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THE ROLE OF CREDIBILITY FOR THE EFFECTS OF A CHANGE IN THE EXCHANGE-RATE POLICY

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Abstract:

This paper analyses the real and monetary effects of a shift in the exchange-rate policy in an economy where the private sector is uncertain about the true intentions of the government.

In a repeated game of incomplete information, we show that a shift towards a tight, fixed exchange-rate policy leads to a loss in output and to a deficit on the current account in the period in which the policy lacks credibility. We also show that the long interest rate is above the short interest rate, reflecting the risk that the government reneges on its announced exchange-rate target.

1. Introduction

The point of departure of this paper is a situation where the economy so far has experienced a kind of expansionary policy regime in which the currency has been devalued quite frequently in order to stimulate economic activity while the current account is kept in check. As a result of this, nominal wages grow at a high rate reflecting the wage-earners' attempt to keep pace with the inflation rate. Furthermore, the economy is also characterized by widespread devaluation expectations because the private sector has become familiar with the policy makers' way of reconciling the expansionary internal objectives with the goal of external balance.

Against this background now suppose that a new government comes into power and announces "stable prices" as its major goal and hence declares that it will adhere to a tight, fixed exchange-rate policy. How does such a shift in regime influence the behaviour of the economy? To obtain insight in this issue we assume from the beginning that policy announcements lack credibility because the private sector is well aware that the government may have an incentive to renege. In this respect the analysis is related to work by Barro and Gordon (1983), Backus and Driffill (1985a,b), and Barro (1986) who analysed the effects of disinflation in a closed economy, and Horn and Persson (1985) who looked at the same problem in the open economy. Before we turn to the results of this paper let us therefore briefly summarize the most important results in Horn and Persson (1985) and Barro (1986), which are the papers that have most in common with our model.

Horn and Persson focus on the interplay between wage setting and the exchange-rate policy, assuming that wages are set by a trade union and that the government has full discretion w.r.t. the exchange rate. An important implication of their analysis is that a change in regime is likely to eliminate inflation in the beginning of the election period in the sense that the union goes for the lowest possible wage. Then follows a period where the union occasionally demands a high wage reflecting the increase in the likelihood that the government devalues if it is an expansionary type like the one it has just replaced. Hence in this phase of the game some inflation is inevitably due to the government's credibility problem. At the end of the game where the new policy has gained sufficient credibility the union sets the wage accordingly and hence goes for a low wage. This scenario is similar to the prediction in Barro (1986), who focused on a slightly different situation, namely a game between a government which controls the inflation rate and a private sector which is in charge of the expectations' formation. In that paper it was also shown that an anti-inflationary policy in the short term eliminates inflation and inflationary expectations. Thus in this time perspective the regime shift is neutral with regard to output as it is also in Horn and Persson. Then follows, however, a period with output loss due to a rise in expected inflation which has the same negative effect on output as the more aggressive union behaviour in Horn and Persson. At the end of the game, where the new policy is credible, output returns to the full-employment level.

In this paper, where anticipated inflation, triggered off by anticipated currency depreciations, also play a crucial role in the economy, it is shown that the output scenario in Barro (1986)

hinges crucially on one particular assumption, namely the assumption that the private sector with full certainty believes that a new government never starts out by expanding even when the private sector is well aware that the government could be an expansionary type. If it is assumed instead that the private sector believes that there is a positive probability that such a government expands initially, the consequences of disinflation are quite distinct from the findings in Barro, and Horn and Persson. In fact, we show that disinflation is bound to lead to a loss in output also in the short term. This is, in our opinion, the most plausible outcome which Barro, and Horn and Persson are unable to explain unless some exogenous variables, like the election period, happen to fulfil some specific requirements, a possibility none of the authors devote much attention to.

Aside from investigating the effects on output and inflation, this paper also analyses the effects on the current account, the stock of foreign reserves, and the term structure of interest rates. These are issues which so far have been disregarded in the literature. We show that disinflation leads to an immediate worsening of the current account essentially due to the decline in income and saving. The stock of foreign reserves improve initially due to a decline in devaluation expectations which leads to an inflow of capital. At the end of the game both the current account and the stock of foreign reserves improve, reflecting that the new policy now has become fully credible. With regard to the behaviour of interest rates, it is shown that both the short and long nominal interest rates initially decline. The decline in the long interest rate is, however, less than the fall in the short interest rate due to the risk that the government might

devalue in the future. When the private sector is persuaded that this will not occur, there is a further drop in interest rates. This shows that disinflation leads to a stepwise decline in interest rates. The first decline occurs when the policy is implemented, the second occurs when the policy becomes credible. In the Appendix we have argued that this scenario is broadly consistent with what happened in the Danish economy following the shift in the exchange-rate policy in autumn 1982.

The remaining part of the paper is organized as follows: Section 2 describes the structure of the economy. Section 3 analyses the interplay between the government and the private sector. Section 4 analyses the real and monetary effects of disinflation. Section 5 presents a few extensions of the model and discusses some weaknesses of the analysis.

2. A Small Open Economy Model

In this section we extend the short-run small-open-economy model with a financial sector and a simple monopoly trade-union model. This enables us to study how a change in the exchange-rate policy affects interest rates, money demand, the stock of foreign reserves, and wage formation in the economy, which in turn plays a crucial role for the behaviour of output given that labour is the only variable production factor. To simplify the analysis, we ignore the role of wealth effects and foreign interest payments. These simplifications have very little importance for our results, cf. below.

Consider first the behaviour of output given by

$$y_t = b(p_t - w_t) \ , \quad b > 0 \qquad (1)$$

where y_t, p_t, w_t denote output, the domestic output price, and the nominal wage. Following the conventional practice, all variables - except interest rates - are in logs. Behind equation (1) is the assumption of profit-maximization by a price taking firm. Thus, when the real wage declines, labour demand increases, hence output goes up. Due to the assumption that the home good and foreign good are perfect substitutes, the domestic output price is given as

$$p_t = e_t \qquad (2)$$

where e_t is the exchange rate, and where we have used the normalization that the natural level of the (constant) foreign price level equals one.

Consider next the wage formation in the economy. It is assumed that the union sets the wage so as to maximize its utility function, defined over the real wage and employment level, and subject to the constraint that firms determine the employment level. According to this model, the union sets the nominal wage so as to achieve a desired real-wage level (and employment level). If the union is going to achieve its real-wage target by setting the wage prior to knowing the price level, due to the existence of one-period contracts in the labour market, the wage-rule is given as

$$w_t = E_{t-1}p_t \qquad (3)$$

where $E_{t-1}p_t$ is the rationally expected price level in period t conditional on the information available in period t-1, cf. below. By combining equations (3) and (2) with (1) we note that it is only unanticipated devaluations that affect output and employment in the economy.

