions are crucial to the argument, but make it simpler.

15 A few more details should be mentioned: All of the government's expenditure is assumed to go to the services sector. Investment demand is only for industrial goods. Intermediate imports are assumed to be exclusively intra-regional in the developed world, but exclusively extra-regional in SSA. The data appear to allow for such a simplification, as, first, the overwhelming part of imports to SSA comes from outside the region and, secondly, it is likely that intermediates such as industrial goods and machinery have to be imported from the northern hemisphere. However, these differences are crucial neither to the model structure nor to simulation outcomes.

16 We also examined different degrees of factor substitutability, but found little effect on the overall results.

17 Our Doha scenario reflects, however crudely, the state of the negotiations at the beginning of 2006. It features a full removal of export subsidies and elimination of agricultural output subsidies in ROW and industrial tariffs in SSA. The extent of this liberalization is certainly stylized, but it gives us a blueprint to discuss the interests of the involved parties.

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15

Technology, Capital Flows and the Balance of Payments Constraint in a Structuralist North–South Model

*Marcelo Curado, Gabriel Porcile and Ricardo Viana**

15.1 Introduction

In the 1990s Latin America witnessed the return of foreign capital to the region, after having been left aside as a destination for international lending during the 'lost decade' of the 1980s (CEPAL, 1998: ch. III). This has been a mixed blessing, however. Clearly, by easing the external constraint, capital inflows contributed to the resumption of growth during the 1990s. But mounting trade deficits and external indebtedment, along with an increasing fragility in the capital account, raised once again in the agenda of several Latin American countries the shadow of currency and debt crises by the end of the 1990s (French-Davis, 2000). The currency crises of Mexico in 1994, Brazil in 1999, and especially that of Argentina and Uruguay in 2002, highlighted the gravity of this problem.

This chapter presents a simple model that aims to describe the forces that led to external fragility in Latin America in the 1990s. It is argued (as in the writings of Raúl Prebisch and the Economic Commission for Latin America and the Caribbean, ECLAC) that Latin America is prone to external disequilibria as a result of its relative technological backwardness, which hampers international competitiveness (Prebisch, 1949, 1986; Rodríguez, 1980: 69–71; Fajnzylber, 1990; Cimoli and Correa, 2005). This implies that the rate of growth consistent with current account equilibrium tends to be significantly lower than the rate of growth required to absorb the population unemployed or employed in the low-productivity sectors. Financing a higher rate of growth in these conditions requires attracting foreign lending on the basis of higher interest rates (assuming that international competitiveness remains constant). But this avenue for fostering growth is limited, as international

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lenders will see a rise in interest rates as an indication of increasing risk. When the interest rate becomes higher than a certain critical value, the perception of increasing risk will make foreign lending less responsive to higher interest rates in the South.

The combination of these factors (weak international competitiveness, the need to achieve higher rates of growth to reduce unemployment, and the inability of the interest rate to attract more foreign capital) produces curves of demand and supply of foreign exchange which give rise to external vulnerability in the South. In this context, small variations in the initial conditions or in the parameters of the system are capable to unleash a major currency crisis and/or to sharply reduce economic growth.

To keep the model simple, two key assumptions about the behaviour of the government and the foreign exchange market will be made. First, the economy operates under a regime of fixed nominal exchange rate, and the government is firmly committed not to use devaluation as a policy instrument. This reflects fairly accurately the exchange rate regime adopted by Brazil, and especially by Argentina, in the 1990s. The instruments of the government are thus circumscribed to the fiscal policy, which it uses with the aim of fostering economic growth and reducing unemployment. Secondly, the interest rate responds endogenously to changes in the Central Bank reserves of foreign exchange. To the extent that in a regime of fixed exchange rate the supply of money is a function of the balance of payments, there will be a direct association between changes in the interest rate and changes in the reserves hold by the Southern central bank.

The chapter consists of four sections. Section 15.2 presents the demand curve for foreign exchange based on a North–South technology gap, complemented by a supply curve of foreign exchange specified as a nonlinear function of the interest rate. Section 15.3 analyses the dynamics of the interest rate and discusses the problem of external fragility in the South under the assumption of an exogenously given rate of economic growth. External vulnerability is explained by a simple dynamics based on weak international competitiveness and increasing risk in foreign lending. Section 15.4 offers a more formal treatment of equilibria and stability in the dynamic system, which complements the graphical analysis of section 15.3. Section 15.5 makes the rate of economic growth an endogenous variable based on the assumption that in the long run the current account deficit to GDP ratio must remain stable, as suggested by Moreno-Brid (1998–1999). Finally, the main conclusions of the chapter are briefly summarized.

