

De Grauwe, Paul; Grimaldi, Marianna

Article

Exchange rate regimes and financial vulnerability

EIB Papers

Provided in Cooperation with:

European Investment Bank (EIB), Luxembourg

Suggested Citation: De Grauwe, Paul; Grimaldi, Marianna (2002) : Exchange rate regimes and financial vulnerability, EIB Papers, ISSN 0257-7755, European Investment Bank (EIB), Luxembourg, Vol. 7, Iss. 2, pp. 33-48

This Version is available at:

<https://hdl.handle.net/10419/44818>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

Exchange rate regimes and financial vulnerability



Paul De Grauwe



Marianna Grimaldi

1. Introduction

The financial crises of the 1990s have created the perception that one of the fundamental reasons for the occurrence of such crises is to be found in the fact that exchange rates were pegged for too long. These pegged exchange rates inevitably invited speculative attacks in the foreign exchange markets that quite often spilled over to the banking sector, and led to banking crises.

Recently, the analysis of the financial crises has led to a new consensus among policy makers, i.e., the *bipolar view* (see Fischer, 2001). According to this view, countries should allow for either flexible or irrevocably fixed exchange rates in order to avoid future crises while the intermediate solutions, such as pegged exchange rate regimes, should be avoided. The advantages of such intermediate exchange rate regimes have been offset by the disadvantages in terms of uncertainty in the financial markets.

In this paper we analyse this link between the exchange rate regime and the probability of financial crises. We first analyse in the next section the relation between the exchange rate regime and the occurrence of foreign exchange crises, while Section 3 briefly reviews the associated empirical evidence. We then study the relation between the exchange rate regime and the occurrence of banking crises (Section 4). This analysis will also allow us to connect crises in the foreign exchange markets and banking crises. Section 5 concludes.

Before moving into a formal analysis it is useful to start from the essential features present in financial crises. These can be described as follows. Financial crises arise in an environment in which some agents make a promise to convert an asset into another one at a fixed price. For example, monetary authorities promise to convert the domestic currency into a foreign one at a fixed rate. Banks promise to convert outstanding deposits in cash at par. These promises, however, at some point turn out to be a burden on those who have made them, and create a temptation to renege on the promise. When agents suspect that this is the case, they will test the resolve of those who made the promise by converting their assets at the promised price. This triggers a crisis, which can become self-fulfilling.

2. The exchange rate regime and foreign exchange crises: The theory

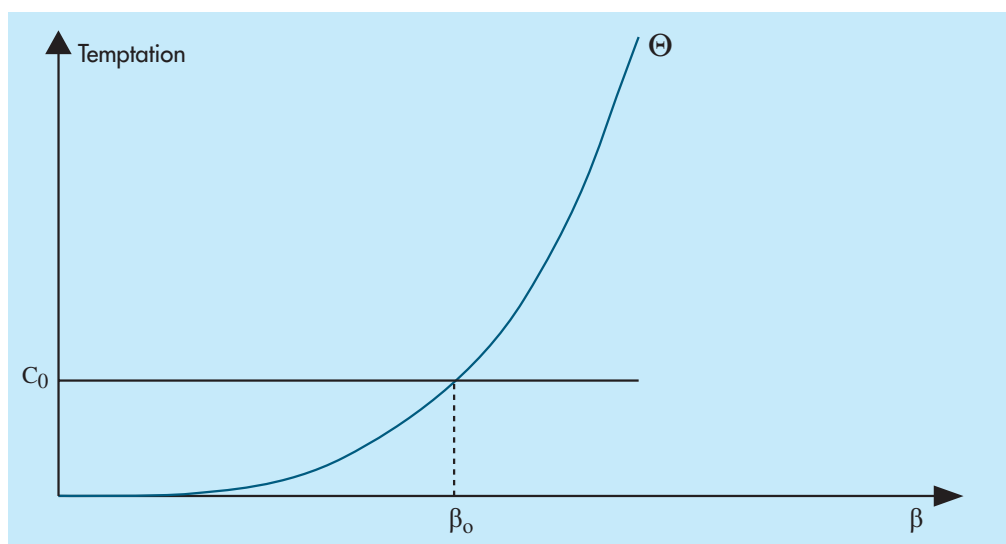
Economists have been very active in developing models analysing the dynamics of foreign exchange crises, both theoretically and empirically. In this section we present a prototype model that will allow us to study the mechanisms underlying the emergence of financial crises.

We start from the promise made by a central bank to fix the exchange rate today and in the future. Let's assume that apart from the objective of fixing the exchange rate, this central bank also pursues a domestic objective (or is forced by the government to pursue such an objective). This domestic

Paul De Grauwe is Professor of economics at the Katholieke Universiteit Leuven. Marianna Grimaldi is a Research Fellow at the same university.

objective could be the stabilisation of output, or the financing of the government budget deficit. The weight it attaches to this domestic objective is represented by β . We can now derive the following schedule (see Figure 1), which describes the relation between the temptation of the central bank to renege on its promise (to devalue) and the parameter β (1). Temptation, Θ , is defined as the benefit for the authorities of devaluing, given that agents expect that the central bank is honest (i.e. will never renege on its promise). We see that when $\beta > 0$ the central bank is tempted to devalue, and that this temptation increases with β (2). Clearly such a regime in which the central bank fixes the exchange rate and then gives a non-zero weight to a domestic objective will not be credible. Rational agents will test the central bank and attack its stock of international reserves. Since most central banks in the world give some non-zero weight (however small) to domestic objectives, fixing the exchange rate will most of the time not be credible. We should not observe fixed exchange rates very often.

Figure 1. A central bank's temptation to devalue versus the weight given to domestic policy objectives



While a strong commitment to a fixed exchange rate system and high costs of abandoning it make such systems more credible ...

