

No. 2170

**CURRENCY CRISES: A PERSPECTIVE ON
RECENT THEORETICAL DEVELOPMENTS**

Olivier Jeanne

INTERNATIONAL MACROECONOMICS



Centre for Economic Policy Research

CURRENCY CRISES: A PERSPECTIVE ON RECENT THEORETICAL DEVELOPMENTS

Olivier Jeanne

Discussion Paper No. 2170
June 1999

Centre for Economic Policy Research
90–98 Goswell Rd
London EC1V 7RR
Tel: (44 171) 878 2900
Fax: (44 171) 878 2999
Email: cepr@cepr.org

This Discussion Paper is issued under the auspices of the Centre's research programme in **International Macroeconomics**. Any opinions expressed here are those of the author(s) and not those of the Centre for Economic Policy Research. Research disseminated by CEPR may include views on policy, but the Centre itself takes no institutional policy positions.

The Centre for Economic Policy Research was established in 1983 as a private educational charity, to promote independent analysis and public discussion of open economies and the relations among them. It is pluralist and non-partisan, bringing economic research to bear on the analysis of medium- and long-run policy questions. Institutional (core) finance for the Centre has been provided through major grants from the Economic and Social Research Council, under which an ESRC Resource Centre operates within CEPR; the Esmée Fairbairn Charitable Trust; and the Bank of England. These organizations do not give prior review to the Centre's publications, nor do they necessarily endorse the views expressed therein.

These Discussion Papers often represent preliminary or incomplete work, circulated to encourage discussion and comment. Citation and use of such a paper should take account of its provisional character.

Copyright: Olivier Jeanne

June 1999

ABSTRACT

Currency Crises: A Perspective on Recent Theoretical Developments*

This Paper puts recent theoretical developments in the literature on currency crises in perspective by comparing two theoretical approaches, one based on the speculative attack model of Krugman-Flood-Garber and the other approach, which evolved following the 1992–3 crisis of the European Monetary System and that we call here ‘escape clause’. The escape clause approach broadens the set of fundamentals to non-monetary variables, including unemployment or the state of the banking sector and even ‘softer’ fundamentals such as the reputation of the policymaker and the rules of the game played by the participants in a fixed exchange rate arrangement. It also suggests that the relationship between the economic fundamentals and devaluation expectations is in general non-linear and may give rise to multiple equilibria. We argue that, while the speculative attack approach provides useful insights on the anatomy of currency crises, it must be complemented by the escape clause approach if one wants to understand the underlying causes of the crises that we have witnessed in the 1990s.

JEL Classification: F30, F40

Keywords: currency crises, European Monetary System, self-fulfilling speculation, speculative attack, multiple equilibria, contagion, escape clause, fixed exchange rate systems, fundamentals

Olivier Jeanne
Research Department
International Monetary Fund
700 19th Street NW
Washington
DC 20431
USA
Tel: (1 202) 623 4272
Fax: (1 202) 623 6334
Email: ojeanne@imf.org

*Previous versions of this paper benefited from comments by Robert Flood, Peter Isard, Paul Masson, Gian Maria Milesi-Ferretti, Peter Kenen and one

anonymous referee. It was influenced by discussions with Barry Eichengreen, Marcus Miller, Maury Obstfeld, Andrew Rose and Charles Wyplosz. Some of these discussions took place while the author was visiting the Department of Economics of UC Berkeley, the hospitality of which is gratefully acknowledged. I also thank Catherine Fleck for her precious help in editing the final version of the paper. This paper reflects the views of its author, not necessarily those of the IMF.

Submitted 29 April 1999

NON-TECHNICAL SUMMARY

The 1990s will be viewed, by historians of economic thought, as a decade of great upheavals in the theory of currency crises. New generations of models come to life at an alarming pace, an acceleration in fecundity that no doubt reflects the speed with which exchange rate arrangements have fallen apart. While this profusion of new models is undoubtedly justified by the variety of the recent crises, from the EMS to Mexico and Asia, it also raises the question of the key analytical points behind the inevitable claims to novelty made by their proponents, which distinguish one generation from the other. This paper attempts to make a first step in that direction by putting in perspective some recent developments in the theory of currency crises.

The prevailing intellectual framework for thinking about currency crises until the early 1990s was the speculative attack model developed by Krugman (1979) and Flood and Garber (1984). The speculative attack approach views currency crises as runs on foreign exchange reserves at central banks, occurring in situations where the domestic authorities pursue monetary or fiscal policies that are excessively expansionary. The main contribution of this approach is to show that the run need not be ascribed to the irrationality of market participants and in fact is the joint result of bad policies on the side of policymakers and rational arbitrage on the side of speculators.

This view of currency crises was put in question after the EMS crisis of 1992–3. Excessively expansionist monetary or fiscal policies were clearly not an issue in countries such as France or Great Britain. The credibility of the latter countries' commitment to the ERM was eroded by the combination of mounting unemployment and the high interest rates imposed upon them by the German monetary unification shock. European (non-German) policymakers were caught in a dilemma between their desire to reduce interest rates and their commitment to the ERM.

Explaining the EMS crisis led researchers to develop a new strand of models, that we regroup in this paper under the name of 'escape clause' approach (a term that we prefer to the more widely used 'second generation' label, for reasons that are explained in the paper). The escape clause approach to currency crises views exchange rate arrangements as conditional commitment devices. A country that adheres to a fixed exchange rate arrangement commits itself to maintain the exchange rate within a range in view of certain benefits (in terms of anti-inflationary reputation or credibility, for example). This commitment, however, is limited, in the sense that the country's policymaker can always exercise an escape clause, i.e. devalue, revalue, or float. The policymaker makes this decision by weighing the benefits of maintaining the fixed peg against the costs of this policy, given the economic

environment. A currency crisis, in this perspective, is a situation in which private agents, given the prevailing conditions, perceive that the policymaker is on the brink of exercising the escape clause.

One important theme of this Paper is that the escape clause approach to currency crises transcends its origin. We argue that the insights from the escape clause approach go beyond the EMS crisis and shed interesting light on the 1994–5 Mexican crisis as well as the Southeast Asian crisis.

The first contribution of the escape clause approach relates to the nature of the fundamental determinants of crises. The notion of fundamental, in the escape clause approach, is much more encompassing than in speculative attack models. In addition to ‘hard’ observable fundamentals, such as unemployment, the trade balance, the level and maturity of public debt, it includes ‘soft’ fundamentals, such as the beliefs of the foreign exchange market participants on the more or less cooperative nature of the game that is played by the members of the fixed exchange rate arrangement, or the policymakers’ reputational capital. Taking a holistic view of the fundamentals makes it easier to understand a number of problems associated with the crises of the 1990s, such as the international contagion of crises, or the costs and benefits involved in a strategy of playing the ‘confidence game’ with international investors.

The second contribution of the escape clause approach (and the one that has received most of the attention in the literature) is that it provides a new theory of self-fulfilling speculation. In the escape clause approach, the world is not a completely deterministic one in which causality flows exclusively from the fundamentals to market expectations. Causality runs both ways and this circularity can generate multiple equilibria and self-fulfilling speculation. The crises of the 1990s have revived old debates on whether the blame for crises should be attributed to bad fundamentals or to market excesses and the escape clause approach has contributed to this debate by providing a new framework to analyse this question.

We review in this paper the main recent developments in the debate between the ‘fundamentalist’ and ‘self-fulfilling’ views of currency crises. The self-fulfilling view is consistent with a number of features of the crises we have witnessed this decade, including the observed disconnection between fundamental developments and the timing of crises, contagion and other stylised facts that are rather difficult (but not impossible) to explain otherwise. The escape clause approach shows, moreover, that the two views are not mutually exclusive. The occurrence and precise timing of a crisis may be impossible to predict solely on the basis of the fundamentals, but the latter nevertheless play a crucial role, to the extent that it is their deterioration that makes the crisis possible.

The Southeast Asian crisis has prompted some economists to call for a 'third generation' model of currency crises, a terminology with which we are a bit uncomfortable. The names we choose are important insofar as they reflect the way we view theory and, of course, once adopted they influence the way we think about facts. In the Asian crisis some phenomena that were apparent before, such as the link between banking and currency crises and the contagion of crises across countries, became exacerbated: subsequently new models putting the analytical focus on these phenomena were developed. As we argue in this paper, however, these new models fall naturally under the speculative attack or the escape clause approaches and it is not yet clear at this stage what is the theoretical principle that would organize them in a distinct theoretical approach.

1 Introduction

The 1990s will be viewed, by historians of economic thought, as a decade of great upheavals in the theory of currency crises. New generations of models come to life at an alarming pace, an acceleration in fecundity that no doubt reflects the speed with which exchange rate arrangements have fallen apart. While this profusion of new models is undoubtedly justified by the variety of the recent crises—from the EMS to Mexico and Asia—it also raises the question of the key analytical points behind the inevitable claims to novelty made by their proponents, which distinguish one generation from the other. This paper attempts to make a first step in that direction by putting in perspective some recent developments in the theory of currency crises in the context of a common theoretical framework. We compare two theoretical approaches, one based on the speculative attack model of Krugman-Flood-Garber and the other approach called here “escape clause”, which is often associated with the work of Obstfeld. On the empirical side, our discussion puts special emphasis on the events that primarily motivated the development of the escape clause approach—the crisis of the Exchange Rate Mechanism of the EMS in 1992-93, but it also expands on the Mexican and Asian crises.

The prevailing intellectual framework for thinking about currency crises until the early 1990s was the speculative attack model developed by Krugman (1979) and Flood and Garber (1984a). The speculative attack approach views currency crises as runs on foreign exchange reserves at central banks. The main contribution of this approach is to show that the run need not be ascribed to the irrationality of market participants, but in fact can be explained by the very rationality of their expectations. If the reserves did not flee, speculators could foresee the date of the devaluation and make sure profits. The main message of the speculative attack literature is that the reserve flight that happens during a currency crisis is provoked by rational arbitrage.

The speculative attack approach has yielded important insights on the anatomy of currency crises, but proved to be less illuminating on the underlying causes. In most models the speculative attack is provoked by a monetary or fiscal policy which, by assumption, is inconsistent with the maintenance of the fixed currency peg. A bad fundamental, then, is not difficult to diagnose: it is simply a monetary or fiscal policy that makes a devaluation inevitable. In retrospect, what appears as tautological naiveté in the definition of the fundamentals owes more, we would argue, to the historical context in which the speculative attack literature evolved than to an intrinsic limitation of the approach. One of the main contributions of the speculative attack literature was to show that the currency panics associated with the failure of stabilization plans of the 1970s and 1980s in Latin American countries were the perfectly natural consequence of the monetary and fiscal policies followed in these

countries, not a sign of market malfunctioning. The purpose of this literature was not to explain *why* Latin American countries were implementing monetary and fiscal policies that were inconsistent with their announced exchange rate objective.

The limitation of the speculative attack approach regarding the underlying causes of currency crises became more frustrating after the EMS crisis of 1992-93. While excessively expansionist monetary or fiscal policies may have been an issue in some countries, such as Italy or Spain, they were clearly not in others, like France Great Britain. The credibility of the latter countries' commitment to the ERM was eroded by the combination of mounting unemployment and the high interest rates imposed upon them by the German monetary unification shock. These factors not only increased the temptation to devalue and implement an expansionary monetary policy, but also made raising the interest rate to defend the currency more painful. The first challenge to theorists, thus, was to develop a framework that would define the determinants of currency credibility in a broader and more holistic sense than the speculative attack approach.

The EMS crisis raised a second theoretical challenge, not related, this one, to the nature of the economic fundamentals but to the nature of their relationship with speculation. Even invoking a broader set of economic fundamentals did not solve all the puzzles of the EMS crisis. Unemployment had been increasing and German interest rates had been high for years before the crisis—and in fact, German interest rates were decreasing at the time of the crisis. How is it, then, that the crisis erupted so abruptly and unexpectedly? This question gave rise to another more controversial theme: that the speculation was not determined solely by the economic fundamentals, but that it also was to some extent also self-fulfilling.

