Disinflation and credibility effects: the Swedish case[1]

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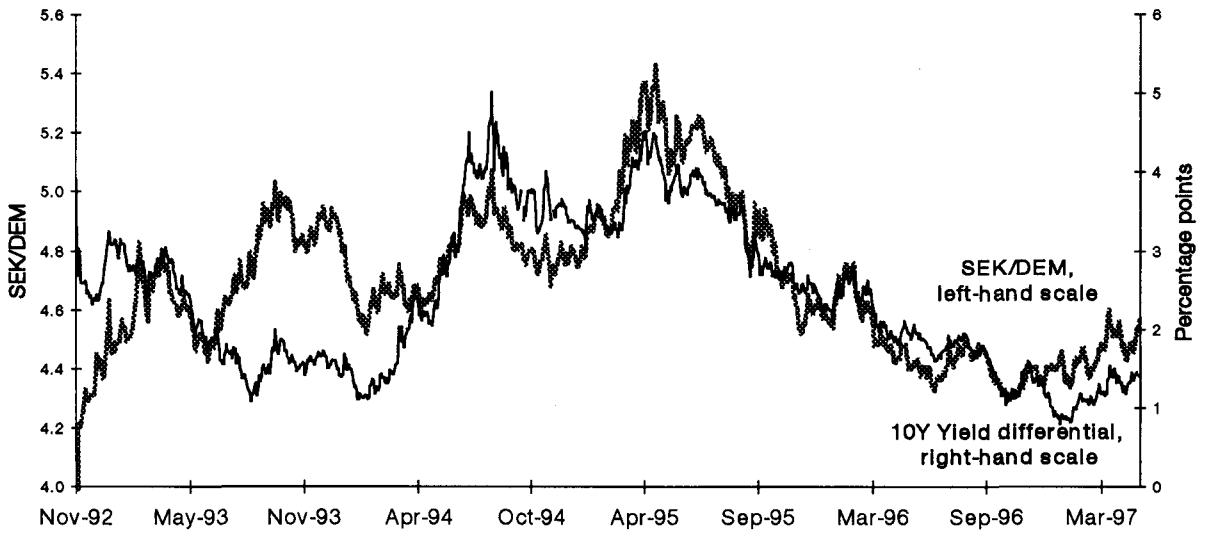
Introduction

The interaction between financial markets in Sweden, on the one hand, and the real economy and the inflation process, on the other, has probably changed substantially in recent years due to the change from a fixed to a floating exchange rate regime with an explicit inflation target. There are several aspects of special importance. First, the adoption of an inflation target that differs markedly from the historical inflation rates in the seventies and eighties generated credibility effects that differed both in size and nature from effects associated with devaluation expectations in the fixed exchange rate regime. Moreover, uncertainties regarding the evolution of public finances have evidently reinforced these credibility effects.

The volatile developments in financial markets (see Figure 1) in recent years underline the importance of analysing the effects of imperfect and fluctuating credibility for economic policy, as well as the effects related to the monetary regime shift. It is not very useful to analyse the transmission mechanism without a framework in which the volatile developments of the exchange rate and long-term interest rate can be understood.

Figure 1
The (SEK/DEM) exchange rate and the long term yield differential



Apart from these credibility considerations, there are other changes that probably have altered the transmission mechanism per se. For instance, the role of the exchange rate channel is likely

to be of greater importance in the present floating exchange rate regime. Moreover, the market's interpretation of monetary policy actions, such as changes in the repo rate (the key official interest rate), is different in the new regime with an explicit inflation target, as it modifies the transmission from the repo rate to market rates for longer maturities. These subjects, important as they are, will not be discussed in this paper.

Instead, this study tries to illustrate some of the consequences of the above-mentioned changes for the Swedish economy by means of simulations in a macro model. Especially, we will focus on the effects elicited by credibility shocks and the role of the disinflation process in this respect. We consider the main contribution of this study to be the work on modelling and quantifying credibility effects. We do not provide a detailed account of the macroeconomic development in Sweden since the announcement of the inflation target in January 1993. Instead, we regard this paper as an input to our ongoing calibration work on the model. At the present stage, we merely give a very stylised account of the *main* features of the Swedish disinflation process, in particular, the modelling of credibility effects and their repercussions on the real economy.

The paper is organised as follows. In Section 1, changes in the Swedish economy related to the monetary regime shift are discussed as well as different notions of imperfect credibility. In Section 2 we briefly discuss the main features of the macro model we employ for the simulation analysis.[2] Next, in Section 3 we present two alternative scenarios for a disinflation process, with different kind of credibility effects. In the final section, we summarise and draw conclusions.

1. The monetary regime shift and credibility effects in Sweden

1.1 The monetary regime shift[3]

Traditionally, a fixed exchange rate has served as an intermediate target for the ultimate objective of price stability in Sweden. After the break-down of the Bretton Woods system in 1972 Sweden participated in the so called currency snake, which can be seen as a precursor to the EMS. In August 1977 the krona was taken out of the snake system and unilaterally pegged to a weighted index, which in 1991 was replaced by the ECU. During the seventies and eighties, actual and expected inflation was, however, too high relative to other countries and the fixed exchange rate regime was sometimes not credible. This development resulted in several devaluations and, finally, an abandonment of the fixed exchange rate regime in November 1992. Against this background, in January 1993 the Governing Board of the Riksbank adopted an explicit inflation target as a means to guiding inflationary expectations and in this way improve the credibility of monetary policy. The inflation target was set to 2% with a tolerance interval of $\pm 1\%$, and it became operative in 1995.[4]

As will be discussed shortly, the credibility of the low inflation policy has improved substantially, even though this favourable trend periodically has been interrupted by events related to

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2 We gratefully acknowledge the very generous support and help from the Bank of Canada provided to us. Without their assistance our macro model project would not have been possible.

3 For a more detailed discussion of the monetary regime shift in January 1993 and the consideration behind the introduction of the new inflation target in Sweden, see Andersson and Berg (1995) and Svensson (1995).

4 In this context, inflation is measured as the twelve-month increase in the consumer price index and the inflation target should be evaluated against the average inflation rate during a year. In 1993 and 1994, i.e. before the inflation target became operative, monetary policy was directed towards preventing the underlying rate of inflation to be rising. At the time the underlying rate of inflation was around 2%.

political uncertainty as well as to uncertainty regarding the development of the fiscal position in Sweden. The next section defines in more detail and discusses what is meant by imperfect credibility.

1.2 Credibility effects

Before making statements about how the credibility of an economic policy directed at price stability changes over time, it is necessary to define credibility and relate it to some quantitative measure. In general, credibility problems of monetary policy arise when expectations of the target variable (e.g. the exchange rate or the inflation rate) deviate from the declared target. However, inflation expectations are difficult to observe and interpret and similar problems arise when it comes to the definition and quantification of imperfect credibility. Moreover, even in an economy characterised by perfect credibility with respect to the inflation target, actual inflation as well as inflation expectations will deviate from the target due to unavoidable short-run inflation effects. It is, however, extremely difficult to separate these effects from those due to imperfect credibility. With these considerations in mind, the gap between inflation expectations and the inflation target will be viewed as an indicator rather than a perfect measure of credibility problems.

Furthermore, in analysing the economic effects that imperfect credibility may have we find it useful to distinguish between two types of credibility: operational and political.[5] Operational credibility refers to mechanisms that can be analysed endogenously within our model whereas political credibility refers to effects that have to be treated as exogenous shocks. It is worth emphasising that this decomposition of credibility into an endogenous and an exogenous part reflects features of the model used in this study and should not be seen as a universal modelling device.

Before discussing in more detail and separately how to model operational and political credibility we will present an overview of these concepts and point out some important features. Operational credibility mainly refers to the extent to which agents expect that future inflation will be in line with the inflation target *within the* current regime. In other words, operational credibility does not incorporate effects arising from expectations that the current target for monetary policy might change in the future. Operational credibility thus largely depends on the conduct of monetary policy and will improve if actual inflation evolves in accordance with the inflation target. Furthermore, the degree of operational credibility is mainly reflected in surveys of inflation expectations and it heavily influences price and wage setting behaviour but also to some extent financial prices, since changes in inflation expectations affect expectations of future monetary policy actions and thereby short term interest rates.