15.2 The technology gap and the demand for foreign capital

The literature on balance-of-payments (BOP) constraints on growth suggest that demand-side variables, especially those related to international trade, are the key to why growth rates differ (McCombie and Thirlwall, 1994: ch. 5;

Patel and Pavitt, 1998; Cimoli, 1988). This kind of approach is very close to ECLAC's early concerns with the asymmetric diffusion of technology in the international economy and its effects upon the pattern of specialization, which, in ECLAC'S view, continuously reproduces external disequilibrium. This chapter takes this literature as the basis to develop a North-South growth model with capital inflows.

Following Amable (1994) and Verspagen (1993), we specify the demand for exports and imports in the South as follows:

$$x = \alpha_1(p - p^*) + \beta_1\left[\ln\left(\frac{Ts}{Tn}\right)\right] + \varepsilon z \tag{15.1}$$

$$m = \alpha_2(p^* - p) + \beta_2\left[\ln\left(\frac{Tn}{Ts}\right)\right] + \pi y \tag{15.2}$$

where small letters represent proportionate rates of growth (*v.g.*, $x = (dX/dt)(1/X)$, where X is the variable in levels). Equations (15.1) and (15.2) state that real exports growth (x) and real imports growth (m), respectively, are a function of the difference between domestic inflation (p) and foreign inflation (p^*), the technology gap (G), real GDP growth in the North (z) and real GDP growth in the South (y). As in Verspagen (1993), the technology gap G is defined as the natural logarithm of the ratio between technological capabilities in the North (Tn) and that in the South (Ts) (*i.e.* $G = \ln(Tn/Ts)$). $S = 1/G$, the inverse of the technology gap, is the non-price competitiveness of the South. While in the literature non-price competitiveness is related to the quality of goods and to competitive devices such as financing, post-delivery services and infrastructure (McCombie and Thirlwall, 1994: 284–9), in this work it is entirely determined by technological variables. α_1 and α_2 are negative price elasticities, ε and π are positive income elasticities, and β_1 and β_2 are positive technology-gap elasticities of the demand for exports and imports, respectively. The nominal exchange rate (E) is assumed to remain constant and equal to unity.

Balance-of-payments (BOP) equilibrium requires the value of imports (which is the volume of imports, M, times the price of imports denominated in the domestic currency, P^*E) to equal the value of exports plus net capital inflows denominated in domestic currency (PF), *i.e.* $P^*EM = PX + PF$ (Thirlwall and Hussain, 1982). Taking logarithms and differentiating with respect to time renders:

$$p^* + m = a(p + x) + (1 - a)(f + p) \tag{15.3}$$

where $a = PX/(PX + F)$ is the participation of nominal exports in total foreign exchange earnings (in domestic currency units) and $f = (dF/dt)/F$. Substituting from equations (15.1) and (15.2) into (15.3) gives the rate of growth of the South consistent with BOP equilibrium (y_e):

$$y_e = \frac{(1 + a\alpha_1 + \alpha_2)(p - p^*) + (a\beta_1 + \beta_2)[\ln(Ts/Tn)] + a\varepsilon z + (1 - a)f}{\pi} \quad (15.4)$$

As in the long run the real exchange rate adjusts to purchasing power parity ($p = p^*$), equation (15.4) turns into (15.5):

$$y_e = \frac{\beta S + a\varepsilon z + (1 - a)f}{\pi} \quad (15.5)$$

where $\beta = (a\beta_1 + \beta_2)$ and $S = 1/G = \ln(Ts/Tn)$.

G is solely determined in the model at a technological level, according to a linear North–South diffusion curve of Northern technology (as in Fagerberg, 1988a and 1998b), given by

$$\frac{dS}{dt} = \mu - \mu\left(\frac{Ts}{Tn}\right) - \rho \quad (15.6)$$

where μ is a measure of the local effort at technological imitation in the South and ρ is the exogenous rate of technological innovation in the North. The assumption $\mu > \rho$ is required to have a meaningful solution. Equation (15.6) gives a stable equilibrium solution for the capabilities ratio $(Ts/Tn)^* = (\mu - \rho)/\mu$, and therefore for G and S. In what follows it will be assumed that the technology gap is always in equilibrium. Substituting (Ts/Tn) for its equilibrium value in (15.5) gives:

$$y_e = \left(\frac{1}{\pi}\right)[\beta S_e + a\varepsilon z + (1 - a)f] \quad (15.7)$$

where $S_e = \ln[(\mu - \rho)/\mu] < 0$.

