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Stabilisation, Crises and the "Exit" Problem – A Theoretical Model

by

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Outline

Stabilisations, Crises and the "Exit" Problem - A Theoretical Model

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Abstract

Exchange-rate-based stabilisations, even if successful, usually lack credibility initially. This is reflected in high (ex post) real interest rates and some degree of real exchange rate appreciation. Empirical observation suggests that wage inflation declines smoothly over time whilst interest rates are volatile. We capture this by assuming that expectations are formed adaptively in labour markets, but rationally in financial markets. The model provides insights into: the eruption of exchange rate crises after a long period of apparently successful stabilisation; the potential advantages of a heterodox approach; when to delay a stabilisation attempt; and the optimal date for "exit" to a floating exchange rate.

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1 Introduction

A feature of exchange-rate-based stabilisations is that, even if successful, success is not immediate. Agents in financial and labour markets are often sceptical initially, and this is reflected in real exchange rate appreciation and high nominal interest rates relative to the realised inflation rate (Dornbusch, 2001; Edwards, 1993; Kaminsky and Leiderman, 1998). Modern currency crisis theory suggests that both fundamental (macroeconomic) factors and financial market expectations are important to the success of a stabilisation attempt. The scope for multiple equilibria in this theory, however, creates a great deal of indeterminacy and makes many issues difficult to analyse, including the so-called "exit problem": when to reintroduce exchange rate flexibility without risking the price stability achieved by pegging.

To judge by inflation differentials, most stabilisation attempts that have not yet collapsed show evidence of increasing credibility over time. Nevertheless market-determined interest rate differentials tend to behave in a more volatile manner, suggesting a varying degree of speculative pressure. Traditionally, continuing wage inflation has been interpreted as a reflection of either backward-looking indexation or forward-looking expectations combined with doubts about the success of the stabilisation. The contrasting behaviour of inflation and interest rate differentials suggests that, if the expectations interpretation is correct, then expectations in the labour market are not formed in quite the same way as in the financial markets. The key innovation in this paper is to build this feature into a theoretical model. In the model developed below, labour market expectations are assumed to be formed adaptively. These expectations fix the path of the fundamentals, and the paper explores the implications of this in the context of modern theories of currency crises in which financial markets form their expectations rationally. The path of the fundamentals has a crucial bearing on the likelihood of eventual success of the stabilisation attempt. The paper characterises the conditions under which a stabilisation attempt is worthwhile, and also discusses the optimal date for a return to floating.

2 Background

Calvo and Vegh (1999), in a detailed survey of exchange-rate-based stabilisations, find a consistent tendency to real appreciation and deterioration of trade and current account balances associated with slow convergence of the inflation rate to the rate of devaluation. The tendency for exchange-rate-based stabilisations to be accompanied by real exchange rate appreciation is illustrated in Tables 1 and 2. Table 1 gives data for Mexico, which pegged its exchange rate in 1988, but was forced to abandon the peg in the crisis of December 1994. Table 2 gives data for Argentina, which adopted a currency board in 1991 and has recently abandoned it. In Mexico the nominal exchange rate was never completely stabilised vis-à-vis the United States dollar. Even by 1994, however, the crawling peg never quite compensated for the inflation differential and the cumulative real appreciation from 1988 to 1994 was over 29%. The same phenomenon occurred in the European Monetary System from 1979 to 1992: especially after the reforms of 1987, higher-inflation countries such as Italy experienced real exchange rate appreciation within the system. In Argentina, by contrast, the inflation differential was eliminated by 1994 and the cumulative real appreciation was smaller (23 %).

Interest rate differentials, on the other hand, tend to be much more volatile: for example, the interest rate differential between Argentina and the US rose from 2.1% in November 1994 to 8.1 % in December and, after peaking at 13.3 % in March 1995, was down to 1.3 % by June. All this had no noticeable impact on wage behaviour. The recent collapse of Argentina's currency board highlights the issue of choosing the optimal exit date, given that inflation had been effectively zero in Argentina since 1995.

The differences in the historical patterns of interest rate and inflation differentials are difficult to reconcile with the combination of (a) a lack-of-credibility explanation of continuing inflation differentials *and* (b) the assumption that all agents have identical expectations. In this paper we drop the second assumption and treat the evolution of labour market exchange rate expectations as exogenous.

3 The Model

The model is familiar in structure. Output is boosted by unexpected depreciation, but the government also cares about price stability. The government decides at time zero to peg the currency for an indefinite period in order to achieve price stability. The stabilisation attempt may collapse in a devaluation at any date, if the current-period cost of sustaining the peg becomes too great, as in the currency crisis models of Jeanne (1997), Masson (1995) and Obstfeld (1996). Essentially, a devaluation is triggered, if output falls to a low enough level under the peg. We treat this as a constraint: the peg becomes politically unsustainable at this point.