Political credibility, as used in this paper, reflects investors' fears that the economy will switch to an inflationary regime, which in turn will increase long-term interest rates and the exchange rate. The quantitative effect of such fears can be formalised as a regime shift premium representing the probability of a regime shift times the change in the average rate of inflation associated with this regime shift.[6] The effects of imperfect political credibility probably depend on the degree of political support for the inflation target and the perceived sustainability of public finances; experience tells us that these factors are of greater importance during periods of international turmoil on the financial markets. Political credibility is, therefore, treated exogenously because its determinants are very hard to model endogenously when long-run inflation expectations are tied to the inflation target and the sustainability of public finances is a constraint. As we will see in Section 1.4, shocks to political credibility will be modelled as exogenous, simultaneous shocks in long-term interest rates and the exchange rate in a manner that can be justified theoretically.

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5 Operational and political credibility are concepts introduced and discussed by Andersson and Berg (1995).

6 See Dillén (1994, 1996) and Dillén and Hopkins (1997) for analysis of regime shift premia and their impact on interest rates. Regime shift premia in the exchange rate is analysed by Dillén and Lindberg (1997) and discussed in Section 1.4.

Table 1
Features of operational and political credibility

Type of credibility	**Operational**	**Political**
Determinants	Actual inflation and monetary policy actions.	Political support for the inflation target. The perceived sustainability of public finances. Actual inflation.
Characteristics	Events that cause a deviation between inflation expectations (within the current regime) and the inflation target.	Occasional and exogenous shocks often related to international and political events.
Endogenous or exogenous in this study	Endogenous.	Exogenous.
Indicators	Surveys of inflation expectations. Financial prices to some degree.	Financial prices. Surveys of inflation expectations to some degree.
Effects	Price and wage setting behaviour and to some extent financial prices.	Financial prices, especially long term interest rates and the exchange rate.

In practice it is often difficult to distinguish between operational and political credibility and the two mechanisms regularly interact. If actual inflation substantially exceeds the inflation target it will mainly damage operational credibility but political credibility may weaken as well. On the other hand, weak political credibility will give rise to volatile financial markets and therefore makes the transmission process more unpredictable. This in turn affects the conduct of monetary policy. A notable difference is that political credibility to a lesser extent is reflected in surveys of inflation expectations. Political credibility represents expectations of potential shifts to high inflation regimes, which should be included in inflation expectations. However, it seems that such expectations are, to only a limited extent, incorporated in surveys of inflation expectations. One explanation is that surveys reflect agents' assessment of the most likely outcome for future inflation rather than inflation expectations in a mathematical sense.[7]

1.3 Operational credibility and endogenous inflation expectations

When the Swedish inflation target was announced in 1993, inflation expectations tended to be above the target, especially the long-term expectations. Since then inflation expectations have been revised downwards to levels close to the inflation target.[8] This development is most pronounced for long-term inflation expectations, whereas short-term inflation expectations are also strongly affected by the actual evolution of inflation. Overall, there seems to be a gradual adjustment of inflation expectations towards the inflation target, which probably to a large degree can be attributed to improved operational credibility.

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[7] However, as discussed by Dillén and Hopkins (1997), it appears that surveys of financial investors' inflation expectations to some extent reflect regime shift expectations.

[8] During the period 1993-95 one-year inflation expectations of households normally fluctuated in the upper half of the tolerance interval (1-3%) whereas expectations at or below the target have been observed since 1996. One-year inflation expectations in industry were even higher (3-4%) before they at the end of 1995 rapidly started to decline towards the lower limit of the tolerance interval. Bond investors' long-run inflation expectations have exhibited a declining trend from almost 5% in early 1993 towards slightly below 3% at the end of 1996. For further details about these surveys, see various issues of the Riksbank's Inflation Report.

Inflation expectations were normally above the actual inflation outcome during this period, indicating imperfect operational credibility. Inflation expectations that systematically exceed the actual inflation outcome do not in this case necessarily imply irrational expectations, but rather asymmetric information. Even if price stability is the overriding objective of monetary policy, this is not known by private agents and the degree of commitment to the announced target has to be learned by examining the actual developments of inflation and how monetary policy responds to different shocks. This gradual adjustment of expectations can be modelled within the model in a straightforward way. The formation of inflation expectations can schematically be described as:[9]

$$\pi^e = \alpha\pi_{backward} + (1-\alpha)\pi_{perfect\ foresight} \quad (1)$$

As seen from equation (1), inflation expectations combine a backward-looking component, given a weight α, with a forward-looking (or model-consistent) component, given a weight $(1-\alpha)$. Inflation expectations represent perfect foresight if $\alpha = 0$. The backward-looking component can be seen as adaptive expectations that reflect the historical pattern of inflation. If historical inflation is significantly above the target when this is announced, inflation expectations will be above the target. However, if actual inflation evolves in accordance with the target then this backward-looking component will converge towards the target. In this way inflation expectations will gradually adjust towards the target. The formation of expectations is endogenously determined within the model, implying that the analysis of operational credibility problems, as indicated by the gap between expectations and the target, are treated *endogenously*.

1.4 Political credibility effects as exogenous shocks to financial markets

Expectations and credibility problems are in practice complicated concepts and very difficult to characterise fully endogenously. The long-run credibility of the inflation target is mainly affected by mechanisms (often of a political nature) that are difficult to capture within the model. In particular, this type of imperfect credibility is suitably modelled as expectations of shifts to high inflationary regimes (see e.g. Dillén (1994, 1996) and Dillén and Hopkins (1997)). Such regime shift expectations are not easily incorporated into our model, which assumes only one regime with a single-steady state inflation rate. In a fixed exchange rate regime, similar credibility problems in the form of devaluation expectations will arise. As pointed out by Dillén (1994), a loss of exchange rate target credibility mainly increases short-term interest rates, whereas a loss of inflation target credibility is likely to increase long-term interest rates.[10] To formalise these ideas we consider the following expression for the logarithm of the nominal exchange rate:

$$s = s_0 + s_{rs} \quad (2)$$

where s_0 is the normal component of the exchange rate, reflecting normal factors affecting the exchange rate including normal monetary policy actions, and s_{rs} is the regime shift component, reflecting the effects of monetary regime shifts expectations. For example, Bertola and Svensson (1993) derive an expression for the exchange rate essentially of the form of equation (2) in which the regime shift component is proportional to the expected rate of devaluation.[11] In the case of a free floating exchange rate regime with an inflation target, Dillén and Lindberg (1997) derive a

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9 A more detailed description of how expectations are formed within the model will be presented in Section 3.

10 In the regime switching model of Dillén (1994) a loss of credibility of an inflation target means a larger probability of switching to a high inflation regime.

11 See Bertola and Svensson (1993, equation (19)), in which the regime shift component is of the form $s_{rs} = \alpha g$, where g is the expected rate of devaluation. Notice, however, that g also appears in some exponential terms that take care of the so called "smooth pasting conditions".

closed-form expression for the regime shift component representing the effects of investors' fears that the economy will shift to a high inflation regime. Moreover, given that Germany is a country with very high credibility with respect to its low inflation policy, it can be shown that the regime shift component is approximately related to the long term yield differential, d^L, relative to Germany, as:

$$s_{rs} = \gamma d^L \tag{3}$$

One way to understand equation (3) is to consider the degree of monetary policy credibility as a demand factor. A reduction of the credibility of an exchange rate or inflation target will lower the demand for bonds denominated in the domestic currency, which presumably will lead to higher interest rates as well as a weaker currency. A fluctuating regime shift premium can, in this way, explain a positive correlation between the exchange rate and the interest rate differential. Conceptually, regime shift premia represent peso type credibility problems, since shifts to a more inflationary regime typically do not occur in the analysis. On a more general level, however, equation (3) can be seen as representing a fluctuating demand factor that can incorporate risk premia of various kinds. In what follows we therefore include the possibility that the regime shift premium also incorporates other kinds of premia that give rise to similar effects.[12]

In order to get a quantitative feeling for the credibility effects, let us reconsider Figure 1. During 1993 the long-term interest rate (differential) gradually declined from the very high levels that prevailed during the currency crises in 1992; to some extent, this can be seen as a gradual adjustment of expectations towards a low inflation regime. The depreciation of the krona during 1993 is somewhat hard to explain but, on occasions, political credibility shocks seem to be present. From 1994 to 1996 there is clear evidence of political credibility shocks of the kind discussed above. First, notice the positive correlation between the long-term interest rate differential and the exchange rate – a phenomenon that is difficult to explain without introducing a fluctuating regime shift premium (or another demand factor). It is also difficult to attribute the large movements in the exchange rate and the interest rate differential to other economic factors. Thus, it seems that a fluctuating regime shift premium might have been the dominant determinant of the volatile evolution of the exchange rate and the interest rate differential in recent years. Given this conjecture, the value of parameter γ in equation (3) can be assessed by "eye-econometrics": the fall of the long-term interest rate differential by slightly more than 3% since April 1995 has been accompanied by an appreciation of around 15%, which suggests a γ-value in the range 4 – 5. However, more careful analyses that take other important determinants into account sometimes suggest a lower value for γ. In the simulations we assume a γ-value of 4.