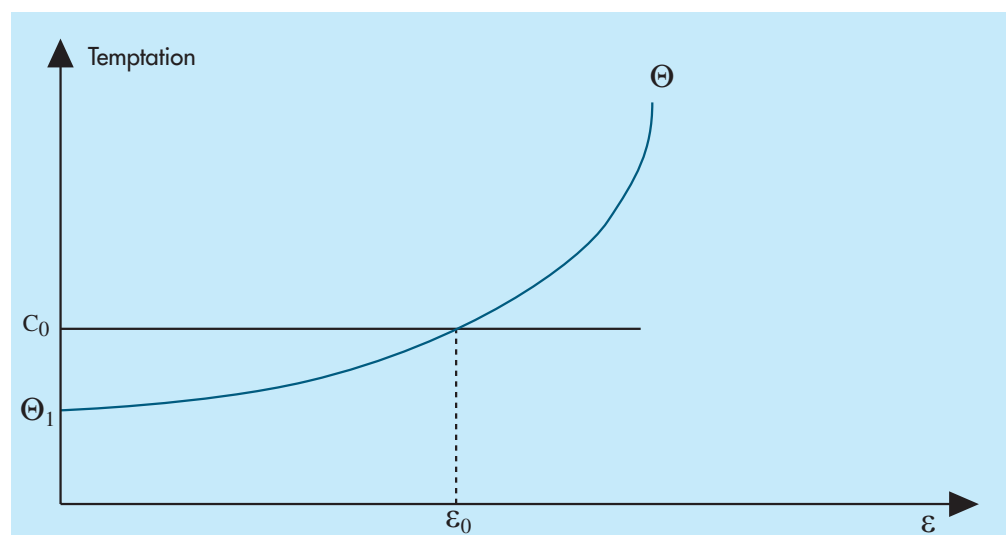
One way to allow for the possibility of fixed exchange rates to have credibility is to introduce the notion that renegeing on one's promise by devaluing is costly. The cost is a loss of reputation of the monetary authorities. It could also include the cost of having to move into a new exchange rate regime. Let's call this cost C_0 , and let us assume it is fixed. We show the effect of this cost in Figure 1. We now find that as long as $\beta < \beta_0$ the fixed exchange rate can be made credible, i.e. the expectations of agents that no devaluation will occur is borne out by the model. Thus, a central bank, which is not too ambitious in pursuing domestic objectives, can maintain a credible fixed exchange rate. Can it do this in all states of nature? The answer is negative. We show this in Figure 2, where we draw the temptation curve, Θ , as a function of the size of the shock (the derivation is found in the Annex). The temptation curve in Figure 2 is drawn for a given β , say β_1 . It is upward sloping because the temptation to devalue increases with the size of the shock when the central bank attaches a non-negative weight to a domestic objective. When the shock is zero ($\varepsilon=0$)

1) A formal derivation is given in the Annex.

2) We draw this relation to be non-linear. This has to do with the quadratic utility function of the monetary authorities (see the Annex).

temptation is Θ_1 . If this is smaller than C_0 , the fixed exchange is credible. In fact, in Figure 2 we have shown the case where the fixed exchange rate is credible when shocks are smaller than ε_0 .

Figure 2. The central bank's temptation curve in the presence of shocks



... exogenous shocks are likely to undermine them before too long.

The analysis of Figure 2 leads to an important insight. As time goes by, the probability that some shock will exceed ε_0 is positive (3). As a result, sooner or later countries are hit by a sufficiently large shock that makes the fixed exchange rate non-credible. It will then collapse. Thus, fixed exchange rate commitments cannot stand the passage of time. Only if the central bank can make it clear that it does not pursue any domestic objectives ($\beta=0$) can this problem be avoided (4).

The previous analysis is based on what has been called the 'first generation' models (Krugman, 1979). These models stress that fixed exchange rates will inevitably collapse when the monetary authorities pursue domestic objectives. Ultimately they will run out of reserves. Thus, the ultimate cause of a foreign exchange crisis always lies with the authorities that pursue inconsistent objectives (see, for example, Flood and Garber, 1984). Speculators have the role of messengers who reveal this basic truth.

Things get more complicated, and more interesting, in the 'second generation' models (Obstfeld, 1996). Consider the case of a country for which $\beta < \beta_0$ (see figure 1), i.e. it attaches a low weight to domestic objectives so that the expectations of agents that no devaluation will occur actually is borne out by the model. In other words, the fixed exchange rate is credible and can be sustained.

Does this mean that no speculative crisis will occur? Not necessarily. To see this, assume that for some reason speculators expect the currency to be devalued. The authorities that want to maintain

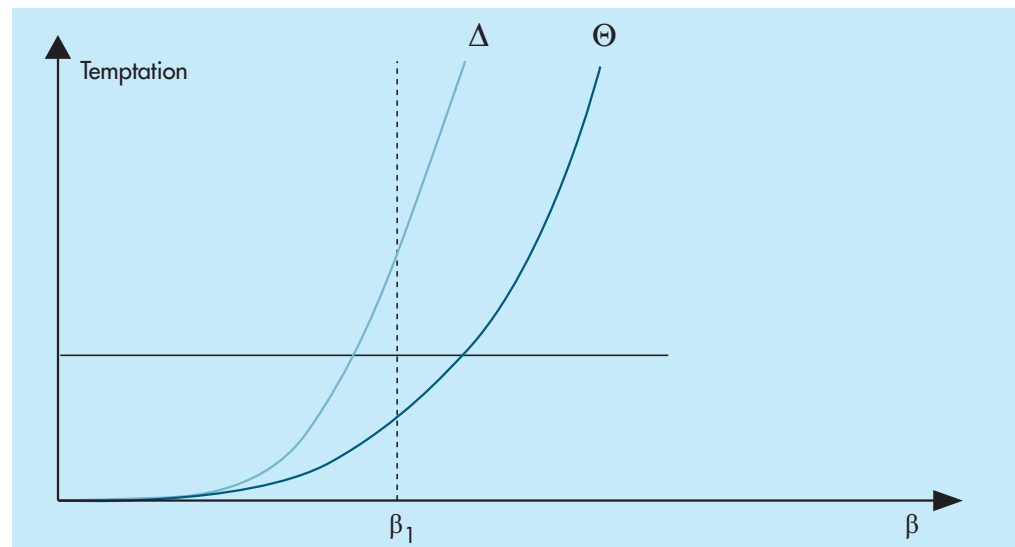
3) The First World War was such a large shock that destroyed the gold standard. Similarly, the EMS crisis of 1992-93 can be interpreted as the result of a large shock (the deep recession of 1992-93) that changed the cost-benefit calculus of maintaining the fixed exchange rate in major EMS-countries.