So much for the goods and labour markets. The financial sector consists of four assets, namely non-traded domestic money, m_t, a short (one-period) domestic and foreign bond with interest rates given as r_t and r_t^*, and a long domestically issued bond which yields the rate of return $R_{t,n}$ each period from t and until it matures in t+n. Given the assumptions of perfect capital mobility and risk neutrality the short domestic interest rate equals the (constant) foreign interest rate plus the anticipated rate of depreciation, i.e.

$$r_t = r^* + E_t\hat{e}_{t+1} \qquad (4)$$

where $\hat{e}_{t+1} = e_{t+1}-e_t$. The term structure of interest rates is determined by the expectations hypothesis. The return on a sequence of short holdings is therefore equal to the return on long holdings. Hence, $(1+R_{t,n})^n = (1+r_t)(1+E_tr_{t+1}) \ldots\ldots (1+E_tr_{t+n-1})$, $n \geq 2$. By taking logs of this expression and by using the approximations $R_{t,n} \tilde{} \log(1+R_{t,n})$, $r_t \tilde{} \log(1+r_t)$ etc. we obtain

$$R_{t,n} = \frac{1}{n}\sum_{i=0}^{n-1} E_tr_{t+i} \quad , \quad n \geq 2 \qquad (5)$$

This shows that the long interest rate in period t equals a simple average of the expected short interest rates from t to the date where the long bond matures. Money demand is determined in the conventional way as

$$m_t^d - p_t = \lambda_o y_t - \lambda_1 r_t \quad , \quad \lambda_o, \lambda_1 > 0 \tag{6}$$

Thus we assume that the demand for money increases when output goes up, and declines when the opportunity cost of holding money increases. Because the domestic credit component of the monetary base is held constant we can without loss of generality set it equal to zero. The domestic money supply is therefore given by

$$m_t^s = f_t \tag{7}$$

where f_t is the stock of foreign reserves. Given the arbitrage equations (4) and (5), the financial sector is in equilibrium when money demand is equal to money supply, which we assume to be the case. Due to the passive domestic credit policy an increase in the demand for money has to be satisfied through a sale of bonds in the foreign market, which in turn leads to an increase in the stock of foreign reserves of the same order of magnitude. This shows that there is a one to one correspondence between the demand for money and the stock of foreign reserves.

From the National Accounts we know that in a short-run model with a constant capital stock the current account equals total saving in the economy. To simplify matters, suppose that the government finances its interest payments by levying lumpsum taxes on the private sector such that public saving equals zero. In that case,

the current account equals private sector saving. In the absence of foreign interest payments and wealth effects, private saving is assumed to be a function of total output and the anticipated real interest rate, where the latter is measured by the short real interest rate since there are no durable goods in the model. However, since the expected short real interest rate is constant (equals the foreign interest rate, cf. (4)), the current account is essentially only a function of output, i.e.

$$b_t = \beta_o y_t \quad , \quad 0 < \beta_o < 1 \tag{8}$$

Below, we discuss the extent to which the current-account effect is modified had we introduced foreign interest payments and wealth effects into the model.

Now we have to specify the preferences of the policy maker who is assumed to take over in period 0. The new government is either an inflationary type (I-type) or a non-inflationary type (NI-type) with a pay-off function given as

$$V_t^g = \begin{cases} y_t - \frac{a}{2}\hat{p}_t^2 & \text{if inflationary} \\ -\frac{a}{2}\hat{p}_t^2 & \text{if non-inflationary} \end{cases} \tag{9}$$

where $\hat{p}_t = p_t - p_{t-1}$. This shows that both types of governments dislike inflation. The I-type's welfare is, however, also declining when output declines. This reflects its concern for the employment level and for the current account since both deteriorate when output goes down. By use of (1), (2) and (3), (9) can be rewritten as

$$V_t^g = \begin{cases} b(e_t - E_{t-1}e_t) - \frac{a}{2}\hat{e}_t^2 & \text{if inflationary} \\ -\frac{a}{2}\hat{e}_t^2 & \text{if non-inflationary} \end{cases} \qquad (10)$$

where $\hat{e}_t = e_t - e_{t-1}$. The policy maker chooses an exchange-rate policy so as to maximize the value of the game. The value of the game equals the present value of pay-offs given by

$$\sum_{t=0}^{T} (1+\gamma)^{-t} V_t^g \qquad (11)$$

where T is the election period, γ is the rate of time preference. Under the assumption that the policy maker takes exchange-rate expectations for granted (Nash-behaviour), and that the identity of the policy maker is common knowledge, the exchange-rate policy and the exchange-rate expectations are given as $\hat{e}_t = E_{t-1}\hat{e}_t = 0$ if the government is a NI-type, and $\hat{e}_t = E_{t-1}\hat{e}_t = \frac{b}{a}$ if the government is an I-type. This shows that a NI-type goes for a fixed exchange-rate policy, while the I-type has a temptation to devalue the currency each period in order to stimulate output and improve the current account. However, since this is correctly foreseen by the private sector neither output nor the current account improve. The only effect of the policy is to increase the inflation rate and the interest rates in the economy.[1)]

In the next section we analyse the evolution of the game in case the private sector is unaware of the true identity of the new policy maker who takes control of the economy in a situation with inflation. In this case an I-type may have an incentive to masquerade as a NI-type so as to influence future exchange-rate ex-

pectations and hence the gains from a surprise devaluation. For this reason, a disinflationary programme is faced with a credibility problem.

3. The Policy Game Under Incomplete Information

With incomplete information about the preferences and the likely policy actions of the government the private sector faces a non-trivial problem in forming expectations about the future exchange-rate policy. Let the private sector assign a probability that it faces a NI-type in period t, conditional on the available information in t-1, given as $\alpha_t = Pr(NI|\Omega_{t-1})$, where the information set Ω_{t-1} is defined by $\Omega_{t-1} = \{\hat{e}_{t-1}, \hat{e}_{t-2}, ..\}$.[2)] At the initial instant where the new government takes over, this probability is exogenously determined and equals α_o, where $o < \alpha_o < 1$. One can think of α_o as being determined by the fraction of governments which historically have turned out to be non-inflationary, and the appearance and personality of the winning politicians under the election campaign. Because an I-type may have an incentive to pretend that it is a NI-type, the private sector also assigns a probability to the possibility that an I-type does not devalue in period t, given as $\tilde{\varrho}_t = Pr(\hat{e}_t = 0|I, \Omega_{t-1})$. The initial equilibrium value is constrained to fulfil $0 \leq \tilde{\varrho}_o < 1$, where we have imposed the restriction that $\tilde{\varrho}_o$ is strictly less than one. Thus we assume that the private sector always believes that there is a positive probability that an I-type starts out by devaluing. Here our approach differs crucially from the credibility analysis in Barro (1986), cf. below. As time goes by, the government's re-

putation is updated according to Bayes' law [see Barro (1986)], which is given as

$$\alpha_{t+1} = \begin{cases} \dfrac{\alpha_t}{\alpha_t+(1-\alpha_t)\tilde{\varrho}_t} & \text{if } \hat{e}_\tau = 0,\ \forall\tau\varepsilon[0,t] \\ 0 & \text{if } \exists\tau\varepsilon[0,t]:\hat{e}_\tau = b/a \end{cases} \qquad (12)$$