2. Presentation of the simulation model [13]

The model used in this paper consists of two sub-models: the *"steady-state model"*, which describes the long-run equilibrium features of the economy, and a *dynamic model* that explains short and medium-run adjustment paths of relevant macro variables when, after shocks, the economy is off its steady-state path. Permanent shocks will by definition change the steady state.

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[12] Due to peso type problems it is very difficult to distinguish between regime shift premia and other kinds of premia with similar characteristics. Any kind of a statistical verification of a regime shift model requires observations of regime shift. However, during the period with a fixed exchange rate policy several regime shifts in the form of devaluations were observed in Sweden.

[13] Our current model is a slightly modified version of the Quarterly Projection Model (QPM) of the Bank of Canada. For a full documentation of QPM see Black, Laxton, Rose and Tetlow (1994) and Coletti, Hunt, Rose and Tetlow (1996).

The model assumes an exogenously growing one good economy characterised by a demographic structure with overlapping generations and non-Ricardian features. The model describes the behaviour of households, firms, the government, the central bank and the rest of the world. The decisions of these agents interact to determine the ultimate levels of key stocks: capital, government debt, and net foreign assets. These target stock levels in turn are key determinants of the associated flows, such as consumption, saving, investment, government spending and revenues, and the external balance. There is a formal stock-flow accounting framework that ensures full consistency among all variables both in the long run and along the dynamic adjustment path.

The model provides solutions for both the desired wealth of consumers in the long run and the consumption/savings paths that will sustain that level. Household supply of labour is treated as exogenous. Firms take the real cost of capital as given and choose the optimal stock of capital to go with it, as well as the path for investment spending that will take the economy to that equilibrium and maintain it. The government chooses a steady-state ratio of government debt to GDP. With these three steady-state decisions taken, aggregate net borrowing or lending for the economy as a whole is determined, resulting in the net foreign asset position of the country. Associated with this equilibrium net foreign asset position will be a unique external balance, i.e. imports, exports and foreign debt service. The relative price that will adjust to achieve this is the real exchange rate.

An important characteristic of the model is that the steady-state allocation of real variables is independent of the target rate of inflation. This implies, among other things, that the long-run level of all real stocks are left unchanged. Accordingly, there is no mechanism in the model that determines an optimal rate of inflation. That has to be determined by factors outside the model and then imposed as the inflation target rate of the monetary authorities.

The dynamics in the model originate from mechanisms explaining *gradual adjustments* of real as well as nominal variables such as prices and wages. The dynamics stem from three different sources. The first source is intrinsic to the economic structure and refers to all sources of gradual adjustment not related to expectations. These include labour market contracts, the fixed costs associated with investment, and so on. Such features give rise to a gradual response to disturbances, regardless of how large the disequilibrium might be. One can think of this as a general phenomenon of costly adjustment, which causes all agents in the economy to choose not to adjust immediately to disturbances.

A second source of dynamics is the *expectation mechanisms* in the model. Expectations are formed in a flexible way. In principle they are constructed as a combination of *backward-(adaptive) and forward-looking* elements. The weights attached to the two types of expectations differ between variables. A high degree of backward-looking expectations implies a high degree of rigidity in the adjustment of a variable. For instance, it takes time before changes in monetary policy feed into price and wage formation, which in turn implies a need for substantial adjustments in real variables. In contrast, a high degree of forward-looking expectations generates more flexible adjustments.

The third source of dynamics is the reaction of policies to disturbances. As the main purpose of the model is to analyse monetary policy, the endogenous reaction of the fiscal authority is not modelled in all its details. In order to respect the governments budget constraint and targets for public expenditure and debt as ratios to GDP, the income tax rate changes endogenously. Furthermore, the model includes a monetary policy reaction function, according to which a rise in anticipated inflation above target produces a rise in interest rates (slope of the yield curve) intended to move inflation back towards its target level over a horizon of six to seven quarters. The horizon is not arbitrary but an approximation of the sort of horizon over which monetary policy can have a meaningful influence on the trend rate of inflation. With monetary policy represented in this way, the response on the part of monetary authorities to economic disturbances that affect inflation is built-in; i.e. interest rates (slope of the yield curve) adjust automatically to put inflation on a path that will converge towards its target level.

More formally, the dynamic elements give rise to the following general structure of the determination of the GDP-deflator:

$$LP_t = \alpha LPBACK_t + (1-\alpha)LPFOR_t + \phi MAV(GAP_t) + \upsilon MAV(GAPPOS_t) \tag{4}$$

$$LPBACK_t = A(L)LP_{t-1} \tag{5}$$

$$LPFOR_t = \sum_{s=0}^{T} \rho^s E_t\left(LP^*_{t+s}\right), \qquad 0 < \rho < 1 \tag{6}$$

$$E_t(LP_{t+s}) = \delta B(L)LP_{t-1} + (1-\delta)LP_{t+s} \tag{7}$$

$$R^s - R^L = \theta\left[\tfrac{1}{2}\sum_{s=6}^{7}\left(\pi_{t+s} - \pi^{target}\right)\right] \tag{8}$$

where *A(L)* and *B(L)* are lag polynomials in *LP*. Equation (4) shows that the (log of) the GDP deflator has a backward and a forward-looking part. Behind this general formulation lies an intertemporal pricing problem for a firm facing adjustment costs in changing its price. The backward-looking part, equation (5), is derived from the fact that the *rate of change*, not just the level, is of importance. The forward-looking part, equation (6), consists of the discounted expected future *desired* price levels, with the horizon truncated *T* periods ahead. The desired price level is given by the static first order condition for the firm, taken from the steady-state model. Expectations of the future price level are modelled as a mixture of adaptive and model consistent elements according to equation (7).

Equation (8) describes the monetary policy rule. If actual inflation, six to seven quarters into the future, exceeds (is lower than) the target rate of inflation, the monetary authority raises (reduces) the short term interest rate. Eventually the inflation gap is eliminated through movements in the slope of the yield curve, short-term interest rate minus long-term rates, which in turn induces an output gap, *GAP*. As can be seen from equation (4), the output gap enters into the determination of prices in an asymmetric way. A positive output gap will have a larger inflationary impact on prices compared to the deflationary effects that a corresponding negative gap gives rise to. This general model structure of the dynamic behaviour of the GDP deflator is common to nominal wages as well as to the deflators of the GDP-components.

The determination of the short and the long-term interest rate and the nominal exchange rate is highly endogenous. The interdependence goes via the yield curve and the assumption of uncovered interest parity (UIP). However, expectations about the future nominal exchange rate do not exhibit perfect foresight. There are some expectation errors in the short run. In the long run the nominal exchange rate is determined by the level of the real exchange rate and the difference between the domestic and the foreign price level. Of these only the real exchange rate is solved in the steady-state model, since there is no price level targeting. The actual levels for prices will depend on the exact type of shock under study and the dynamic factors that drive the inflationary process until the target inflation rate is reached again.

The long-term interest rate is partly determined by the expectation theory of the term structure and partly by the inflation differential with rest of the world. Furthermore, there is a direct link between shifts in the short-term rate and movements at the longer end of the yield curve, assumed to represent the empirical observation of a high degree of volatility in long-term interest rates in Sweden; i.e. more than the pure expectation theory predicts. In the long run, interest rates and the nominal exchange rate obey relative PPP; i.e. they adjust to accommodate differences in actual and expected rates of inflation between Sweden and the rest of the world.