4) Note that in this case the temptation curve in Figure 2 is a horizontal line coinciding with the horizontal axis. In the EMS period The Netherlands came close to this situation. As a result, it never faced a speculative crisis.

the fixed exchange rate will have to defend it against these speculators. Such a defence, however, is costly. The central bank will have to raise the interest rate, which has an unfavourable effect on output and on the government budget. It may also fragilise the banking system (we come back to this theme later). As a result the central bank will be tempted to abandon the peg. Here the temptation arises from the fact that when speculators expect a devaluation, defending the fixed rate is costly. By devaluing, this cost is avoided. We show the temptation to abandon the peg when speculators expect a devaluation in Figure 3, by the upward sloping line, Δ .

Obviously the higher the coefficient β , the greater is the temptation to abandon the fixed exchange rate in the face of a speculative attack. We have also assumed that this temptation curve Δ is located above the temptation curve Θ (which represents the temptation to cheat when speculators do not expect a devaluation). This is due to an asymmetry. The welfare loss involved in applying deflationary policies to defend the peg in the face of a speculative attack is greater than the welfare gain obtained from the expansionary output effects of a surprise devaluation. As a result the temptation to abandon the peg during a speculative crisis is larger than the temptation to cheat in normal times.

Figure 3. The central bank's temptation curve with (Δ) and without expectations of a devaluation (Θ)

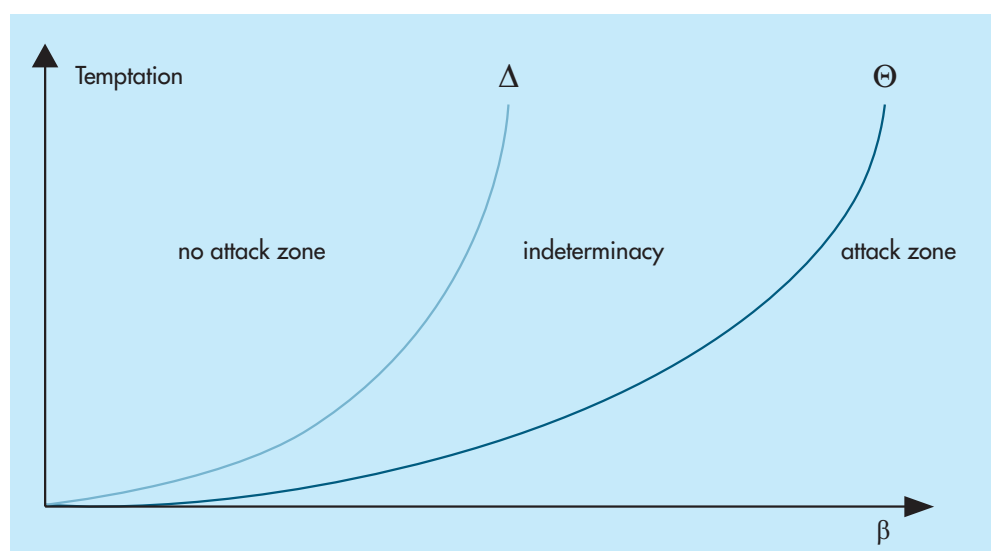


The life expectancy of a fixed exchange rate system is the longer the higher the cost of abandoning it.

We now obtain the following interesting result. Consider a country with $\beta = \beta_1$. The cost of devaluation is C_0 (see Figure 3). It can be seen that if speculators do not expect a devaluation the temptation of the central bank to devalue, Θ , is lower than the cost of a devaluation. Thus when no devaluation is expected the central bank has no incentive to devalue. There will be no devaluation. The expectations of the speculators are model-consistent (rational). Consider now what happens when speculators expect a devaluation. The relevant temptation curve is Δ , and we observe that the temptation to devalue is now larger than the cost of a devaluation. Thus the central bank now has an incentive to devalue, and will do so. Speculators were right to expect a devaluation. Their expectations are model-consistent (rational). There are therefore two possible equilibria that depend solely on the state of expectations. When agents do not expect a devaluation the authorities have

no incentive to devalue so that the exchange rate remains fixed. When, however, speculators expect a devaluation, the ensuing speculative attack creates an incentive for the authorities to devalue, and there will be a devaluation.

Figure 4. Speculative attacks, temptation to abandon the peg, and non-monetary central bank objectives



The example given in Figure 3 is only one of many possibilities. Whether or not crises occur will depend on the combinations of β and C . Three situations can occur (as shown in Figure 4):

- When β is low and C is high, we are in the no attack zone. The cost of devaluing will always exceed the temptations to devalue even when speculators expect a devaluation. As a result, even if attacked, the authorities have no incentive to devalue. No devaluation occurs.
- When β is high and C is low we are in the attack zone. In this case, the cost of devaluation is lower than the temptations so that a speculative attack is inevitable and the fixed exchange rate must collapse.
- Finally, there is the intermediate zone (indeterminacy zone) where the cost of devaluation is intermediate between the two temptation curves. This is the zone where two solutions exist, i.e. one in which the exchange rate is kept fixed and the other in which a devaluation occurs.