Output depends on the fundamentals, whose path is determined by the evolution of the credibility of the stabilisation in the minds of labour market agents, and on financial markets' expectations. Financial markets are assumed to form their expectations rationally, whilst expectations in the labour market are formed adaptively (this condition gives us a determinate path for the fundamentals).

The currency peg can only be sustained so long as the output cost does not exceed the inflation cost of devaluation plus an additional term that reflects the "humiliation" costs of being forced off the peg. We assume that purchasing power parity holds, with foreign inflation of zero, so that inflation is equal to the rate of exchange rate depreciation.

In each period output is defined by a Lucas surprise supply function, with the price surprise being measured relative to financial market expectations. Output is equal to its "natural" level, plus the expanding effect of the unexpected component of exchange rate depreciation:

$$y_t = \bar{y}_t + \alpha(\varepsilon_t - \varepsilon_t^e); \tag{1}$$

where $\alpha > 0$, y_t is output in period t, ε_t is the one-period change in the log of the exchange rate (domestic currency units per unit of foreign currency), ε_t^e = devaluation expectations in period t and $\bar{y}_t$ = natural output level at time t.

The government is forced to abandon the peg in period t, if the following condition is met:

$$\left(y_t^{peg} - y^*\right)^2 > \left(y_t^{devaluation} - y^*\right)^2 + \beta\varepsilon_t^2 + C; \tag{2}$$

where y_t is output in period t (with the superscript "peg" or "devaluation" according to whether the exchange rate peg is maintained or abandoned), y* is the output target value, β (> 0) is a parameter that reflects the importance of the price stability objective relative to the output objective, and C (> 0) is the humiliation cost of abandoning a pegged exchange rate without pre-announcement. Thus equation 2 says that a devaluation of the exchange rate occurs, if the one-period welfare losses from lower output under a pegged (fixed) exchange rate regime exceed the inflation and humiliation costs of devaluing. This equation may be thought of as the outcome of minimising a one-period loss function, $L = \left(y_t - y^*\right)^2 + \beta\varepsilon_t^2 + jC$; where j = 1 if the peg is abandoned and zero if not. Even if the future benefits of continuing to peg exceed the costs, the stabilisation attempt collapses, if the above condition holds.[1]

In this model, the optimal rate of devaluation, should one occur, depends on market expectations. With rational expectations, if the devaluation probability is μ, then the expected depreciation is:

$$\frac{\mu\alpha}{\alpha^2(1-\mu)+\beta}\left[y^* - \bar{y}_t\right] \tag{3}$$

[1] What we have in mind is that the peg becomes politically unsustainable, if its current-period cost is too high.

The game is structured as follows. At the beginning of period zero, there is an exchange-rate-based stabilisation. Then private sector agents set their expectations of the exchange rate, which they cannot revise until the next period. Finally, the government sets the exchange rate and output is determined. If the exchange rate peg has been maintained, the game is repeated in the next period.

As mentioned above, expectations in the labour market and in the financial markets seem to be based on different processes. If wage increases reflect labour market expectations, then the experience of exchange-rate based stabilisation suggests a pattern of a gradual increase in the credibility of the exchange rate peg over time. It seems plausible that expectations in a market where negotiations take place relatively infrequently and over agreements covering a longer time period are based on approximations of longer-term trends. One could model this process therefore as an adaptive mechanism.

We turn now to the detailed specification of the model. We start by examining the problem from the point of view of labour market agents. These agents observe an exchange-rate-based stabilisation in period zero.

Let the labour market agents believe at the beginning of period zero that the exchange rate will be floated in that period with probability μ and will remain pegged with probability $1 - \mu$. The parameter μ therefore measures initial scepticism or lack of credibility of the peg. We treat this parameter as exogenous. It is likely to reflect factors such as the consistency between fiscal and monetary policy, the level of foreign exchange reserves and the government's political position. Wage-earners' expectations of the depreciation rate in period zero are than exactly as stated in equation 3.