Thinking about these questions led researchers to develop a new strand of models, that we regroup in this paper under the name of “escape clause” approach.¹ The escape clause approach to currency crises views fixed exchange rate arrangements as conditional commitment devices. A country that adheres to a fixed exchange rate

¹A number of authors have identified the key characteristic of the new models with the presence of an optimizing policymaker (Isard, 1995; Sutherland, 1995) or the fact that exchange rate policy is endogenous (Buiter, Corsetti and Pesenti, 1998; Cavallari and Corsetti, 1996). Other names, such as “New Crisis” (Krugman, 1996) or “second generation” (Flood and Marion, 1999a,b), choose to stress more the novelty of the approach than its content. The first version of the present paper (1994) coined the term of “cost-benefit” approach, which survived for a short time in the literature (see, e.g., Velasco, 1996). The term “second generation” seems to have fared best in the process of evolutionary selection of names. We still resist adopting this terminology here because it is often used to refer to models of currency crises with multiple equilibria, which, as we argue below, is not the most relevant criterion to distinguish recent developments from the Krugman-Flood-Garber model.

arrangement commits itself to maintain the exchange rate within a range in view of certain benefits, in terms of anti-inflationary reputation or credibility, for example. Its commitment, however, is limited, in the sense that the country's policymaker can always exercise an escape clause, i.e. devalue, revalue, or float.² The policymaker makes this decision by weighing the benefits of maintaining the fixed peg against the costs of this policy, taking into account the broad economic environment. A currency crisis, in this perspective, is a situation in which private agents, given the prevailing conditions and their beliefs about the policymaker's objectives, perceive that the policymaker is on the brink of exercising the escape clause.

The first contribution of the escape clause approach is that it has led the profession to reconsider the notion of fundamental. The notion of fundamental, in the escape clause approach, is much more encompassing than in speculative attack models, and in the limit can involve any variable that influences the policymakers' decision whether or not to defend the fixed peg. In addition to "hard" observable fundamentals, such as unemployment or the trade balance, it includes "soft" fundamentals, such as the beliefs of the foreign exchange market participants on the more or less cooperative nature of the game that is played by the members of the fixed exchange rate arrangement, or the policymakers' reputational capital.

The second contribution of the escape clause approach, and the one that has received most of the attention in the literature, is that it provides a new theory of self-fulfilling speculation and multiple equilibria. In most escape clause models, causality does not flow exclusively from the fundamentals to market expectations. Causality runs both ways and this circularity can generate multiple equilibria. For example, an increase in devaluation expectations can become self-validating because it makes it more costly for the authorities to maintain the fixed exchange rate peg, by forcing them to raise the interest rate. Under these conditions, the authorities' optimal policy may be to validate *ex post* the market expectations, i.e., devalue if speculators expect a devaluation, or maintain the fixed peg if they don't. Whether and when a crisis occurs is determined by the self-fulfilling mood of the market –what Keynes called its "animal spirits"– and is not necessarily related to fundamental developments.

It may seem surprising, in retrospect, that the debate between the self-fulfilling and fundamentalist views of currency crises, which is still going on, was revived by the EMS crisis of 1992-93. It seems clearer now that there is not much in the EMS crisis that makes it *more* suggestive of multiple equilibria than other crises. True, some features of the EMS crisis, such as the disconnection between fundamental developments and the timing of crises, are suggestive of multiple equilibria, but these features are not really specific to the EMS crisis. What the EMS crisis made clear was the inadequacy of models where the crisis is the mechanical consequence of excessively

²This is all the difference between a fixed currency peg and a common currency.

expansionary monetary policy, and the need to develop models based on the conflict between competing objectives of policymakers. *A priori*, this conflict can be thought of completely separately from multiple equilibria. However, it also happened that the escape clause models generically give rise to multiple equilibria, and thus became the vehicle for a debate on self-fulfilling speculation. In retrospect, the emergence of this particular theme at this particular time looks like a theoretical accident.

The reasons why the multiplicity of equilibria became such a popular feature of escape clause models go beyond the EMS crisis. First, it is consistent with a widely held view among economists and practitioners that speculation is motivated not only, or even not primarily, by the economic fundamentals. George Soros' "theory of reflexivity", for example, while it is presented by its author as a general criticism of economic theory, can easily be interpreted in terms of multiple equilibria (Soros, 1994).³ Second, it is consistent with a number of features of many currency crises, including the already mentioned disconnection between fundamental developments and the timing of crises, but also contagion, and other stylized facts that are rather difficult to explain otherwise. Last but not least, it provides a political compromise between the view that crises result from a market failure and the view that they are self-inflicted by governments implementing bad policies. The view that speculation is self-fulfilling is often resisted for the reason that it seems to absolve policymakers from all blame in the crises that hit their countries. The escape clause approach shows, however, that the self-fulfilling and "fundamentalist" views are not mutually exclusive. For a currency to be vulnerable to self-fulfilling speculation, the fundamentals must first put it in a state of fragility. The occurrence and precise timing of a crisis may be impossible to predict solely on the basis of the fundamentals, but the latter nevertheless plays a crucial role, to the extent that it is their deterioration that makes the currency ripe for an attack.

The taxonomy adopted in this paper is different from the one used in much of the recent literature, based on the distinction between "first generation" and "second generation" models of currency crises. First generation models are often defined as those in which speculation is determined solely by the fundamentals, and second generation models as those where it can be self-fulfilling. While this distinction may be the most natural one when discussing the policy implications of theory, we would argue that it is also potentially confusing for a newcomer to the theory of currency crises willing to build a clear analytical understanding of its most recent developments. We prefer to emphasize here the difference between models where the policies that

³By "reflexivity" G. Soros means that the causal relationship between market expectations and the economic fundamentals runs both ways, so that the former may not be uniquely determined by the latter. The two equations presented in Soros' (1994) Chapter 1 reproduce exactly the structure of a model with multiple equilibria.

ultimately bring down the fixed exchange rate peg are taken as exogenous and models where these policies are endogenized. This classification seems more in line with the general evolution of thought in macroeconomics, in which government policy also evolved from being included as an exogenous variable in macroeconomic models to become explicitly modeled as the result of a more or less constrained process of optimization. Furthermore, it brings out more clearly that the contribution of the new models is not only, or even not essentially, about multiple equilibria. On the one hand, some variants of the basic speculative attack model developed in the 1980s involve multiple equilibria (Flood and Garber, 1984b; Obstfeld 1986; Grilli, 1986). On the other hand, as Krugman (1996) points out, it is not true that all escape clause models lead to multiple equilibria. Thus the multiplicity of equilibria should not necessarily be the distinguishing feature of the first versus second generation models.⁴

The recent Asian crisis has prompted some economists to call for a “third generation” model of currency crises, a terminology with which, again, we are a bit uncomfortable. The names we choose are important insofar as they reflect the way we view theory, and, of course, once adopted they influence the way we think about facts. In the Asian crisis some phenomena that were apparent before, such as the link between banking and currency crises and the contagion of crises across countries, became exacerbated: whence new models putting the analytical focus on these phenomena were developed. As we argue below, however, these new models fall naturally under the speculative attack or the escape clause approaches, and it is not yet clear at this stage what is the theoretical principle that would organize them in a distinct theoretical approach. The name “third generation” also has the inconvenience of suggesting that the Asian crisis is as different from the EMS crisis as the latter was from its predecessors, and that it is now time to put previous models back on the shelf and start developing a new framework. This view neglects important dimensions by which the escape clause approach transcends its origin. The main message of the escape clause approach is that currency crises should be analyzed in the context of a conflict between contradicting policy objectives. This is a good starting point to analyze not only the EMS crisis of 1992-93 but also older events or the most recent ones.⁵ Clearly the Asian authorities were faced with a dilemma between the external objective of defending their currency, which required high interest rates, and the internal objective of preserving their banking sectors, which required low ones. In

⁴This point is also made in Corsetti, Pesenti and Roubini (1998), Drazen (1998), and Eichengreen and Jeanne (1998).

⁵For example, the same escape clause model can be applied to the analysis of the French franc crisis of 1992-93 and the 1931 sterling crisis (Jeanne, 1997b, and Eichengreen and Jeanne, 1998). See also Bordo and Schwartz (1996).

the limit, *any crisis can be analyzed in the escape clause perspective*, the whole point being to specify well the terms of the dilemma with which the policymaker is faced.

The paper is organized as follows. We first present a simple model of the exchange rate allowing us to embed the comparison between old and new approaches in the context of a common framework. Sections 3 and 4 then discuss the properties of the speculative attack and escape clause approaches respectively. We conclude the paper by discussing the merits of the two approaches with reference to the recent crises in Southeast Asia.

2 The framework

We present in this section a simple model of the exchange rate, which will serve of framework for the analysis in the following sections. In order to focus attention on the logic of currency crises, we have adopted a model of the exchange rate that is as simple and as uncontroversial as possible, essentially a two-period version of the open economy neoclassical synthesis framework.

The world economy comprises two countries, a domestic and a foreign country, and lasts two periods, that represent the short and long term. We denote by E the exchange rate of the domestic currency, i.e., the price of the foreign currency in terms of the domestic one. The question that we scrutinize throughout this paper is the conditions under which the domestic currency remains pegged to the foreign currency at rate \bar{E} .

We assume that the domestic price level is rigid in the short term, but adjusts to the monetary conditions in the long term. Thus, P_1 , the domestic price level in the first period, is an exogenous variable of the model, while P_2 , the price level in period 2, is endogenous and satisfies purchasing power parity:

$$P_2 = E_2 P^* \tag{1}$$

where P^* is the (exogenous) foreign price level in both periods.

For the sake of simplicity, and without loss of generality, we assume that the first period domestic price level is given by $P_1 = \bar{E} P^*$. This means that P_1 , which is an exogenous variable and does not *a priori* satisfy purchasing power parity, is nevertheless consistent with this parity. This assumption, which would be easy to relax, has the merits of simplifying the algebra and making clear that a currency crisis occurring in period 1 is not caused by a real overvaluation of the domestic currency.

Private agents allocate their financial portfolio between two types of assets: domestic and foreign bonds. Assuming risk neutrality and perfect mobility of capital (and this is an important assumption of the model, which is not met if there are foreign exchange controls, for example), domestic and foreign bonds are perfectly substitutable. The first period nominal yield⁶ on domestic bonds must be equal to the yield on foreign bonds times the factor of depreciation of the domestic currency relative to the foreign currency between period 1 and period 2:

$$I_1 = \left(\frac{E_2}{E_1} \right) I^* \quad (2)$$

while the second period interest rate is exogenous and set (for the sake of simplicity) at $I_2 = I^*$.

Domestic agents hold domestic money because of its utility in making transactions. We assume that the demand for domestic money is given by a standard LM equation:

$$\frac{M_t}{P_t} = \frac{Y}{v} I_t^{-\alpha} \quad \alpha > 0, \quad t = 1, 2 \quad (3)$$

where M_t is the quantity of money in period t , Y is a production index, assumed to be constant, and v is a measure of the velocity of money.

The endogenous variables are the first period nominal interest rate I_1 , the exchange rates E_1 and E_2 , and the second period price level P_2 . The reduced form of the model can easily be computed as:

$$E_2 = \left(\frac{M_2}{\bar{M}} \right) \bar{E} \quad (4)$$

$$I_1 = \left(\frac{M_1}{\bar{M}} \right)^{-\frac{1}{\alpha}} I^* \quad (5)$$

$$E_1 = \left(\frac{M_1}{\bar{M}} \right)^{\frac{1}{\alpha}} \left(\frac{M_2}{\bar{M}} \right) \bar{E} \quad (6)$$

where \bar{M} is the quantity of money consistent with the maintenance of the fixed peg at periods 1 and 2, given by:

$$\bar{M} = \frac{Y P^* \bar{E}}{v I^{*\alpha}} \quad (7)$$

Equation (4) states that, in the long run, the exchange rate is proportional to the quantity of domestic money. Equation (5) reflects the *liquidity effect* of monetary

⁶The nominal yield is equal to 1 plus the nominal interest rate.

policy: an increase in the quantity of money decreases the nominal interest rate in the first period. Finally, equation (6) shows that the exchange rate at period 1 depends on the quantity of money at periods 1 and 2. A transitory increase in the quantity of money at period 1 depreciates the domestic currency by reducing the nominal interest rate. An increase in the quantity of money at period 2 has the same impact, through its effect on the long-term exchange rate.⁷

3 Speculative attacks

The seminal papers in the speculative attack literature are Krugman (1979), who built on the analysis of the Gold Standard by Salant and Henderson (1978), and Flood and Garber (1984a), who gave the speculative attack model its canonical form. The purpose of this section is to present the logic of these models in the context of our two-periods framework.⁸ Sections 3.1 gives the main assumptions and presents the logic of the run on reserves. The fundamental-based and self-fulfilling speculative attack approaches are then presented in sections 3.2 and 3.4 respectively.