This shows that if the private sector believes that there is a high risk that the government devalues, i.e. if $\tilde{\varrho}_t$ is low, then the government obtains a large increase in its reputation, provided of course that the government does not devalue. If, on the other hand, the government devalues, its reputation is ruined since it is known that a NI-government never devalues. Because the private sector is uncertain both w.r.t. to the type of government it faces and the prospect of a devaluation, the anticipated depreciation equals the probability that the government is an I-type times the probability that it devalues times the preferred depreciation rate, i.e.

$$E_{t-1}\hat{e}_t = (1-\alpha_t)(1-\tilde{\varrho}_t)(b/a) \qquad (13)$$

This equation shows that the expected rate of depreciation for period 0 is positive but less than b/a since $0 < \alpha_0 < 1$ and $0 \leq \tilde{\varrho}_0 < 1$. Hence, there is a decline in devaluation expectations for period 0 due to the possibility that the new government might be a NI-type. In Barro (1986), where $\tilde{\varrho}_0$ is free to take any value, it turns out that the equilibrium value of $\tilde{\varrho}_0$ equals one unless the exogenous T and/or α_0 happen to be very low, a possibility Barro (1986) does not devote much attention to. Hence, in general

there are no problems of establishing credibility of the disinflationary strategy in the beginning of the game. The credibility problems arise at a later stage as described by Barro (1986). However, since we find it rather implausible that devaluation expectations completely disappear overnight we have excluded the Barro-equilibrium by assumption. Below, we show that there exists another equilibrium which, in our opinion, is more plausible and indeed also fits the Danish case fairly well, see Appendix.

Consider now the behaviour of the government. For a NI-type the problem is straightforward since it never has an incentive to devalue, hence $\hat{e}_t = 0$, $\forall t \varepsilon [0,T]$. For the I-type the problem is more difficult since it may have an incentive to behave like a NI-type. We shall show that there exists an equilibrium where the I-type devalues with probability $1-\varrho_t$, and postpones the devaluation with probability ϱ_t. For such a mixed strategy equilibrium to make sense, the value of the game of devaluing in period t (the present value of pay-offs from t to T) must equal the value of not devaluing in t, and then in t+1 playing a lottery over either devaluing or postponing, and so forth. The same condition must hold in the next period, t+1. From these "equal pay-off" conditions it follows that the value of the game of devaluing for sure in period t must equal the value of devaluing for sure in t+1, given that the value of the game in the latter case is transformed into period t units. The value of the game of devaluing in period t is given as

$$b\left(\frac{b}{a} - E_{t-1}\hat{e}_t\right) - \frac{a}{2}\left(\frac{b}{a}\right)^2 + \frac{1}{1+\gamma} \sum_{i=t+1}^{T} \left(\frac{1}{1+\gamma}\right)^{i-t-1} \left(-\frac{a}{2}\left(\frac{b}{a}\right)^2\right) \quad (14)$$

The first term is the output gain from a surprise devaluation in period t, the second term is the costs of inflation in t, and the last term is the present value of the costs of inflation in all future periods. If the I-government postpones the devaluation to t+1, the value of the game is given as

$$-bE_{t-1}\hat{e}_t + \frac{1}{1+\gamma}[b(\frac{b}{a}-E_t\hat{e}_{t+1}) + \sum_{i=t+1}^{T}(\frac{1}{1+\gamma})^{i-t-1}(-\frac{a}{2}(\frac{b}{a})^2)] \quad (15)$$

The first term is the output loss in t arising because the private sector anticipates a devaluation, the second term is the present value of the output gain from the devaluation in t+1, the third term is the present value of the costs of inflation from t+1 and onwards. By setting (14) equal to (15) we obtain

$$E_t\hat{e}_{t+1} = (\frac{1-\gamma}{2})(\frac{b}{a}) \quad , \quad t \geq 0 \quad (16)$$

Thus for the I-type to be indifferent between devaluing the currency with certainty and playing a mixed strategy with probabilities to be calculated below, the conditional devaluation expectations must be constant from period 1 to T.[3] It is noteworthy that the existence of an equilibrium in mixed strategies does not impose any constraints on the anticipated rate of depreciation for period 0, defined as $E_{-1}\hat{e}_0 = (1-\alpha_0)(1-\tilde{\varrho}_0)(b/a)$, cf. (13). As a consequence $\tilde{\varrho}_0$ is indeterminate, which reflects that the model has multiple rational expectations equilibria, see Andersen and Risager (1987). This is a feature shared with most sequential equilibrium models, see Kreps and Wilson (1982). To avoid the indeterminacy in period 0, we have to impose some further constraints. We impose the restriction that there must not be any anticipated jumps in expectations as long as the identity of the

policy maker has not been revealed. Hence, we assume that (16) also holds for period 0. This procedure can be motivated in a number of ways. First, it can be shown that this is the unique equilibrium in the corresponding continuous time version of the model, see Andersen and Risager (1986). The intuition behind this is simple. In a continuous time rational expectations model there cannot be anticipated jumps in expectations since rational agents will take actions which prevent anticipated infinite capital gains associated with such jumps. Secondly, the restriction does not violate the rational expectations hypothesis. Below, we show that the rationally expected rate of depreciation for period 0 and the subsequent periods in fact become equal to the expression given by (16). Thirdly, all equilibria which fulfil the constraint that devaluation expectations do not disappear overnight, expressed by $\tilde{\varrho}_0 < 1$, possess the same qualitative properties as the case we shall analyse. Hence, there is no loss in economic insight by using the above mentioned procedure.