If the peg is maintained in period 0, then in period 1 and all subsequent periods until the peg is abandoned, the peg is assumed to acquire credibility at a rate (1 - λ), where $0 < \lambda < 1$, and the game is repeated. More precisely, the perceived probability (by labour market agents) of a devaluation in period t is $\mu\lambda^t$. This is equivalent to expectations following a geometric progression towards the observed outcome, as in an adaptive expectations model. We conceive λ as reflecting the gains in credibility simply from being able to sustain the peg over time. If λ is low, credibility is gained quickly; if λ is high, it only accrues slowly. As is shown below, this acquisition of credibility is favourable to the maintenance of the peg. On the other hand, as will become clear below, past lack of credibility drives equilibrium output further from the government's target. This effect works in the opposite direction, The game is structured as follows. At the beginning of period zero, there is an exchange-rate-based stabilisation. Then private sector agents set their expectations of the exchange rate, which they cannot revise until the next period. Finally, the government sets the exchange rate and output is determined. If the exchange rate peg has been maintained, the game is repeated in the next period.

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If the peg has lasted for t periods (0 to t-1), and is then abandoned, then the exchange rate is assumed by wage-earners to depreciate by:

$$\varepsilon_t^{e,L} = \frac{\mu\lambda^t\alpha}{\alpha^2\left(1-\mu\lambda^t\right)+\beta}\left[y^* - \bar{y}_t\right] \tag{4}$$

This straightforward adjustment of probabilities in each period can also be motivated by looking at the incentives agents face in the labour market. Analogously to the way Lux (1995) explains herd behaviour in the financial markets, it can be argued that agents will maximise their expected future income, which is future real wage income times the probability of employment, by following the majority. If agents are more pessimistic than the majority about the sustainability of the fixed peg policy and consequently demand higher nominal wages, their probability of employment will fall significantly, with the increase in their demanded relative real wage. However, if agents are more optimistic, they will demand a lower relative real wage and have less income. Assuming that their last-period wage income, relative to its corresponding employment probability, was optimal[2], agents will maximise expected future income by demanding exactly the same proportionate increase in nominal wages as the majority of agents in the market. It pays therefore to act according to the market consensus. As the consensus becomes more optimistic over time, agents adapt accordingly.

In contrast, indicators of financial market expectations, such as interest rates, point to almost continuous decision-making covering shorter time periods. We therefore assume a rational expectations process for financial markets. The crucial question is whether the exchange rate policy is sustainable in any given time period. Agents therefore take into account the policy condition of equation 2. They deduce the optimal devaluation rate (ε^*) from the government's preferences over inflation and unemployment. Their expected devaluation rate will therefore be the optimal rate times the perceived devaluation probability (p_t). The devaluation probability can have any value between 0 and 1. This reflects imperfect information about the

[2] To be more precise, it also has to be assumed that this is an efficiency wage labour market. Offering lower wages does not significantly improve the individual employment probability, but demanding more than the efficiency wage will significantly lower the individual employment probability.

actions of other speculators. The actions of the speculators will be reflected in the realised average expected devaluation rate, which in turn impacts on the policy condition for giving up the exchange rate policy. As is well known, this introduces the possibility of multiple equilibria into the model (i.e. the exchange rate decision may vary with p_t).

Finally, let us consider the dynamics of the natural rate of output. A standard approach is to model the natural rate of output as a stochastic variable with a mean that is independent of time: $\bar{y}_t = \bar{y} + u$ (e.g. Obstfeld, 1996). In order to capture the real appreciation that tends to occur in practice when an exchange rate peg lacks credibility, we model the dynamics of the natural rate of output as a deterministic process related to past labour market exchange rate expectations:

$$\bar{y}_t = \bar{y}_{t-1} - \phi\alpha\varepsilon_{t-1}^{e,L} \quad \text{(pegging)} \tag{5}$$

$$(\bar{y}_t - \bar{y}_0) = \psi\left(\bar{y}_{t-1} - \bar{y}_0\right) \quad \text{(floating)}\ ; \tag{6}$$

where $\phi > 0$, and $0 \leq \psi < 1$. The inclusion of α in equation 5 simplifies the algebra.

Equation 5 says that, under a peg, the natural rate of output falls in proportion to wage-earners' expected rate of depreciation in the previous period.[3] The idea is that non-zero depreciation expectations reflect the lack of credibility of the peg as perceived by labour market participants. This lack of credibility is reflected in higher nominal wage settlements, putting pressure on international competitiveness. This effect cannot be represented directly in the model because of the assumption of purchasing power parity, so instead we assume that it impacts on the equilibrium level of output. The strength of the effect is denoted by the parameter ϕ.

Equation 6 says that, if the exchange rate is floated, the natural rate of output returns gradually to its initial level. This aspect will become relevant when we consider the exit problem.