3.1 The logic of speculative attacks

We assume, and this is the first crucial assumption of the Krugman-Flood-Garber model, that the monetary policy instrument is not the quantity of money or the interest rate, but one component of the central bank's balance sheet: domestic credit. Writing the supply of money as the sum of domestic credit and foreign exchange reserves:

$$M_t = D_t + R_t, \quad t = 1, 2 \quad (8)$$

we assume that the variable determined by the monetary authorities is domestic credit, D . The level of reserves, R , is then determined residually, as the difference between the demand for money and domestic credit.⁹

⁷Note that a *permanent* increase in the quantity of money at period 1 depreciates the domestic currency more in the short run than in the long run. One does not need more than a two-period model to explain the essence of Dornbusch's overshooting result.

⁸We do not attempt, on the other hand, to provide an exhaustive review of the literature on speculative attacks. The interested reader may refer to Agénor, Bhandari and Flood (1992), Blackburn and Sola (1993) or Garber and Svensson (1995).

⁹Note that according to equation (8) variable M should be interpreted as the monetary base, while the money demand equation should involve broad money. This discrepancy raises no serious problem in theory if there is a stable relationship between the monetary base and the broader monetary aggregate that appears in LM. But it matters if one tries to give an empirical content to

This assumption means that the monetary authorities, after they have monetized a given level of domestic credit, do not respond to changes in the the level of foreign exchange reserves by concomitant changes in domestic credit. In other terms, the central bank does not sterilize reserve flows, nor does it augment their impact on money supply, “inside” period 1 or 2. One may justify this assumption by the fact that reserve flows are very sudden during currency crises, and do not necessarily leave enough time for the monetary authorities to intervene. Alternatively, the monetary authorities are able to adjust domestic credit to reserve movements instantaneously, but reluctant to do so because of an objective in terms of domestic credit that overrides their exchange rate commitment.

The second crucial assumption of the model is that the amount of reserves must stay above a floor \underline{R} :

$$R_t > \underline{R}, \quad t = 1, 2 \quad (9)$$

This constraint sets a limit on the amount of reserves that the central bank commits to the defense of the domestic currency. For example, the monetary authorities may wish to spare a cushion of reserves \underline{R} so as to preserve their ability, after the devaluation, to intervene in the foreign exchange market, possibly to defend a new fixed peg. The floor on the foreign exchange reserves is not necessarily positive. The bank may borrow foreign currency from its foreign counterparts or private agents in the foreign exchange market. If these operations are massive –and they will typically be during a currency crisis– the bank may become a net debtor in terms of foreign currency, which corresponds to $\underline{R} < 0$. The assumption $R > \underline{R}$ then sets a limit on the amount of foreign currency that the bank is able –or wishes– to borrow, equal to $-\underline{R} > 0$.

A speculative attack is a run on the foreign exchange reserves of the central bank. We think it may be useful to recall briefly the logic of the run equilibrium in the terms laid out by Diamond and Dybvig (1983), because this clarifies some assumptions of the speculative attack model that are often left implicit in the literature.

The model of run relies on a sequence that takes place *inside* period 1 or 2. At the beginning of the period, private agents address their demands of foreign exchange reserves against domestic currency to the domestic central bank. This demand is served by the bank at rate \bar{E} as long as some foreign exchange reserves remain available. If total demand is larger than $R_t - \underline{R}$, all demanders cannot be served, because of the constraint (9). They are then randomly allocated in a “queue”, which determines the order in which they are served, and at which rate. The first ones in the

variable D .

queue are served at rate \bar{E} until the reserves are exhausted. The following ones are faced with a different rate, the shadow flexible exchange rate, which is determined by the post-devaluation monetary conditions.¹⁰ The shadow flexible exchange rate is the exchange rate that prevails when the central bank does not hold any reserves in excess of the floor. Formula (6) implies that the shadow flexible exchange rates at periods 1 and 2 are given by:

$$\hat{E}_1 = \left(\frac{D_1 + R}{M} \right)^{\frac{1}{\alpha}} \left(\frac{D_2^e + R}{M} \right) \bar{E} \quad (10)$$

$$\hat{E}_2 = \left(\frac{D_2 + R}{M} \right) \bar{E} \quad (11)$$

where D_2^e is the period 2 level of domestic credit expected in period 1.

The central point of the speculative attack model is that a run is an equilibrium if and only if private agents expect it to be associated with a *devaluation*, i.e., the shadow flexible exchange rate is higher than the fixed rate:

$$\hat{E}_t > \bar{E} \quad (12)$$

Private agents, knowing that the domestic currency is about to be devalued, will try to outrun the devaluation. This behavior is completely rational: if an attack occurs, each individual agent is better off participating in the attack in order to have a chance of being at the beginning of the queue and taking advantage of the better exchange rate. If the shadow flexible rate implied a revaluation, private agents would keep their domestic assets and there would be no speculative attack.¹¹

The literature on speculative attack generally assumes that if condition (12) is satisfied the run on the foreign exchange reserves is the unique equilibrium. This is generally justified by the fact that private agents are faced with a “one-way bet”. The risk incurred by speculators is one-sided; it is that of a devaluation, not a revaluation, so that each individual speculator loses nothing by running alone on the reserves, but exposes himself to a loss by not running if the others do. In game theoretical terms, attacking the domestic currency is a dominant strategy, and standard refinements of Nash equilibria (involving, for example, a slight uncertainty over the action chosen

¹⁰Thus, there are two different exchange rates in the same period if an attack occurs.

¹¹As Grilli (1986) has shown, it is possible to build speculative attacks leading to a revaluation, if one assumes that reserves cannot go above a *ceiling*. This is the type of speculative attacks that “strong” currencies may be confronted with. The reserve ceiling may come from a concern of the domestic monetary authorities not to increase excessively the quantity of money.

by the other players) would lead to the selection of the speculative attack as the only “robust” equilibrium.^{12 13}

3.2 Speculative attacks caused by “bad fundamentals”

We proceed to study how the occurrence of a speculative attack is determined by the exogenous variable of the model, domestic credit. A speculative attack occurs at period 1 if the shadow exchange rate is higher than the fixed parity:

$$\hat{E}_1 > \bar{E} \quad (13)$$

If the attack has not occurred in the first period it is expected to take place in the second one if:

$$\hat{E}_2 > \bar{E} \quad (14)$$

Figure 1 represents, in the space (D_1, D_2^e) , the *loci* in which these conditions are satisfied as equalities. A speculative attack occurs in period 1 if current and expected domestic credits determine a point in region III, in which condition (13) is satisfied. In region II, the fixed peg is not attacked in the first period, but it is expected to collapse in the second period. In region I, the fixed currency peg is expected to survive in both periods.

The important point here is that the occurrence of the speculative attack is determined not only by the current stance of monetary policy but also by market expectations over future monetary policy. Starting from a situation in which the credibility of the fixed peg is perfect, such as point A on the figure, a rise in the expected level of domestic credit may move the economy from region I to region II, where a speculative attack starts to be anticipated. This expectation leads to an unsterilized reserve

¹²The argument in Krugman (1979) is slightly different and makes use of the perfect foresight nature of his model. All speculators know that the fixed currency peg will be abandoned before the date at which the reserves would be exhausted in the absence of speculative attack. The attack cannot occur at this time, otherwise it would involve a jump in the exchange rate. Rational backward induction then implies that the attack must occur exactly when the shadow exchange rate is equal to the fixed parity.

¹³A rigorous interpretation of the speculative attack in terms of game theory would require writing the speculators’ payoffs of attacking and not attacking. This is done by Obstfeld (1996) in the context of a model with two large speculators. Obstfeld also assumes that exchanging the domestic currency against the foreign one involves a small transaction cost, and then shows that attacking is not always a dominant strategy, and can even be strictly dominated. The attack must involve some coordination of the speculators, and it can succeed only if they have enough domestic currency to throw in the battle against the bank.

outflow, which reduces the supply of domestic money and raises the interest rate. As long as the economy remains in region II, however, the reserve outflow is not large enough to exhaust the reserves in period 1. But if expected domestic credit increases further, so as to put the economy in region III, the reserves constraint becomes binding, and a speculative attack is triggered in period 1. Thus, an increase in expected future domestic credit can bring about an attack, even if the current level of domestic credit seems consistent with the fixed peg.

[Insert Figure 1 approximately here]

This very simple model does not do justice to the many insights offered by the speculative attack literature. First, the point originally made by Krugman (1979) and Flood and Garber (1984a) was that in continuous time, the exchange rate – unlike foreign exchange reserves – does not jump at the time of the attack. If it did, the speculators, knowing in advance the date of the attack, could realize unlimited profits by arbitrage. The assumption of perfect foresight was relaxed by a number of authors who assume instead that the domestic credit process is stochastic, implying that the date of the attack is uncertain and that the period leading up to it exhibits a peso effect in the domestic interest rate.¹⁴ Other authors have scrutinized the behavior of the domestic real economy before and after a speculative attack. In the context of a model with traded and nontraded goods, Calvo (1987) finds that the attack is preceded by a real appreciation and followed by a persistent real depreciation of the domestic currency. Willman (1988) introduces nominal rigidities into the model, and finds that the level of output and the trade balance deteriorate before the attack and improve afterwards.¹⁵

Beyond their differences, these models share one feature that make all of them models of speculative attacks: the currency crisis is modeled as a run on the foreign exchange reserves at the central bank, and this run occurs as soon as the shadow flexible exchange rate is higher than the fixed parity. They also share another feature which, though not constitutive of the speculative attack approach, nevertheless came to be identified with it in later discussions: the exogenous economic fundamentals are

¹⁴See Buitier (1987), Claessens (1991), Dornbusch (1987), Flood and Garber (1984a), Goldberg (1991), Grilli (1986), Obstfeld (1986).

¹⁵Other extensions include the study of speculative attacks against target zones (Krugman and Rotemberg, 1992) and crawling pegs (Connolly and Taylor, 1984). Some authors have analyzed how the dynamics of the attack are modified when the monetary authorities seek to establish a new fixed currency peg (Obstfeld, 1984; Grilli, 1986), or a crawling peg (Dornbusch, 1987) after the devaluation.

defined in a narrow way, that is limited to monetary and fiscal policies.¹⁶ Overall, the speculative attack literature adopted the somewhat tautological view that currency crises are caused by monetary or fiscal policies that are inconsistent with the maintenance of the fixed currency peg, and did not address the question of where these policies come from.¹⁷

3.3 Self-fulfilling speculative attacks

The previous section showed how a speculative attack may precipitate a devaluation made inevitable by the course of monetary or fiscal policy. In this section, we present a different view of speculation, one in which the speculators may or may not provoke a devaluation, independently of the economic fundamentals. The occurrence of the speculative attack is determined by the collective behavior of speculators, not the policy actions of the government.

As Obstfeld (1986) showed, this change in perspective can be obtained at the cost of a small modification of the model.¹⁸ One simply needs to assume that *the second period monetary policy depends on the government's decision whether or not to devalue in the first period*. Let us assume that the first period domestic credit $D_1 < \overline{M} - \underline{R}$ being given, the monetary authorities choose D^f in the second period if they have managed to maintain the fixed peg in the previous period, and D^d if they have not. The reaction function of the monetary authorities, thus, may be written as follows:

¹⁶In stochastic models it is usually assumed that the exogenous variable is domestic credit, which follows a Markov process. Buiter (1987), Van Wijnbergen (1991) and Willman (1988) assume that the expectations on domestic credit are determined by the monetization of the public debt, an “unpleasant monetary arithmetics” that allow them to extend the definition of the fundamentals to fiscal policy.