3. Simulation results

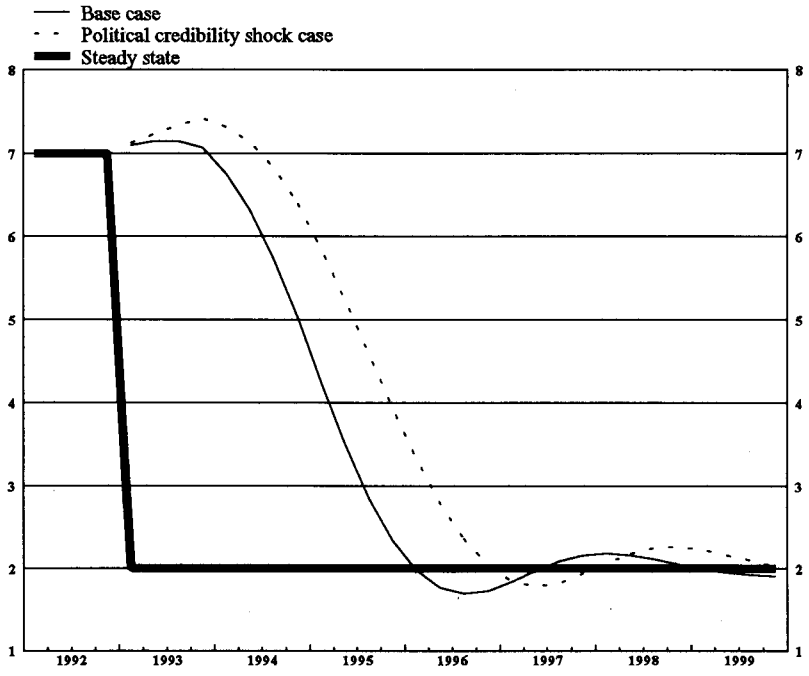
The purpose of this section is to illustrate some of the main effects of introducing an inflation target when the credibility of this target is imperfect. Since our main focus is not on tracking historical data very closely, we make the simplifying assumption that we start our simulations from a steady-state situation. A more realistic analysis would start from a disequilibrium situation that resembles the Swedish macroeconomic environment at the time of the introduction of the inflation target. Instead, we try to implement the concepts of operational, or endogenous, credibility and political, or exogenous, credibility in the context of a general equilibrium model.

Section 3.1 presents the general characteristics of two different disinflation scenarios and relates the model simulations to operational and political credibility. Next, in Section 3.2 we discuss in more detail the results when only operational credibility effects are taken into account. This scenario is taken as our base case. In Section 3.3 the outcome of a scenario containing operational as well as political credibility effects is compared with our base case.

3.1 Two disinflation scenarios

Our base case disinflation scenario entails a permanent reduction of the target rate of inflation from 7 to 2% per annum. The reduction of the domestic inflation rate by 5% illustrates the shift from a high inflation regime during the eighties, with an average inflation rate of about 7%, to the present low inflation regime where the official target rate of inflation is 2%. In addition, we assume that the foreign target or long-run inflation rate is reduced from 4 – 2% annually.

Figure 2: Annual inflation rate (%)



In Figure 2, the thick line shows the shift in steady-state or target inflation from 7 to 2% taking place in the first quarter of 1993. The thin continuous line represents the transition path for inflation during our base case scenario. Disregard the dotted line for the time being. Even in the base

case scenario it takes time to change expectations of private agents about future inflation, since expectations are modelled as a weighted average of backward and forward-looking elements, as can be seen from equation (1) above. Consequently, the adjustment to the new and lower inflation target will be a gradual process.[14] Figure 2 shows that it takes approximately three years to reach the new target rate of inflation.

The time it takes to reach the new inflation target is partly dependent upon the relative importance of the backward-looking component of expectations (α in equation (1)). The larger this weight, the more importance agents attach to the past when forming expectations about future inflation. If we assume completely model consistent expectations ($\alpha = 0$), the history of inflation plays no role at all in forming inflation expectations. In this special case, agents fully believe the new inflation target in the sense that past inflation outcomes are not considered. In general, however, agents pay attention to previous inflation outcomes when forming expectations about future inflation ($0 < \alpha < 1$). Assuming that the central bank does its job, actual inflation will gradually approach the target rate and this in turn causes inflation expectations to be revised downwards towards the new target rate. This feature of expectations formation is *operational* or *endogenous credibility*.

In the second scenario, we attempt to model *political* or *exogenous credibility* effects. Informal empirical evidence suggests that a 1% increase in the long-term interest rate differential is associated with a 4% depreciation of the exchange rate as described by equation (3) above. We take this observation as a guide to the determination of the magnitude and correlation of exogenous shocks to the nominal exchange rate and the domestic long-term interest rate.

There is an instantaneous 4% depreciation of the Swedish krona which abates over four quarters and then reverses somewhat for another four quarters; this pattern is consistent with the depreciation of the krona in the period following the introduction of the inflation target. This disturbance is accompanied by a rise in the long-term interest rate differential towards the rest of the world.

Our second disinflation scenario contains two elements of credibility. First, we have operational or endogenous credibility through the gradual revision of expectations. Second, we have added an exogenous component, political or exogenous credibility, by shocking the nominal exchange rate and the domestic long-term interest rate.

3.2 Disinflation with purely endogenous credibility effects

In this section we give an account of the disinflation process when only endogenous credibility effects are present – our base case. The results are presented in Figures 3-18 below. The dotted line in these figures, representing the political credibility shock case, will be analysed in the following section.

Generally, monetary policy affects the rest of the economy via three channels: (i) a change in interest rates; (ii) real exchange rate movements through the uncovered interest rate parity condition; and (iii) altered expectations. Immediately after the announcement of the new inflation target, an inflation gap arises; i.e. a deviation between the actual and the target inflation rate, amounting to 5%, as can be seen from Figure 3.

To reduce the inflation gap, short-term interest rates have to increase in order to restrain aggregate demand and enforce the new inflation target on the expectations of private agents. The short-term interest rate is raised by roughly 500 basis points (Figure 5), whereas the long-term rate actually falls somewhat due to lower expected future inflation, as shown in Figure 6. The slope of the yield curve, i.e. the short minus the long rate, is shown in Figure 4.

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[14] However, due to adjustment costs for real as well as nominal variables, there is a gradual response to shocks even in the absence of partly backward-looking expectations.

Figure 3: Inflation gap (shock - control, %p.)

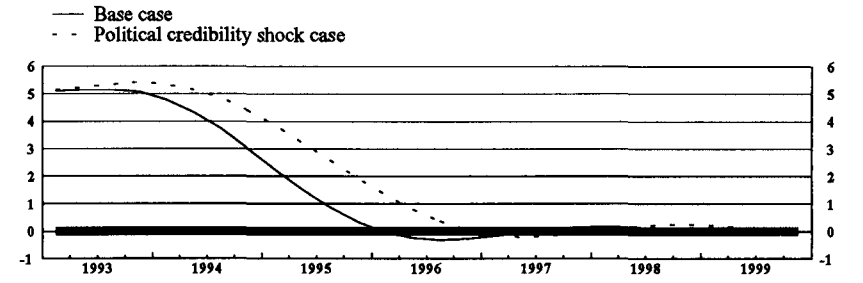


Figure 4: Short minus long interest rate (shock - control, b.p.)

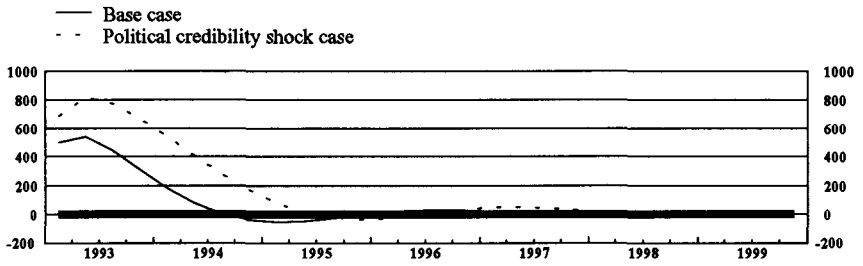


Figure 5: Short term nominal interest rate (shock - control, b.p.)

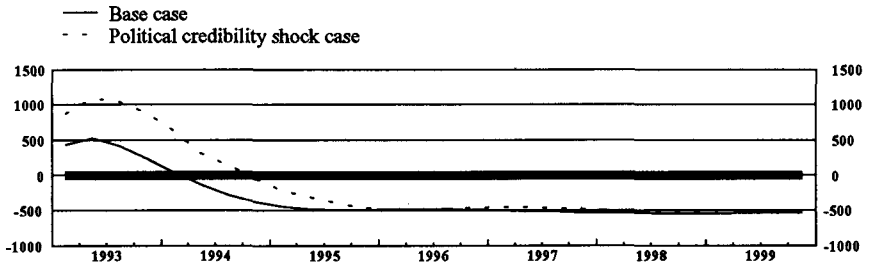


Figure 6: Long term nominal interest rate (shock - control, b.p.)