We can use this framework to analyse some policy issues. The first issue has to do with capital movements. Since the early 1990s, many countries have liberalised capital movements. This may be good policy to improve the development prospects of emerging countries. It is also clear, however, that the liberalisation of capital movements fragilises fixed exchange rate regimes. This can be shown using the framework of Figure 4. The effect of greater capital mobility is to shift the temptation line (Δ) upwards. The reason is that in a world of high capital mobility the expectations of devaluation lead to an immediate increase in domestic interest rates, an inversion of the yield curve and large outflows of capital. All this raises the cost of defending the existing peg, and thus the temptation of the authorities to abandon the fixed peg. As a result, the no attack zone shrinks

while the indeterminacy zone becomes larger. Thus, in a world of capital mobility the fixed exchange rate regime becomes more prone to unpredictable self-fulfilling speculative attacks. In addition, in such a world contagion is more likely to be important. The reason is that when a country is located in the indeterminacy zone a crisis in a neighbouring country, which affects expectations, is likely to turn into a self-fulfilling speculative attack.

While capital account liberalisation reduces the survival chance of fixed exchange rates...

How can countries deal with the increased fragility of the fixed exchange rate in a world of capital mobility? The most obvious answer is to move away from the fixed exchange rate regime and to allow for more flexible exchange rates. Major international institutions, like the IMF, have been tempted by the previous analysis to advise countries exactly that. It is clear that if foreign exchange crises are the only financial crises one has to worry about, this advice makes a lot of sense. It is unclear, however, that this remains the sensible policy advice if one takes into account the possibility of banking crises. We return to the issue of banking crises in the next section.

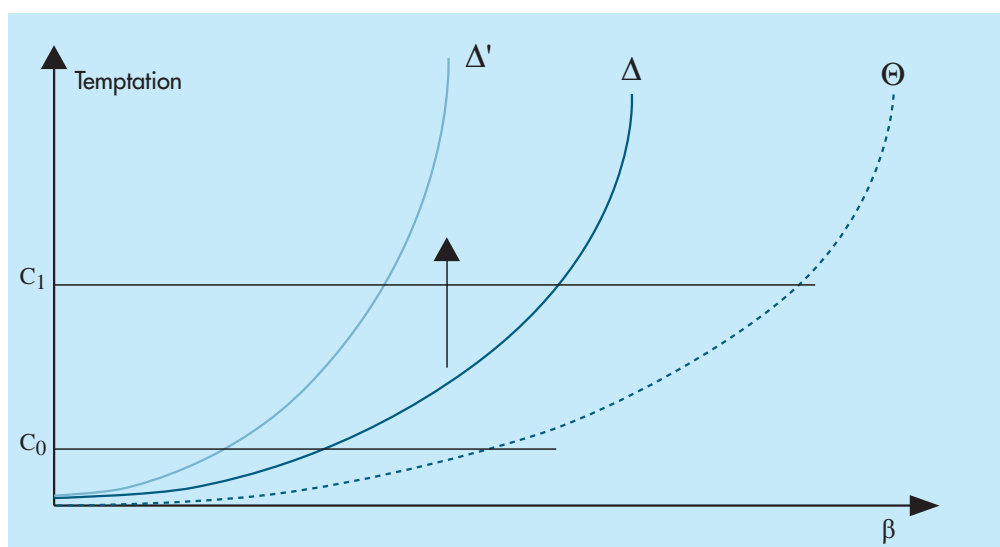
Another sensible policy advice is to re-impose capital controls. Some countries in fact have done this in the aftermath of the Asian financial crises. It is doubtful, however, whether this is a long run solution. The reason is that as economic integration proceeds, the necessity to open up capital markets becomes more intense. Thus, sooner or later, countries with fixed exchange rates that integrate into the world economy are confronted with the increasing fragility of the fixed exchange rate.

Is there a way to reduce the fragility of the fixed exchange rate regime in a world of capital mobility? The framework of Figure 4 provides some answers. There are essentially two ways to achieve more robust fixed exchange rate regimes. The first method consists in increasing the cost of devaluations, the second in reducing the weight countries attach to domestic objectives.

These solutions are depicted in Figure 5. As a result of increasing capital mobility, the temptation curve Δ shifts upwards (from Δ to Δ'). If the authorities wish to keep the economy within the no attack zone, they can do one of two things (or a combination of the two). They can increase the cost of devaluation from C_0 to C_1 , which allows them to maintain the same weight for domestic objectives. Or they can reduce the weight for domestic objectives, β , while leaving the cost of devaluations unchanged.

Many countries, which have chosen to maintain a fixed exchange rate, have moved in the direction of increasing the cost of a devaluation. Some have achieved this by a currency board. An interesting experiment was provided by the EU countries prior to the start of EMU. In the context of the Maastricht convergence criteria, countries had to maintain a fixed exchange rate (albeit with a large band). Failure to do so was punished by a ban on entry into EMU. As the political commitment to EMU was strong, the penalty for devaluation became very high during the transition period. The result was that the prospective EMU countries were spared foreign exchange crises during the transition. This happened while the rest of the world (Asia, Russia, Latin American countries) experienced major financial crises.

Figure 5. Maintaining exchange rate stability with increasing capital mobility



This episode can be instructive for Central and Eastern European countries preparing themselves for the accession into the EU and the subsequent entry into EMU. Once the date of entry has been fixed, making the entry conditional on a no-devaluation clause is likely to stabilise the foreign exchange market and to eliminate the risk of foreign exchange crises on the road to EMU. Such a condition should ensure a crisis-free transition period.