Equation (15.7) endogenously determines the rate of growth of the South given its non-price competitiveness, the rate of growth of the rest of the world and real capital inflows.

Equation (15.7) may be considered from a different perspective. Assuming a desired rate of growth (y_d) for the South (see below), to which the government is committed and which it actively pursues (for instance, through an expansionary fiscal policy), (15.7) can be written as a demand equation for foreign currency *given* the rate of economic growth:

$$f_d = \left[\frac{1}{(1 - a)}\right][\pi y_d - \beta S_e - a\varepsilon z] \quad (15.8)$$

where f_d is the proportionate rate of growth of capital inflows (Fd) the South will have to borrow in the international market to sustain y_d. The amount of foreign capital needed in the South increases with y_d given its non-price competitiveness (as mentioned, a function of the parameters of North–South technological diffusion), the rate of growth of the North and the participation of capital inflows in the BOP (equal to $1 - a$).

The desired rate of growth of the Southern economy is defined as the rate of growth that produces full employment. This is the objective the government seeks to achieve by using conventional fiscal instruments. In a dual economy with a large low-productivity sector, this objective means that the modern sector must grow at a rate capable of producing the demand of employment required to absorb not only the vegetative growth of the workforce, but also the people forced to abandon the low-productivity subsistence sector. The desired rate of growth is taken as exogenous in this section, but this assumption will be removed later (section 15.4). There is a vast literature which illuminates how the desired rate of growth is determined. It will be a function of the size of the subsistence sector, the elasticity of substitution between labour and capital and the impact of international trade and technological change on the low-productivity sector (Rodríguez, 1980: 98–107; Ros, 2000: 71–6). For the purposes of this chapter, it is suffice to say that y_d is such that $\pi y_d > \beta S_e + a\varepsilon z$. This makes necessary the assistance of foreign lending to keep the BOP in equilibrium.[1]

Initially, it will be assumed that the desired rate of growth y_d is always achieved by means of an active fiscal policy. This assumption is aimed at stressing the importance of the barriers to full employment in a context of external fragility. However, this is highly unrealistic and therefore it will be subsequently abandoned. In a second step, the effective rate of growth the economy can attain (and which the government is actually able to sustain) falls as the interest rate rises. In other words, y_d will be a function of the interest rate $y_d(i)$, where $[\delta(y_d)/\delta i]$ is negative. Higher interest rates depress investment and heighten the burden of public and private debt. As a result, y_d will be the rate of growth the economy succeeds to obtain in an increasingly less favourable environment. In this case the gap between the full employment rate of growth and the effective rate of growth becomes larger as the interest rate increases.

It should be observed that the model gives no role for inflation in shaping long-run growth. As it is assumed that (i) purchasing power parity is valid, (ii) the exchange rate is fixed, (iii) foreign inflation is constant and (iv) growth is only constrained by external disequilibrium, then domestic inflation is an exogenous constant which neither affects competitiveness nor growth. These assumptions are, of course, highly restrictive. The efforts by the government to achieve full employment through fiscal policy may probably lead to some crowding-out effects in the long run and to adjustments through prices as well as through output. However, these assumptions are useful for making the model tractable and highlight the role of structural constraints in long-run growth.

Attention will now be given to the supply of foreign capital. The supply of capital from the North is modelled as a nonlinear differential equation on the interest rate, where f_s is the proportional rate of growth of the supply of foreign capital, F_s:

$$f_s = \frac{[dF_s/dt]}{F_s} = b_0 i - b_1 i^2 \tag{15.9}$$

In this chapter the interest rate i refers to the difference between the domestic and the external interest rate, i.e. $i = i_d - i_f$, where i_f is a given constant. The basic idea is that up to a certain point North agents increase their investments in Southern bonds as the interest rate increases (Porcile and Curado 2002; Stiglitz and Weiss, 1981). However, once a critical value for the interest rate is surpassed ($i = b_0/2b_1$), agents regard further increases in the interest rate as potentially destabilizing and as an indication of external vulnerability. Essentially, growing interest rates after the critical point are associated with increasing risk of default. Northern investors will therefore reduce the rate of growth of investment in Southern bonds. In Stiglitz and Weiss (1981), higher interest rates lead to adverse selection (as more prudent and reliable borrowers exit the credit market) and to moral hazard (as agents investing in highly risky projects, with very low probability of success, are stimulated to take credits). This implies that there exists an interest rate that maximizes the expected returns from lending. Such an idea, defined at a micro level, could be extended to a macro level with a view to analyzing the evolution of international lending to Southern countries.