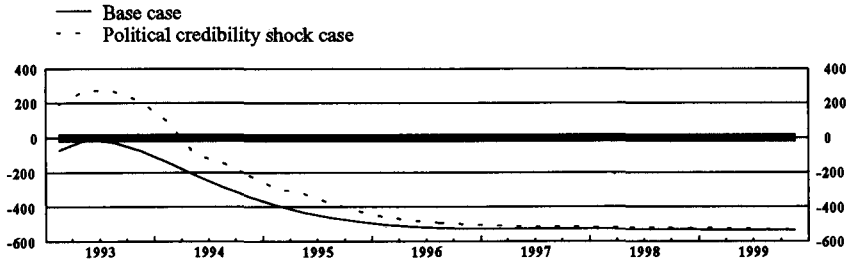


Figure 7: Output gap (shock - control, %)

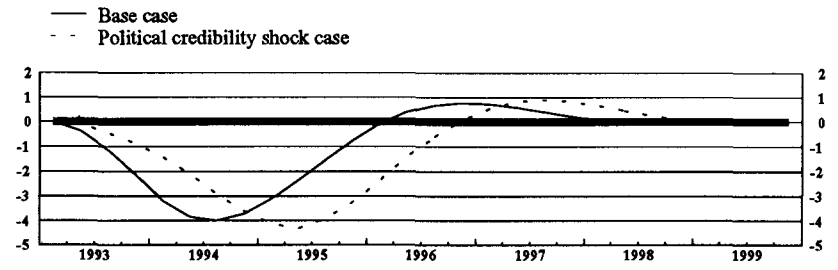


Figure 8: Cumulative output loss (shock - control, %)

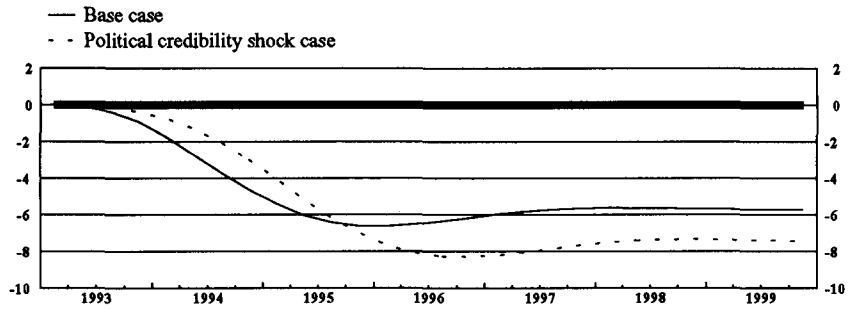


Figure 9: Consumption (shock - control, %)

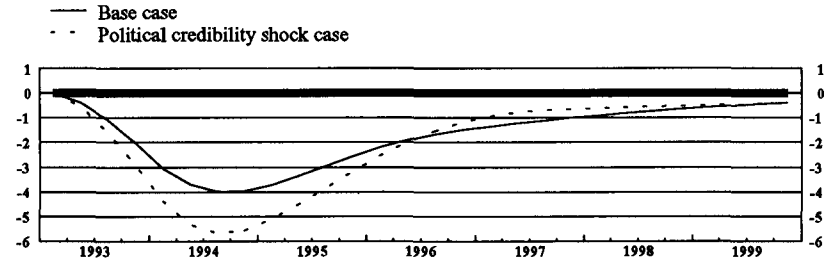


Figure 10: Investment (shock - control, %)

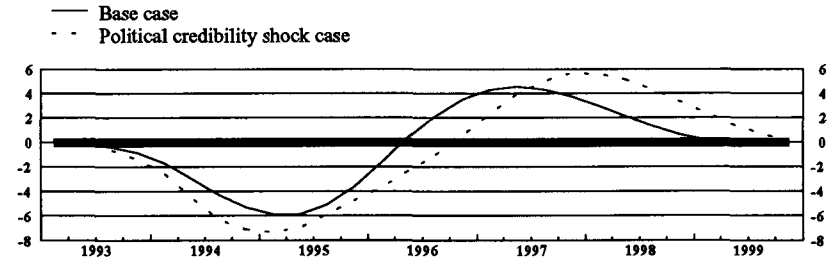


Figure 11: Net exports (shock - control, %)

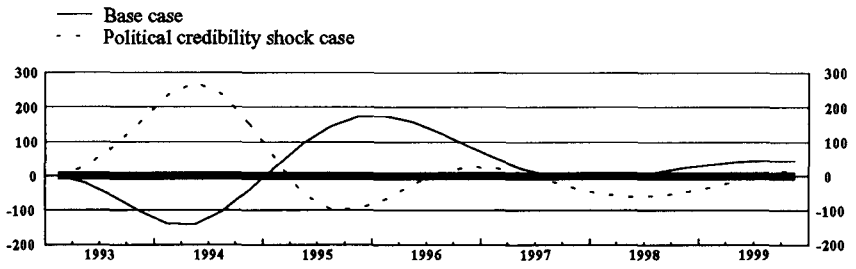


Figure 12: Real exchange rate (shock - control, %)

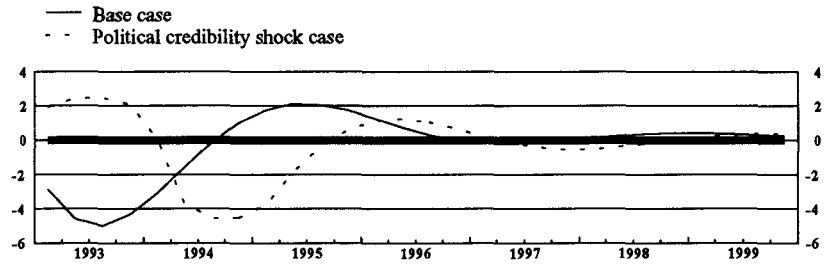


Figure 13: Exports (shock - control, %)

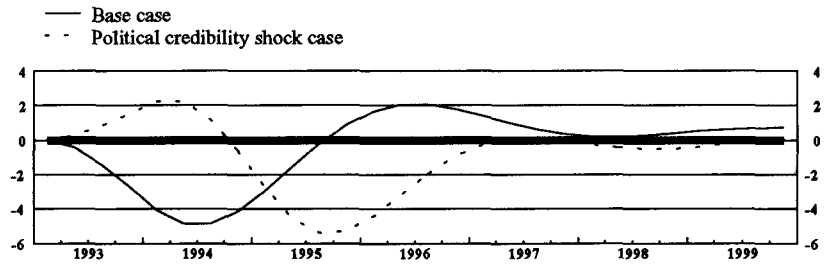


Figure 14: Imports (shock - control, %)

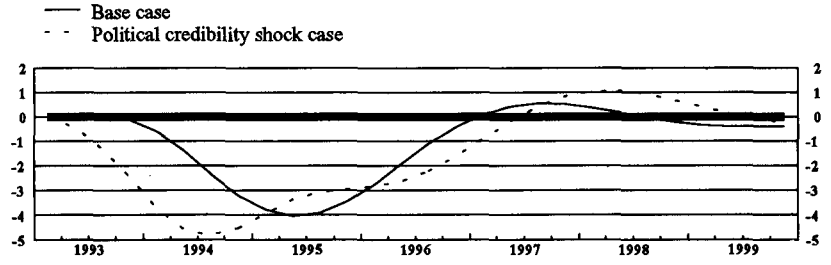


Figure 15: Nominal exchange rate (index)

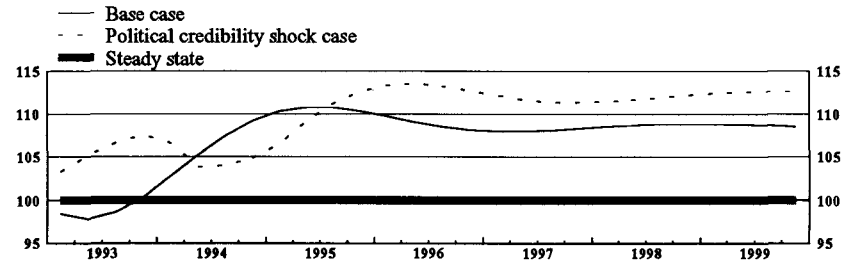
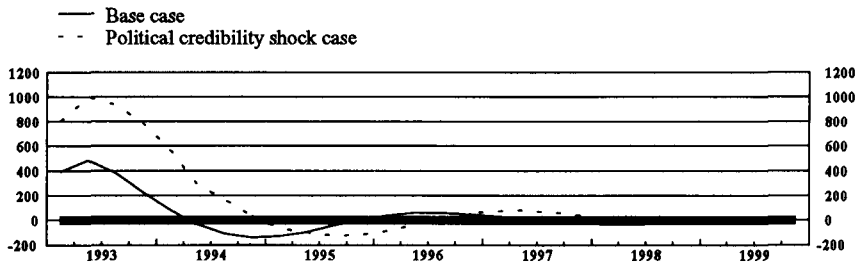


Figure 16: Real short term interest rate (shock - control, b.p.)