... this effect can be mitigated by raising the cost of abandoning them.

The previous analysis suggests that by increasing the cost of devaluations the credibility of fixed exchange rate regimes can be increased. We should have no illusions though. As we showed earlier, time is generally against fixed exchange rate regimes. With the passage of time some shock large enough to destroy the authorities willingness to defend a fixed exchange rate commitment is bound to occur. This implies that the transition period for the Accession countries should not be too long.

3. Empirical evidence

The first and second generation models have been tested empirically. The procedure has been to search for leading indicators (fundamental economic variables) capable of predicting the occurrence of foreign exchange crises (see, for example, Kaminsky, Lizondo and Reinhart, 1998; Kaminsky and Reinhart, 1998; and Sachs, Tornell and Velasco, 1996). A currency crisis is identified by a measure of exchange rate pressure (crisis index). This index is computed by a weighted average of exchange rate changes and foreign reserves changes (5). When the index value is above its mean by (at least) three standard deviations it is considered as a crisis. A variable is a useful leading indicator when it displays "anomalous" behaviour before a crisis and a "normal" behaviour in tranquil periods. In order to identify an "anomalous" behaviour a selection rule is adopted such that it minimises the probability of not predicting a crisis and the probability of giving

5) A better index should include also interest rate changes. However, they are excluded because of the lack of data.

a false signal. A set of “best predictors” has been identified for a currency crisis. The best predictors are (in descending order):

- overvaluation of the real exchange rate,
- worsening of the ratio exports/imports,
- an increasing ratio of (broad) money over foreign exchange reserves,
- a decline of stock prices and output.

It should be stressed that the predictive quality of these leading indicators remains relatively poor. This no doubt has to do with the problem identified in the second-generation model, i.e. the existence of a zone of indeterminacy. The latter implies that sometimes a given change in the leading indicators triggers a crisis and sometimes it does not. Recent research by the authors shows that in high inflation countries these leading indicators have a higher predictive power than in low inflation countries. This suggests that when the size of the changes in the leading indicators becomes very high (which is typically the case in high inflation countries) they have an unambiguous effect in triggering crises.

4. The exchange rate regime and banking crises

As was mentioned earlier, the analysis of the causes of foreign exchange crises has led to a consensus view that in a world of increasing financial integration fixed exchange rate regimes have become too fragile. This has led to the view that countries have only two options, either to move to more flexible exchange rate regimes or to move into a monetary union. Does this conclusion hold when we enlarge the analysis to include banking crises?

Foreign exchange crises may trigger banking crises (and vice versa). This possibility increases the cost of abandoning the fixed rate, thus making its demise less likely.

The relation between the exchange rate regime and banking crises is complicated. This complexity has to do with the fact that there are opposing forces at work. In this section we analyse the nature of this link.

A first thing to note is that the foreign exchange market and the banking sector are intricately linked, so that crises in the foreign exchange market spill over into the banking sector. This link is twofold.

First, there is the interest rate link. When an exchange crisis erupts, this forces the monetary authorities to raise the short-term interest rate. Typically this results in a strong inversion of the yield curve. It is not uncommon during speculative crises that the very short-term interest rate (e.g. call money rate) shoots up to several hundred percents. The business of banks is to borrow short and to lend long. As a result, during a foreign exchange crises banks suffer considerable losses, making it not uncommon that the crises that started in the foreign exchange market ends up in a domestic banking crisis.

A second link that reinforces the contagion between crises in the foreign exchange market and the banking sector has to do with the latter's role in the payments system. With each crisis in the foreign exchange market, large capital outflows occur. This also shows up in the form of a reduction of the reserve position of the domestic banks. In order to avoid that the capital outflow leads to a liquidity

crisis in the domestic banking sector, the central bank routinely uses sterilisation policies, i.e. it prevents that the capital outflow reduces domestic liquidity. This is fine as far as the banks are concerned, but this policy weakens the balance sheet of the central bank and makes the rundown of its international reserves more likely. Thus, quite often the central bank will want to preserve the liquidity position of the domestic banks in order to avoid a banking crisis. This, however, makes the central bank itself more vulnerable to renewed speculative attacks, which in turn weakens the liquidity position of commercial banks. The upshot of all this is that a fixed exchange rate has the potential of making the domestic banking system more fragile.

It should be noted that the causality often moves in the other direction, i.e. a banking crisis can trigger a foreign exchange crisis. When a banking crisis erupts, the attempts of the central bank to provide liquidity to the banking sector weakens the central banks balance sheet and makes it more vulnerable to speculative attacks. Currency and banking crises are therefore often labelled as the twin crises since they have common roots and a reciprocal reinforcing nature (Kaminsky and Reinhart, 1998).

Following up on the experience of Asian countries, economists have identified an additional link between a fixed exchange rate and the probability of a banking crisis (6). This goes as follows. When the authorities fix the exchange rate and commit themselves to maintaining this, they may create a moral hazard problem in countries where the domestic interest rate exceeds the foreign one. Banks may then have an incentive to borrow at the low foreign interest rate and to transform the proceeds of this foreign borrowing into domestic currency loans. In efficient markets this incentive should not occur because banks will correctly perceive the risks involved. However, there are several reasons to believe that banks may misperceive the risks. First, the solemn commitment to a fixed exchange rate may lure the banks to underestimate the risks involved. Second, and more importantly, the expectation of bailouts by the authorities may give poorly supervised domestic banks an incentive to over-borrow in foreign currency.

Thus, there are reasons to believe that a crisis that erupts in the foreign exchange market is transmitted to the banking sector, so that it degenerates into a twin crisis involving both the exchange market and the banking sector. This is all the more so when the liberalisation of capital movements increases the size of the liquidity flows and the domestic interest rates in the wake of a speculative movement in the foreign exchange market. It has been argued that the combination of high capital mobility, fixed exchange rates and relatively feeble bank supervision is a major cause of the banking crises of the 1990s.

