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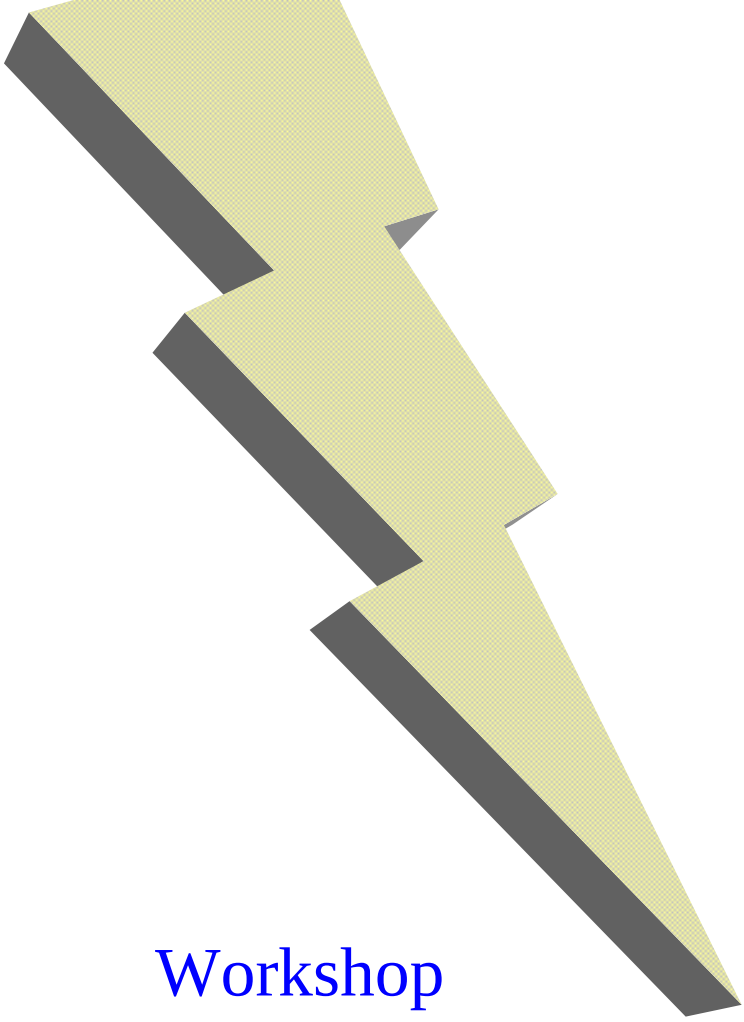

Workshop on Inflation Targeting

Prague, Czech Republic
September 14–15, 1998

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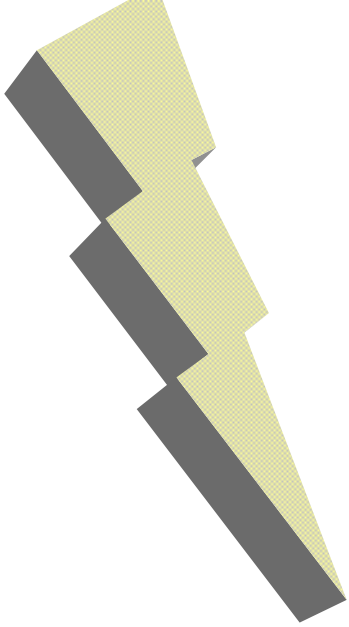

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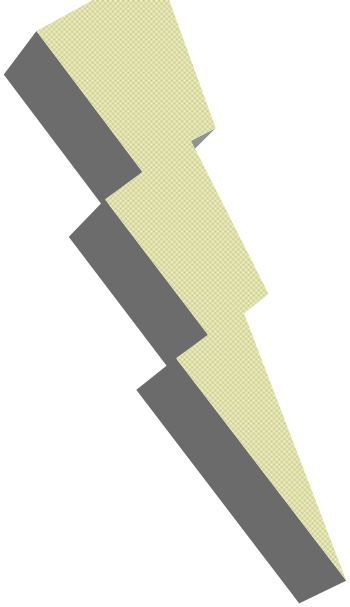


FOREWORD

On September 14–15, 1998, the Czech National Bank, in cooperation with the Bank of England, held a two day workshop on *Inflation Targeting.*

The aim of this workshop was to bring together Czech and foreign experts so that they could present their knowledge and experience in the area of inflation targeting and discuss the problems and complex issues involved.

We are pleased to say that the workshop was a success. The informal atmosphere allowed participants and guests to discuss and share ideas and, in turn, suggest solutions geared to the more efficient implementation of inflation targeting.

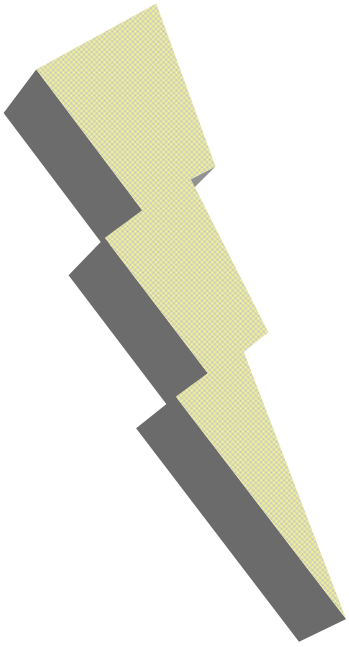
We would like to thank the following speakers for their expertise and contribution during the workshop:

Andrew Haldane – The Bank of England
Miroslav Hrnčíř – The Czech National Bank
Leonardo Leiderman – The Bank of Israel
Lavan Mahadeva – The Bank of England
David Mayes – The Bank of Finland
Emil Stavrev – The Czech National Bank
Kateřina Šmídková – The Czech National Bank
Zdeněk Tůma – The European Bank for Reconstruction and Development

Due to the invaluable information presented at the workshop, we thought that it would be appropriate as well as useful to publish the proceedings in book form.
The Czech National Bank, therefore, has the pleasure of presenting this publication, containing the lectures and discussions that took place during the workshop.

We hope that it will be a practical source of information and inspiration for all of those interested in the theory and practice of inflation targeting.

Miroslav Hrnčíř Kateřina Šmídková



Pursuing Price-Stability
Evidence from the United Kingdom and Other Inflation-Targeters

Andrew Haldane

1 Introduction

The inflation-targeting countries now number eight: in chronological order, New Zealand, Canada, Australia, the United Kingdom, Sweden, Finland, Spain and now the Czech Republic (see, for example, Haldane (1995), Leiderman and Svensson (1995), Lowe (1997)). The longest duration of an inflation-targeting regime is eight or nine years in the case of New Zealand. That may sound short. But to take the United Kingdom as an example, inflation-targeting has already proved to be the most durable of the monetary frameworks put in place in the post-Bretton Woods era. The same is true in New Zealand and Canada.