By combining (16), extended to hold also for the expectations for period 0, with (13) we obtain

$$(1-\alpha_t)(1-\tilde{\varrho}_t) = (1-\gamma)/2 \qquad (17)$$

Following standard practice in game theory we shall now look for a consistent equilibrium to our game of incomplete information. A consistent equilibrium is defined as an equilibrium where the subjective probability $\tilde{\varrho}_t$ and the objective probability ϱ_t coincide, cf. Friedman (1986, Ch. 2); see also Barro (1986, p. 11). This is, of course, a restrictive practice. However, we hope to show that even disregarding the kind of misperception which

exists when the subjective $\tilde{\varrho}_t$ deviates from the objective ϱ_t, reputation plays a substantial role for the effects of a policy regime shift. Under the consistency assumption we are now able to describe the evolution of the government's reputation. Thus by combining (17) with (12) we obtain

$$\alpha_{t+1} = \begin{cases} 2\alpha_t/(1+\gamma) & \text{if } \hat{e}_\tau = 0,\ \forall \tau \varepsilon [0,t] \\ 0 & \text{if } \exists \tau \varepsilon [0,t] : \hat{e}_\tau = b/a \end{cases} \tag{18}$$

By solving this first-order difference equation in α_t we obtain

$$\alpha_t = \begin{cases} \alpha_0 (2/(1+\gamma))^t & \text{if } \hat{e}_\tau = 0,\ \forall \tau \varepsilon [0,t[\\ 0 & \text{if } \exists \tau \varepsilon [0,t[: \hat{e}_\tau = b/a \end{cases} \tag{19}$$

Because $2/(1+\gamma) > 1$, there is a steady increase in the credibility of the fixed exchange-rate policy as long as the government has not devalued. By substituting (19) into (17) the I-type's exchange-rate policy is given as

$$1-\varrho_t = ((1-\gamma)/2)/(1-\alpha_0(2/(1+\gamma))^t) \text{ if } \hat{e}_\tau = 0, \forall \tau \varepsilon [0,t[\tag{20}$$

This shows that $1-\varrho_t$ increases as the currency has not yet been devalued. Thus, it becomes more and more likely that the I-type devalues, see also Figure 1. This tends to increase inflationary expectations, cf. (13), and therefore to reduce the "return" of a devaluation. This effect is, however, exactly offset by the rise in α_t such that the expected depreciation remains constant, cf. (16). Thus, except for the initial decline in devaluation expectations which occurs in the anticipation of a possible change of

Figure 1: The evolution of reputation (α_t) and the probability that an expansionary government devalues ($1-\rho_t$).

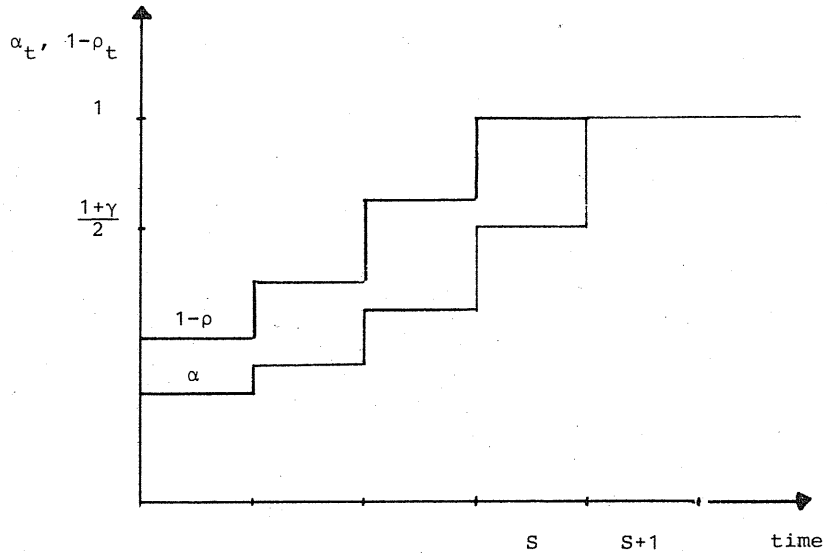


Figure 2: The short interest rate.

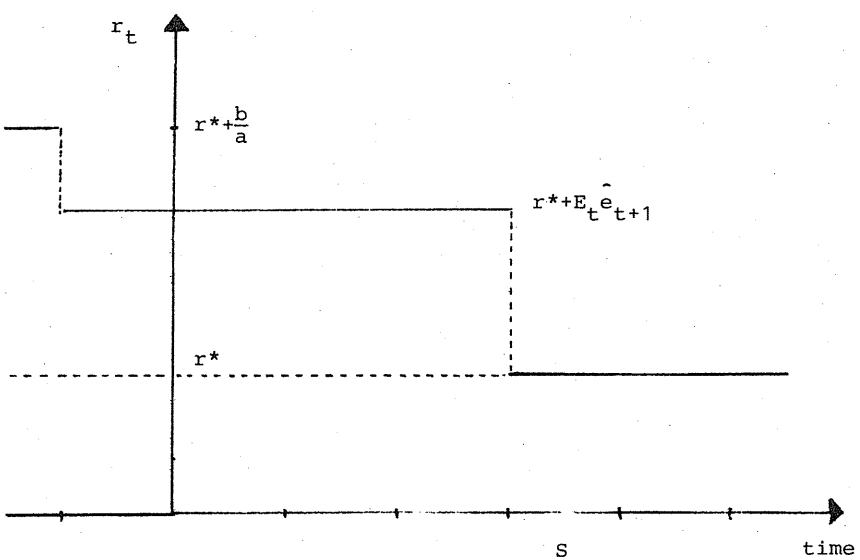


Figure 3: Output.

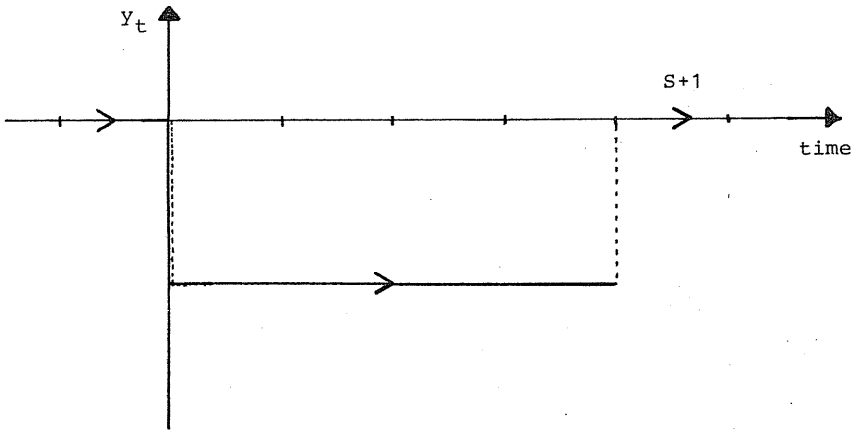
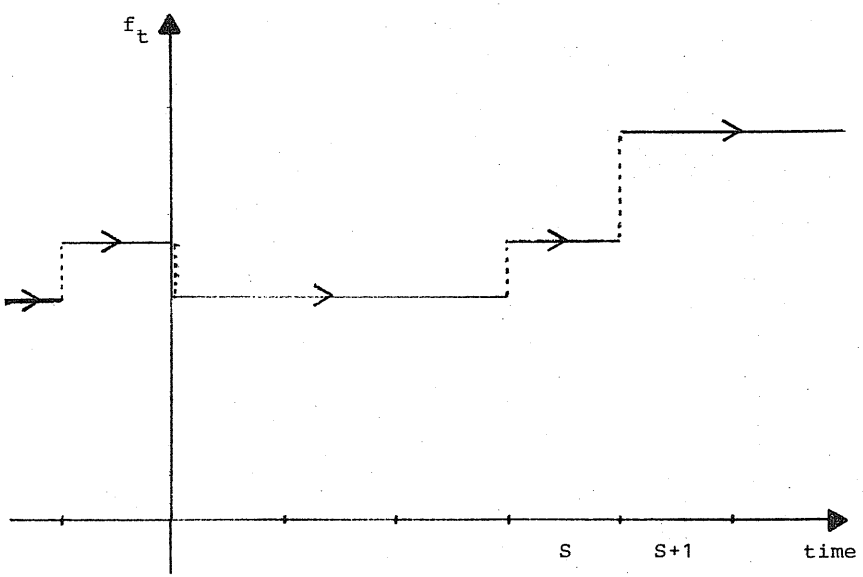


Figure 4: Foreign Reserves.



government in period 0, devaluation expectations are constant as long as the government has not revealed itself, see Figure 2.