¹⁷As we have already stated, this narrow way to look at the causes of crisis does not result from an intrinsic limitation of the speculative attack model. It would have been possible to develop the speculative attack approach into the direction of endogenizing domestic credit. An example of this is Velasco (1987), who emphasizes that the rise in domestic credit may be due to a banking crisis forcing the monetary authorities to provide liquidity to the banking sector (see also Calvo, 1996). It should also be noted, in this connection, that most empirical applications of the speculative attack model involve channels that do not appear in the benchmark model, such as the impact of trade deficits on reserves (Blanco and Garber, 1986).

¹⁸The possibility of self-fulfilling attacks *à la* Obstfeld is also underlined by Grilli (1986). There are other ways to generate multiple equilibria in the basic Flood-Krugman-Garber framework. Flood and Garber (1984b), for example, note that self-fulfilling attacks could result from bubbles in the shadow exchange rate. Flood and Marion (1999b) propose a model of self-fulfilling speculative attack that relies on another form of multiple equilibria in the determination of the underlying shadow exchange rate. Savastano (1992) presents a model of self-fulfilling attacks based on a Laffer curve in the collection of seigniorage revenue.

$$(R) \begin{cases} \text{no devaluation in period 1} & \implies D_2 = D^f \\ \text{devaluation in period 1} & \implies D_2 = D^d \end{cases}$$

Let us assume that monetary policy is more expansionary in period 2 if a devaluation has occurred in period 1, i.e., $D^d > D^f$. This can be the case, as argued by Obstfeld (1986), if the government is cut off from external borrowing after a devaluation and has to monetize its public debt to a larger extent than before.¹⁹ Or it may be that the government, having forgone the benefits of its commitment to the fixed currency peg, switches to the optimal monetary policy under floating, which may be more expansionary than the policy required to maintain the fixed peg.²⁰ If we assume, furthermore, that (D_1, D^f) lies in region I of Figure 1, while (D_1, D^d) is in region III, then the model admits two equilibria. In the first equilibrium, the domestic currency is not attacked in period 1, and the authorities maintain the fixed peg in the second period by implementing a moderate expansion of domestic credit. In the second equilibrium, the domestic currency is attacked in the first period, and the authorities validate *ex post* the attack by a more vigorous expansion of domestic credit. The fate of the currency is then determined by the “animal spirits” of speculators, or to put it more formally, an exogenous sunspot variable coordinating their expectations on one equilibrium or the other.

Self-fulfilling speculative attacks are observationally equivalent to fundamental-based attacks—the behavior of speculators looks the same, and in both cases the attack is justified *ex post* by an expansionary shift in period 2 monetary policy—but they imply very different views of the role of speculation. In the model of the previous section speculation was purely the reflection of an underlying fundamental problem, for which the responsibility lay squarely with the domestic authorities. On the other hand, the model of this section allows an interpretation of the crisis that is less favorable to speculators, since it is their collective behavior that causes the collapse of the currency. The domestic policymaker is partly responsible of the crisis, however, by making himself suspect of having the response function (R). But where does this response function come from? In order to investigate further the determinants of the government’s response to speculation, one needs a model that endogenizes the policymaker’s actions, which is precisely the purpose of the escape clause approach to currency crises.

¹⁹This argument is modelled by Van Wijnbergen (1991).

²⁰The monetary policy chosen under floating is not necessarily optimal, however, for example in the case where opting out involves a switch to discretion.

3.4 A critique

The speculative attack approach has often been criticized for failing to account for the main features of the EMS crisis. Speculative attack models predict that the crisis should be preceded by excessively expansionary monetary or fiscal policy associated with a real overvaluation of the currency and a trade deficit. As we said in the introduction, speculators attacked some ERM currencies that exhibited none of these features, and were instead fragilized by the contradiction between domestic objectives—containing the rise in unemployment—and their commitment to the EMS. In order to understand such situations, one would need a model of the expectations over future monetary policy that is less rudimentary than in the speculative attack approach and considers the response of the monetary authorities to a wide range of variables. In the context of our two-period version of the speculative attack model, one would like to have an equation like:

$$D_2^e = F(X_1, X_2, \dots) \quad (15)$$

where the X_i are variables that matter for the government's decisions over monetary policy, such as unemployment, the state of the banking system, etc. One problem of the Krugman-Flood-Garber model, in this regard, is that, in order to remain simple, it needs assumptions—such as the perfect flexibility of prices—that make monetary policy largely irrelevant for anything real in the economy. This difficulty is one of the reasons why the theory was reconstructed in the context of a different framework.

A less commonly acknowledged weakness of the speculative attack model relates to the specification of the monetary authorities' behavior in a speculative attack. It is crucial for the logic of the run that the monetary authorities do not adjust domestic credit instantaneously to changes in market expectations. There is some evidence, however, that monetary authorities can sterilize reserve flows instantaneously, and that they do it during currency crises (see, e.g., Flood, Garber and Kramer, 1996, for the case of the 1994 Mexican peso crisis). But if, in our model, the central bank can adjust variable D_1 to contemporaneous developments in market expectations, it can make the domestic currency immune to runs by adopting a monetary policy rule that maintains the shadow exchange rate equal to the fixed parity. Written in terms of the level of domestic credit, this rule is given by:

$$D_1 = \bar{M}^{1-\alpha} (D_2^e + \underline{R})^{-\alpha} - \underline{R} \quad (16)$$

which, as equation (10) readily shows, ensures that $\hat{E}_1 = \bar{E}$, so that the run is not an equilibrium at period 1. Equation (16) says that the monetary authorities must respond to a rise in the level of expected domestic credit by restricting domestic credit in period 1.

The intuition behind this rule becomes obvious once it is written in terms of the nominal interest rate:

$$I = I^* \frac{E_2^e}{\bar{E}} \quad (17)$$

In plain words, the monetary authorities can defend the fixed peg by raising the nominal interest rate to a level that offsets the devaluation expectations. Thus, viewing currency crises as runs on the foreign exchange reserves obscures one simple and important fact: the possibility for the central bank to attract reserves by raising the nominal interest rate.²¹ Once the role of the interest rate is acknowledged, the logic of currency crises appears in a new perspective. There is *always* a level of the nominal interest rate that offsets the devaluation expectations of the private sector and maintains the fixed parity. If raising the interest rate was not costly in one way or another, a government would never be drawn out of a fixed exchange rate system, i.e., currency crises would not occur. If currency crises do occur, and governments sometimes decide to give up defending the parity, this must be because raising the interest rate has some cost, which is sometimes higher than the benefit of maintaining the fixed peg. The question that should be at the core of the theory of currency crises, hence, is why the monetary authorities, who are always *able* to implement rule (16) or (17), are not always *willing* to do so. By dodging this question the speculative attack approach, we would argue, misses an important link in the logic of currency crises.

4 The escape clause approach to currency crises

In the speculative attack approach the speculators' problem is essentially ballistic. It is to determine the optimal time for running on the foreign exchange reserves, given an exogenous monetary trajectory. The escape clause approach offers a more holistic view of currency crises, in which each speculator has to figure out how the broad economic conditions, including the expectations of other speculators, influence the policymaker's decisions over the exchange rate. The devaluation is no longer the consequence of an exogenous reserves shortage – it is assumed that the central bank can attract reserves by raising the interest rate – but of the incentives with which the policymaker is faced when considering whether or not to devalue.

The escape clause approach began to evolve into a consistent theoretical body following the 1992-93 crisis of the EMS when, starting with the contribution of Ob-

²¹Much of the argument here is common with Bensaid and Jeanne (1997).

stfeld (1994), several papers set out to give a theoretical account of the events.²² We present here a simple illustrative model in which the variable driving the currency crisis is unemployment. We then discuss extensions of the model in which exchange rate stability depends on other fundamentals, such as public debt and the policymaker's reputational capital, or involves systemic effects. We conclude the section by offering some perspectives on the literature on self-fulfilling speculation.

4.1 An illustrative model: unemployment and currency crises

We go back to our two-period exchange rate model, but replace the assumptions of the speculative attack approach by the following ones. First, we assume that the monetary authorities can sterilize reserves flows instantaneously and set the quantity of money in periods 1 and 2 at any desired level. Thus, there is no need to distinguish between domestic credit and foreign exchange reserves on the asset side of the central bank's balance sheet, and monetary policy can be defined as setting variables M_1 and M_2 . Second, we assume that the government always maintains the fixed parity in the first period ($E_1 = \bar{E}$) but may devalue in the second period, and decides whether or not to do so by considering the implications of this decision for unemployment.

We assume that the amount of the devaluation, if it takes place, is d . This means that the monetary authorities, if they devalue, set the quantity of money at $M_2 = (1 + d)\bar{M}$ in period 2, implying $E_2 = (1 + d)\bar{E}$. (It is not very difficult, though analytically more cumbersome, to endogenize the amount of the devaluation: see for example Obstfeld, 1994.) Since the domestic price level is consistent with purchasing power parity in both periods, the domestic rate of inflation between periods 1 and 2, $\pi = P_2/P_1 - 1$, is equal to d if the government devalues, zero if not.

The government decides whether or not to devalue by considering the implications of this decision for the domestic unemployment rate in period 2. We assume that the level of the unemployment rate is determined by an expectations-augmented Phillips Curve:

$$U_2 = \rho U_1 - \alpha(\pi - \pi^e) \quad (18)$$

where U_1 and U_2 are the deviations of the unemployment rate from its natural level at periods 1 and 2 respectively, and π^e is the expected rate of inflation. A customary

²²Policy rules with escape clause are examined, in a domestic context, by Lohman (1990) and Persson and Tabellini (1990). Models of fixed exchange rate regimes with an escape clause were also studied, before Obstfeld (1994), by De Kock and Grilli (1993), Flood and Hodrick (1986), Flood and Isard (1989), and Obstfeld (1997) (first circulated in 1991 as NBER Working Paper No. 3603). Obstfeld (1994) was the first to present the escape clause approach as an alternative to the speculative attack approach and to compare the two with reference to the 1992-93 EMS crisis.

justification of this relationship is that the second period nominal wage is predetermined in period 1, so that unexpected inflation increases employment above the natural rate by reducing the real wage. Equation (18) also includes a persistence effect in the dynamics of unemployment, which may be due to rigidities in the domestic labor market.

We assume that the domestic policymaker decides whether or not to devalue in period 2 by minimizing the loss function:

$$L = (U_2)^2 + \delta C \tag{19}$$

where δ is a dummy variable indicating the policymaker's decision (equal to 1 if she devalues, 0 if not), and C is the cost of opting out of the fixed exchange rate arrangement.

There is an abundant literature on the nature of this opting-out cost, or equivalently, the nature of the benefits of a fixed exchange rate arrangement for its members. The literature on optimum currency areas (and most economic agents) would point to the adverse effects of increased exchange rate volatility on international trade and investment.²³ The literature on the EMS has also stressed the benefits of a fixed peg in terms of anti-inflationary credibility (Giavazzi and Giovannini, 1989). From that point of view, the cost C should be interpreted as the loss of credibility or reputation associated with a devaluation, and this is the way the opting-out cost has usually been endogenized in the escape clause approach to currency crises (Bensaid and Jeanne, 1998, De Kock and Grilli, 1993). The opting-out cost may also result from the risk of retaliatory "beggar-thy-neighbour" devaluations by other members of the fixed exchange rate arrangement and the shift to uncooperative monetary policy equilibria. More broadly, there are a number of benefits of belonging to a fixed exchange rate arrangement that may be understood only in the wider context of the ongoing relationships with the other members of the arrangement. For example, an important objective for countries like France in staying at the core of the ERM was to maintain its influence on the evolution of the system and the shape of the future monetary union (Drazen, 1998).

There is nothing stochastic in the model. Private agents form their expectations in perfect foresight, expecting a devaluation either with probability zero or with probability one. We characterize the equilibria by proceeding backward, looking first at the optimal decision of the policymaker in period 2 given the expectations of the private sector, and then determining the conditions under which these expectations are rational.