The tight policy pursued by the monetary authorities reduces aggregate demand and its components and creates a negative output gap (Figure 7), that reaches a minimum of -4% of GDP after roughly a year and a half. This negative output gap in turn has a dampening effect on prices and wages via the Phillips curve. Figure 8 shows the accumulated output loss associated with a monetary policy pursued in order to get inflation back on target.

The slope of the yield curve, expected income and changes in wealth determine private consumption in the short and medium run. All three components act to reduce consumption (Figure 9), by approximately 4% after six to seven quarters. Investment is mainly driven by the real cost of capital and an accelerator mechanism, both of which have a dampening effect, as is evident from Figure 10. The real cost of capital depends primarily on the real interest rate, which rises due to the monetary policy response as seen in Figure 16.

In addition to the interest rate channel, the transmission of monetary policy works through the exchange rate. The rise in real interest rates creates a slight appreciation of the real exchange rate through the uncovered interest parity condition (Figure 15). Given that prices are sticky in the short run, the real exchange rate also appreciates, as shown in Figure 12, which in turn causes net exports to fall, as seen from Figure 11.

The separate effects on exports and imports are depicted in Figures 13-14. The dampening of imports through the decline in consumption and investment is offset during the first year by a real appreciation of the krona such that imports are more or less unchanged during this time.

Eventually, all variables will settle down to their previous steady-state values, except for nominal variables such as the nominal exchange rate, which exhibits a drift in its level as witnessed from Figure 15. This ends our tour of the base case disinflation scenario. We will next discuss the effects of incorporating a political credibility shock.

3.3 Disinflation including political credibility shocks

The same basic mechanisms that were at work in the base case disinflation scenario are also operative in our alternative scenario incorporating political credibility shocks. However, the introduction of political credibility shocks elicits some additional effects.

First of all, the initial depreciation gives rise to an additional inflationary impulse, as can be seen by comparing the two inflation paths in Figure 3. Via the UIP condition the current nominal exchange rate is connected to its expected value the next quarter. The expected nominal exchange rate depends, in turn, on expected prices and the expected real exchange rate. The price level drift that accompanies the propagation of the initial shock will give rise to further depreciation tendencies and thereby prolong inflationary pressures. In order to defend its inflation target, the monetary authority is forced to raise the short-term interest rate considerably more than in the base case. Figure 5 shows that the difference in response is a hefty 500 basis points. In order to interpret this figure correctly one has to remember that we want to reduce the inflation rate by 5%, starting from a steady-state situation with full employment of all resources. Long-term interest rates also rise substantially, partly in response to higher expected future inflation but also as a direct consequence of the long-term interest rate shock (Figure 6).

From Figure 4 we note that the monetary policy response, as measured by the spread between the short and long-term interest rates, is severely tightened compared with the base case. This has obvious effects on output, consumption and investment. The negative output gap is prolonged, compared with the base case, see Figures 7-8. Another difference is the development of foreign trade. Due to the initial depreciation shock the resulting weak currency provides a stimulus to net exports. Compared with the base case, we tend to get a "dual economy", in which the traded goods sector is stimulated through a temporarily depreciated real exchange rate, whereas the non-traded or sheltered sector is depressed by the tight monetary policy stance (Figures 9-11).

Inflation settles down to the new target about one year later and, in the meantime, inflation is higher compared with the base case. Thus, the upward drift in the price level and the nominal exchange rate is more pronounced, indicated by an extra 4% depreciation of the nominal exchange rate in the long run, as shown in Figure 15.

A measure of the real cost imposed by the political credibility shock, on top of what is already inherent in the base case, is given by the difference in the cumulative output loss associated with the two scenarios. As is evident from Figure 8, we now have an accumulated output loss that amounts to about 8% of annual GDP, compared with 6% in the base case. Thus, the additional real cost amounts to roughly 2% of GDP. Although one should bear in mind the highly stylised character of our simulations, the results indicate that political credibility effects are non-trivial for reasonable magnitudes of the imposed exogenous shocks.

3.4 A closer look at expectations

Since expectations, especially those concerning inflation, play an important part in the disinflation story we would like to discuss the effects on inflation expectations per se, in addition to what is already incorporated in the behaviour of other macro variables. We compare actual inflation, one-year and two-year expected inflation in Figures 17-18 below. The one and two-year expected inflation rates are defined as follows:

$$E_{t+i}(\pi_{t+i+4}) = \left[E_{t+i}(LP_{t+i+4}) - E_{t+i-4}(LP_{t+i})\right] \quad i = 0,\ldots,n \tag{9}$$

$$E_{t+i}(\pi_{t+i+8}) = \left[E_{t+i}(LP_{t+i+8}) - E_{t+i-4}(LP_{t+i+4})\right] \quad i = 0,\ldots,n \tag{10}$$

where i=0 denotes the current period and n is the length of the simulation period.

Actual inflation vs. one-year inflation expectations

Figure 17A: Base case (%)

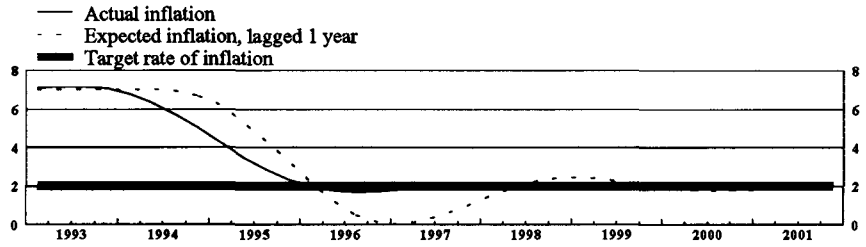
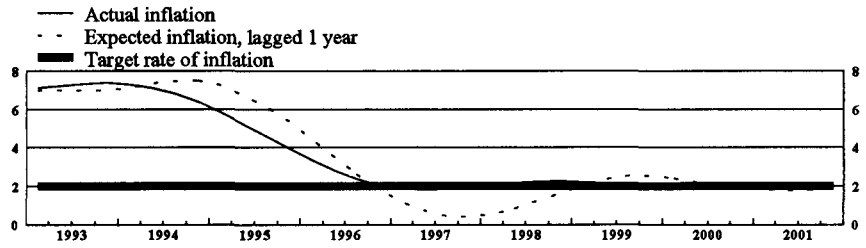


Figure 17B: Political credibility shock (%)



In the base case (Figure 17A), we compare the actual inflation rate during the disinflation process, denoted by a continuous line, with the inflation rate expected one year ahead, represented by a dotted line. In order to facilitate the comparison, the dotted line shows the expected one-year inflation rate lagged one year, which means that for each date on the horizontal axis the actual and the expected inflation rate refer to the same period. Hence the vertical difference between the dotted and the continuous line can be interpreted as a measure of the expectation error for a given period. For instance, in the period 1995Q1 in Figure 17A, the actual inflation rate is approximately 4%, whereas the expected inflation rate, close to 6%, is considerably higher giving an expectation error that overstates actual inflation by roughly 2%.

As would be expected from partly backward-looking expectations, expected inflation lies above actual inflation for the period immediately following the regime shift (1993Q1), as is evident from Figure 17A. However, from the beginning of 1996 until the middle of 1998, expectations underestimate the target inflation rate, sometimes quite considerably. Figure 17C shows the difference between expected and actual inflation; i.e. the expectation error for a one-year horizon in our base case. From Figure 17A we notice that actual inflation is inside the tolerance interval, $\pm 1\%$, of the target around the middle of 1995. This date is indicated by a vertical line in Figure 17C. Deviations of expected from actual inflation, after that period, can be interpreted as a measure or indication of a lack of credibility of the inflation target.