From (20) it follows that there is a final period $\bar{S}$ where the I-type for certain has revealed itself. This period is defined by $1 = 1-\varrho_{\bar{S}} = ((1-\gamma)/2)/(1-\alpha_0(2/(1+\gamma))^{\bar{S}})$. Hence,

$$\bar{S} = (\ln(\tfrac{1+\gamma}{2})-\ln\alpha_0)/\ln(\tfrac{2}{1+\gamma}),\ \alpha_0 < (1+\gamma)/2 \qquad (21)$$

where we have assumed that $\alpha_0 < (1+\gamma)/2$ to rule out the trivial case where the government devalues for certain in period $t = 0$. Given this, and the discrete-time assumption, an I-type devalues for certain in period S, where the integer S is defined as $S-1<\bar{S}\leq S$. If $S\leq T$, the government reveals itself before or at the date where the game terminates. At that instant, devaluation expectations increase to the level experienced under the former government. If, however, it turns out that the government maintains the fixed exchange-rate target the private sector realizes that the government in fact is a NI-type. Hence, devaluation expectations disappear as shown in Figure 2. In the polar case where $S > T$, arising when α_0 and/or T are low, there is a probability that an I-type has not revealed itself within the horizon of the game. Since we know that an I-type always has an incentive to reveal itself before the game terminates this cannot be an equilibrium. A few minor modifications are therefore required.[4)]

Suppose, therefore, that the I-type devalues for sure in the last period. Under this assumption the relevant terminal condition is $1-\varrho_T = 1$, which is equivalent to $\alpha_T = (1+\gamma)/2$, cf. (17). By imposing the latter condition on (18), the solution for α_t is now

given as $\alpha_t = (1+\gamma)/2)(2/(1+\gamma))^{t-T}$ for $t \geq 1$. Hence, $\alpha_1=((1+\gamma)/2)^T$. Given this, we can now determine the value of ϱ_0 such that α_t in fact increases to the level $((1+\gamma)/2)^T$ in t=1. From Bayes' formula ϱ_0 is implicitly given as $((1+\gamma)/2)^T = \alpha_0/(\alpha_0+(1-\alpha_0)\varrho_0)$. This gives

$$\varrho_0 = \frac{\alpha_0}{1-\alpha_0}\,[1 - (\frac{1+\gamma}{2})^T]/(\frac{1+\gamma}{2})^T \qquad (22)$$

Since the main problem in this case is that the government starts out with too bad a reputation, the trick is to lower ϱ_t at t = 0, compared to what would otherwise have been the case. Thus by increasing the devaluation threat initially the government achieves the right amount of reputation in period t=1 and in the subsequent periods. By substituting the above solution for α_t into (17) we then obtain the behaviour of $(1-\varrho_t)$ from t = 1 to t = T. Because the dynamic adjustment of α_t and $1-\varrho_t$ is qualitatively similar to the case where $S \leq T$ we henceforth confine our attention to the latter case.

4. The Effects of Disinflation

So far we have characterized the scenario of the government's reputation, the exchange-rate policy of the two types of potential policy makers and the exchange-rate expectations in the economy. In this section we analyse how a tight, fixed exchange-rate policy affects the economy, assuming that the new policy lacks credibility.

Consider first the behaviour of wages. The goal of the union is to keep the real wage at a constant target level, cf. (3). Under

the former government the union has therefore increased the money wage each period in order to keep pace with inflation. In the period preceeding the change of government there is a decline in inflationary expectations for period 0. Due to that, the union moderates its wage demands for period 0 in the sense that the growth rate of wages is less than what has been experienced so far. However, since inflation drops to zero, the real wage overshoots the target in period 0. For period 1, the union expects the same increase in the price level as it did for period 0. For this reason, the wage is set at the level prevailing in period 0. But since the government continues to play zero inflation, the real wage is also surprisingly high in this period. In period S, the union is persuaded that the government in fact is a NI-type. Hence, in period S+1, the money wage declines to the level consistent with the real-wage target. Viewed with the benefit of hindsight, the union should also have chosen this wage rate in the former periods. However, since the union rationally has expected some inflation the wage has been set at a level which, unfortunately, turns out to be too high, ex-post. Due to that, output is low in the entire adjustment period, see Figure 3. This shows that disinflation is costly. This reflects, of course, the credibility problem of the government. Thus had the union been certain about the intentions of the government, the wage would have been lowered immediately, and the transition to a world of stable prices would have been painless.

Due to the fall in output in period 0, the tight exchange-rate policy leads also to an immediate decline in saving and therefore to a worsening of the current account, cf. (8). This result is also likely to hold in a model with foreign interest payments and

wealth effects.[5] Because output continues to be at a low level, the current account is in a bad shape in the transition period. At the end of the game, where output returns to the full-employment level, the current-account deficit vanishes.

Let us now turn our attention to the financial sector. Because the short interest rate equals the foreign interest rate corrected for the anticipated depreciation there is a stepwise decline in the short interest rate as shown by Figure 2. The question now is how the short and long interest rates are related. From (4) and (5) we find that the long interest rate equals

$$R_{t,n} = \frac{1}{n} \sum_{i=0}^{n-1} E_t\hat{e}_{t+1+i} + r^*, \quad n \geq 2 \tag{23}$$

Thus, the long interest rate is also above the foreign interest rate in the adjustment period. To obtain insight into the term structure of interst rates we have to investigate the determinants of the anticipated rate of depreciation. The anticipated depreciation for period t+m can be expressed as

$$E_t\hat{e}_{t+m} = (1-\alpha_{t+1})(1-\prod_{i=1}^{m} \varrho_{t+i})(\frac{b}{a}) \tag{24}$$