In the next section both curves will be combined. It will be argued that they define a situation of high external fragility in the South stemming from technological asymmetries that hamper Southern exports, and from the ineffectiveness of the interest rate policy to equilibrate the market for foreign exchange.

15.3 Interest rate dynamics and external fragility

15.3.1 The case of a horizontal curve of economic growth

Equilibrium between supply and demand of Southern bonds is achieved through variations in the interest rate. The interest rate responds to changes in the stock of foreign reserves in the Central Bank. As the nominal exchange rate is fixed, money supply varies *pari passu* with Central Bank reserves of foreign exchange. Assuming that initially the demand and supply of foreign exchange are in equilibrium, the growth of demand at higher rates than the growth of supply will produce a fall in the reserves of the Central Bank. This in turn leads to a fall in money supply and to a rise in the interest rate. The demand growth of foreign exchange is given by equation (15.8), while supply growth is given by equation (15.9). The dynamics of the interest rate depends on the difference between f_d and f_s which shapes the growth of excess demand for foreign exchange:

$$\frac{di}{dt} = \upsilon\left[\left(\frac{1}{1-a}\right)(\pi y_d - \beta S_e - a\varepsilon z) - b_0 i + b_1 i^2\right] \qquad (15.10)$$

where υ is a positive parameter.

Expectations about the nominal exchange rate will be static as long as the interest rate works as an effective policy instrument, in other words, as long it succeeds in equilibrating the supply and demand of foreign exchange. But when the interest rate cannot play this role any longer, a currency crisis may occur. Note that the model is not intended to endogenously produce a currency crisis. It just describes why Southern economies with BOP constraints on growth are more akin to suffer this kind of crisis or at the very least to recurrently experience serious pressure for devaluation or for reducing their rate of growth.

Figure 15.1 describes the dynamic behaviour of the interest rate. When the horizontal line representing the rate of growth of the demand for capital inflows (f_d) is above the curve that gives the rate of growth at which foreign capital is supplied by Northern investors (f_s), the interest rate must be increasing. Inversely, when the rate of growth of capital supply is higher than that demanded by the South, foreign exchange reserves in the Central Bank are growing (with the consequent expansion of domestic money supply) and the interest rate is falling. The interest rate thus adjusts the rate of growth of the demand and supply of foreign capital. In equilibrium, both rates of growth are equal and central bank reserves remain stable.

The system shows two equilibrium solutions, points A and B in Figure 15.1, where $f_s = f_d$ and the interest rate is steady. Are these points stable?

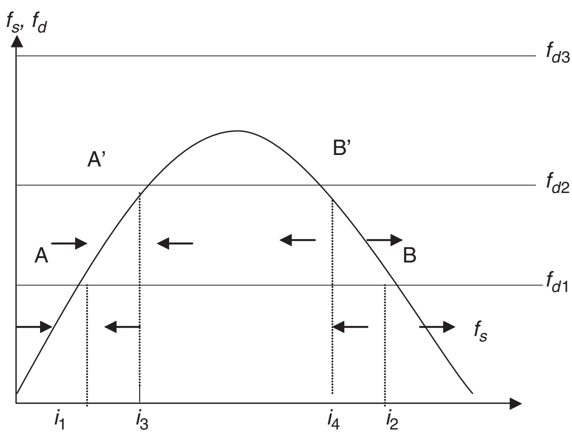

Figure 15.1 Changes in the f_d curve

For answering this question one must look at *di/dt* in the vicinity of the equilibrium values of the interest rate (see also section 15.3). For points to the left of i_1, *di/dt* is positive and hence the interest rate is increasing. For points to the right of i_1, *di/dt* is negative and the interest rate is falling. i_1 is therefore an attractor (stable). Inversely, to the left (right) of i_2, *di/dt* is negative (positive) and hence i_2 is a repeller (unstable).

The model asserts that when the interest rate is higher than i_2 it will be unable to provide a stable solution to a continuous fall in the reserves of the central bank (this fall stemming from the asymmetry in the growth of the demand and supply of foreign capital). An increase in the demand of foreign capital increases the interest rate, but this fails to attract new capital because of the perception that the risk of default is rising. A higher interest rate is in this case moves the system away from equilibrium.