The pool of inflation-targeting countries may well swell further. For example, in Norway and Israel, a combination strategy of exchange-rate-cum-inflation targeting is currently being pursued. More recently in these countries the policy focus has shifted towards inflation-control, as both countries have introduced greater flexibility into their exchange rate arrangements. And both countries now publish *Inflation Reports* – as in all the other inflation-targeting countries – to monitor and forecast inflation developments.

In the euro-area (of which Finland and Spain are now a part), a combination strategy – this time monetary-cum-inflation targeting – is being pursued. And in the United States there is an active debate on the merits of shifting from the dual objectives embodied in the Humphrey-Hawkins Act to a single price-stability objective (see Bernanke, Mishkin, Laubach, Posen (1999)). With exchange rate pegs in South-East Asia and Brazil having recently been dislodged, one option for these countries would also be the pursuit of an inflation target. So in the medium term, experience with an inflation target may broaden as well as deepen.

This paper considers a range of issues which are central to the design of an inflation-targeting regime. It discusses these from the particular perspective of the United Kingdom. But it also attempts to discuss the approaches to these problems which have been undertaken by the other inflation-targeters; and how these approaches may need to be different in a transitional economy such as the Czech Republic.

The particular issues the paper discusses are: the institutional framework for monetary policy; specification of the inflation target; dealing with monetary transmission lags; dealing with (in particular inflation) uncertainties; dealing with output objectives, in particular following supply shocks; transparency about monetary policymaking; and dealing with the exchange rate. All of these have direct relevance to the Czech Republic, as it builds up experience of operating within an inflation-targeting framework.

2 The Institutional Framework for Inflation-Targeting

There seems to be an increasing consensus across central banks about the necessary institutional conditions for the effective pursuit of price-stability. One such necessary condition is a degree of operational autonomy on the part of the central bank in the course of setting monetary policy. The Czech National Bank has for some time had a relatively high degree of *de jure* independence. But in the United Kingdom, such autonomy has only recently been granted and enshrined in statute in the Bank of England Act 1998. This Act confers instrument-independence on the Bank of England, though the goals of policy continue to be set by the government. There is, in the jargon, goal-dependence but instrument independence. Among these goals, price-stability is given primacy.

Monetary policy decisions in the UK are made on a regular monthly cycle by a nine-person Monetary Policy Committee (MPC). The MPC comprises 5 “insiders” to the Bank of England (the Governor, two Deputy Governors and two of the Bank’s Executive Directors) and 4 “outsiders”, with prior technical expertise in the monetary policy area. Seven of the nine members are appointed by government, two by the Bank itself. The minutes of the MPC’s monthly

deliberations are published, with a two week lag.[1] The minutes disclose the voting patterns of each of the individual MPC members. The discussion in the minutes is unattributed, though it provides a detailed account of the analysis discussed by the MPC in the course of reaching its decision.

Though operationally independent in their choice of the interest rate, the MPC is held to account for its views in a variety of ways: through the published minutes of their monthly meetings; through published quarterly *Inflation Reports*; through appearances by MPC members before Parliamentary committees (including after the publication of *Inflation Report)*; through the Bank writing "Open Letters" to the Chancellor in the event of the inflation target being breached by one percentage point in either direction (discussed further below); and through an "override" (of the Bank's interest rate decisions) clause, which allows the Chancellor to exercise interest rate control "in extreme economic circumstances".

This institutional architecture, and the inflation-targeting regime more generally, seem to have yielded some tangible benefits, measured in term of inflation expectations relative to target (credibility, crudely defined). Chart 1 shows a set of term structures of inflation expectations on a variety of dates, derived from nominal and real bond yields in the United Kingdom. Immediately following the UK's exit from the ERM in September 1992, inflation expectations were between 5% and 7% at maturities 10 to 20 years ahead – well above the inflation target at the time of 1–4%. By April 1997, five years into the regime, inflation expectation had ratcheted down to just over 4%. The announcement of operational independence in May 1997 caused a further fall in inflation expectation across all maturities. And by June of 1998, inflation expectations at all maturities were around the UK's 2.5% inflation target. This gradual improvement in the credibility of the inflation-targeting framework seems in no small measure to have been enhanced by the institutional arrangements for the monetary policymaking in the UK.

Many of these institutional arrangements can also be found among the inflation-targeters, including in the Czech Republic. There are some differences in that the Czech National Bank has goal as well as instrument independence. But there is no international consensus on whether or not goal-independence is desirable. The euro-area operates with one model, which includes goal independence; others, including the UK, operate with another.

Looked at from a UK perspective, however, goal-dependence can in some circumstances have some merits. First, it ensures that a degree of democratic accountability is exercised over the central bank. And second, it can in some circumstances usefully help deflect criticism of the central banks' policy actions. Provided the central banks' policies and priorities are well-attuned to those of the public, however, neither of these advantages need necessarily be significant.

3 Specification of the Inflation Target

In the UK, the numerical value of the inflation target is affirmed on an annual basis by the government. The price-stability objective is enshrined in statute, however, and the target itself is timeless. Currently, the UK has a point target of 2.5%. This raises two technical questions about the specification of the target: why 2.5%?; and why a point target?

The reasons for choosing 2.5% are manifold. First, there are well-known measurement biases in the UK's CPI, as there are in all other countries. In the UK, we estimate these biases to be around 1% on an annual basis (Cunningham 1995), again in line with other developed countries. Second, an inflation rate of 2–3% is in line with the current inflation norm in other developed countries, including in the other inflation-targeters. Third, and

[1] Up until October 1988, the minutes were published with a 5–6 week lag.

importantly, 2–3% seems to be close to the general public's preferred inflation rate. Chart 2 shows the distribution of survey responses to a questionnaire which asked the public to suggest their preferred rate of inflation. As the chart shows, almost all respondents wanted inflation to lie above 0% and below 5%. And the vast majority suggested an optimal inflation rate of around 2–3%.

The Czech Republic is of course coming from a different inflationary background than that in the UK, though recent inflation rates have fallen to close to UK levels. An interesting question in this context is what benefits are conferred by pushing down inflation that few extra percentage points? Might not these benefits be outweighed by the costs?