The evolution of the gap between the desired output level and the natural output level is determined as follows (whilst the peg is maintained), using 5 and 4:

[3] It simplifies the model to use previous-period rather than current-period expectations here, without making any essential difference.

$$(y^* - \bar{y}_t) = 1 + \frac{\alpha^2 \phi \mu \lambda^{t-1}}{\alpha^2 \left(1 - \mu \lambda^{t-1}\right) + \beta} (y^* - \bar{y}_{t-1}) \tag{7}$$

Natural output shrinks continuously, but at a rate that decreases with time, until scepticism is completely eliminated.

The optimal devaluation rate in any period, if a devaluation occurs, is:

$$\varepsilon_t^* = \frac{\alpha}{\alpha^2 (1 - p_t) + \beta} [y^* - \bar{y}_t] \tag{8}$$

The model works like this: At time zero $\bar{y}_t$ is equal to $\bar{y}_0$ and the government announces a peg of the exchange rate. The sets of agents in the private sector then set their expectations of the time zero exchange rate. To see whether the peg is abandoned or not, we compare the losses from continuing the peg ($\varepsilon_t = 0$) with the losses from abandoning it ($\varepsilon_t = \varepsilon_t^*$).

We are now in a position to analyse the various possible outcomes of the stabilisation attempt:

The losses from pegging at time t are:

$$L_t^{fix} = \left[\frac{\alpha^2 + \beta}{\alpha^2 (1 - p_t) + \beta} (\bar{y}_t - y^*)\right]^2 \tag{9}$$

Losses if the policy is abandoned unannounced are:

$$L_t^{flex} = \frac{\beta^2 + \alpha^2 \beta}{(\alpha^2 (1 - p_t) + \beta)^2} (\bar{y}_t - y^*)^2 + C \tag{10}$$

The policy condition for abandoning the exchange rate policy unannounced is:

$$\frac{\alpha^2 (\alpha^2 + \beta)}{(\alpha^2 (1 - p_t) + \beta)^2} (\bar{y}_t - y^*)^2 > C \tag{11}$$

The left-hand side of 11 is influenced by the evolution of the natural output gap (which is solely determined by labour market expectations) and by financial market expectations (p_t). Since financial market expectations of the devaluation rate can take any value between 0 and 1, there is a considerable degree of variance in the evolution of the loss functions, as period losses depend on financial market expectations, given the natural output gap and C.

It should be noted that the corridor of possible loss realisations for different values of p_t is narrower for the L^{flex} case than for the L^{fix} case. This follows from a comparison of the functions, where L^{flex} can be expressed relative to L^{fix}:

$$L^{flex} = \frac{\beta}{\alpha^2 + \beta} * L^{fix} + C$$

The easiest way to look at the consequences of this is to consider the extreme cases of p_t being equal to 0 or 1. If p_t equals zero equation 11 becomes:

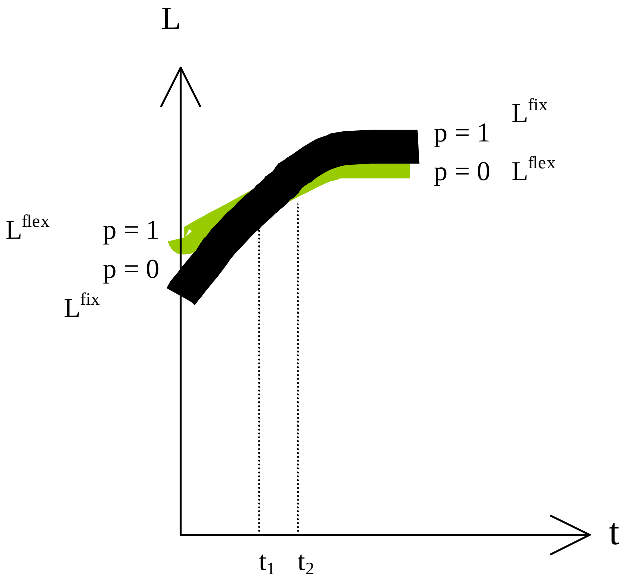
$$\frac{\alpha^2}{\alpha^2 + \beta} \left(\bar{y}_t - y^*\right)^2 > C \tag{12}$$

This significantly reduces the left-hand side and therefore makes a crisis far less likely. The opposite happens if p_t equals one, as can be seen in the corresponding equation:

$$\frac{\alpha^2 \left(\alpha^2 + \beta\right)}{\beta^2} \left(\bar{y}_t - y^*\right)^2 > C \tag{13}$$

Since lack of credibility causes the output gap to increase over time, both L^{flex} and L^{fix} have an upward trend. There are several possibilities:

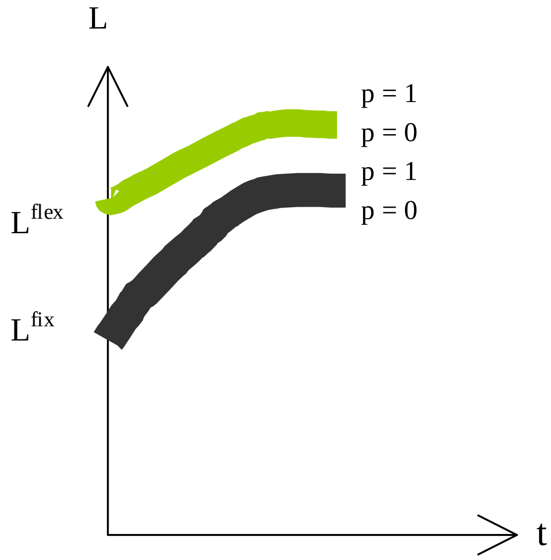
Figure 1: crisis occurs between t_1 and t_2



The lighter line represents L^{flex}.

In the first case a crisis is inevitable, but there is not one date at which the crisis definitely occurs. Although the crisis must occur by t_2, it can happen at any time from t_1 onwards. At t_1 a crisis can only occur, if p_t is equal to one. At t_2 a crisis will occur even if p_t is equal to zero.

Figure 2: no crisis



In the second case there is no crisis. Even if $p_t = 1$, when speculators are completely convinced that a devaluation will occur, it never does.

Figure 3: possible crisis

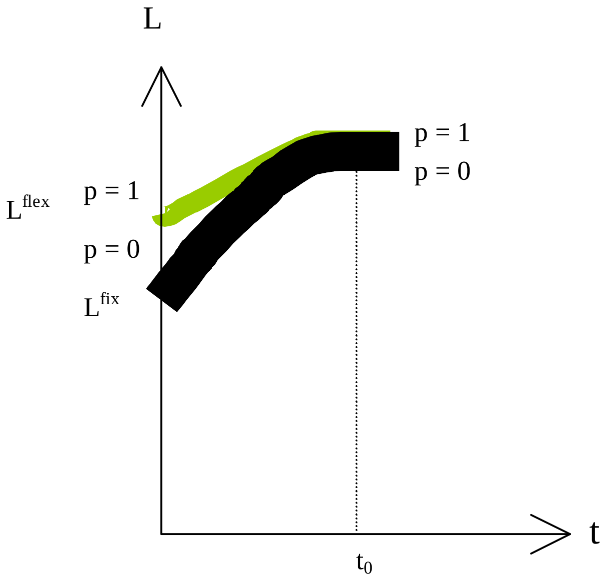


Figure 3 represents an interesting intermediate case, where a crisis becomes possible from t_0 onwards (p_t has to equal one for a crisis to occur precisely at t_0). However, the loss functions stabilise before the point is reached where a crisis occurs even with p_t being equal to zero. Consequently, if expectations become sufficiently pessimistic at any time $t > t_0$, a crisis will occur.

Which of these three cases applies may simply depend on the value of C, the fixed cost of abandoning the peg. For any given value of C, however, the rate of loss of international competitiveness, as given by equation 7, is important. We can see from that equation that the higher are λ (the persistence of labour market scepticism) and ϕ (the degree to which it is reflected in wages), the more rapidly natural output shrinks and therefore, from equation 11, the sooner a crisis occurs. If ϕ is low, then natural output does not shrink much over time, whilst if λ is low the shrinkage effect decays quickly to zero. These are the cases where a successful stabilisation is most likely (as in Figure 2).

Note in particular that the importance of ϕ can be interpreted as a justification for heterodox policies, in which wage controls are implemented in the early stages of the stabilisation. Such policies are effectively an attempt to keep the value of ϕ low, thus increasing the chances of success.

4 Are all stabilisation attempts worthwhile?

Instead of considering a government that has already announced a stabilisation attempt in period zero, and therefore incurs a cost from departing from the peg, we now turn to the case of a government which has not yet made such an announcement. We assume that the government initially has a crawling peg regime with devaluation at the rate

$$\varepsilon = \frac{\alpha}{\beta}\left(y^{*} - \bar{y}_{0}\right),$$

which minimises the government's loss function given below. We show now that if the stabilisation attempt has insufficient credibility, it is better to postpone it and to continue with the crawling peg.