Equation (24) says that the expected depreciation for period t+m, formed in period t, is equal to the probability of facing an inflationary government times one minus the probability that the government has not revealed itself before period t+m times the rate of currency depreciation an I-government chooses if it actually devalues in period t+m. From (24) it follows that the expected depreciation for period t+m+1 exceeds the expected de-

preciation for period t+m, i.e. $E_t\hat{e}_{t+m+1} > E_t\hat{e}_{t+m}$. This relationship reflects the fact that if the I-type has not devalued in period t+m, the likelihood increases that the I-type devalues in t+m+1 since it is known that the I-type always is going to reveal itself at some point in time. By substituting (24) into (23) we obtain

$$R_{t,n} = \frac{1-\alpha_{t+1}}{n} \sum_{i=1}^{n} (1 - \prod_{j=1}^{i} \varrho_{t+j}) \frac{b}{a} + r^* \qquad (25)$$

By subtracting (25) from (4), using (13), it can be shown that[6)]

$$R_{t,n} > r \quad , \forall t,n \quad , n \geq 2 \qquad (26)$$

This shows that the interest rate on a bond which matures no less than two periods ahead is always greater than the current short interest rate. This result reflects the financial sector's uncertainty w.r.t. the government's exchange-rate policy. The result holds for all n, and hence also for a bond which matures beyond time S. Finally, it should be remarked that as soon as the financial markets realize that the incumbent government is a NI-type both r_t and $R_{t,n}$ deline to the level prevailing in the rest of the world.

Consider next the behaviour of the stock of foreign reserves, which is determined by the demand for money. Due to the decline in the short interest rate in the period preceding the possible change of government, money demand increases. This leads to an increase in the stock of foreign reserves, see Figure 4. The inflow of capital is, however, immediately followed by an outflow due to the fall in output. Then follows a period with a constant stock of foreign reserves. In period S there is a further in-

crease in foreign reserves due to the disappearance of devaluation expectations. This effect is strengthened in the subsequent period because output returns to the full-employment level. The stock of foreign reserves is now at a higher level, both in nominal and real terms, compared with the level under the inflationary regime.

5. Extensions and Qualifications

Now we briefly wish to investigate under what circumstances international exchange-rate cooperation lessens the NI-type's credibility problem. To this end we imagine that the country is a participant in an international monetary system. First we consider the case where the country has to ask for a devaluation, assuming that such an inquiry is kept secret.

To capture this idea, suppose that there is a probability, say δ, that the international monetary system concedes. For simplicity, assume that δ is a constant. In this case the expected depreciation equals

$$E_{t-1}\hat{e}_t = (1-\alpha_t)(1-\varrho_t)(\delta)(\frac{b}{a}), \quad 0 \leq \delta \leq 1 \tag{27}$$

This modification does not change much of the previous analysis since the equilibrium condition, cf. (16), says that $E_{t-1}\hat{e}_t$ should also equal $((1-\gamma)/2)(b/a)$, hence

$$(1-\alpha_t)(1-\varrho_t)\delta = \frac{1-\gamma}{2} \tag{28}$$

Basically, the effect of introducing this modification is to in-

crease the likelihood, $1-\varrho_t$, that an I-type wishes to devalue. However, since it is the combination of the government's temptation and the international community's willingness to accept a devaluation that matters, this does not lead to a shortening of the period in which the private sector is uncertain about the intentions of the government. The costs and effects of disinflation are therefore unchanged.

So far we have assumed that the I-type at least has some possibility each period to devalue the currency. Now consider the case where the government is only allowed to devalue once within the election period. Does such a system provide a sufficient substitute for the NI-type's inability to commit itself? To answer this question, we first compute the value of the game in case the I-type devalues in period t, given as

$$b(\hat{e}_t - E_{t-1}\hat{e}_t) - \frac{a}{2}(\hat{e}_t)^2 \qquad (29)$$

If the devaluation is postponed to t+1, the value of the game equals

$$-bE_{t-1}\hat{e}_t + \frac{1}{1+\gamma}\,[b(\hat{e}_{t+1}-E_t\hat{e}_{t+1}) - \frac{a}{2}(\hat{e}_{t+1})^2] \qquad (30)$$

Following the previous reasoning (29) must equal (30). This gives

$$E_t\hat{e}_{t+1} = -\frac{\gamma b}{2a} < 0 \qquad (31)$$

Hence for the I-type to be indifferent between devaluing in period t or in t+1, the private sector must expect a revaluation in period t+1 if the government has not yet devalued. The reason is that the postponement of the devaluation causes an output loss in period t due to the devaluation expectations formed in t-1,

cf. the first term in (30). To compensate for this, there must be a large pay-off of a devaluation in t+1 which is only possible if the private sector expects a currency revaluation. However, since this is infeasible, the I-type devalues as soon as it has taken over. Thus, when the international exchange-rate cooperation reduces the member countries' discretionary power in such a way that they are only permitted to devalue once per election period, the costs and effects of a switch towards a non-inflationary exchange-rate policy disappear immediately after the first period.

The virtue of the last example is to show that international exchange-rate cooperation only lessens the credibility problems of the NI-type if the rules are fairly strict, and apparently more rigorous than the rules underlying the cooperation within the EMS, which is a system that has more in common with the first example. Under the present institutional set-up adoption of a non-inflationary exchange-rate policy is therefore likely to give rise to serious credibility problems.[7)]

A central purpose of this paper has, therefore, been to demonstrate the existence of an equilibrium where the "reputational mechanism" plays an important role. Under the assumption that private agents attach a non-zero probability that an I-type devalues the currency when it takes over, we have shown that insufficient credibility alone is able to explain why a disinflationary exchange-rate policy leads to a temporary decline in economic activity and to a deficit on the current account. The latter effect is a result of the fall in current income, which is assumed to lead to a fall in saving. Insofar as saving depends on other variables like consumer's wealth, as it is the case in the empiri-

cal version of the Ando-Modigliani model, we have argued that the current account is likely to improve in the adjustment process. If we go one step further and assume that a fraction of the consumers save according to the forward-looking life-cycle model, our analysis has, however, underestimated the short-run current-account deficit because current consumption in that case is only marginally affected by the decline in current income since there is only a minor fall in permanent income. Thus, irrespective of whether consumers are governed by current income, or by current income and wealth, or by permanent income, it seems safe to conclude that the current account deteriorates in response to a change in regime.

It is important to stress that the credibility hypothesis does not rely on irrational beliefs or expectations, but is fully consistent with the notion of rational expectations. Actually, the equilibrium concept underlying this model is stronger than what is necessarily implied by the rational expectations concept since private agents' subjective beliefs about the outcome of the I-type's randomization coincide with the actual outcome. To repeat an earlier discussion, this equilibrium concept has merely been chosen because the model otherwise is unmanageable. However, since the consistent equilibrium property is a very strong assumption, it is quite likely that the analysis underestimates both the explanatory power of the credibility hypothesis and the short-run effects on output and the current account following the adoption of a non-inflationary exchange-rate policy in a small open economy.