In sum, there is a stable equilibrium (at i_1 in point A) and a unstable equilibrium (at i_2 in point B) for the interest rate. Beginning from any point within a certain interval of i (between i_1 and i_2), the economy will move towards the stable equilibrium. This defines the stability region in which the South will be able to get the foreign exchange it needs to achieve the desired growth rate.[2]

There are two potential sources of instability.

First, there exists a value of y_d for which a stable equilibrium ceases to be possible. This critical value of y_d represents the bifurcation point, as the qualitatively behaviour of the system changes when this value is surpassed. If y_d is high enough, the straight line f_d will never cut the f_s curve, the interest rate will increase boundlessly and foreign exchange reserves will simply evaporate. The line f_{d3} illustrates such a case in Figure 15.1. A negative exogenous shock in f_d (for instance, a technological positive shock in the North which increases the technology gap or a negative demand shock which reduces the rate of growth of the North) may potentially move f_d upwards and take it irreversibly away from the stability path.

Secondly, as already mentioned, even when f_d cuts f_s, for $i > i_2$, the interest rate ceases to work as an effective instrument for achieving external equilibrium. When the f_d curve is far from the origin (as in f_{d2}, with stable and unstable equilibrium points in A′ and B′, respectively), the instability region is already very large. In this case any minor shock in the interest rate or in the position of the f_d line will place i in the instability region.

Not only changes in the demand curve affect the stability of the debt path. Changes in the position of the f_s curve can play a similar role. f_s will move as a result of alterations in the parameters b_0 and b_1, which reflect the lenders' perceptions of the risk of increasing their investments in Southern bonds. There exists a certain combination of b_0 and b_1 that represents a bifurcation point, since no equilibrium is possible for the system when b_0/b_1 is below this critical value. Figure 15.2 illustrates such a case, assuming that b_0 falls and b_1 increases (for instance, because of contagion effects arising from a currency crisis in other regions of the world), moving f_s from f_{s1} to f_{s2}. In this

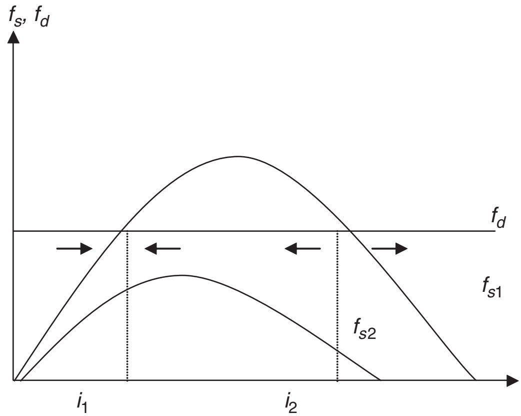

Figure 15.2 Changes in the f_s curve

particular example, the alteration in the parameters of the supply curve makes stability impossible at the previous rate of growth. Either the government alters its fiscal policy bringing about a fall in the rate of growth (this implies a downward revision of y_d) or it gives way to devaluation.

15.3.2 The case of a downward-sloping curve of effective growth, $y_d(i)$

The assumption that the government always attains the full-employment growth rate is implausible, as higher interest rates will be associated with crowding-out in capital markets, higher uncertainty and lesser stimulus for private and public investment. It is more reasonable to suppose that the government accepts a higher level of unemployment as the interest rate increases, or that it simply admits that it does not have the power nor the instruments required to implement its preferred policy. As a result, the desired rate of growth will decline as the interest rate escalates. The motion of the interest rate will be described in this case by equation (15.11):

$$\frac{di}{dt} = \upsilon\left[\left(\frac{1}{1-a}\right)(\pi g - \pi hi - \beta S_e - a\varepsilon z) - b_0 i + b_1 i^2\right] \tag{15.11}$$

In this equation it is assumed that the desired (and effective) rate of growth falls linearly according to:

$$y = g - hi \tag{15.12}$$

where g is the rate of growth of autonomous expenditure. Such a situation does not qualitatively alter the analysis presented in the previous section. This can be seen in Figure 15.3.