On the face of it, there is some academic support for this proposition. It is, for example, difficult to find convincing evidence of inflation having a damaging effect on growth at rates of inflation below 10% (Barro (1995)). There is, however, evidence of inflation **volatility** having an effect on growth at rates of inflation below 10% (Judson and Orphanides (1996)). Moreover, inflation need only adversely affect the **level** of GDP – not necessarily its growth rate – for it to have a significant welfare cost. A particularly interesting example of the size of such costs, even at low inflation rates, has recently been provided by Feldstein (1997). Feldstein considers the welfare costs of inflation's interaction with the unindexed capital income taxation system. Feldstein estimates the GDP-equivalent welfare gains from reducing inflation from 2% to zero in the US to be around 1% of GDP. Similar-sized numbers – sometimes a littler larger, sometimes a little smaller – have recently been found for the UK, Spain, Germany, New Zealand and elsewhere.

Moreover, the benefits of low inflation are permanent, whereas the costs of disinflation are transient, provided we believe in a vertical long-run Phillips curve. So the net present welfare value of a reduction in inflation could well be quite large. For example, assuming a 5% discount rate and trend growth of 2.5%, Feldstein's estimates would deliver a net present value welfare gain of anywhere between 10–60% of initial GDP for developed countries. That is much larger than any plausible estimate of the output cost of disinflation.

Turning to the issue of inflation target points versus ranges, there is clearly no consensus on this issue across the existing inflation-targeters. For example, the UK, Finland, Sweden and Australia all have point targets; whilst Canada, New Zealand, Israel, Spain and the Czech Republic all operate with inflation target ranges.

There are several reasons for the choice of a point target in the UK. First, it serves as a clear *ex-ante* fix-point for monetary policy decision-making. There is a danger that an inflation range becomes a "band-of-indifference", within which the authorities do not adjust policy. If this is the case, then the probability of breaching the band becomes very high and inflation will spend long periods deviating from the target. An inflation target needs a clear trigger, above or below which policy will respond. A point target makes transparent that trigger.

Second, a point inflation target can also serve as a useful fix-point for private sector agents' inflation expectations. The UK provides a good case study here. It was striking, for example, that inflation expectations in the UK became "stuck" at the top of the UK's 1–4% inflation range between 1992–1996. More recently, as the UK has moved from an inflation band to a 2.5% point target, expectations have ratcheted down to around the point inflation target (Chart 3).

Using the inflation target as a reference point for expectations is likely to be important during the transition to low inflation. The target then serves as a means of guiding downwards inflation expectations over time. That, for example, was the way the inflation-targets in the UK, Canada and New Zealand operated when they were first put in place, with a downwards transition path built in. It is also the way that inflation targets are currently being operated in Israel and the Czech Republic.

There is an *ex-post* as well as *ex-ante* dimension to the specification of the UK's inflation target. In particular, there is a fluctuation margin of +/-1% points around the

UK's inflation target. This is meant to accommodate inevitable ex-post inflation variability, which results from shocks. Breaches of this fluctuation margin have to be accounted for in an open letter from the MPC to the government. This *ex-post/ex-ante* dimension to the specification of the inflation target in the UK is a useful way of helping sharpen *ex-ante* policy actions and public inflation expectations, while at the same time recognising the inherent *ex-post* difficulties of inflation-control.

4 Dealing with Monetary Transmission Lags

There are well-known "long and variable lags" between changes in the instruments of monetary policy and their ultimate impact on output and inflation. For example, in developed countries the maximum marginal impact of a change in short-term interest rates on inflation comes after around two years. In transition economies the lag is probably shorter, for example because of the greater degree of price flexibility in these economies. These lags in policy do mean, however, that inflation-targeting needs to have a strictly forward-looking perspective. Responding to past inflation, for example, would mean that policy was always acting too late to prevent inflationary pressures taking hold.

It is for this reason that, in some inflation-targeting countries, monetary policy is based explicitly on inflation forecasts. These countries include Canada, New Zealand and the United Kingdom. In the UK, for example, inflation forecasts up to two years ahead are published in the Bank of England's quarterly *Inflation Report*.[2] These forecasts can he thought of as, in effect, the intermediate target for monetary policy (see Haldane (1997)). For example, the Bank of England's "policy rule" can be thought to take the generic form:

$$E_t \ \pi_{t+2} \mid i_t \ = \ \pi^* \qquad (1)$$

That is, interest rates today (i_t) are set at such a level that expected inflation two years ahead ($E_t \ \pi_{t+2}$) is in line with the inflation target (π^*). Policymaking in practice, of course, is never quite that mechanical. But as a pedagogical device, this approach of "inflation-forecast-targeting" has some clear attractions, as a response to the transmission lags in monetary policy. It also means of course that publication of the inflation forecast becomes of paramount importance, in facilitating outside agents' understanding and monitoring of the authorities' monetary rule.

There are at least two questions left open by the operation of an inflation-forecast-targeting policy rule such as (1). First, how are the forecasts themselves produced? And second, what determines the two-year-ahead forecasting horizon for policy? On the first question, the starting point for the quarterly forecasting round is a core, small structural macro-model. This model is a conventional open-economy IS/LM type of system. The outputs from this core model are augmented with various pieces of "off-model" information. This off-model information includes the MPC's subjective judgement on various issues, survey data, various financial market information, etc. This is data which is important to understand and embody when monitoring inflationary dynamics, but which it is difficult to encompass in a small model framework. The published inflation forecasts reflect and embody the views of the MPC, and is agreed as the end-product of a series of meetings between them and the Bank staff.

On the choice of inflation forecast horizon, two years is around the horizon which the Bank has found to be optimal using model-based simulations. Chart 4 shows the results of a typical such simulation. The dotted line in both panels shows the "optimal control" response of inflation following a one percentage point inflation disturbance in the

[2] Mahadeva (1998) describes the inflation forecasting procedures at the Bank in greater detail.

first period.[3] Inflation returns to target after roughly 8 – 10 quarters. The upper and lower panels show the results from using, respectively, horizons which are too short (2–3 quarters) and too long (5 years). In the first case, policy is forced to do "too much, too soon" and itself generates secondary inflationary cycles. In the second case, the disinflation path is just too gradual – policy is doing "too little, too late" – and inflation as a result spends a protracted period away from target.

The precise optimal forecasting horizon depends of course on the nature of the shocks to the economy; the authorities' relative inflation/output preferences; and the dynamics of the monetary transmission mechanism. But taking illustrative UK values of these parameters, two years seems to be roughly about the right horizon. For the Czech Republic, transmission lags are shorter but the economy is more prone to supply shocks. The net effects of these two offsetting influences upon the optimal inflation forecasting horizon would require careful empirical evaluation.