Whereas it seems quite reasonable that it takes some time before inflation expectations are revised downwards when the new and lower target is introduced, we are less happy about the subsequent rather large and persistent undershooting of inflation expectations. In Figure 17C it takes almost five years before expectations finally settle down inside the tolerance interval. Although there is only very scant empirical evidence regarding expectations, a cursory look at the available survey

Figure 17C: One-year inflation expectation error

Base case (%p.)

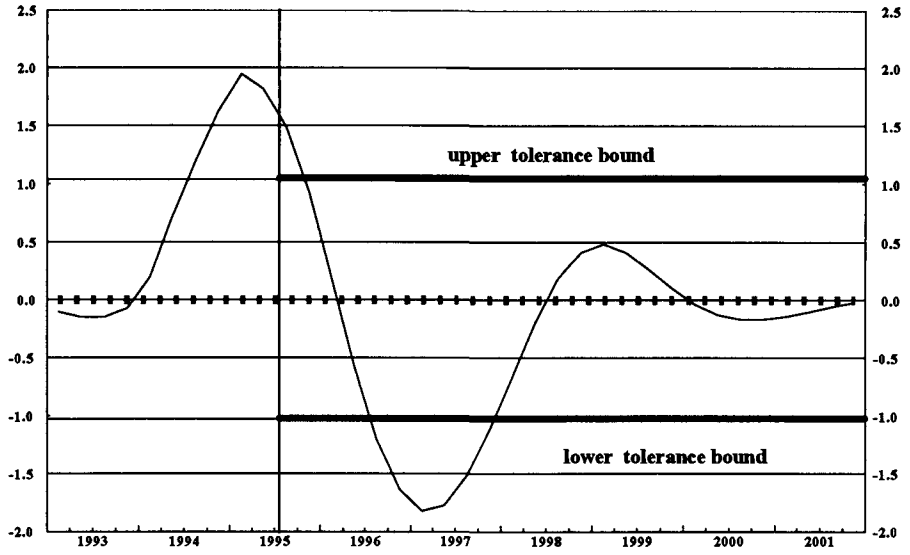
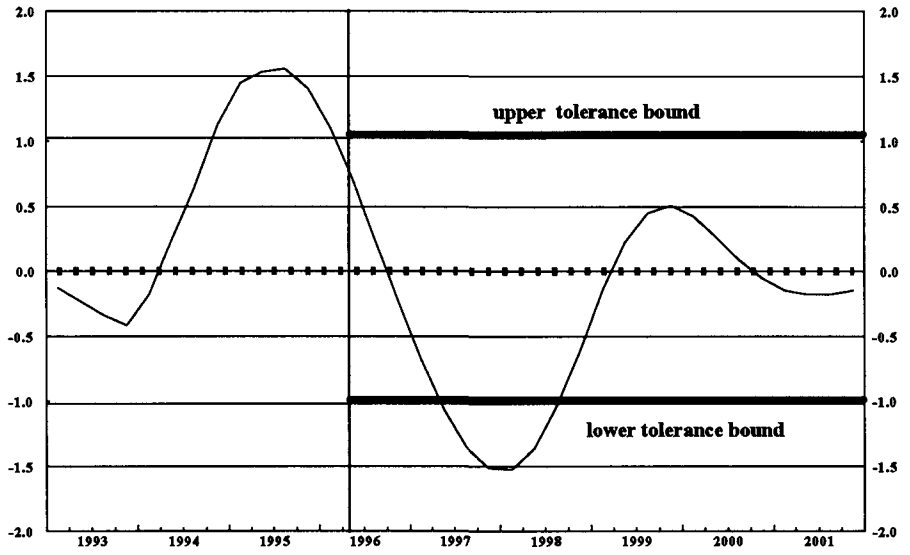


Figure 17D: One-year inflation expectation error

Political credibility shock case (%p.)



data suggests a period of about three years, beginning 1993, before expectations were in line with the inflation target.[15] Figure 17D shows the expectation error for a one-year inflation forecast associated with our political credibility shock scenario. Actual inflation now comes down within the tolerance interval and one-year inflation expectations are in line with the target about three quarters later, compared to the base case.

The corresponding graphs for expected inflation two years ahead are shown in Figures 18A-D, with the same general pattern of initially overestimating and later underestimating actual inflation evident from Figures 18A-B. Not surprisingly, inflation expectations for a two-year horizon show larger deviations from the target rate and settles down within the tolerance interval about a year later compared to one-year inflation expectations.

Actual inflation vs. two-year inflation expectations

Figure 18A: Base case (%)

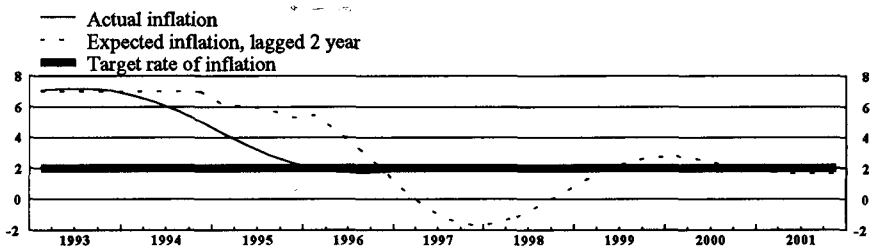


Figure 18B: Political credibility shock (%)

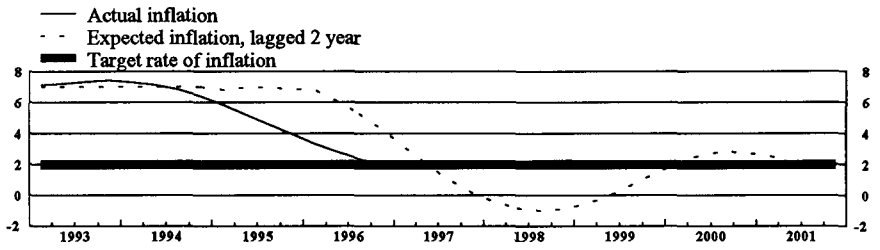


Figure 18C shows the expectation error for a two-year inflation forecast associated with our base case scenario. Compared to one-year inflation expectations it takes about one year longer for two-year expectations to be consistent with the inflation target. As with one-year expectations, political credibility shocks delay the settling down of expectations by slightly less than a year, as seen from Figure 18D.

[15] See e.g. the March 1997 issue of the Inflation Report by Sveriges Riksbank.

Figure 18C: Two-year inflation expectation error

Base case (%p.)

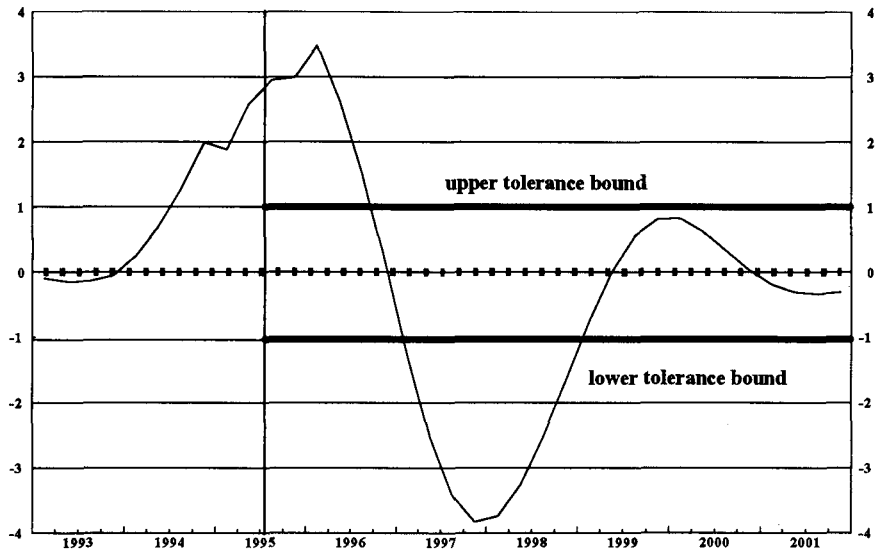
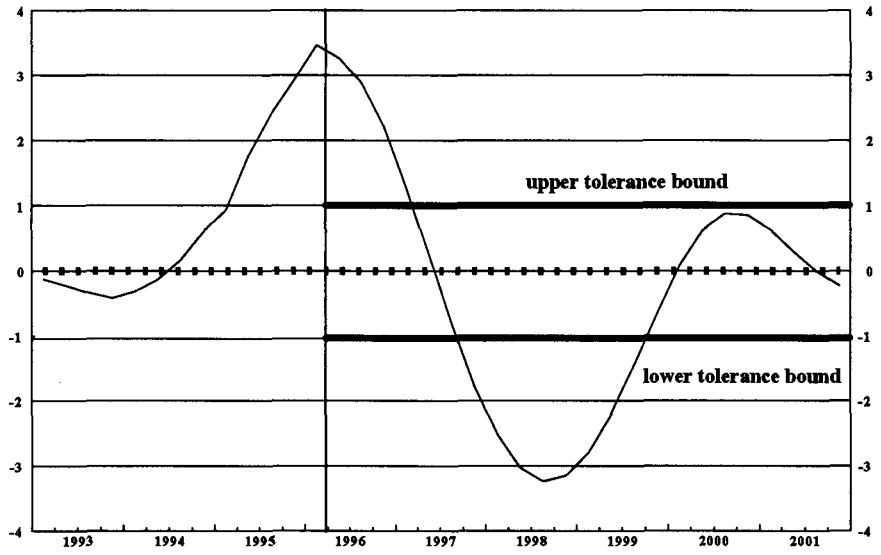