²³This cost has proved elusive to understand theoretically and detect empirically. See, for example, Frankel and Wei (1995) for the case of the EMS.

If the private sector expects no devaluation ($\pi^e = 0$), then the government's loss function is $L^D = (\rho U_1 - \alpha d)^2 + C$ if it devalues and $L^F = (\rho U_1)^2$ if it does not. Not devaluing is the optimal decision if:

$$\frac{C}{\alpha d} - 2\rho U_1 > -\alpha d$$

If the private sector expects a devaluation ($\pi^e = d$), the domestic government is faced with the choice between defending the fixed currency peg, yielding a loss $L^F = (\rho U_1 + \alpha d)^2$, and devaluing, which yields a loss $L^D = (\rho U_1)^2 + C$. Devaluing is now the optimal decision if:

$$\frac{C}{\alpha d} - 2\rho U_1 < \alpha d$$

Defining the “fundamental” as:

$$\Phi = \frac{C}{\alpha d} - 2\rho U_1 \tag{20}$$

we are led to distinguish between three cases:

- **Heaven:** if $\Phi > \alpha d$ there is one unique equilibrium, in which the fixed currency peg is maintained in period 2;
- **Hell:** if $\Phi < -\alpha d$ there is one unique equilibrium, in which the policymaker devalues in the second period (and this is perfectly anticipated by the private sector);
- **Purgatory:** if $-\alpha d < \Phi < \alpha d$, there are two equilibria, one in which the policymaker devalues in period 2, and the other with no devaluation.

Though very stylized, this model yields two important results, one related to the nature of the fundamentals, and the other on the relationship between the fundamentals and the devaluation expectations. First, the fundamental developments susceptible to destabilizing the fixed exchange rate arrangement are a rise in the unemployment rate or a fall in the opting-out cost. When the rate of unemployment U_1 increases, the fixed exchange system may switch from a stable to an unstable state, in which a currency crisis may occur, or even become the sole equilibrium. The reason is that the loss function of the government being convex in the unemployment rate, the temptation to reduce unemployment is increasing with its level.

Second, devaluation expectations are not always uniquely determined by the fundamentals. There are zones of the fundamentals where market expectations are

uniquely determined. They involve the certainty of no devaluation when the fundamentals are excellent (in “heaven”) and the certainty of a devaluation when the fundamentals are very bad (in “hell”). In these cases the net benefit of the fixed exchange rate peg for the policymaker is positive or negative in period 2 irrespective of market expectations, so that the equilibrium is unique.

Between heaven and hell lies a grey zone (“purgatory”) in which a devaluation is possible but not certain. The intuition behind the multiplicity of equilibria is that devaluation expectations, by raising the level of wages, increase the level of unemployment that the government has to bear in order to maintain the fixed peg. The discontinuous expansion of the set of equilibria that takes place when the fundamental enters the interval $]-\alpha d, \alpha d[$ is called a *bifurcation* in the theory of nonlinear dynamics. Thus, a short way of characterizing the relationship between the fundamentals and speculation in this model is to say that speculation can become self-fulfilling following a bifurcation in the fundamentals (Jeanne, 1997a).

In the model as in everyday language, we define a currency crisis as a situation in which the devaluation probability increases abruptly to unusually high levels. Our model can encompass two competing explanations of how a currency crisis may come about, one based on the fundamentals and the other one based on self-fulfilling speculation. According to the first explanation, a currency crisis may come from a deterioration of the fundamental, that is, a decrease from a high level of Φ to a low level of Φ . In this case, it is clear that the crisis is *caused* by the fundamental. But if the fundamental is in the intermediate range with multiple equilibria, the crisis may also result from a self-fulfilling jump in devaluation expectations. The crisis is still caused by the fundamentals, but in the much weaker sense that it is made possible by the fact that Φ lies in the range $(-\alpha d, +\alpha d)$. Strictly speaking, however, it is not triggered by fundamental developments (in particular, it can occur while the fundamental remains the same). It is generated by the “animal spirits” of the market, which, in the theoretical literature, are usually modeled as a “sunspot” variable coordinating market participants on high or low devaluation expectations.²⁴

The essential properties of the model are robust to a number of changes in the assumptions. Many discussions of currency crises stress the cost of high interest rates, an idea that is not difficult to capture in the context of our model. One simply needs to replace the Phillips curve assumption by a monetary policy channel involving the interest rate. Let us drop equation (18) and assume that the domestic rate of unemployment is now determined by:

$$U_2 = \rho U_1 + \alpha \log \left(I_1 \frac{P_1}{P_2} \right) \quad (21)$$

²⁴We discuss in section 4 some problems related to the selection of the equilibrium.

where $I_1 P_1 / P_2$ is the real interest rate between periods 1 and 2. Because of perfect foresight, this interest rate can be interpreted either as the *ex ante* real interest rate observed at period 1 or the *ex post* real interest rate observed at period 2. The assumption, in the first case, would be that the unemployment rate at period 2 depends on the *ex ante* real interest rate of the previous period because of some lags in the transmission of monetary policy, and in the second case that it depends on the *ex post* real interest rate through the balance sheet channel of monetary policy.²⁵

Using equation (21) and the approximation $\log(1 + d) \simeq d$, it is not difficult to show that the equilibria are characterized as before, with the fundamental variable now given by:

$$\Phi' = \frac{C}{\alpha(1 + d)} - 2\rho U_1 - 2\alpha \log I^* \quad (22)$$

The novelty, with respect to the model based on the Phillips curve, is that foreign monetary policy is now part of the fundamentals. A restrictive shift in the foreign monetary policy (i.e., an increase in I^*) tends to generate currency crises by raising the domestic rate of unemployment, a point originally made by Ozkan and Sutherland (1998) in their model of the EMS crisis.²⁶ As before, multiple equilibria can arise because the devaluation expectations of period 1 increase the level of unemployment at period 2. The only difference is that the monetary policy channel now involves the interest rate, not wage setting.

Other natural extensions of the basic model include relaxing the perfect foresight assumption, considering more general time structures, endogenizing the opting-out cost and the amount of the devaluation. The models in Obstfeld (1994, 1997), for example, can be viewed as infinite time stochastic versions of the model presented above. The government minimizes a loss function depending on output and a fixed opting-out cost. It devalues when the output shock goes beyond a level, which depends on the parameters and the stochastic structure of the model. It is also possible to endogenize the opting-out cost as the cost of switching to the discretionary monetary regime (De Kock and Grilli, 1993; Bensaïd and Jeanne, 1998).

One can also endogenize the amount of the devaluation, d , in the context of a tradeoff between inflation and unemployment (see, e.g., Obstfeld, 1994). Interestingly, endogenizing d brings out a point where the speculative attack and the escape clause

²⁵The case where the cost of defending the currency depends on the *ex ante* real interest rate of the current period is considered in Krugman (1996) and Jeanne and Masson (1999). These papers are discussed in section 4.

²⁶Ozkan and Sutherland (1998) present a model in which the foreign (German) interest rate follows an exogenous continuous time stochastic process and the domestic policymaker optimally devalues when this interest rate exceeds a triggering level.

approaches are not easy to reconcile. In the speculative attack approach a sufficient condition for an attack is that the shadow exchange rate must be larger than the fixed parity. In the escape clause approach one can also endogenize the shadow exchange rate as the exchange rate chosen by the policymaker after he has opted out. However, a shadow exchange rate that is higher than, but very close to, the fixed parity does not trigger a crisis, because in that case the benefit of devaluing is too small to make for the fixed opting-out cost. The shadow exchange rate must be *far enough* from the fixed parity for an attack to occur.²⁷

4.2 The quest for the fundamentals: from the “hard” to the “soft”

In the escape clause approach, the only condition that a variable must satisfy in order to qualify as an economic fundamental is to directly or indirectly enter the objective function of the policymaker. Even if one restricts the list of economic variables that appear directly in the policymaker’s objective function to the most basic ones, such as output, unemployment or inflation, a number of other variables could qualify as fundamentals, insofar as they influence the level of output, unemployment or inflation indirectly. One way the escape clause literature evolved was by incorporating in the formal analysis the economic variables that seemed to matter in the EMS and Mexican peso crises, in particular the real exchange rate and fiscal variables such as the level and maturity structure of public debt. This extension of the set of fundamentals also encompassed much “softer” variables, such as the reputation of the policymaker or the more or less cooperative rules of the game played by the participants in a fixed exchange rate system.

The most obvious reason why a policymaker may be tempted to devalue is to offset an overvaluation of the currency. In some sense, this idea is already been captured by the stylized model that we presented in the previous section. Assuming that the Phillips curve (18) results from the predetermination of the nominal wage under rational expectations, a high level of unemployment in period 2 will result from an excessive level of the domestic wage in terms of foreign currency, or in other terms an overvaluation of the domestic currency. Currency overvaluation may be costly for reasons other than unemployment, most notably trade imbalance, and maybe, under some circumstances, deflationary pressures. For example, Andersen (1994) presents a model in which the shock triggering the crisis is in the foreign price level. The domestic country must choose between staying in a fixed exchange rate system (at

²⁷This point is also made by Cavallari and Corsetti (1996).

the cost of importing foreign inflation or deflation), or opting out and switching to the discretionary regime forever. It is shown that the optimal decision involves opting out when the foreign price shock exceeds some level. This model not only adds foreign price developments to the list of fundamentals, but also helps us to understand the contagion of crises as a “domino” effect. A devaluation by one country constitutes a shock for the other members of the fixed exchange rate arrangement, which may induce them to devalue.

Another reason why the policymaker may be tempted to devalue is to inflate away the existing stock of public debt, an insight modeled by De Kock and Grilli (1993), Obstfeld (1994) and Velasco (1996), among others. The decision whether or not to devalue may be viewed as a problem of optimal taxation, where the choice is between monetary seigniorage and fiscal taxes. A larger public debt, other things equal, will tend to tip the balance toward a devaluation. Furthermore the level of public debt at a given point in time is affected by the devaluation expectations that prevailed in the past, through the level of interest rates. This circularity can generate multiple equilibria.²⁸ There is an intermediate level of public debt for which the currency is vulnerable to self-fulfilling speculation (Velasco, 1996). Obstfeld (1994) presents a model that is representative of this approach in order to interpret the 1992 crisis of the Italian lira. This is a two-period model, in which the government may finance its second-period budget deficit by taxing the economy or creating money and devaluing the domestic currency. The government minimizes a quadratic loss function depending on the levels of taxation and depreciation. Obstfeld then shows the possibility of self-fulfilling currency crises: devaluation expectations tend to raise the nominal interest rate and the burden of the debt, which induces the government to devalue in the second period. Sachs, Tornell and Velasco (1996) present an interpretation of the 1994 Mexican peso crisis along similar lines.

The Mexican peso crisis showed that not only the level but also the maturity structure of public debt matters. The incentives with which the policymaker is faced when deciding whether or not to devalue are not the same if a large fraction of public debt may have to be repaid at short notice. Cole and Kehoe (1996) present a model of debt crisis—which could easily be reinterpreted as a model of currency crisis—in which the fundamental determinants of the crisis include both the level and the maturity structure of public debt. Their model is an escape clause one, to the extent that the decision whether or not to default on the public debt is taken by a government that weighs the costs and benefits of each policy option.²⁹ If at a given period foreign

²⁸This point was originally made, in the context of sovereign debt crises, by Calvo (1988).

²⁹One interesting particularity of Cole and Kehoe (1996), in this regard, is that the objective function of the government has explicit microeconomic foundations. They adopt a dynamic general equilibrium framework and assume that the government maximizes the utility of the domestic

investors do not roll over their short-term loans to the government, the latter is faced with a choice between two costly options, reducing public spending, or defaulting. The incentives to default depend on the size of the debt that comes to maturity at a given period, which itself is determined by the overall size of the debt as well as its maturity structure.

The fundamentals that we have discussed until now—be they unemployment, public debt, or currency overvaluation—share the characteristic of being observable and measurable, at least in theory. Some fundamentals, however, are not observable: for example, in the stylised model of the previous section, the opting-out cost C . Other things equal, it is in the policymaker’s interest to make the market believe that his C is very high, that is, to develop a reputation for “toughness”.³⁰ The policymaker’s reputation may be viewed as a fundamental determinant of currency stability in the same way as the trade balance or unemployment, and this fundamental may be improved over time by policy actions. A strategy often adopted by policymakers is to build a reputation for toughness or, in the terms of Krugman (1998), play the “confidence game”.