5 Dealing with Uncertainty

Basing policy around inflation forecasts is not without its costs. Perhaps most importantly, inflation forecast errors are substantial. The mean absolute error of UK inflation forecasts one-year-ahead is, for example, over one percentage point. In the UK, there are two aspects to dealing with these uncertainties – one *ex-ante*, the other *ex-post*.

The *ex-ante* dimension amounts to making clear up front the full extent of the uncertainties attaching to any inflation forecast. The way this is done at the Bank of England is by publishing a "fan chart" for inflation over the next two years – a full probability density function for future inflation. An example of this is shown in Chart 4, taken from the Bank's August 1998 *Inflation Report*. There is a 10% probability of inflation lying in the deepest-shaded area. The progressively lighter-shaded areas fanning out from this are 10% probability contours. In total, the shaded distribution is meant to cover 90% of the distribution of inflationary outcomes up to two-years ahead.[4]

The benefits of presenting an inflation forecast in this way are essentially four-fold. First, publishing a forecast distribution means that the general public are not focussed on a single inflation forecast point. The central bank is thereby not open to criticism for having got the forecast "wrong" when, given shocks, this is an inevitable part of the forecasting process. Second, the distribution quantifies for the public the full extent of likely forecast uncertainties. Third, the distribution also embodies asymmetries. It allows inflationary risks at different horizons to be unbalanced. For example, in Chart 5 upside inflation risks are greater two-years-ahead. This is important because, often in policymaking, the distribution of the underlying variables may be asymmetric. For example, various asset prices may be thought to be under or overvalued; external risks may be unbalanced, etc. The fan chart allows those unbalanced risks to be embodied explicitly in the inflation projection and hence in policy decision-making. Fourth, related to all of the above, a quantified distribution allows policy to be exercised in an explicitly probabilistic fashion. In an inflation-forecast-targeting framework, statements such as "inflation will be at target x periods ahead" make no sense, given shocks. The most that can be said is that "there is an x% chance of inflation lying between y–z%"; or "there is a z% chance of the inflation target being breached". The published inflation distribution allows such an *ex-ante* quantification to facilitate monetary policy decision-making.

In the current environment, inflation uncertainties are likely to be substantial in the Czech Republic, not least given the on-going process of structural change. Although

[3] The loss function used to calculate this optimal response places equal weight on inflation deviations from target and output deviations from trend.

[4] Further details of calculating this distribution are described in Whitley (1998).

historical data is sparse, there is no merit in disguising the extent of these inflation uncertainties – indeed, the converse. Published fan charts provide one vehicle through which these uncertainties can be transparently signalled to the public and can be used for policy calibrations.

There is also an *ex-post* dimension to dealing with inflation control errors in the UK. If inflation deviates from the inflation target by more than one percentage point in either direction, then the MPC has to write an open letter to the Chancellor. The open letter system is an accountability device, ensuring target misses are properly explained and appropriate remedial policy action is taken. Reflecting this, the open letter has to contain three elements: an explanation of why the deviation from target occurred; an explanation of what the MPC intends to do about it; and a statement of the time horizon over which inflation is to be returned to target. It is through the third of these aspects – the choice of time horizon – that output objectives come to be factored into policy choices under an inflation-targeting framework. We now turn to a discussion of that issue.

6 Dealing with Output

Although the centrepiece of an inflation-targeting regime is the inflation target itself, this does not mean that real objectives – for example, for output and employment – are disregarded in the setting of policy under such a regime. The Bank of England Act 1998, for example, states that the Bank's objectives shall be: "(a) to maintain price stability; and (b) subject to that, to support the economic policy of the government, including its objectives for growth and employment." This is also consistent with the statutes of the European Central Bank.

But how is this concern for output and employment objectives made operational within an inflation-targeting regime? The first point to make is that, because the "output gap" is usually seen as a useful predictor of future inflation by most central banks, basing policy on expectations of future inflation means that output and employment are already **implicitly** entering inflation-targeters' policy rule. In other words, a policy rule such as equation (1) could be rewritten to have the output gap on the right-hand-side. The absence of output terms from such a rule may be more apparent than real.

Second, in a world where there were only **demand** shocks, hitting an inflation target while simultaneously smoothing output relative to trend ought to pose few dilemmas for monetary policymakers. Examples would include shocks to fiscal policy, to external demand and to investors' "animal spirits". In those situations, inflation is likely to end up above target at just the same time as output is above target (or vice-versa). So to smooth both output (relative to trend) and inflation (relative to target) the right response is to tighten policy (or to loosen it in the event of an opposite shock). There is no conflict of output/inflation objectives.

Third, **supply** shocks pose an altogether different (and far trickier) problem, however – for example, shocks to the NAIRU, the terms of trade or indirect taxes. These shocks will tend to shift output and inflation in opposite directions, and so pose a dilemma for policymakers. Should policy be tightened or loosened? Existing inflation-targeting regimes well recognise these supply shock difficulties. They are likely to be especially acute in small open economies (where terms of trade shocks will be more prevalent) and economies undergoing structural transition – both of which characterise the Czech Republic currently. So dealing with supply shocks is likely to be an issue of considerable importance.

Approaches to dealing with supply shocks differ across the inflation-targeters. In each case, however, the aim is to accommodate the first-round effects of the shock, thereby cushioning any adverse effects on output of adhering to the inflation target. In New Zealand, for example, the Policy Targets Agreement allows significant supply shocks from a pre-specified list to be exempted from the measure of inflation. Another approach is to allow greater inflation variation around the inflation target before a remedial policy adjustment takes place. Inflation target bands, as operated for example in Canada, allow this. In

both of these cases, the intention is to allow short-run accommodation of the supply shock – not aiming to offset the shock's first-round effects on inflation – while at the same time ensuring inflation expectations remain anchored over the medium term.

A third approach to supply shock accommodation, and the one employed in the UK, is to allow the flexibility built into the inflation forecast horizon: that is, by allowing inflation to return to target over a longer horizon when large supply shocks strike. This allows for a more graduated, and hence accommodative, policy stance, smoothing the path of output relative to potential at the same time as the path of inflation relative to target. Simulation work at the Bank of England has shown that, by judicious choice of the forecast horizon, inflation-forecast-targeting regimes can achieve as much by way of output smoothing as policy rules which target output explicitly (Batini and Haldane (1998)). The vehicle through which the Bank of England exercises this leverage over the inflation target horizon is the open letter system. Reflecting its concerns about the profile for output as well as inflation, the Bank of England publishes a "fan chart" for output growth as well as inflation.