Figure 18D: Two-year inflation expectation error

Political credibility shock case (%p.)



Conclusions

This paper sets out to study the effects of a lack of credibility during the process of establishing a new monetary regime in Sweden in the early nineties. We distinguished between operational or endogenous credibility effects on the one hand, and political or exogenous credibility on the other.

The former is closely associated with how expectations about future inflation gradually adjust in the light of the actual inflation performance of the monetary authority in response to a downward shift of the inflation target. This mechanism is treated endogenously in our model. Next, we introduced political credibility shocks in the form of exogenous disturbances to the nominal exchange rate and to the long-term interest rate, such that there was an initial depreciation of the exchange rate and a widening of the long-term interest rate differential vis-a-vis the rest of the world. Political credibility shocks of this kind could go a long way in explaining the observed positive correlation between exchange rates and interest rates in Sweden, especially in the beginning of the nineties.

The main conclusion is that, in addition to the costs already associated with a transition to a low inflation regime, these political credibility shocks have substantial real effects. Our simulations suggest that these additional costs, measured as cumulated output losses, are in the neighbourhood of 2% of GDP. It should be emphasised that this estimate is probably biased upwards, since we have assumed that the regime shift is completely unannounced and initiated from a situation characterised by full employment of all resources. A more realistic simulation, starting from a disequilibrium, would probably reduce this figure.

Appendix

The one and two-year expected inflation rates are defined respectively as follows:

$$E_{t+i}(\pi_{t+i+4}) = \left[\frac{E_{t+i}(P_{t+i+4}) - E_{t+i-4}(P_{t+i})}{E_{t+i-4}(P_{t+i})} \right] \quad i = 0,\ldots,100$$

$$E_{t+i}(\pi_{t+i+8}) = \left[\frac{E_{t+i}(P_{t+i+8}) - E_{t+i-4}(P_{t+i+4})}{E_{t+i-4}(P_{t+i+4})} \right] \quad i = 0,\ldots,100$$

where $i = 0$ represents the current period. Thus, the inflation rates expected one and two years into the future, measured from the current period, are given by the following:

$$E_t(\pi_{t+4}) = \left[\frac{E_t(P_{t+4}) - E_{t-4}(P_t)}{E_{t-4}(P_t)} \right]$$

$$E_t(\pi_{t+8}) = \left[\frac{E_t(P_{t+8}) - E_{t-4}(P_{t+4})}{E_{t-4}(P_{t+4})} \right]$$

Likewise, the inflation rates expected one and two years into the future, measured from the next period ($i = 1$), are given by the following:

$$E_{t+1}(\pi_{t+5}) = \left[\frac{E_{t+1}(P_{t+5}) - E_{t-3}(P_{t+1})}{E_{t-3}(P_{t+1})} \right]$$

$$E_{t+1}(\pi_{t+9}) = \left[\frac{E_{t+1}(P_{t+9}) - E_{t-3}(P_{t+5})}{E_{t-3}(P_{t+5})} \right]$$

$$DLPEAQ = E_{t-1}(\pi_t) = \chi \left[\frac{E_{t-1}(LP_{t+20}) - E_{t-1}(LP_t)}{20} \right] + (1-\chi)\pi_t^{target}$$

where $\pi_t^{target} = \sum_{i=3}^{12} PTAR(t-i)/40$

$$DLPEA = 4 \cdot DLPEAQ$$

$$LP\_DA\_DIFF = DLPEA - DLPROWEA$$

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Comments on: "Disinflation and credibility effects: the Swedish case" by Hans Dillén, Tohmas Karlsson and Jonny Nilsson

by Stefan Gerlach

The purpose of this paper is to study the macroeconomic effects of "credibility" shocks, by simulating the Riksbank's macroeconomic model which is very closely related to the Bank of Canada's QPM model. While this topic is of broad interest for many countries, it is particularly relevant in the Swedish case, where the credibility of monetary policy was limited after the floating of the krona in 1992, and where expectations as to whether the Riksbank will reach its inflation target have shifted over time. Of course, the topic is also of interest from a modelling perspective; shifts in investors' expectations of the likely future course of policy are likely to be common, and it is therefore important to know how to study them.

In the first section of the paper the authors briefly review the credibility of Swedish monetary policy since the floating of the krona in 1992, and argue that this period can be divided into two parts. Defining credibility shocks as disturbances that give rise to a positive comovement of the krona/DM exchange rate and the long-term interest rate differential with Germany, the authors show that between the end of 1992 and the summer of 1994, credibility shocks were relatively modest. Since then, however, there have been a number of shocks, and credibility has risen considerably.

I have two minor comments with this exercise. First, one should recall that monetary policy in Germany has been relaxed gradually since 1992. There are good reasons to believe that this helped underpin credibility of monetary policy in Sweden. Thus, it is not clear that the credibility shocks are all domestic, as implicitly assumed by the authors.

Second, the authors argue that under floating rates, a lack of credibility is likely to show up at the far end of the yield curve (in contrast to under fixed rates, when it shows up in very short-term interest rates). In light of this, and the fact that the Bank of Sweden does estimate zero coupon yield curves for several countries, it would be interesting to see what Figure 2 would look like if instantaneous forward rates, say ten years from now, were plotted instead of long bond yields.

In Section 2 of the paper the authors provide a clear overview of the model used for the simulations. The authors indicate that expectations are modelled as having two components: a forward-looking component, which is said to be *model consistent*, and a backward-looking component, which is *adaptive*. The authors seem too apologetic about the use of backward looking expectations. It is well-known that when the economy is disturbed by a mixture of permanent and transitory shocks, it is rational to form expectations about the realisation of the permanent shocks adaptively.

This is of course precisely the scenario considered in the paper: there is a permanent shift in the central bank target rate of inflation, and this policy change lacks credibility precisely because the public doesn't now yet whether the shift is permanent or transitory. The notion that expectations are partially backward-looking is therefore quite natural in this context.

In the simulation the authors consider a permanent reduction of inflation from seven to two percent, and show that the economy adjusts gradually to the policy change. It was not clear to me if the gradual response occurred solely because expectations were partially backward looking, or if there were other causes of the lagged response. Some clarification of this issue would be desirable.

Next follows an interesting discussion of how to model credibility shocks. The authors do so by shocking the nominal exchange rate and the nominal long-term interest rate. Since these variables are endogenous, this exercise strikes me as bit strange; I would have preferred if the authors left these variables unconstrained, and used them to see if they respond to the credibility shocks as one would expect on the basis of theory.

Finally, a few words on the simulation results. The key finding is that a lack of credibility makes disinflation costlier than otherwise. Of course, this finding is neither new nor surprising. What is new, however, are the quantitative estimates of these effects: the results suggest that lack of credibility makes the recession induced by the disinflation deeper by about 1.5% of GDP, and 1-2 years longer. It would be interesting to see how sensitive these results are to the alternative assumptions regarding the degree to which expectations are backward-looking. It would also be interesting to see whether it is optimal for the central bank to disinflate quickly or slowly.