Finally, it is also a weakness of the analysis that the credibi-

lity of the exchange-rate target only depends on the government's exchange-rate management and on its willingness to bear the investment costs required to establish credibility. In the real world, the design of the other policy instruments and their consistency with the overall policy objectives seems also to be important. To take that into account is a challenge for future research.

Notes

* Comments from participants at a workshop on Game Theory and Macroeconomics at the Institute of Economics, University of Aarhus, Nov. 1986, and from participants at a seminar at the Institute for International Economic Studies, Stockholm, have improved the paper. In particular, we are grateful to Lars Calmfors, John Driffill, Nils Gottfries, Thor Gylfason, Michael Hoel, Morten Hviid, Kim Asger Olsen and Bo Sandemann Rasmussen.

1) The specification of (9) implies that $\hat{e}_t$ is a dichotomous variable, taking the value 0 or b/a. We believe that this is a fairly reasonable assumption in this context since there is little point for a NI-type to undertake small discrete devaluations.

2) Given the structure of the model, current inflation is a sufficient statistic for the new information obtained in each period on the preferences of the policy maker.

3) An alternative way of deriving (16) is given in Barro (1986).

4) In this note we briefly describe how our equilibrium is related to Barro (1986): In Barro (1986) it is assumed that the I-type inflates for sure in T. If α_0 and/or T are not very low, α_t remains at the level α_0 over an extended period. For

this to be the case, $\tilde{\varrho}_t$ must equal 1 in the same period, cf. (12). In our set-up with $\tilde{\varrho}_0 < 1$, there is immediate updating of α_t, i.e. $\alpha_0 < \alpha_1 < \alpha_2$ etc. For this reason, α_t may reach the critical level $(1+\gamma)/2$, corresponding to $1-\varrho_t = 1$, before T. Is that consistent with optimizing behaviour? Yes, given the restriction $\tilde{\varrho}_0 < 1$, the government is by construction indifferent between devaluing in T or in e.g. T-1, etc., i.e. there is no well defined terminal condition; see also Andersen and Risager (1987a). Finally, if S<T, it might be thought that the I-type has an incentive to cheat, i.e. to devalue in S+1. That possibility is, however, ruled out by the consistency assumption $\tilde{\varrho}_t = \varrho_t$, implying that such a move would be perceived by the private sector. Due to this, the I-type has no incentive to devalue beyond S.

5) In this case saving in t is a positive function of disposable income in t, given as the sum of current output and the real-value of the interest payments on the stock of foreign bonds held in the end of t-1, and a negative function of real wealth held in the end of t-1, given as the real value of the holdings of money and foreign bonds. As the holdings of foreign bonds goes up in period -1, interest payments increase in t=0, cf. below. In t=1, interest payments decline. Taken together, it is therefore uncertain whether the interest-payment's effect alters the average value of the current-account in this time perspective. What about wealth? Wealth is predetermined in t=0. Hence, the short-run current-account effect is not changed by introducing the wealth effect. In the subsequent periods, wealth declines due to the deficit. This leads to a tendency for saving to increase and therefore to a modification of the current-account result.

6) We have that $r_t - R_{t,n} = \frac{1-\alpha_{t+1}}{n}[n(1-\varrho_{t+1}) - \sum_{i=1}^{n}(1-\prod_{j=1}^{i}\varrho_{t+j})]b/a$, and because $1-\prod_{j=1}^{i}\varrho_{t+j} > 1-\varrho_{t+j}$ for $\forall i \geq 2$, it follows that $r_t - R_{t,n} < 0$

7) Note also that the effectiveness of the system just described relies on the consistent equilibrium assumption which is quite a restrictive assumption, cf. below.

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Appendix. The Danish Experiences

In this section we briefly discuss the recent shift in the Danish exchange-rate policy. In our view, this provides an interesting example of the relevance of the model.

The regimeshift took place in autumn 1982, where the (present) government - a liberal-conservative minority coalition - came into power and announced a fixed exchange-rate policy.[1)] This signalled a fundamental change compared to the recent past, where various governments quite frequently had devalued the Danish Krone (D-kr) in the hope that this could improve both the current account, which had been in a deficit since 1963, and the domestic activity level. Thus from the start of the European Monetary System in March 1979 to autumn 1982, the D-kr was devalued 4 times. This contributed to a depreciation of the trade-weighted exchange rate. From 1979 to 1982 the value of the D-kr fell by 18%. Despite of the substantial depreciation there was no sign of a solution to the external and internal problems. Due to this, and the fact that the private sector had become familiar with the policy makers' "reaction function", there were widespread devaluation expectations in the economy which is indicated by the very high (and increasing) interest rates in the first half of 1982, see Figure 5.[2)] The expectations of a devaluation were stimulated further during September and October 1982, due to a 3% devaluation of the Norwegian Krone September 6, a 16% devaluation of the Swedish Krone October 8, and a 3.8% and a 5.7% devaluation of the Finnish Mark October 6 and October 11, respectively. This led to turmoil in the market for foreign exchange, to an outflow