A key message for the Czech Republic, however, is that a concern for output objectives is safest when inflation is already close to its medium-term target. There is less scope for accommodation of inflation shocks during the process of disinflationary transition to price-stability. In these circumstances, positive inflationary impulses which are not offset risk damaging credibility and stoking-up inflationary expectations. The same is not, however, true of negative inflation shocks which lower inflation. During the disinflationary process, these negative shocks should be fully accommodated and locked-in. In other words, during disinflationary transition, shocks should be dealt with "opportunistically" – the favourable shock presenting an opportunity which ought to be seized through accommodation, but the unfavourable one not being accommodated.

This situation seems to characterise well the current one in the Czech Republic. The favourable shocks which have pushed inflation down to near its target for the year 2000 should not be reversed. This would inflict an unnecessary further disinflation on the economy, with its attendant costs. Instead such favourable shocks should be gratefully pocketed, and policy set such that lower inflation expectations become locked-in. Once these lower inflation expectations are locked in, there is then greater scope for monetary policy to smooth out the effects of supply shocks on output/employment, perhaps using some of the institutional mechanisms highlighted above.

7 Transparency

A defining feature of inflation-targeting regimes is the extent of their transparency. In some ways this is also a necessary feature, because the policy rule under this regime – equation (1) – is undoubtedly a complex one. For example, without publication of the inflation forecast and some notion of its origin, it would be difficult for the public to monitor whether monetary policymakers were adhering to the rule. Credibility may be damaged. That is one reason why inflation forecasts are explicitly published in the UK and New Zealand.

There are a variety of other ways in which monetary policy transparency is enhanced in the UK. The minutes of the monthly MPC meetings are now published with a two week lag; and the Bank's *Inflation Report* is produced on a quarterly cycle. The latter contains the Bank's projections for inflation and output growth. These publications give an insight into the analysis underlying the Bank's inflation outlook; and the way in which this analysis in turn affects the distribution of future inflation and, ultimately, the MPC's decision-making. This is a degree of policy transparency probably unparalleled in monetary history. And though the UK is perhaps at one end of the transparency spectrum, it is significant that all the inflation-targeting central banks – indeed, some non-inflation targeters too, such as Norway and Israel – are also now publishing inflation or monetary policy reports on

a regular cycle. The Czech Republic is the latest of the *Inflation Report* recruits.

It is worth considering some of the benefits that enhanced transparency confers. There are both internal and external benefits. Internally, the act of exposing policy analysis to outside scrutiny acts as a powerful incentive to ensure this analysis is of the highest possible standard. It exposes internal thinking to a powerful external discipline. Externally, transparency serves as a useful accountability device – a political-economy benefit. It also, however, delivers macroeconomic benefits. For example, it increases the degree of predictability of the authorities' reaction function and hence ought to help stabilise the yield curve.

To understand this latter benefit, imagine a world in which the policymakers' policy rule was perfectly predictable and the authorities' inflation target was fully-credible.

We would then see the yield curve moving around in response to macroeconomic "news", to the extent that such news affected the central banks' inflation forecast and hence the settings of its policy instrument. But we would not expect to see any response from the yield curve in response to monetary policy changes. These policy changes would contain no extra information; they would be perfectly anticipated because the policy rule was fully transparent.

There is evidence of just this having happened in the period since the introduction of the UK's inflation target. Some evidence is given in Table 1 (taken from Haldane and Read (1997)). The numbers show the percentage point response of different maturity forward interest rates – from one month to twenty years – to a one percentage point change in official interest rates in the UK. The first column shows the average response of forward rates over the period January 1985 to March 1997. The second column shows the way in which this average response is altered by looking only over the period since the UK inflation target was introduced (September 1992 to March 1997).[5]

Table 1

Yield Curve "Surprises"

Maturity	Jan '95-Mar '97	Change since Sept '92
Spot	0.46	-0.41
1 Month	0.47	-0.52
3 Months	0.30	-0.39
6 Months	0.35	-0.29
2 Years	0.24	-0.23
5 Years	0.14	-0.16
10 Years	-0.13	0.04
15 Years	-0.16	0.05
20 Years	-0.08	-0.01

[5] Note the sample covers the period prior to the announcement of the Bank of England's operational independence, and the establishment of the MPC.

Two points are significant. First, the response of the yield curve to official rate changes is significant along the entire yield curve (a * indicates significance at 95%), with a response which is around one third at the short end and which is negative at the long end. Second, however, these responses have been (statistically significantly) damped following the introduction of the inflation target and its accompanying transparency reforms. Policy "surprises" have been fewer in the transparent, inflation-targeting regime. This is evidence of one tangible macroeconomic benefit of greater transparency – greater stability in the yield curve. It goes some way towards explaining the drive towards greater openness among all central banks over recent years – including, significantly, the Czech National Bank.

8 Dealing with the Exchange Rate

The inflation-targeting countries are all architypical small, open economies. This means that they inevitably face difficult questions about how best to respond to movements in the exchange rate, given its important influence on inflation and output dynamics. This is particularly the case in as open an economy as the Czech Republic. There are broadly two approaches which inflation-targeting central banks have used to analyse the effects of exchange rate movements on monetary conditions.

The first is the construction of Monetary Conditions Indices (MCI), weighting together interest and exchange rate movements, with weights depending upon their relative importance for output/inflation dynamics. Such indices have been widely used by the Reserve Bank of New Zealand and the Bank of Canada. The Bank of Canada, for example, has a "desired" path for monetary conditions – consistent with their inflation target – and compares the actual MCI with this when deciding whether to tighten or loosen the monetary stance.

The second approach is what we might call the "spot-the-shock" approach. This is the approach used in the UK. It begins by asking the question: what shock caused the exchange rate to move? For example, was it temporary or permanent? Was it caused by domestic or foreign developments? Are these shocks real or monetary in nature? The reason for asking these questions is that different shocks may have very different implications for monetary conditions and hence for the setting of monetary policy.

Perhaps the best way of illustrating this approach is with an example. Between August 1996 and the middle of 1998, sterling rose by over 20%. Why? Did it simply reflect the effect of the (relative) tightening of UK monetary policy over the period – a temporary effect? Or was the shift due to something structural and hence more permanent in nature? One means of identifying the "monetary" component of exchange rate movements is to look at relative yield curve movements. Using the uncovered interest parity theorem, it is possible to calculate how much of a given exchange rate change is induced by relative yield curve news (see Bridgen, Martin and Salmon (1997)). An example of this type of exercise, from August 1996 onwards, is shown in Chart 6. The light line shows the cumulative actual change in the exchange rate; the darker lines, the range of appreciation that can be explained by relative yield curve movements – "monetary news" – on the assumption that uncovered interest parity holds. As is clear, monetary shocks do not seem capable of explaining more than 2–3% of the 20% appreciation.