The policymaker’s reputation has been incorporated in the escape clause approach by Drazen and Masson (1994), and Masson (1995).³¹ These authors consider a framework very similar to the stylized model of the previous section, but assume that the public does not know whether the domestic policymaker has a low or high opting-out cost, i.e., whether she is an easy-devaluer or a hard-pegger. This complicates the relationship between unemployment and the credibility of the fixed peg in an interesting way. On the one hand, increasing unemployment decreases the credibility of the peg by increasing the temptation to devalue. On the other hand, this reinforces credibility through a reputational mechanism: not devaluing signals that the monetary authorities are of the “hard-pegger” type. Whether it is the temptation or the reputation effect that dominates depends on the parameters of the model.

Drazen and Masson develop their point with reference to the “franc fort” policy,³² but it is more general and can be viewed as a warning on the gains to be expected from playing the confidence game with international investors. In general, the credibility of a fixed peg is determined in a complex way by a potentially broad set of fundamentals. The policymaker’s reputation is only one of them. Investing in reputation may not

representative agent.

³⁰This does not mean that it is optimal to make C very high, if this cost actually corresponds to a social cost. Flood and Marion (1999a) study the optimal *ex ante* determination of the opting out cost C in a fixed exchange rate regime with an escape clause.

³¹See also Bensaid and Jeanne (1997, 1998), Benigno and Missale (1997) and Velasco (1996).

³²They conclude that the temptation effect has dominated the reputation effect in France at least since 1987. Masson (1995) reaches a similar conclusion for the British pound in 1990-92.

help to stabilize the currency if this is obtained at the cost of deteriorating other relevant fundamentals.

An apparently less costly way to solve the credibility problem is to delegate the defense of the currency to an independent central banker with a reputation of being a “tough pegger”. Bensaïd and Jeanne (1998) show, however, that such arrangements may be suboptimal. Like Drazen and Masson, Bensaïd and Jeanne (1998) depart from the benchmark escape clause model by assuming that the private sector does not know the opting-out cost of the monetary authorities. They show that under this informational asymmetry, self-fulfilling currency crises take the form of a war of attrition between the monetary authorities and the speculators. The speculators continuously explore the opting-out cost of the monetary authorities until the peg is abandoned. A tough central banker is ready to bear a higher unemployment rate than a soft government before devaluing. But even a tough central banker will give in at some point, and speculators may set out to explore his limit of resistance. As a result, the central banker is no less vulnerable to self-fulfilling speculation than a soft government, and has the additional inconvenience of defending the fixed peg for too long.

The models we have considered until now involve only two countries, and so implicitly treat a fixed exchange rate *system* as the sum of independent unilateral pegs. Buitier, Corsetti and Pesenti (1998) argue that because of the trade externalities that link together the countries participating in a fixed exchange rate system, purely bilateral models cannot offer a reasonable picture of crises such as that of the EMS in 1992-93.³³ In a fixed exchange rate system, each member country’s incentives to devalue depend on the other member countries’ policy actions or reactions, and the equilibrium outcome is determined by the more or less cooperative nature of the relationships inside the system. Thus, the fundamentals should include not only the beliefs of foreign exchange market participants on each country taken separately, but also their beliefs on the nature of the *game* played by national monetary authorities. Buiding on this insight, Buitier, Corsetti and Pesenti (1998) interpret the EMS events of 1992-93 in the context of a policy-optimizing model of systemic currency crises. In a cooperative equilibrium, countries at the periphery of the system react to a positive demand shock in the center country by a modest coordinated realignment. A non-cooperative equilibrium, on the other hand, involves large devaluations by a subset of countries at the periphery. Buitier and his co-authors then ascribe the unexpected burst of speculation of September 1992 to the large and solitary devaluation of Italian

³³See also Loisel and Martin (1998) for an escape clause analysis of currency crises in exchange rate systems. Loisel and Martin analyze how international cooperation can alter the possibility of self-fulfilling currency crises.

lira on the 14th of September, which led foreign exchange market participants to suddenly revise their beliefs on the game played by the European monetary authorities, putting more weight on the noncooperative scenario.

In a similar spirit, Drazen (1998) argues that the benefit of belonging to a collective fixed exchange rate arrangement has the same nature as the membership of a club, in the sense that it depends on the number and quality of other members. The membership benefit of a given country, hence, is reduced when other countries drop out of the arrangement, which may explain why currency crises are intrinsically systemic. Exchange rate clubs may be implicit, so that this type of contagion may affect countries that are not linked by a formal exchange rate arrangement.

4.3 Are currency crises self-fulfilling?

The currency instability of the 1990s has triggered a major effort in empirical research to identify the fundamental determinants of currency crises. Overall, it is a fair generalization to say that this literature has found crises difficult to predict on the basis of the observable economic fundamentals.³⁴ It is generally found that a degradation of the fundamentals significantly increases the probability of a crisis, but this probability evolves sluggishly and remains low even in periods when crises are observed, so that the precise timing of a crisis involves a considerable element of randomness. One possible objection to these studies is that they leave out “soft” fundamentals, which may be difficult for the econometrician to measure, such as the beliefs of market participants on the perceived health of the banking system or the political willingness to defend the currency. If this was the whole answer, however, market participants would perform better than econometricians at predicting crises, which the empirical evidence suggests is not the case (Rose and Svensson, 1994; Goldfajn and Valdes, 1998).

These results are not completely surprising if one considers the typical course of currency crises. Invariably, the fundamental problems to which the crisis is ascribed after the fact –whether this is domestic unemployment, real overvaluation of the currency, a liquidity mismatch or banking fragility– have built up progressively in the period leading up to the crisis in the indifference of markets, even when these problems were perfectly observable. And the crisis, when it finally erupts, is generally *not* concomitant with exceptional developments in the fundamentals. The relative disconnection between the dynamics of the fundamentals and those of expectations is

³⁴See, for example, Kaminsky, Lizondo and Reinhart’s (1998) early warning indicator approach or Frankel and Rose’s (1996) probit estimation. Berg and Pattillo (1998) provide a good review of this literature.

difficult to reconcile with a purely fundamentals-based theory of crisis, and has led a number of economists to consider seriously the hypothesis that speculation involves a self-fulfilling component (Obstfeld and Rogoff, 1995). The appeal of the escape clause approach, in this regard, is that it provides a political compromise between the “fundamentalists” and the proponents of the self-fulfilling view. The occurrence of crises and their precise timing involve multiple equilibria, yes, but the latter can grow only on the fertile ground of deteriorated fundamentals.

The empirical literature provides ample evidence that devaluation expectations are subject to abrupt shifts that do not seem related to the economic fundamentals. This evidence has been presented by some authors in the context of the Markov-switching regimes model developed by Hamilton. Jeanne and Masson (1999), Piard (1997) and Psaradakis *et al* (1997) show that Markov-switching regimes models in which speculative activity jumps up or down following the realization of a shock unrelated to the fundamentals do a better job of explaining the experience of the French franc than simple linear models. Martinez-Peria (1998) applies the same methodology to a broader sample of EMS countries, Gonzalez-Garcia (1999) to the 1994 Mexican peso crisis, and Cerra and Saxena (1999) to the 1997 crisis of the Indonesian rupiah. The regime shifts identified by the estimation can be interpreted as jumps between multiple equilibria. Such an interpretation is buttressed by Jeanne and Masson’s (1999) result that a Markov-switching regimes model of the devaluation expectations can in fact be interpreted as a linearized reduced form of a structural escape clause model with sunspots.

More structural empirical work is scarcer, in large part because of the difficulty to estimate nonlinear models with multiple equilibria. Jeanne (1997a) estimates an escape clause model for the crisis of the French franc on monthly data over 1991-93 using the maximum likelihood method. The main finding is that, while the different episodes of crisis were associated with bad fundamentals (most notably a high rate of unemployment), the jumps in expectations that occurred in September 1992, the first quarter of 1993 and July 1993 are better interpreted as self-fulfilling. Interestingly, it is found that the fundamentals bifurcated in August 1992, just before the September 1992 crisis.

This evidence has been criticized on different grounds, most notably for being essentially by default. The empirical literature interprets the excessive volatility of devaluation expectations as evidence of multiple equilibria, but does not test this explanation against alternatives. This objection is a serious one, because models with multiple equilibria may be observationally close to purely fundamentals-based models with rational learning. Krugman (1996) considers the example of a country in which unemployment mounts inexorably, and the prior beliefs of market participants put

a lot of weight on the prediction that the government will devalue when the unemployment rate reaches a threshold level comprised between, say, 10 and 12 percent. Devaluation expectations jump up when unemployment reaches 10 percent and back down when it exceeds 12 percent, a phenomenon that looks like a self-fulfilling jump in expectations, even though it is the consequence of rational learning.

Other models, such as Caplin and Leahy's (1994) model of "crash and wisdom after the fact", might explain how a currency crisis can suddenly burst under a fundamental pressure that has built slowly over time. A crucial feature of Caplin and Leahy's model is that each investor receives a *private* signal on the true state of the economy that is not revealed to other investors until the time of the crisis. In most models of financial markets, private information is efficiently diffused to all investors through the observation of an aggregate variable, such as the price level. This is not the case in Caplin and Leahy's world, where investors have to pay a fixed cost to reallocate their portfolio and for that reason do not reveal immediately the nature of their information by their actions. As a result the crisis may simmer for some time, until a point where a threshold is reached and all investors withdraw at the same time. The information that was dispersed among many investors is suddenly aggregated in a crash.

The models of informational cascades of Banerjee (1992) and Bikhchandani *et al* (1992) also rely on the idea that information is dispersed among many investors, but their logic is somewhat different. Investors are assumed to take their decisions sequentially, each one observing the decisions taken by the investors located before him in the line. If the signals received by individual investors are noisy enough, it may be optimal for each investor to ignore his private information and imitate his predecessors. Again, the private information of investors is not revealed by their actions. The aggregate outcome is determined by the signal that the first investor in the line happened to receive. Chari and Kehoe (1998) show that informational cascades can make international capital flows excessively volatile, in the sense that one piece of information received by one investor may trigger a sudden capital account reversal.

These models have appealing features but it is not clear that they can account for the stylized features of currency crises as convincingly as models with multiple equilibria. It is not clear, in Caplin and Leahy's model, what the fixed cost of attacking the currency is.³⁵ Informational cascade models need the decision process to be sequential, which does not seem to be a realistic feature of financial markets. More importantly, these models need the assumption that information is private, while in fact foreign exchange markets may be the markets where the information is the most

³⁵Note that this cannot be a small cost of the "menu" variety, otherwise it would not prevent speculators from reacting to bad news for a protracted period of time.

public. The problems to which the recent crises were ascribed after the fact—whether this is the rise of unemployment in the EMS before 1992-93, the buildup of the dollar-denominated debt in Mexico—were well-known.³⁶ The problem does not seem to be that market participants did not have access to this information, but rather that they ignored it.

The self-fulfilling hypothesis has also been criticized at the purely theoretical level. In a paper from which this section borrows its title, Krugman (1996) argues that the escape clause approach needs implausible assumptions on the monetary policy channel to produce multiple equilibria. Krugman argues that in the real world, devaluation expectations make themselves costly by raising the *ex ante* interest rate, and shows that under this assumption multiple equilibria do not arise if the fundamentals deteriorate deterministically over time. The date of the crisis is uniquely determined, following a backward induction logic that is similar to the same author's 1979 article on speculative attacks – allowing him to question the theoretical specificity of the escape clause approach. As noted by Kehoe and Obstfeld in their comments on Krugman's paper, this result hinges crucially on the fact that, through the *ex ante* interest rate, the policymaker's decision is effectively sensitive to the devaluation expectations formed in the *current* period, while in other escape clause models the same decision is dependent on the expectations formed in the *previous* period. This apparently innocuous difference in timing seems to alter the properties of the model to a surprising extent.