The previous analysis suggests that a fixed exchange rate regime is conducive to bank crises. This also seems to have become the consensus view. The trouble with this analysis is that there is very little empirical evidence indicating that banking crises have been more frequent in fixed exchange rate environments than in flexible exchange rate regimes. We briefly survey the evidence.

The studies mentioned before (7) also trace out the link between leading indicators and measures of banking crises (with this being identified by a bank run or extraordinary operations as mergers,

**High capital mobility
combined with feeble
bank supervision
increases the risk of
“twin crises”.**

6) This analysis has led to so-called “third generation models” of financial crises.

7) That is Kaminsky, Lizondo and Reinhart (1998), Kaminsky and Reinhart (1998), and Sachs, Tornell and Velasco (1996).

take-overs or bailouts). The best leading indicators for a banking crisis are (again in descending order):

- change in the real exchange rate,
- change in the money multiplier,
- the worsening of the stock market,
- a decline of output.

The earliest signals of the leading indicators are within a window of 18 months before the banking crises. None of these studies finds significant effects of the exchange rate regime on the probability of banking crises. The only empirical study to date identifying such an effect is Domaç and Peria (2000), which paradoxically finds that flexible exchange rate regimes in developing countries are more likely to lead to banking crises than fixed exchange rate regimes. This result appears to be quite robust for different definitions of the crisis index.

The surprising result that banking crises are as frequent under flexible as under fixed exchange rates may be because flexible exchange rates indicate loss of macroeconomic credibility.

How can this empirical evidence be explained? We propose two avenues. The first one is based on the idea that especially in developing countries a floating exchange rate is an indicator of domestic monetary and financial upheaval. Most developing countries that allow the exchange rate to fluctuate are countries that have lost credibility in their macroeconomic policies. The domestic turbulence that ensues provides an environment for frequent business failures, which in turn triggers banking crises.

Second, contrary to what mainstream economic models tell us, flexible exchange rates generally do not perform their stabilising role well. The traditional view about flexible exchange rates is that they allow countries to adjust more flexibly to asymmetric shocks originating in the goods and labour markets. When, for example a deterioration of the terms of trade occurs, a depreciation of the currency will soften the macroeconomic effects of this shock. The empirical evidence, however, is that the exchange rates react very little to shocks in macroeconomic fundamentals. Instead most of the changes in the exchange rates are produced by the news in the exchange rates themselves (Goodhart, 1989; Goodhart and Figliuoli, 1991; Frankel and Rose, 1995; and Obstfeld and Rogoff, 2000). This implies that the movements of exchange rates are an independent source of volatility, unrelated to the volatility of underlying macroeconomic fundamentals. In such an environment the volatility of the exchange rates increases the fragility of the balance sheets of local businesses and banks. This is especially the case in countries where the supervision of banks is poorly organised.

All this leads to the conclusion that a flexible exchange rate does not necessarily provide for an environment conducive to financial stability. The evidence of the developing countries indicates that flexible exchange rates for many of them are a more serious source of financial fragility than fixed exchange rates. The consensus view among policy makers that countries that are unable or unwilling to move into a monetary union (or some other form of union such a 'dollarization') should allow for more exchange rate flexibility should be revised.

The previous analysis about the problems with flexible exchange rates allows us to amend our analysis of financial crises in a fixed exchange rate model. Let us return to figure 5. We argued that the increase in capital mobility increased the cost of defending the exchange rate under attack, so that when a speculative attack arises, the central bank will have a strong incentive not to defend the fixed exchange rate. As a result, the fixed exchange rate regime is made more fragile. This analysis now turns out to be incomplete. One should add that as time goes by, more banks are willing to increase their foreign exposure in a fixed exchange rate regime. As a result, when a speculative attack occurs the central bank will find it very costly to devalue, knowing that such a devaluation will lead to large losses in banks and in the corporate sector. Thus the gradual liberalisation of capital movements has led to an upward shift of both the cost of temptation curve (Δ) and the cost of a devaluation. The net effect on the fragility of the fixed exchange rate regime is therefore ambiguous.

5. Conclusion

The analysis of this paper leads to a number of conclusions. These can be summarised in three points.

First, fixed exchange rate regimes are becoming more fragile in a world of intense financial integration. Since the exchange markets and the banking sector are strongly intertwined, crises in the foreign exchange markets can easily spill over into the domestic banking sector leading to a twin crisis.

Second, flexible exchange rates are also conducive to banking crises. In fact, in developing countries, banking crises occur more often in an environment of flexibility of the exchange rate. The reasons are that the flexibility of the exchange rate usually reflects a failure of national authorities to follow stable and predictable policies. In addition, it appears that the exchange rate is rarely a tool to improve the adjustment process following macroeconomic disturbances. It is more often than not a significant source of monetary and macroeconomic instability endangering the stability of the banking sector.

The view that more exchange rate flexibility reduces the probability of financial crises is not well founded.

Third, a crucial factor in determining how the exchange rate regime affects the stability of the banking sector is the quality of bank supervision. In countries with well-developed supervision a crisis in the foreign exchange market rarely leads to a banking crisis. For example, the ERM pegged exchange rate regime led to frequent foreign exchange crises. None of these crises spilled over into a banking crisis. Similarly, the substantial flexibility of the dollar vis-à-vis the major currencies did not trigger banking crises in the major industrialised countries. In the absence of a well-functioning supervisory system both fixed and flexible exchange rate regimes contain a number of triggers that can precipitate banking crises. The surprising empirical finding is that flexible exchange rates may produce more of these triggers than fixed exchange rates.

We conclude that the consensus view that emerging countries should allow for more exchange rate flexibility as a means to reduce the probability of financial crises is not well founded.