The fault could of course lie with assumption of uncovered interest parity. But the same technique has been shown to account for a substantial proportion of previous large exchange rate movements. Chart 7, for example, shows the movement in sterling following its exit from the European Exchange Rate Mechanism (ERM) in September 1992. Movements in relative interest rates – monetary shocks – plausibly accounted for most of the 10% depreciation in that instance.

But if most of sterling's appreciation between 1996 and mid-1998 was not sourced in monetary policy, what was its source? Another possible explanation was a fall in the sterling risk premium – for example, resulting from EMU uncertainties which affected the EU countries against whom

sterling appreciated most strongly. Again, some calculations can be conducted using the uncovered interest parity condition and survey-based measures of exchange rate expectations. Chart 8 illustrates. The estimated risk premium on sterling assets versus a synthetic euro asset (comprising France, Germany and Italy) went from being positive in mid-1996 to strongly negative at the end of 1996 and through 1997. This is consistent with part of sterling's appreciation being driven by a lowering of its perceived riskiness relative to other euro currencies in the run-up to EMU. Towards the end of the sample, as EMU uncertainty abated, the estimated risk premium rose again – and sterling fell.

A third potential factor behind sterling's appreciation was a real exchange rate shift – for example, some exogenous improvement in the demand for UK exports. Historical variance compositions from structural VARs suggested this too may have been part of the explanation. Such an explanation has very different implications, however, for the evaluation of monetary conditions. First, the shift is then more likely to be permanent, or at least persistent. And second, it implies that sterling's appreciation need not be as damaging for competitiveness and hence for output, since it represents a rise in the equilibrium real exchange rate.

This example serves to illustrate some of the merits of the "spotting the shocks" approach, when feeding the exchange rate through a macro-model and generating quantified inflation forecasts. Indeed, without an appreciation and understanding of these shocks, a mechanical feeding through of the exchange rate is likely to prove misleading. This applies with particular force in very open economies, like the Czech Republic.

9 Summary

This paper has discussed some of the technical issues which arise when operating monetary policy according to an explicit inflation target. It has also discussed the approaches which some inflation-targeting central banks – and the Bank of England in particular – have taken to dealing with these issues. Some of these approaches, if not the issues themselves, are new and there is scope for developing them further – not least when applying them to transitional economies such as the Czech Republic.

None of these technical issues would, however, preclude the effective use of an inflation-targeting regime by a transitional economy. Indeed, the flexibility, transparency and clarity of such a regime means that it would seem to be well suited to transitional economies. For these reasons, we might expect further recruits to the inflation-targeting club looking forward.

Chart 1:

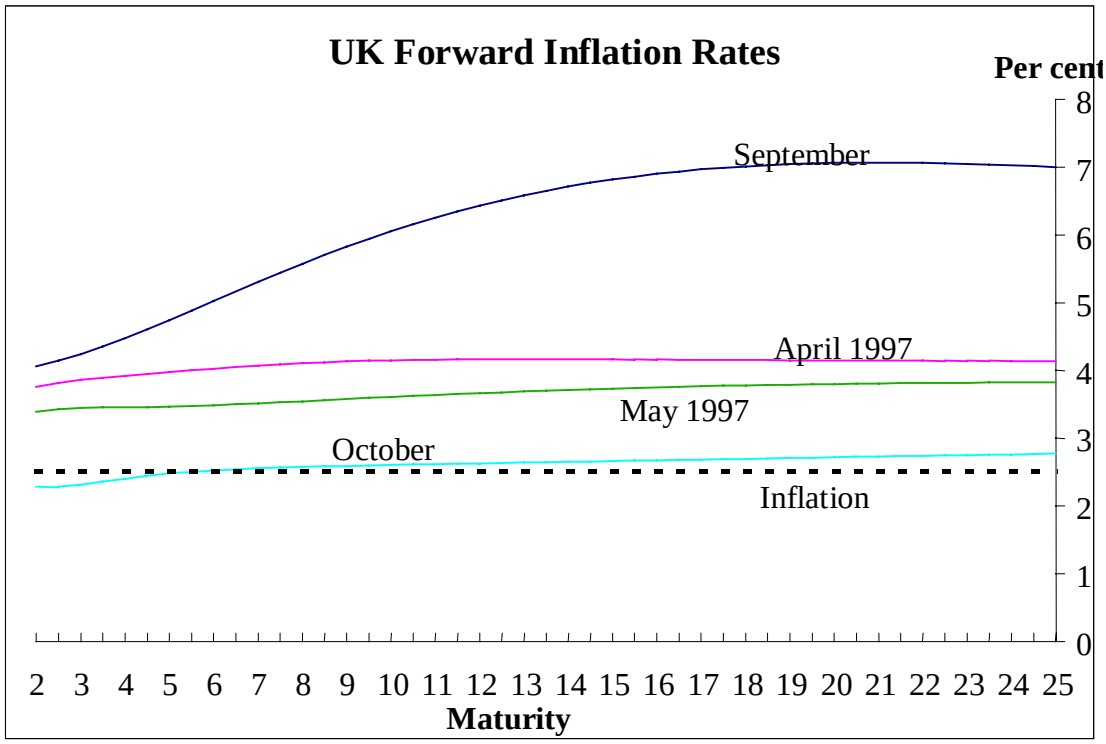


Chart 2:

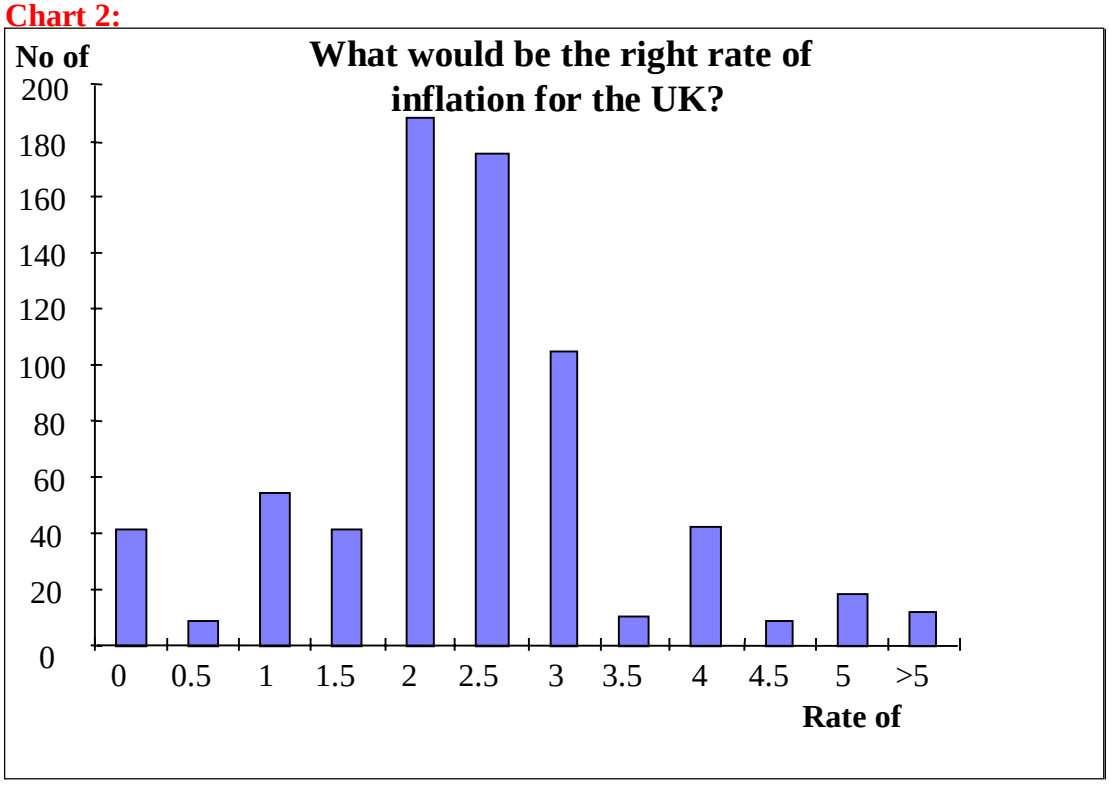


Chart 3:

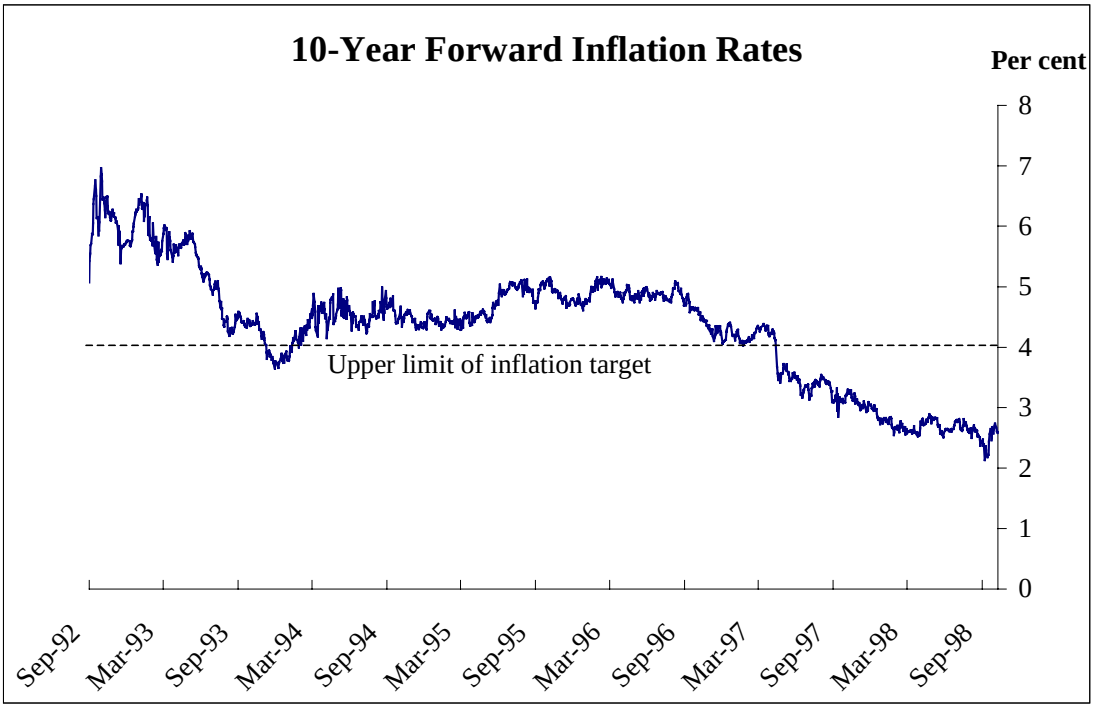


Chart 4 (a):

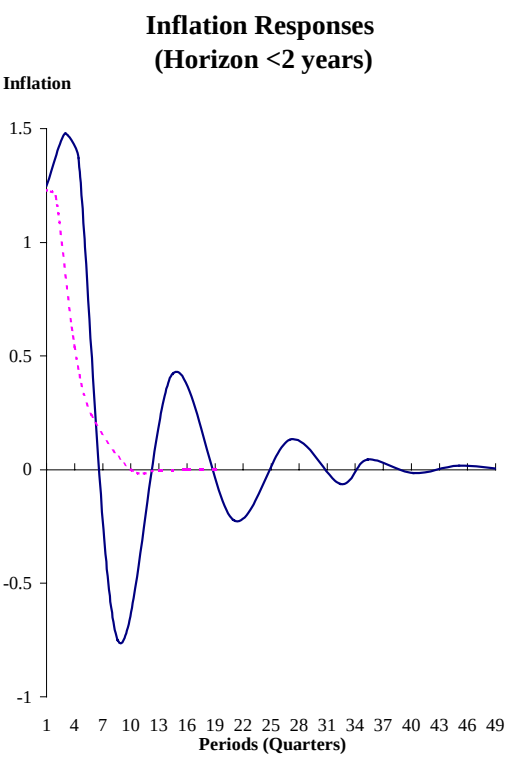


Chart 4 (b):