The issue is therefore whether to continue floating or to peg, assuming that the peg lasts for ever (i.e. the value of C is sufficiently large that it is never abandoned). Let the government's discount factor be ρ (<1). The loss function for each individual time period is:

$$L_t = (y_t - y^{*})^2 + \beta\varepsilon_t^2 \tag{14}$$

If V is the present value of the government's loss function L over all future periods, then with no stabilisation attempt, where output stays at $\bar{y}_0$ and ε_t equals $\frac{\alpha}{\beta}(y^{*} - \bar{y}_0)$, we have:

$$V^{crawl} = (1 + \rho + \rho^2 + ...)\left(1 + \frac{\alpha^2}{\beta}\right)(y^{*} - \bar{y}_0)^2 \tag{15}$$

If stabilisation is attempted, from equation 9 we have:

$$V^{fix} = \left[\left(\frac{\alpha^2 + \beta}{\alpha^2(1 - p_0) + \beta}(y^{*} - \bar{y}_0)\right)^2 + \rho\left(\frac{\alpha^2 + \beta}{\alpha^2(1 - p_1) + \beta}(y^{*} - \bar{y}_1)\right)^2 + ...\right] \tag{16}$$

Note that V^{fix} depends on two factors: financial market expectations of a devaluation in each period (p_t), and the evolution of the natural rate of output ($\bar{y}_t$) as given by equation 7.

The stabilisation attempt yields immediate gains in the form of reduced inflation, which may be more than offset by future losses from reduced output. If p_0 <1, the period 0 value of L^{crawl} is higher than that of L^{fix}. In the most favourable case of μ =0 (100 % labour market credibility and hence no loss of international competitiveness), $\bar{y}_t$ stays at $\bar{y}_0$ in future periods, which means that $V^{crawl} > V^{fix}$. In the general case where $\mu > 0$, we can show that the values of the parameters may be such that $V^{crawl} < V^{fix}$, implying that it may be preferable to postpone the stabilisation attempt.

Let us consider the simplest case where $\lambda = 0$ (so that $\bar{y}$ is fixed at $\bar{y}_1$ after period 1) and $p_t = 0$ for all periods. In that case $V^{fix} > V^{crawl}$ if

$$\frac{\rho}{1-\rho}\left[\left(y^*-\bar{y}_1\right)^2-\left(1+\frac{\alpha^2}{\beta}\right)\left(y^*-\bar{y}_0\right)^2\right] > \frac{\alpha^2}{\beta}\left(y^*-\bar{y}_0\right)^2 \qquad (17)$$

The left-hand side of equation 17 represents the difference between V^{fix} and V^{crawl} from period 1 onwards and the right-hand side equals L^{crawl} - L^{fix} in period 0. Substituting from equation (7) and rearranging, equation (17) becomes:

$$\rho\left[\left(1+Z\right)^2-1\right] > \frac{\alpha^2}{\beta}; Z=\frac{\phi\alpha^2\mu}{\alpha^2\left(1-\mu\right)+\beta} \qquad (18)$$

This condition can easily be met for high enough values of μ.[4] Thus, even in the case where the stabilisation has 100 % credibility amongst wage-earners in the second period (because $\lambda = 0$), so that no further deterioration of the fundamentals occurs, the permanent loss of output from lack of credibility in the first period can be high enough to make the stabilisation attempt unattractive. If $\lambda > 0$, then V^{fix} is even greater for a given μ.

These results imply that stabilisation attempts need to be well enough designed to bring μ below some critical value to make the attempt worthwhile. If, for example, the government is too reliant on seigniorage revenue and cannot undertake the fiscal reforms necessary to reduce μ below the critical level, it would do better to postpone the stabilisation attempt.

[4]For $\mu = 1$ it reduces to $\rho\phi\left(2+\frac{\phi a^2}{\beta}\right) > 1$. Since $\phi = 1$ is a plausible value, ρ would have to be very low for this not to hold.

5 The Exit Problem

Suppose that, while the exchange rate is pegged, the authorities put in place institutional arrangements intended to keep inflation at zero with a view to exiting from the peg at a future date. At a certain date T, a return to floating is announced and implemented. Because the float was pre-announced, the cost C of an unannounced end to the peg is not incurred. After date T, natural output gradually reverts to $\bar{y}_0$ as specified in equation 6. What happens to inflation? It seems reasonable to assume that, if the exit is successful, inflation stays at zero, but that if it is unsuccessful inflation returns to the pre-peg rate of $\frac{\alpha}{\beta}(y^* - \bar{y}_0)$. The problem is how to formulate the probability of the exit being successful. We want to include a factor that reflects the quality of post-exit institutional arrangements, but the credibility of the peg is also likely to play a role. We could relate the success probability at date T to financial market expectations at that date (p_t), but since we have no model of p_t, it would be difficult to draw any useful conclusions. Instead, therefore, we relate the success probability to labour market expectations. Since labour market credibility increases over time, this means that the probability of a successful exit also increases with time - which does not seem unreasonable.