References

- Barro, R. and Gordon, M. (1983). "Rules, discretion and reputation in a model of monetary policy". *Journal of Monetary Economics*, 12(7), pp. 101-121.
- Domaç, I. and Soledad Martinez Peria, M. (2000). "Banking crises and exchange rate regimes: is there a link?" *World Bank Working Paper*.
- Fischer S. (2001). "Exchange rate regimes: is the bipolar view correct?" *Journal of Economic Perspectives*, 15(2), pp. 3-24.
- Flood, R.P. and Garber, P.M. (1984). "Collapsing Exchange-Rate Regimes: Some Linear Examples". *Journal of International Economics*, 17(1-2), August, pp. 1-13.
- Frankel, J. and Rose, A. (1996). "Currency crashes in emerging markets: an empirical treatment". *Journal of International Economics*, (41), pp. 351- 366.
- Goodhart, C. (1989). "News and the Foreign Exchange Market". LSE Financial Markets Group Discussion Paper, (71).
- Goodhart, C. and Figliuoli, L. (1991). Every Minute Counts in the Foreign Exchange Markets. *Journal of International Money and Finance*, (10), pp. 23-52.
- Kaminsky, G., Lizondo, S. and Reinhart, C. (1998). "Leading Indicators of Currency Crises". *International Monetary Fund Staff Papers*, 45(1), March, pp. 1-48.
- Kaminsky, G. and Reinhart, C. (1998). "The twin crises: the causes of banking and balance of payment problems". International Finance Discussion Paper (544), Board of Governors of the Federal Reserve System.
- Krugman, P. (1979). "A model of balance of payments crises". *Journal of Money, Credit and Banking*, (11), August, pp. 311-25.
- Obstfeld, M. (1996). "Models of currency crises with self-fulfilling features". *European Economic Review*, 40(3-5), pp. 1037-47.
- Obstfeld, M. and Rogoff, K.(2000). The Six Major Puzzles in International Macroeconomics: Is there a Common Cause?. NBER Working Paper (7777), July.
- Sachs, J., Tornell, A. and Velasco, A. (1996). "Financial crises in emerging markets: The lessons from 1995". *Brookings papers on economic activity*, 0(1).

Annex

In order to derive the temptation and cost of defence curves we move in three steps. First, we set a model that allows us to derive the optimal rule for the inflation rate. Second, we look at different solutions of the model under different exchange rate regimes. Third, we compute temptation and cost of defence. We start from temptation. In order to do so, we present a model that is based on the standard model of Barro-Gordon (1983). But our model departs from it because we look at an open economy. We then introduce the cost of defending a pegged exchange rate.

The monetary authorities minimise the loss function

$$(A.1) \quad L = (\pi - \pi^*)^2 + \beta(y - y^*)^2 + C(\pi)$$
$$C(\pi) = C \quad \text{if } \pi \neq \pi^*$$
$$C(\pi) = 0 \quad \text{if } \pi = \pi^*$$

where y is the output, y^* the authorities' output target, π is the inflation rate, $\beta > 0$ is the weight attached to output stabilisation. Assuming PPP holds, π corresponds to the rate of currency depreciation. $C(\pi)$ is a cost term that can be viewed as the political cost to reneging on a promise to fix the exchange rate regime (see Obstfeld (1996) for a similar specification). For simplicity we consider this cost to be fixed. Under a fixed exchange rate $\pi = 0$ (1).

Inflation is determined by the expectations-augmented Phillips curve

$$(A.2) \quad \pi = \frac{1}{a} (y - y_n) + \pi^e + \varepsilon$$

where π is the rate of inflation, π^e is expected inflation, y is output, y_n is the 'natural' output level, $(y - y_n)$ can be interpreted as the output gap, and ε is a random inflation shock (2).

It is assumed that the *output target* is larger than the natural output level (3)

$$(A.3) \quad y^* = \lambda y_n \quad \text{with} \quad \lambda > 1$$

Rewriting equation (A.2) in terms of output and substituting together with (A.3) in equation (A.1), and deriving the first order condition, we find the authorities' optimal rule for the inflation rate given the expectations of private agents: (4)

$$(A.4) \quad \pi = \frac{1}{1 + a^2\beta} \pi^* + \frac{(\lambda - 1)a\beta}{1 + a^2\beta} y_n + \frac{a^2\beta}{1 + a^2\beta} \pi^e + \frac{a^2\beta}{1 + a^2\beta} \varepsilon$$

1) More generally, the authorities can peg the rate of depreciation (a crawling peg is typically used in high inflation countries). In that case π is a constant π^* . The cost term C is then the cost of deviating from the crawling peg.

2) The equilibrium is assumed as time invariant, therefore the time subscripts are omitted.

3) This is the usual assumption of the Barro-Gordon model and it leads to an inflation bias. The justification is that the authorities pursue a lower level of unemployment than the natural one because of the distortion of the labour market.

4) It is assumed that the authorities control the inflation directly.

Let us first analyse the solution under discretion, which is the solution in a flexible exchange rate system. (We will call it the *flex solution*). We define it as a benchmark to compare with the solutions under a pegged exchange rate.

The solution for inflation and output under discretion (flex solution) is given by

$$(A.5) \quad \pi = \pi^e + \frac{a^2\beta}{1+a^2\beta} \varepsilon$$

$$(A.6) \quad \pi^e = a\beta(\lambda - 1)y_n + \pi^*$$

$$(A.7) \quad y = y_n - \frac{a}{1+a^2\beta} \varepsilon$$

In deriving (A.5) to (A.7) we have proceeded as follows. First, it is assumed that private agents have rational expectations and, therefore, use all available information, including the preferences of the monetary authorities. Taken this into account, $E[\pi]$ can be determined on the basis of the monetary authorities' optimal rule for the inflation rate as specified in (A.4). Observing $E[\varepsilon] = 0$, one arrives at

$$(A.8) \quad E[\pi] = \frac{1}{1+a^2\beta} \pi^* + \frac{(\lambda - 1)a\beta}{1+a^2\beta} y_n + \frac{a^2\beta}{1+a^2\beta} \pi^e$$

Setting $E[\pi] = \pi^e$ and rearranging terms yields equation (A.6). Second, using (A.4) and (A.6) in (A.2) leads to (A.7). Finally, replacing π^* in (A.4) with the expression for π^* contained in (A.6) results in (A.5).