Jeanne and Masson (1999) attempt to shed some light on this puzzle. The analysis of their paper is based on a framework that is a reduced form for a broad class of models, including that in Krugman (1996). Jeanne and Masson show that while this class of models does not give rise to multiple equilibria when the economic fundamentals exhibit a deterministic trend or are nonstationary stochastic processes, they may also give rise to an *arbitrarily large* number of equilibria if a condition on the fundamentals is satisfied. This property is in sharp contrast with the models of Obstfeld (1994, 1996), Velasco (1996) or Jeanne (1997a), where the number of equilibria is no larger than three, and it comes purely from the timing with which devaluation expectations affect the policymaker's decision. The paper also considers a hybrid model, in which the policymaker's devaluation decision is affected by the devaluation expectations formed both in the current and previous periods, and shows that in this case the dynamics of devaluations expectations can become cyclic or chaotic.

³⁶A case could be made, however, that the extent to which the corporate sector was indebted short-term and in U.S. dollar prior to the crisis in Southeast Asia was not fully known to foreign investors. But this ignorance was public: it is not clear what private signals on the true situation investors had.

Even those economists who support the thesis of self-fulfilling speculation express some dissatisfaction with the state of the art of modeling multiple equilibria. In particular, the assumption that the economy jumps from one equilibrium to another following the realization of an extraneous sunspot shock raises a number of questions. To the extent that the sunspot variable instantaneously coordinates the expectations of all market participants, one would like to relate this variable to an event that is publicly observable. It has sometimes been suggested that public statements by well-known figures, such as famous hedge fund managers, might serve as focus variable giving the signal of the attack (IMF, 1998). It is not the case, however, that the declarations of George Soros *always* move the market, and if the sunspot variable changes over time, the question is only pushed one step further –how do market participants coordinate on the variable triggering the attack?

It could be argued in defense of sunspots that they are best viewed as a theoretical black box covering very complex market phenomena which informational and computational limits put out of reach of deterministic forecasting. In a sense, the economist would be in the same situation as the meteorologist trying to predict storms. The best that the economist could ever hope to achieve is to make probabilistic statements on the likelihood that a crisis will erupt at a particular time. This does not mean, however, that explicitly modeling the dynamics of the beliefs of market participants is a pointless exercise. Indeed, such developments might be quite useful, in helping us understand the kind of phenomena that are susceptible to trigger a jump from one equilibrium to another, and refine our probabilistic statements, a bit in the same way as stylized models of the dynamic interaction of low and high pressure zones may improve the predictive power of the meteorologist.

A first step in that direction has been accomplished in a recent paper by Morris and Shin (1998). These authors present a reduced-form version of an escape clause model of currency crises, in which the cost of defending the currency depends on the number of speculators attacking the currency as well as an exogenous stochastic fundamental. Speculators receive heterogeneous noisy signals on the value of the fundamental. If the actions of individual speculators were publicly observable multiple equilibria would arise. They do not arise in Morris and Shin's model, however, because individual speculators base their decisions whether or not to attack solely on their private signals, not on the observation of what other speculators are doing. This effectively rules out self-fulfilling attacks in which each speculator runs on the currency for the sole reason that everybody does. Morris and Shin's framework lends itself to the analysis of several interesting questions but, like Caplin and Leahy's model or models of informational cascades, it probably goes too far in the assumption that information is decentralized among atomistic agents. In the real world there are numbers of channels –word-to-mouth communications, media-producing public information about the economy as well as the mood of market participants, and

conceivably these media could be manipulated by large agents. Incorporating these phenomena in the analysis of shifts in market moods seems a difficult but promising and exciting challenge for future research.

5 Concluding comments: Asia and beyond

A lot has happened since the first version of this paper was written (1994). We now conclude by outlining how the recent Asian meltdown is shaping current developments in the theory of currency crises. We do not attempt to review the literature on the Asian crisis, which is already large. Our purpose is more narrowly to point out the directions in which the theoretical literature is moving under the pressure of the Asian events, and to interpret these developments in light of the classification that we have developed in this paper.

Is the Asian crisis essentially new or essentially the same? One feature often presented as essential in the Asian crises is the connection between banking problems and currency instability. The relationship between banking and currency crises is not a new phenomenon,³⁷ but it is a very salient one in the Asian case. This has prompted some economists to call for a “third generation” model of currency crises, that would put at its core the nexus between financial fragility and currency crisis (Krugman, 1999). Other economists, on the other hand, argue that we do not need more than a set of extensions of the existing framework that better take into account the banking and financial sides of the economy (Chang and Velasco, 1998b). We implicitly adopt the second view here, by showing how the models that have been proposed so far for the Asian crisis fall under the speculative attack approach or the escape clause one.

It is widely acknowledged that the crisis-hit economies in Asia were made fragile by a liquidity mismatch between the asset side and the liability side in the balance sheet of the corporate sector.³⁸ This made them vulnerable to self-fulfilling liquidity crises, which can be analyzed according to the same logic as bank runs in the model of Diamond and Dybvig. A natural extension of the theoretical literature was thus

³⁷See, for example, Kaminsky and Reinhart (1996) for a study that predates the Asian crisis.

³⁸This liquidity mismatch was augmented in some cases by a currency mismatch, whereby liabilities in dollars were backed by assets in domestic currency. There is some apparent disagreement between those who think that the crises reflected essentially this liquidity problem (Radelet and Sachs, 1998; Chang and Velasco, 1998a,b) and those who argue that the crises were the deterministic and inevitable consequence of underlying fundamental problems (Corsetti, Pesenti and Roubini, 1998). Both sides of this debate, however, share the view that the liquidity mismatch was one of the main factors that made the crisis possible or inevitable.

to make the Diamond-Dybvig model monetary, and international. This is done by Chang and Velasco (1998a) and Goldfajn and Valdes (1997). The latter authors stress the spillover effects between banking and currency crises. Deposits at domestic banks are part of the domestic liabilities that investors will attempt to convert into reserves in a currency crisis, so that a run on the currency is typically associated with a run on the banking system. Conversely, foreign investors running on the banking system for reasons unrelated to the currency will drain the foreign exchange reserves, inducing a currency crisis. Chang and Velasco present a model in a similar vein, but insist more on the multiplicity of equilibria in banking and currency crises, and their implications for normative analysis.

A critique of these models in the spirit of the escape clause approach would be that, as in all speculative attack models, they do not take account of the various ways monetary authorities can defend the currency, in particular by raising the interest rate. The cost of raising the interest rate is that it further weakens the banking system through different channels, in particular by decreasing the price of the assets that serve as collateral on loans. An interesting direction of research is to incorporate these effects in models of banking and currency crises.

Another theme that was projected at the forefront of research by the recent crises is *contagion*. It appeared, first with the Tequila effect following the Mexican peso crisis and then more forcefully with the Asian and Russian meltdowns, that crises have a tendency to propagate very quickly to neighboring countries and even distant unrelated emerging markets. A number of explanations have been put forward for this phenomenon.³⁹ One explanation could be that the economies involved in the same speculative wave shared the same kind of macroeconomic weakness, or were hit by the same external shock.⁴⁰ The recent but already large empirical literature on contagion suggests, however, that explanations in terms of common internal or external fundamentals leave large unaccounted international comovements between a number of crisis indicators (see Kaminsky and Reinhart, 1998, for a review). A third explanation, that we already encountered in our discussion of the escape clause approach, is based on trade spillovers. One country's devaluation gives incentives to devalue to countries that trade with it, or compete in the same third markets. The size of trade flows, however, does not suggest that trade links are large enough to be the main channel of contagion.⁴¹ Drazen (1998) discusses other mechanisms

³⁹The discussion that follows draws on Drazen (1998) and Masson (1998).

⁴⁰Thus, it is sometimes argued that SouthEast Asian economies were fragilized by the high level of U.S. interest rates, the U.S. Fed having the same impact on Asian currencies pegged to the dollar as the Bundesbank on the rest of the EMS in 1992-93. This channel, which Masson (1998) calls "monsoonal", is captured by the version of the escape clause model we presented in section 4.1.

⁴¹It is sometimes argued that the most relevant spillovers occur in financial markets, as third-

of contagion that involve what one might call “informational spillover”. A problem in one country leads investors to revise their beliefs on other countries that share the same unobservable fundamentals, or the same model of economic development or regulation. For example, to the extent that Thailand and other Southeast Asian countries were perceived to share the same model of close bank-firms relationships and the same weakness in banking supervision, a bank failure in Thailand was bad news not only for Thailand (and its creditors) but for the whole region. These fundamentals, argues Drazen, are all the more difficult to measure that they may involve commonalities in political systems and other “soft” variables. Finally, argues Masson (1998), “pure contagion” should be viewed as the consequence of multiple equilibria. If the sunspot variables that coordinate market expectations are correlated across countries, crises are likely to erupt at the same time in different countries irrespective of the fundamentals—provided, of course, that the fundamentals lie in the zone of multiplicity in all countries. Self-fulfilling crises, in other words, have an inherent tendency to become systemic.

This quick overview does not do justice to the many insights that the new theoretical literature on contagion has to offer, but it suggests, to our mind, that the escape clause approach provides a natural framework to think about contagion. The empirical literature suggests that if contagion is to be explained in terms of fundamentals, then these fundamentals must be extremely “soft”—of the kind that the escape clause approach has introduced in models of currency crises. The alternative is the self-fulfilling view of currency crises—again, for which the escape clause approach provides the benchmark model. Many discussions of contagion do not rely on completely worked out models, but invoke arguments that make sense in the context of the escape clause approach, and indeed several of the few models of contagion that we have, such as Drazen (1998) or Masson (1998), adopt this approach.

To conclude, if there is a general lesson to draw from the variety of the recent crises, it is that the system itself is structurally fragile. This new awareness has put the idea of a “new architecture” for the international financial and monetary system back in the forefront of policy debates. A number of proposals of reform have been put forward, some of which give more emphasis to prevention—with measures aiming at making international capital less mobile⁴² and its allocation more transparent, while others seek to reinforce or create at the global level institutions coping with capital mobility, such as an effective lender of last resort. One of the main challenges

country investors liquidate their positions in one country to cover losses incurred in the crisis-hit country.

⁴²Proposed measures include controls on short-term capital flows, orderly workout procedures (Eichengreen and Portes, 1995), a Tobin tax on foreign exchange transactions (Eichengreen, Tobin and Wyplosz, 1995; Jeanne, 1996), and others. See Eichengreen (1999) for a review.

ahead for the theory of currency crises is to better enable us to address the systemic questions that lie at the core of this debate.

REFERENCES

- Agénor, P.R., Bhandari, J.S., and R.P. Flood, 1992, Speculative attacks and models of balance-of-payments crises, *International Monetary Fund Staff Papers* 39, 357-94.
- Andersen, T.M., 1994, Shocks and the viability of a fixed exchange rate commitment, CEPR Discussion Paper 969.
- Banerjee, A.V., 1992, A simple model of herd behavior, *Quarterly Journal of Economics* 107, 797-817.
- Benigno, P., and A. Missale, 1997, High public debt in currency crises: Fundamentals versus signalling effects, mimeo, Dept. of Economics, Università di Brescia.
- Bensaid, B., and O. Jeanne, 1997, The instability of fixed exchange rate systems when raising the nominal interest rate is costly, *European Economic Review* 41, 1461-1478.
- Bensaid, B., and O. Jeanne, 1998, Self-fulfilling currency crises and central bank independence, mimeo.
- Berg, A., and C. Pattillo, 1998, Are currency crises predictable? A test, IMF Working Paper WP/98/154.
- Bikhchandani, S., Hirshleifer, D., and I. Welch, 1992, A theory of fads, fashions, custom, and cultural change as informational cascades, *Journal of Political Economy* 100, 992-1026.
- Blackburn, K., and M. Sola, 1993, Speculative currency attacks and balance of payments crises, *Journal of Economic Surveys* 7, 119-44.
- Blanco, H., and P. Garber, 1986, Recurrent devaluations and speculative attacks on the Mexican peso, *Journal of Political Economy* 94, 148-66.
- Bordo, M., and A. Schwartz, 1996, Why clashes between internal and external stability goals end in currency crises, 1797-1994, NBER Working Paper No. 5710.
- Buiter, W.H., 1987, Borrowing to defend the exchange rate and the timing and magnitude of speculative attacks, *Journal of International Economics* 23, 221-39.