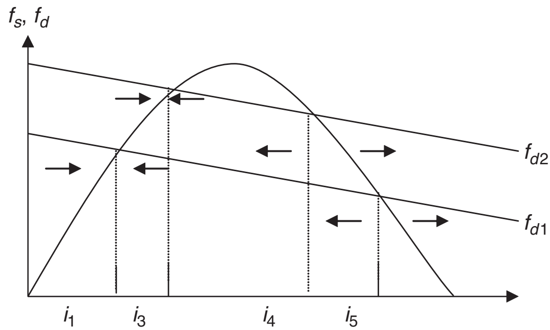

Figure 15.3 Endogenous f_d curve

There are still stable and unstable equilibrium values for the interest rate. The regions of potential instability still depend upon the parameters of the foreign capital supply curve (b_0 and b_1), on technological competitiveness and on the effective rate of economic growth. However, the revised demand function does imply a difference in terms of the region of instability. For being downward-sloping, the new demand curve allows for a broader range of parameters values and interest rates that produce a stable equilibrium. Figure 15.3 shows how the instability region changes when f_d shifts outwards (the new stable equilibrium is obtained at i_3 rather than at i_1 when f_d moves from f_{d1} to f_{d2}), assuming a declining effective rate of growth. Potential instability increases when f_d shifts, but to a lesser extent than in the previous model.

Yet as mentioned above the basic conclusion about the existence of a significant potential for external fragility and instability in the Southern economy remains in place in both cases. Moreover, the increase in the degrees of stability of this variant of the model comes at a cost. It results from the admission that full employment is no longer a viable policy option. The basic message (the difficulty of keeping full employment in a context of weak structural competitiveness, in economies characterized by technological backwardness) has not changed.

15.4 Equilibrium points and stability: a formal approach

Two dynamic models for the evolution of the interest rate $i(t)$ have been considered. The first model, herewith called model I, assumes a horizontal desired growth rate, whereas the second model (model II) considers a downward-sloping curve of effective growth. Both models can be cast in the following general form:

$$\frac{di}{dt} = F(i) = A + Bi + Ci^2 \tag{15.13}$$

where, for model I:

$$A = \frac{\upsilon}{1-a}(\pi y_d - \beta S_e - a\varepsilon z) \equiv \upsilon\tilde{A} \tag{15.14a}$$

$$B = -\upsilon b_0 \tag{15.14b}$$

$$C = \upsilon b_1 \tag{15.14c}$$

and for model II:

$$A = \frac{\upsilon}{1-a}(\pi g - \beta S_e - a\varepsilon z) \equiv \upsilon\tilde{A} \tag{15.15a}$$

$$B = -\upsilon\left(\frac{\pi h}{1-a} + b_0\right) \equiv -\upsilon\tilde{B} \tag{15.15b}$$

$$C = \upsilon b_1 \tag{15.15c}$$

The equilibrium points for the one-dimensional flow generated by equation (15.13), denoted i*, are the zeroes of the function $F(i)$, namely

$$i^*_{1,2} = \frac{-B \pm \sqrt{\Delta}}{2C} \tag{15.16}$$

where

$$\Delta \equiv B^2 - 4AC \tag{15.17}$$

There are, in general, two real equilibrium interest rates for either model, provided Δ is a strictly positive number, i.e., *if* $B^2 > 4AC$. From equations (15.14a)–(15.14c) and (15.15a)–(15.15b) it follows that, for model I, this condition amounts to:

$$\tilde{A} < \tilde{A}_C \equiv \frac{b_0^2}{4b_1} \tag{15.18}$$

and for model II:

$$\tilde{A} < \tilde{A}_C \equiv \frac{\tilde{B}^2}{4b_1} \tag{15.19}$$

A numerical example would help to discuss the problem of equilibria and stability in the system. Assuming that the maximum allowed interest rate is 20 per cent, then $b_0/b_1 = 0.2$. In this case, setting $b_1 = 1$ leads to $\tilde{A}_c = 0.01$ for model I. The case $\Delta = 0$ leads to a single equilibrium interest rate $i^* = -B/2C$. For model I, the equilibrium interest rate will be $i^* = b_0/b_1$. In other words, in the numerical example just considered, the equilibrium interest rate takes on its maximum allowed value.

Moreover, it is also useful to study the conditions to be fulfilled by model parameters so as to yield positive equilibrium interest rates. Situations of economic interest lead to positive υ, b_0, b_1, $\tilde{A}$ and $\tilde{B}$, so that $A > 0$, $B < 0$, and $C < 0$. From equation (15.16) there will be two positive equilibria if $B < -\sqrt{\Delta}$, which is always fulfilled. In addition, the following inequality holds:

$$i_2^* = \frac{|B| - \sqrt{\Delta}}{2C} < i_1^* = \frac{|B| + \sqrt{\Delta}}{2C} \tag{15.20}$$

Similarly, the unique equilibrium, as long as $\Delta = 0$, will always be positive, given by $i^* = |B|/2C$.