We assume that post-float inflation stays at zero (i.e. the exit is successful) with probability 1-$\gamma\mu\lambda^T$, and with probability $\gamma\mu\lambda^T$ inflation returns (i.e., the exit is unsuccessful). Thus the probability of failure is equal to labour market scepticism in period T ($\mu\lambda^T$), multiplied by a factor γ (>1) that represents exit risk and is assumed to reflect the quality of the institutional reforms (the better the reforms, the closer γ is to one).

What determines the optimal exit date? Delaying exit by one period reduces the probability of failure by a factor λ, but also keeps output low for one further period and causes the natural rate of output to move further from the target level. A further important consideration is that the peg might succumb to a crisis in period T, if exit is delayed. Assume for simplicity that $\psi = 0$ (i.e. that natural output returns instantaneously to $\bar{y}_0$ after exit). Then, with a discount factor of ρ, the expected multi-period losses from exit at time T are:

$$V_1 = (1-\rho)^{-1}\left(1 + \gamma\mu\lambda^T\frac{\alpha^2}{\beta}\right)(y^* - \bar{y}_0)^2 \tag{19}$$

This equation reflects the fact that the inflation losses $\left[\frac{\alpha^2}{\beta}(y^* - \bar{y}_0)^2\right]$ are incurred with probability $\gamma\mu\lambda^T$. If exit is delayed for one period, either the peg collapses in period T (probability π) or it does not and exit occurs at time T+1 (probability 1-π). Hence the expected losses are:

$$V_2 = \pi \left[\frac{1}{1-\rho} \left(1 + \frac{\alpha^2}{\beta} \right) (y^* - \bar{y}_0)^2 + C \right] + (1-\pi) \left[L_T^{fix} + \frac{\rho}{1-\rho} \left(1 + \gamma\mu\lambda^{T+1} \frac{\alpha^2}{\beta} \right) (y^* - \bar{y}_0)^2 \right] \quad (20)$$

where L_T^{fix} is given by equation 9. We therefore continue to take the different expectations in the labour and the financial market into account.

Let us consider first the case, where $\pi = 0$ (as in Figure 2). In that case it pays to exit at time T rather than to delay further if

$$L_T^{fix} > \left(1 + \gamma\mu\lambda^T \frac{\alpha^2}{\beta} \right) (y^* - \bar{y}_0)^2 + \frac{\rho}{1-\rho} \left((1-\lambda)\gamma\mu\lambda^T \frac{\alpha^2}{\beta} \right) (y^* - \bar{y}_0)^2 \quad (21)$$

This condition is more likely to be fulfilled if (a) ρ is smaller (the future is discounted more heavily), (b) γ is smaller (post-exit anti-inflation strategy is better designed), and (c) ϕ is larger (since this increases L_T^{fix} through equation 7). In the case of the labour market credibility parameters (μ, λ), matters are a bit more complicated, because both sides of equation 21 are increasing in μ and λ. Using equations 9 and 7, however, we can see that L_T^{fix} increases with $\mu^T \lambda^{\frac{T(T-1)}{2}}$, whereas the right-hand side of 21 is proportional to $\mu\lambda^T$. Thus we can deduce that higher values of μ and λ favour an earlier exit, because of the cumulative impact on equilibrium output of continuing the peg. This necessarily implies, however, that the probability of a successful exit is reduced at the optimal exit date, since not only are μ and λ larger, but also T is smaller. Conversely, with greater credibility, it pays to wait until exit is safer.

We may now consider the case where $\pi > 0$. Since the collapse of the peg produces the same result as an unsuccessful exit but with an additional humiliation cost of C, it is always better to exit, if $\pi > \gamma\mu\lambda^T$ (i.e. if a crisis is more likely than an unsuccessful exit). In general, $\pi > 0$ implies an earlier exit then $\pi = 0$. Thus the examples shown in Figures 1 and 3 suggest an earlier exit date (and therefore a riskier exit) than Figure 2.

In conjunction with those given earlier, these results imply that real exchange rate appreciation should lead governments to formulate plans for an early exit. Not only does real appreciation increase the risk of a currency crisis, but it also makes it optimal to exit at higher probabilities of failure to reduce output costs. In short, it is often better to jump than to risk being pushed.

6 Conclusions

The purpose of the model presented here is two-fold: to develop a formal bridge between the theory of currency crises and of exchange-rate-based stabilisations, and also to incorporate the conventional wisdom about stabilisation experiences. The key to the model is that labour market agents have adaptive expectations, which drive the fundamentals, whilst financial market agents have rational expectations.