- Buiter, W., Corsetti, G. and P. Pesenti, 1998, Interpreting the ERM crisis: country-specific and systemic issues, *Princeton Studies in International Finance* 84.
- Caplin, A., and J. Leahy, 1994, Business as usual, market crashes, and wisdom after the fact, *American Economic Review* 84, 548-65.
- Calvo, G.A., 1987, Balance of payments crisis in a cash-in-advance economy, *Journal of Money, Credit and Banking* 19, 19-32.
- Calvo, G.A., 1988, Servicing the public debt: The role of expectations, *American Economic Review* 78, 647-661.
- Calvo, G.A., 1996, Varieties of capital-market crises, mimeo.
- Cavallari, L. and G.M. Corsetti, 1996, Policy making and speculative attacks in models of exchange rate crises: a synthesis, Economic Growth Center Working Paper No.752, Yale University.
- Cerra, V., and S. C. Saxena, 1999, Contagion, monsoons, and domestic turmoil in Indonesia: a case study in the Asian currency crisis, mimeo, International Monetary Fund.
- Chang, R., and A. Velasco, 1998a, Financial crises in emerging markets: a canonical model, NBER Working Paper No. 6606.
- Chang, R., and A. Velasco, 1998b, The Asian liquidity crisis, mimeo.
- Chari, V.V., and P. Kehoe, 1998, Hot money, mimeo, Research Dept., Federal Reserve Bank of Minneapolis.
- Claessens, S, 1991, Balance of payment crises in an optimal portfolio model, *European Economic Review* 35, 81-102.
- Cole, H.R. and T.J Kehoe, 1996, Self-fulfilling debt crises, *Journal of International Economics* 41, 309-330.
- Connolly, M.B., and D. Taylor, 1984, The exact timing of the collapse of an exchange rate regime and its impact on the relative price of traded goods, *Journal of Money, Credit and Banking* 16, 194-207.
- Corsetti, P. Pesenti and N. Roubini, 1998, What caused the Asian currency and financial crisis?, mimeo, Asian Crisis Webpage.
- De Kock, G., and V. Grilli, 1993, Fiscal policies and the choice of exchange rate regime, *The Economic Journal* 103, 347-358.

- Diamond, DD.W., and P.H. Dybvig, 1983, Bank runs, deposit insurance, and liquidity, *Journal of Political Economy* 91, 401-19.
- Dornbusch, R., 1987, Collapsing exchange rate regimes, *Journal of Development Economics* 27, 71- 83.
- Drazen, A., 1998, Political contagion in currency crises, mimeo prepared for the NBER conference on Currency Crises, Cambridge MA, February 6-7.
- Drazen, A., and P.R. Masson, 1994, Credibilities of policies versus credibilities of policymakers, *Quarterly Journal of Economics* 109, 735-54.
- Eichengreen, B., 1999, *Toward a new international financial architecture*, Institute for International Economics, Washington DC.
- Eichengreen, B., and R. Portes, 1995, Crisis? What crisis? Orderly workout for sovereign debtors, CEPR, London.
- Eichengreen, B., and O. Jeanne, 1998, Currency crisis and unemployment: sterling in 1931, NBER Working Paper 6563.
- Eichengreen, B., Tobin, J., and C. Wyplosz, 1995, Two cases for sand in the wheels of international finance, *Economic Journal* 105, 162-172.
- Flood, R., and P. Garber, 1984a, Collapsing exchange- rate regimes, some linear examples, *Journal of International Economics* 17, 1-13.
- Flood, R., and P. Garber, 1984b, Gold monetization and gold discipline, *Journal of Political Economy* 92, 90-107.
- Flood, R., Garber, P., and C. Kramer, 1996, Collapsing exchange rate regimes: Another linear example, *Journal of International Economics* 41, 223-234.
- Flood, R.P., and Hodrick, R.J., 1986, Real aspects of exchange rate regime choice with collapsing fixed rates, *Journal of International Economics* 21, 1-13.
- Flood, R.P. and P. Isard, 1989, Monetary policy strategies, *International Monetary Fund Staff Papers* 36, 612-32.
- Flood, R., and N. Marion, 1999a, Perspectives on the currency crises literature, *International Journal of Finance and Economics* 4, 1-26.
- Flood, R., and N. Marion, 1999b, Speculative attacks: fundamentals and self-fulfilling prophecies, forthcoming in the *Journal of International Economics*.

- Frankel, J., and A. Rose, 1996, Currency crashes in emerging markets: an empirical treatment, *Journal of International Economics* 41, 351-66.
- Frankel, J., and S.J. Wei, 1995, Emerging currency blocs, in H. Genberg, ed., *The International Monetary System*, Springer Verlag, Berlin, 111-153.
- Garber, P.M., and L.E.O. Svensson, 1995, The operation and collapse of fixed exchange rate regimes, in G. Grossman and K. Rogoff, eds., *Handbook of International Economics* Vol. III, Elsevier, Amsterdam.
- Giavazzi, F., and A. Giovannini, 1989, *Limiting exchange rate flexibility*, Cambridge, MA; MIT Press.
- Goldberg, L.S., 1991, Collapsing exchange rate regimes: shocks and biases, *Journal of International Money and Finance* 10, 252-63.
- Goldfajn, I. and R. Valdes, 1997, Capital flows and the twin crises: the role of liquidity, International Monetary Fund Working Paper No. 97/87.
- Goldfajn, I. and R. Valdes, 1998, Are currency crises predictable?, *European Economic Review Papers and Proceedings* 42, 873-885.
- Gonzalez-Garcia, J.R., 1999, Pressure in the foreign exchange market and the collapse of the peso, mimeo, University of Warwick, Department of Economics.
- Grilli, V., 1986, Buying and selling attacks on fixed exchange rate systems, *Journal of International Economics* 20, 143-156.
- IMF, 1998, Hedge Funds and Financial Market Dynamics, Occasional Paper No 166, Washington DC.
- Isard, P., 1995, *Exchange Rate Economics*, Cambridge University Press, Cambridge UK.
- Jeanne, O., 1996, Would a Tobin tax have saved the EMS?, *Scandinavian Journal of Economics* 98, 503-520.
- Jeanne, O., 1997a, Are currency crises self-fulfilling? A test, *Journal of International Economics* 43, 263-286.
- Jeanne, O., 1997b, The persistence of unemployment under a fixed exchange rate peg: theory and application to the franc fort policy, CIDER Working Paper No. C97-093, UC Berkeley.

- Jeanne, O., and P. Masson, 1999, Currency crises, sunspots and Markov-switching regimes, forthcoming in the *Journal of International Economics*.
- Kaminsky, G.L. and C.M. Reinhart, 1996, The twin crises: Causes of banking and balance-of-payments problems, Board of Governors of the Federal Reserve System, Washington D.C.
- Kaminsky, G.L. and C.M. Reinhart, 1998, On crises, contagion and confusion, mimeo.
- Kaminsky, G.L., Lizondo, S., and C.M. Reinhart, 1998, The leading indicators of currency crises, International Monetary Fund *Staff Papers* 45, 1-48.
- Kenen, P., 1996, Analysing and managing exchange-rate crises, *Open Economy Review* 7, 469-492.
- Krugman, P., 1979, A model of balance-of-payments crises, *Journal of Money, Credit and Banking* 11, 311-325.
- Krugman, P., 1996, Are currency crises self-fulfilling?, *NBER Macroeconomics Annual*, Cambridge: MIT Press.
- Krugman, P., 1997, Currency crises, mimeo prepared for the February 1998 NBER conference on currency crises.
- Krugman, P., 1998, The confidence game, *The New Republic*, October 5.
- Krugman, P., 1999, Balance sheets, the transfer problem, and financial crises, paper prepared for the FloodFest, Washington DC, January 15-16.
- Krugman, P., and J. Rotemberg, 1992, Speculative attacks on target zones, in *Exchange rate targets and currency bands*, P. Krugman and M. Miller eds., Cambridge, Cambridge University Press.
- Lohman, S., 1992, Optimal commitment in monetary policy: credibility versus flexibility, *American Economic Review* 82, 273-286.
- Loisel, O., and P. Martin, 1998, Self-fulfilling currency crises and international monetary cooperation, mimeo, Ceras, Paris.
- Martinez-Peria, M.S., 1998, A regime switching approach to the study of speculative attacks: a focus on EMS crises, mimeo, UC Berkeley, Dept. of Economics.
- Masson, P.R., 1995, Gaining and losing ERM credibility: the case of the United Kingdom, *The Economic Journal* 105, 571-582.

- Masson, P., 1998, Contagion: Monsoonal effects, spillovers and jumps between multiple equilibria, IMF Working Paper No. 98/142.
- Merril Lynch, 1998, Currency crises in emerging markets; A guide to speculative-attack models and early-warning systems, Global Securities Research & Economics Group, Merrill Lynch, New York.
- Morris, S., and H.S. Shin, 1998, Unique equilibrium in a model of self-fulfilling currency attacks, *American Economic Review* 88, 587-97.
- Obstfeld, M., 1984, Balance of payments crises and devaluation, *Journal of Money, Credit and Banking* 16, 208-212.
- Obstfeld, M., 1986, Rational and self-fulfilling balance of payments crises, *American Economic Review* 76, 72-81.
- Obstfeld, M., 1994, The logic of currency crises, *Cahiers Economiques et Monétaires* 43, 189-213.
- Obstfeld, M., 1996, Models of currency crises with self-fulfilling features, *European Economic Review* 40, 1037-47.
- Obstfeld, M., 1997, Destabilizing effects of exchange rate escape clauses, *Journal of International Economics* 43, 61-77.
- Obstfeld, M., and K. Rogoff, 1995, The mirage of fixed exchange rates, *Journal of Economic Perspectives* 9, 73-96.
- Ozkan, F.G., and A. Sutherland, 1998, A currency crisis model with an optimising policymaker, *Journal of International Economics* 44, 339-64.
- Persson, T., and G. Tabellini, 1990, *Macroeconomic policy, credibility and politics*, Harwood Academic Publishers, Chur, Switzerland.
- Piard, S., 1997, Currency crises in the ERM: the experience of the French franc, mimeo, London Guildhall University.
- Psaradakis, Z., M. Sola and M. Tronzano, 1997, Target zone credibility and economic fundamentals, mimeo, Birkbeck College.
- Radelet, S., and J. Sachs, 1998, The onset of the East Asian financial crisis, presented at the NBER conference on crises, February 1998.
- Rose, A., and L. Svensson, 1994, European exchange rate credibility before the fall, *European Economic Review* 38, 1185-1216.

- Sachs, J., A. Tornell and A. Velasco, 1996, The Mexican peso crisis: Sudden death or death foretold?, *Journal of International Economics* 41, 265-283.
- Salant, S.W., and D.W. Henderson, 1978, Market anticipations of government policies and the price of gold, *Journal of Political Economy* 86, 627-48.
- Savastano, M., 1992, Collapse of a crawling peg regime in the presence of a government budget constraint, International Monetary Fund *Staff Papers* 39, 79-100.
- Soros, G., 1994, *The Alchemy of Finance*, John Wiley & Sons, New York.
- Sutherland, A., 1995, Currency crisis models: bridging the gap between old and new approaches, in *European Currency Crises and After*, C. Bordes, E. Girardin and J. Mélitz, eds, Manchester University Press, Manchester, 57-82.
- Van Wijnbergen, S., 1991, Fiscal deficits, exchange rate crises and inflation, *Review of Economic Studies* 58, 81-92.
- Velasco, A., 1987, Financial crises and balance of payments crises, *Journal of Development Economics* 27, 263-83.
- Velasco, A., 1996, Fixed exchange rates: credibility, flexibility and multiplicity, *European Economic Review* 40, 1023-35.
- Willman, A., 1988, The collapse of a fixed exchange rate regime with sticky prices and imperfect substitutability between domestic and foreign bonds, *European Economic Review* 32, 1817-38.