The stability of the equilibrium points is determined by the sign of the derivative of the flow, $F'(\mathrm{i}) = B + 2Ci$, evaluated at each point. Substituting equation (15.16) gives $F'(i_1^*) = \sqrt{\Delta} > 0$ and $F'(i_2^*) = -\sqrt{\Delta} < 0$; hence i_1^* is unstable under small perturbations, whereas i_2^* is an asymptotically stable equilibrium. In the case $\Delta = 0$, then $F'(i^*) = 0$ and the linear stability criterion fails (Hirsch *et al.*, 2004). The stability in this case must be investigated by other means, *e.g.* by considering the phase diagram or the solutions themselves, as follows.

It is possible in this case to obtain analytical solutions for the Cauchy problem related to the one-dimensional flow (15.13), i.e. to find the time evolution of the interest rate, $i(t)$, once its value at the initial time $i_0 = i(t = 0)$ is known. A straightforward integration furnishes, when $\Delta > 0$, the result:

$$i(i_0, t) = \frac{1}{2C}\left\{\sqrt{\Delta}tgh\left[-\frac{t\sqrt{\Delta}}{2} + Artgh\left(\frac{B + 2Ci_0}{\sqrt{\Delta}}\right)\right] - B\right\} \tag{15.21}$$

where $tgh(x) = (\mathrm{e}^x - \mathrm{e}^{-x})/(\mathrm{e}^x + \mathrm{e}^{-x})$ is the hyperbolic tangent of its argument. For large values of time t, the fact that the hyperbolic tangent asymptotes the value -1 is used. This implies that $i(t)$ tends to the stable equilibrium value i_2^*, as expected. Actually it has been proved that i_2^* is not only a locally but also a globally stable equilibrium under arbitrarily large perturbations.

If $\Delta = 0$, the analytical solution is even simpler and reads:

$$i(i_0, t) = \frac{1}{2C}\left[-B + 2\left(\frac{2}{B + 2Ci_0} - t\right)^{-1}\right] \tag{15.22}$$

asymptoting, for large times, to the equilibrium value $i^* = |B|/2C$. Notice that linear stability analysis is unable to determine stability but, since this value is achieved by any initial condition, it follows that the equilibrium is stable.

15.5 The case of a stable current account deficit to GDP ratio

Moreno-Brid (1998–99) has offered a significant contribution to the extended version of the BPC growth model by suggesting that the current account deficit to gross domestic output ratio (deficit to GDP ratio) should remain stable in the long run. In previous sections this problem was left aside. However, the stability of the interest rate should be linked to the stability of the deficit to GDP ratio. If this ratio falls, the risk of default will fall as well and, *ceteris paribus*, interest rates should decline. Inversely, if the current account deficit to GDP ratio grows explosively, the supply of foreign lending will recede, reflecting the growing concern of foreign bankers with the outbreak of an external crisis.

The stability of the deficit to GDP ratio requires that the growth rate of capital inflows should equal GDP growth. This produces a new long-run equilibrium rate of growth, which Moreno-Brid denotes as y_{ca}, consistent with both BOP equilibrium *and* a constant deficit to GDP ratio. Formally:

$$y = y_{ca} = f_d = f_s \tag{15.22}$$

Using equation (15.22) in equation (15.5) it is possible to find the new long-run rate of growth y_{ca} that satisfies (15.22):

$$y_{ca} = \frac{1}{\pi + a - 1}(\beta S_e + a\varepsilon z) \tag{15.23}$$

Note that the equilibrium rate of growth is now a fully endogenous variable defined by the technology gap, the rate of growth of the international economy, the quality elasticity of exports and imports, and the income elasticity of the demand for exports and imports. In this sense the model is no longer a toolbox designed to discuss how different fiscal scenarios affect growth and stability but a model in which long-run growth and interest rates are endogenously determined by the economic structure (technology and the pattern of specialization) of the South.

These assumptions imply that there is a new state variable along with the interest rate, namely the rate of growth of the Southern economy. For this it is necessary that the government adjusts its autonomous expenditures with a view to achieving the stability of the deficit to GDP ratio. Any time this ratio falls there will be room for stimulating the economy by means of an expansive fiscal policy. On the other hand, when the deficit to GDP ratio rises, the government will be compelled to cut its autonomous expenditures. Concurrently, expectations in the private sector will be affected also by the deficit to GDP ratio: a fall (increase) in this ratio would lead to a more optimistic (pessimistic) outlook and to higher (lower) private investment and consumption. In this model adjustments work through the fiscal policy, but in the real world it is likely that changes in both public and private sectors expenditures would contribute to adjust the effective rate of growth to Moreno-Brid's long-run rate of growth. Formally:

$$\frac{dy}{dt} = \gamma(y_{ca} - y) = \gamma\left(\frac{\beta S_e + a\varepsilon z}{a + \pi - 1} - y\right) \tag{15.24}$$