By substituting the equilibrium values of π^e and y in the loss function (but disregarding the cost of devaluation), we identify the loss the authorities incur under discretion. We call this L_{flex} (5).

$$(A.9) \quad L_{flex} = \frac{a^2\beta}{(1+a^2\beta)} \varepsilon^2 + 2a\beta k \varepsilon + [a^2\beta + 1] \beta k^2$$

where $k = (\lambda - 1)y_n > 0$

We now analyse the solution of the model when the authorities peg the exchange rate, i.e. they set $\pi = \pi^*$ (where π^* can be zero if the peg is a fixed exchange rate peg). We will identify solutions to be equilibrium-solutions when they produce an outcome for which the expectations are model consistent. Let us start with the pegged exchange rate solution when agents expect the pegged exchange rate to be maintained. Thus the peg is fully credible. We call this the *fix* solution*. The solution for inflation and output is given by

$$(A.10) \quad \pi = \pi^* = \pi^e$$

$$(A.11) \quad y = y_n - a\varepsilon$$

5) Note that we compute the loss function as a function of the size of shocks.

Substituting those equilibrium values into the loss function (but disregarding the cost of devaluation) yields the loss function under a credible pegged exchange rate (*fix* solution*):

$$(A.12) \quad L_{fix^*} = \beta k^2 + \beta a^2 \varepsilon^2 + 2a\beta k \varepsilon$$

As it is well known from the Barro-Gordon (1983) model, the authorities will have an incentive to renege on their announcement (cheat). In order to find the expression for this incentive we compare L_{fix^*} with the loss obtained under cheating. The *cheat solution* arises when the agents expect a pegged exchange rate and the monetary authorities devalue (cheat). In this case:

$$(A.13) \quad \pi^c = \pi^*$$

$$(A.14) \quad \pi = \pi^* + \frac{(\lambda - 1)a\beta}{1 + a^2\beta} y_n + \frac{a^2\beta}{1 + a^2\beta} \varepsilon$$

$$(A.15) \quad y = \left(\frac{(1 + a^2\beta)\lambda}{1 + a^2\beta} y_n - \frac{a}{1 + a^2\beta} \varepsilon \right)$$

Substituting into the loss function (disregarding the fixed devaluation cost) yields the loss under cheating (L_{cheat}):

$$(A.16) \quad L_{cheat} = \frac{a^2\beta}{(1 + a^2\beta)} \varepsilon^2 + \frac{2a\beta k}{(1 + a^2\beta)} \varepsilon + \frac{\beta k^2}{(1 + a^2\beta)}$$

The difference between the *fix*solution* and the *cheat solution* measures the temptation Θ to devalue. The larger is the temptation the bigger is the authorities' incentive to devalue. To calculate

$\Theta = L_{fix^*} - L_{cheat}$ we use (A.12) and (A.16) and find

$$(A.17) \quad \Theta = \frac{a^2\beta^2}{(1 + a^2\beta)} \left(a^2 \varepsilon^2 + 2ak \varepsilon + k^2 \right)$$

We find that temptation is a non-linear function of the shocks.

We now derive the temptation to devalue when agents expect a devaluation. In order to compute it we assume that the authorities fix the exchange rate but that agents expect that the authorities return to the discretionary solution. We call this a *non-credible fix solution*. We compute the loss obtained under this solution. In order to do so, we first solve for inflation and output, and then substitute into the loss function (disregarding the fixed devaluation cost), i.e.

$$(A.18) \quad \pi = \pi^*$$

$$(A.19) \quad \pi^e = \pi^* + a\beta(\lambda - 1)y_n$$

$$(A.20) \quad y = y_n + a(-a\beta(\lambda - 1)y_n) - a\varepsilon$$

$$(A.21) \quad L_{fix} = a^2\beta\varepsilon^2 + 2a\beta k(1 + a^2\beta)\varepsilon + \beta k^2(1 + a^2\beta)^2$$

L_{fix} can be interpreted as the loss incurred by the authorities when they peg the exchange rate while agents expect the authorities to abandon the peg and to revert to the discretionary equilibrium. We can now find a measure of the cost of defending the exchange rate as the difference between L_{fix} and L_{flex} (the latter is the loss under discretion derived earlier). We call this difference the *temptation to abandon the fixed peg* (Δ), i.e. it is the additional loss resulting from defending the peg in the face of an expected devaluation compared to the loss incurred when the authorities follow a discretionary policy. We find

$$(A.22) \quad \Delta = L_{fix} - L_{flex} = \frac{a^4\beta^2}{(1 + a^2\beta)}\varepsilon^2 + 2a^3\beta^2 k\varepsilon + a^2\beta^2 k^2(1 + a^2\beta)$$

Like Θ , the *temptation*, Δ , is positively related to the size of the shocks.

We find that the second temptation (Δ) is always larger than the first one (Θ). This can be seen by setting $\varepsilon = 0$. We then find that $\Delta > \Theta$. It can also be shown that as $\varepsilon \rightarrow 0$, $\Delta \rightarrow \Theta$.

In figure A.1, we show both temptation functions (Θ and Δ) as a function of the size of shocks.

Figure A.1. Temptations as a function of size of shocks