DOMESTIC AND FOREIGN INTEREST RATES

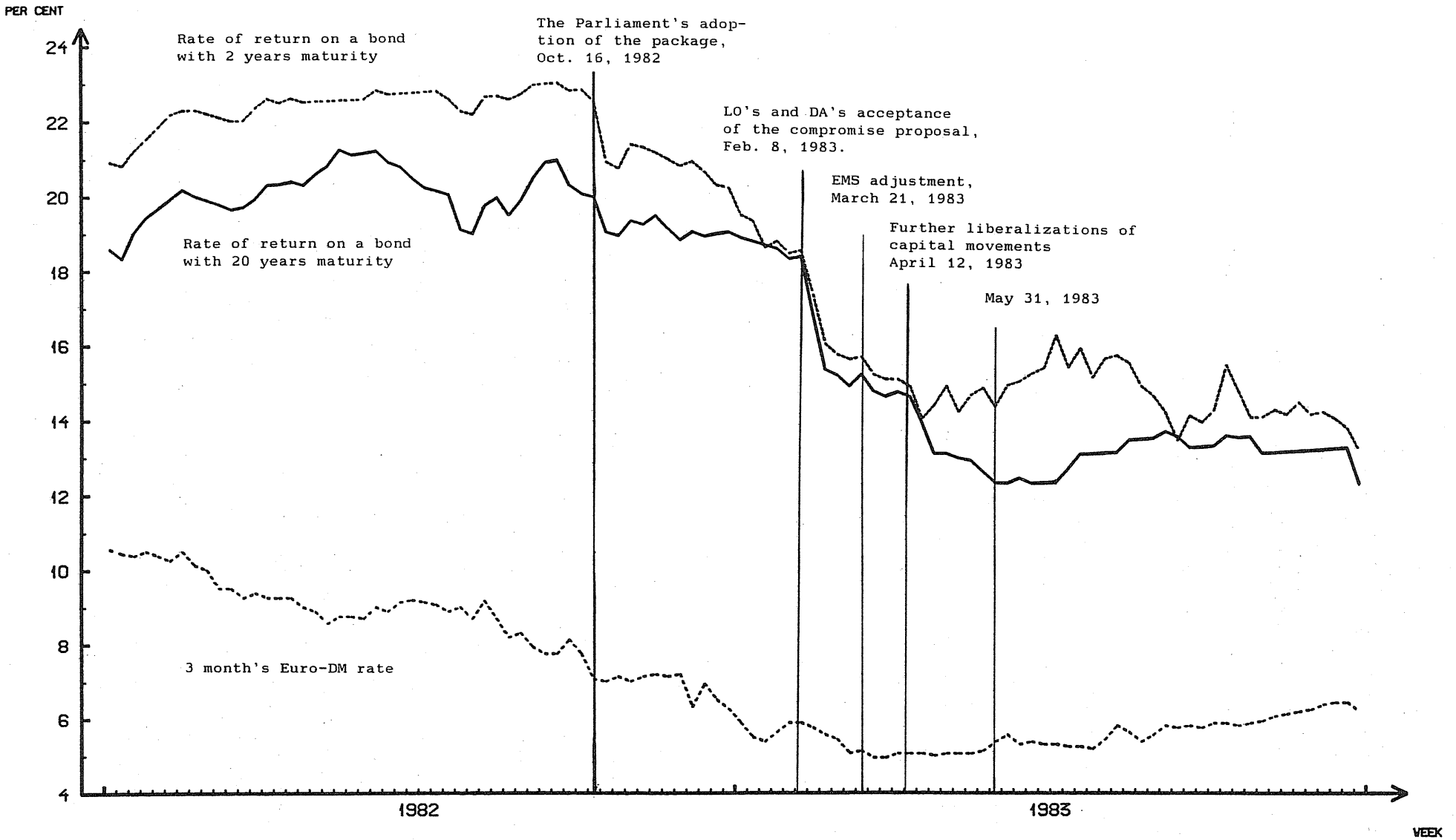

Figure 5.

Datasource: Andelsbanken

A1a

of capital, and to a further rise in interest rates. The question was whether the new government, who came into power September 10 and hence before the Swedish and Finnish devaluations, would take the opportunity to neutralize the adverse effects of these devaluations, or perhaps even devalue the currency in excess of what the two major Nordic devaluations could justify, and hence in that case clearly renege on its promises? It turned out that the government was firm on the new exchange-rate policy, which it supported by abolishing all indexation mechanisms in the wage-formation process, a temporary wage-freeze, and a tight fiscal policy. The overall goals of the policy were to reduce the wage and price increases and to achieve a balanced current account in 1988. The guideline for the wage increases in the forthcoming 2 years was 4% p.a.. There were no targets for the employment level. Instead, it was implicitly clear, due to the exchange-rate target and the design of the fiscal policy, that this was the unions' and employers' own responsibility. The package was passed through the Parliament October 16, 1982. Until that date, it was uncertain whether the government would succeed in getting its policy through, reflecting its minority status. For this reason, the Parliament's adoption of the package also eliminated the speculations about the possibility of a new election, a possible change of government and economic policy.

On the first trading day after the Parliament had accepted the policy, the domestic interest rates fell on average by more than 1 percentage point (p.p.). This was the largest decline in interest rates in 7 years [Finanstidende, Oct. 22, 1982]. Thus the short interest rate fell by 0.94 p.p., the long interest rate fell by 1.6 p.p.. In the same period the Euro-DM rate declined by

0.06 p.p.. Both the timing and magnitude of the jumps in the short and long interest rates indicate that these events to a large extent had their roots in the adoption of the policy measures, cf. the discussion to follow, but also in the government's strong adherence to the fixed exchange-rate target in the days up to October 16. W.r.t. the latter, it is likely that the fact that the government abstained from a devaluation in a situation where previous governments might have devalued contributed to an increase in the credibility of the exchange-rate strategy and therefore also to the decline in the interest rates. Thus, we argue that what might have seemed to be unfortunate exogenous disturbances in 1982 are likely to have been beneficial from the point of view of establishing credibility since they provided a good test of whether the government was an I-type or a NI-type, to use the jargon in the former sections. Following the events in October, the short interest rate stabilizes, while the long interest rate continues to decline, see Figure 5. The outflow of capital is soon followed by an inflow, cf. the Annual Report of the Centralbank [Nationalbankens Aarsberetning (1982), p. 45].

On February 8, 1983 there is a further downward jump in the interest rates, see Figure 5. Thus the short and long interest rates fell by 1.58 p.p. and 1.20 p.p., respectively, while there is only a tiny decline in the foreign interest rate. This decline is usually attributed to the agreement February 8 between the trade union federation (LO) and the employers association (DA) on the wage increases for the forthcoming 2 years [Nationalbankens Aarsberetning (1982), p. 13]. Their compromise resulted in annual wage increases of about half the size experienced in the beginning of the 1980's. The moderate wage settlements, which were

close to - though slightly above - the government's 4% guideline, indicate that the government's policy had had significant effects on LO's inflationary expectations - otherwise it is hard to explain why the wage settlements result in such a substantial decline in the wage increases. Thus in view of the theoretical analysis, it is not surprising that there is a decline in interest rates exactly on February 8.

The next decline in interest rates occurs immediately after the realignment in the European Monetary System March 21, which enhanced the credibility of the exchange-rate policy since the D-kr essentially was held unchanged against the basket, and on April 12, where the government announces a further liberalization of capital movements to take place May 1. To sum up, the short and long interest rates fell by about 8 p.p in the period from October 12, 1982 to May 31, 1983. In the same period the Euro-DM rate declined by about 1.7 p.p..

We have argued that the government's firm commitment to the fixed exchange-rate policy in a period of crisis and attacks on the country's competitiveness, and under the realignment within the European Monetary System, has contributed to an increase in the credibility of the policy and therefore also to the spectacular decline in interest rates and to the moderate wage agreements.[3] However, it is also likely that the tight fiscal policy and the incomes policy have played a role as argued also in the Annual Report of the Centralbank.

This illustrates a weakness of the model since the interest-rate determination is independent of the demand pressure and cost in-

creases at home, due to the heroic small-open-economy construction. From an analytical point of view this construction has, however, some merits because it is easier to analyse the direct effects on inflation and interest rates of a tight exchange rate policy without the interference of the indirect effects which operate through aggregate demand, and which, anyway, are likely to strenghten the direct effects.

Notes

1) Although the government never made it one hundred percent clear what "fixed" means, the intention was to tie the Danish Krone to the basket in the EMS and to avoid discrete Danish devaluations.

2) It was f.i. common knowledge that the 3% devaluation of the D-kr February 22, 1982 was less than what the government had asked for [Nationalbankens Aarsberetning (1982), p. 44].

3) This hypothesis is also supported by the econometric study of Christensen (1986).

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