As in the previous section, the growth of excess demand for foreign capital brings about an increase in the interest rate (the assumption is that the fall in Central Bank holdings of foreign currency would cause a contraction in money supply). The dynamics of the interest rate will be given by equation (15.10) as presented in section 15.1. Note, however, that the effective rate of growth is no longer an exogenous variable. The assumption that the government chooses the rate of growth of fiscal expansion that stabilizes the deficit to GDP ratio brings the effective rate of growth in line with that suggested by Moreno-Brid.

$$\frac{di}{dt} = \upsilon\left[\left(\frac{1}{1-a}\right)(\pi y - \beta S_e - a\varepsilon z) - b_0 i + b_1 i^2\right] \tag{15.10}$$

Equations (15.10) and (15.24) form a system of linear differential equations with two state variables, the effective rate of growth and the interest rate. For the sake of simplicity lets assume $\pi = 1$. In this special case the system becomes:

$$\frac{dy}{dt} = \gamma(y_{ca} - y) = \gamma\left(\frac{\beta S_e + a\varepsilon z}{a} - y\right) \tag{15.24}$$

$$\frac{di}{dt} = v\left[\left(\frac{1}{1-a}\right)(y - a y_{ca}) - b_0 i + b_1 i^2\right] \tag{15.10}$$

In equilibrium $y^* = y_{ca}$ and there will be two equilibrium interest rates.[3] The stability of the system requires $i^* < (b_0/2b_1)$. It can be seen that even in the case that the debt to GDP ratio remains constant and the rate of economic growth is endogenous, a sudden change in the conditions that shape international lending (represented by the parameters b_0 and b_1) may unleash a process of increasing external instability.

15.6 Concluding remarks

The point of departure of this chapter is a BOP-constrained growth model with capital inflows modified in two forms. First, it is assumed that governments are committed to achieving a desired rate of growth. This gives a demand function for foreign exchange which represents the rate of growth of capital inflows required to equilibrate the BOP at the desired rate of economic growth. Secondly, a supply function of capital inflows which is nonlinear on the interest rate is set forth. For the sake of simplicity foreign direct investment and other forms of capital inflows which do not depend upon the interest rate are ignored. Combining both the supply and the demand functions of foreign exchange emerges a framework in which the external fragility of the South is highlighted: the South faces recurrent external disequilibrium when it tries to attain the desired rate of growth. Under certain conditions this disequilibrium cannot be corrected by a rise in the interest rate.

Achieving a rate of growth compatible with full employment is a key policy objective in both the North and the South. But in the South this objective becomes particularly difficult to attain. The existence of a labour surplus puts more pressure on the labour market in the South. And the fact that S is negative imposes a stronger dependence on foreign lending. The result is a f_d curve far from the origin and closer to the point of structural instability. This result remains valid even when it is admitted that the desired rate of economic growth falls when the interest rate increases. In this case the scope for instability is reduced, but the external vulnerability of the Southern economy remains highly significant.

Finally, the chapter discusses the problem of the stability of the current account deficit to GDP ratio. Moreno-Brid correctly argues that this ratio should be stable in the long run. This in turn defines a long-run equilibrium rate of growth consistent with both the BOP constraint and the stability of the deficit to GDP ratio. To ensure this result it is assumed that the government adjusts the rate of growth of autonomous expenditures with a view to keeping the deficit to GDP ratio constant. The model then includes a new state variable, the effective rate of growth, which is endogenously determined along with the interest rate in a dynamic system.

Notes

1 This condition implies that capital inflows are necessary to equilibrate the balance of payments, as the effective rate of growth surpasses the rate of growth compatible with equilibrium in current account. Such a condition is not difficult to hold, since S_e is negative.

2 The slope of the f_s must be high enough to ensure that at i^* the desired growth rate is higher than (or equal to) the rate of real capital inflows, allowing for a decreasing (constant) debt/GDP ratio (a key point raised by Moreno-Brid, 1998–99). This sends a further positive signal to foreign investors as regards the stability of the debt path. The topic is discussed in detail in section 15.4.

3 The values of the interest rate in equilibrium will be given by $i^* = \frac{b_0 \pm (b_0^2 - 4b_1 y_{ca})^{\frac{1}{2}}}{2b_1}$ constrained to produce a positive real number.

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