The model demonstrates that loss of competitiveness is usually critical in the failure of a stabilisation attempt, as has often been noted in practice. It also shows that it is optimal to postpone stabilisation attempts which would lack credibility, perhaps because fiscal and monetary policy are mutually inconsistent. Although such a stabilisation attempt must eventually be successful provided the costs of abandoning it are sufficiently great, the costs in lost output outweigh the inflation gains. This is particularly true, if credibility gains are slow (λ is high) and if the lack of credibility causes greater exchange rate appreciation (ϕ is high). A heterodox policy, with direct controls on wages, can be interpreted as an effort to keep ϕ low and thus to increase the probability of success. These are not particularly startling results, but it is useful to have derived them within a formal model.

The model also sheds light on the "exit problem": when to abandon the peg and unwind the real appreciation without losing the inflation gains achieved by the stabilisation. In general it is optimal to exit before credibility reaches 100%, to reduce output losses from overvaluation. More effective monetary reforms, such as greater central bank independence or inflation targeting, bring forward the optimal exit date and reduce the costs of the stabilisation. An early exit is particularly desirable in cases where, if the peg is maintained, there is a greater danger that it would collapse anyway under speculative pressure. Greater credibility gives policy-makers the luxury of postponing exit until the chances of success are higher.

References

[1] Barro, Robert J. and Gordon, David B., "A Positive Theory of Monetary Policy in a Natural Rate Model", *Journal of Political Economy*, 91 (1983), 589-610

[2] Bleaney, Michael F. and Fielding, David J., "Monetary Discipline and Inflation in Developing Countries: The Role of Exchange Rate Regimes", *Oxford Economic Papers*, 52 (2000), 521-38

[3] Calvo, Guillermo A. and Végh, Carlos A., "Inflation Stabilization and BOP Crises in Developing Countries", *NBER Working Paper*, No. 6925 (1999)

[4] Dornbusch, Ruediger., " A Primer on Emerging Market Crises", NBER Working Paper, No. 8326 (2001)

[5] Drazen, Allan, "Political Contagion in Currency Crises", *NBER Working Paper*, 7211 (1999)

[6] Edwards, Sebastian, "Exchange Rates as Nominal Anchors", *Weltwirtschaftliches Archiv*, 129 (1993), 1-32

[7] Edwards, Sebastian, "Exchange Rate Regimes, Capital Flows and Crisis Prevention", NBER Working Paper, No.W8529 (2001)

[8] Jeanne, Olivier, "Are Currency Crises Self-Fulfilling: A Test", *Journal of International Economics*, 43 (1997), 263-86

[9] Kaminsky, Graciela L. and Leiderman, Leonardo, "High Real Interest Rates in the Aftermath of Disinflation: Is it a Lack of Credibility?", *Journal of Development Economics*, 55 (1998), 198-214

[10] Kaminsky, Graciela L. and Reinhart, Carmen M., "The Twin Crises: The Causes of Banking and Balance-of-Payments Problems", *American Economic Review*, 89 (1999), 473-500

[11] Lux, Thomas, ”Herd Behaviour, Bubbles and Crashes”, *Economic Journal*, 105 (1995), 881-96

[12] Masson, Paul R., ”Gaining and Losing ERM Credibility: The Case of the United Kingdom”, *Economic Journal*, 105 (1995), 571-82

[13] Masson, Paul R., ”Multiple Equilibria, Contagion and the Emerging Market Crises”, *IMF Working Paper*, WP/99/164 (1999)

[14] Obstfeld, Maurice, ”Models of Currency Crises with Self-Fulfilling Features”, *European Economic Review*, 40 (1996), 1037-1047

TABLE 1: MEXICO

Year	Exchange rate (peso per 1 US-$)	Inflation rate	US inflation rate	Real exchange rate appreciation
1988	2.27	113.87	4.02	19.99
1989	2.46	20.14	4.90	5.38
1990	2.81	26.42	5.28	4.87
1991	3.02	22.70	4.32	8.63
1992	3.09	15.57	3.02	8.79
1993	3.12	9.83	2.93	5.37
% Δ 1988-1993	37.45	136.52	22.16	29.01
1994	3.38	6.93	2.64	-3.99

TABLE 2: ARGENTINA

Year	Inflation rate	US inflation rate	Real exchange rate appreciation
1991	168	4.32	61.08
1992	25.37	3.02	17.83
1993	10.71	2.93	7.03
1994	4.30	2.64	1.60
1995	3.09	2.77	0.31
1996	0.00	2.9	-2.90
% Δ 1991-1996	49.25	15.10	22.88

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