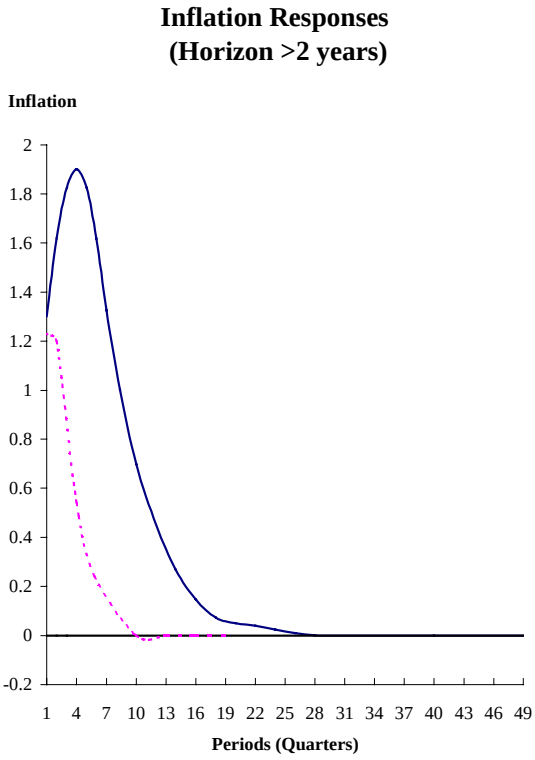


Chart 5: **Inflation Forecasts**

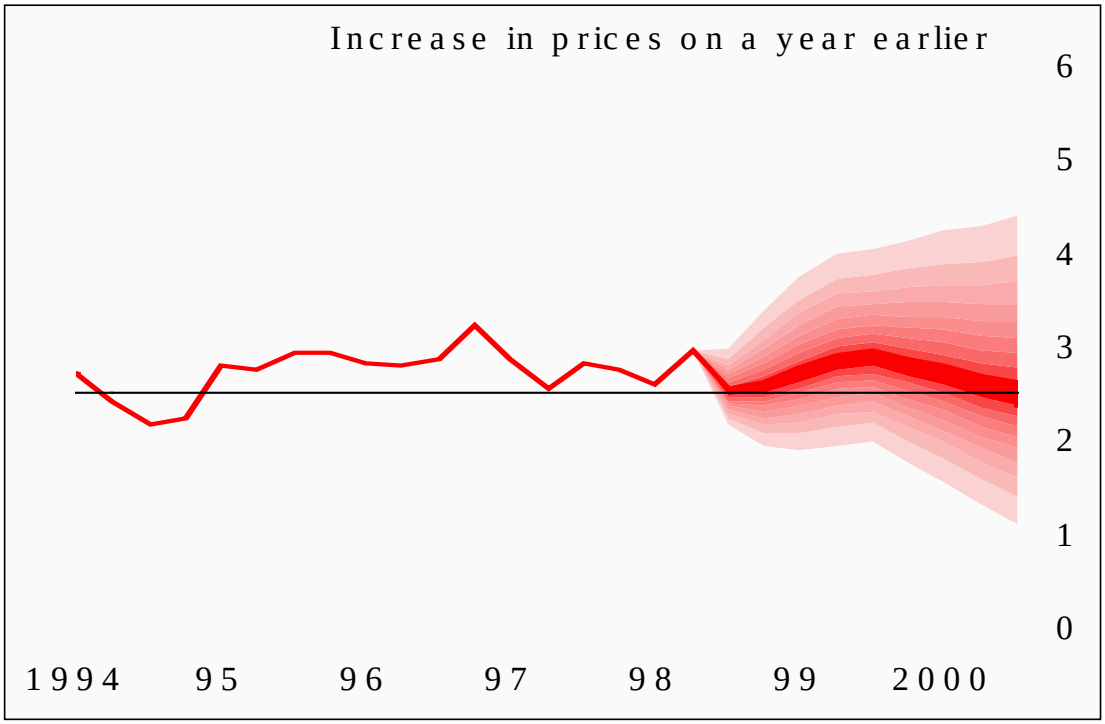


Chart 6:

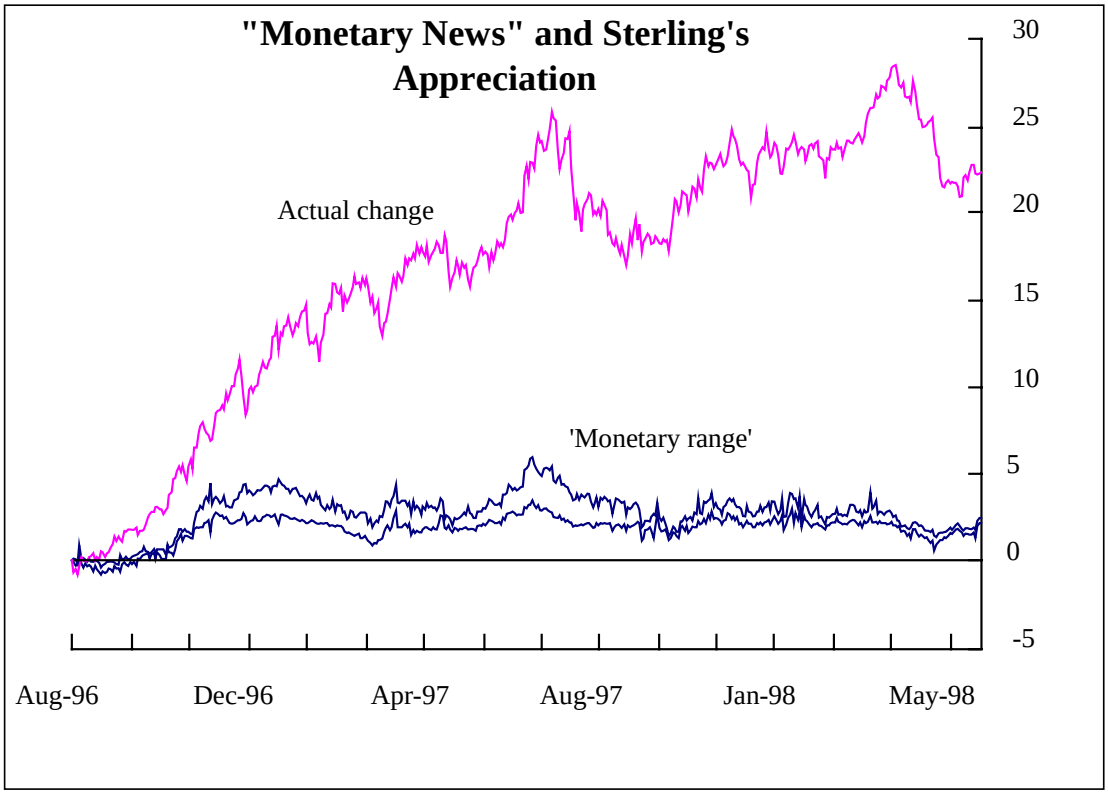


Chart 7:

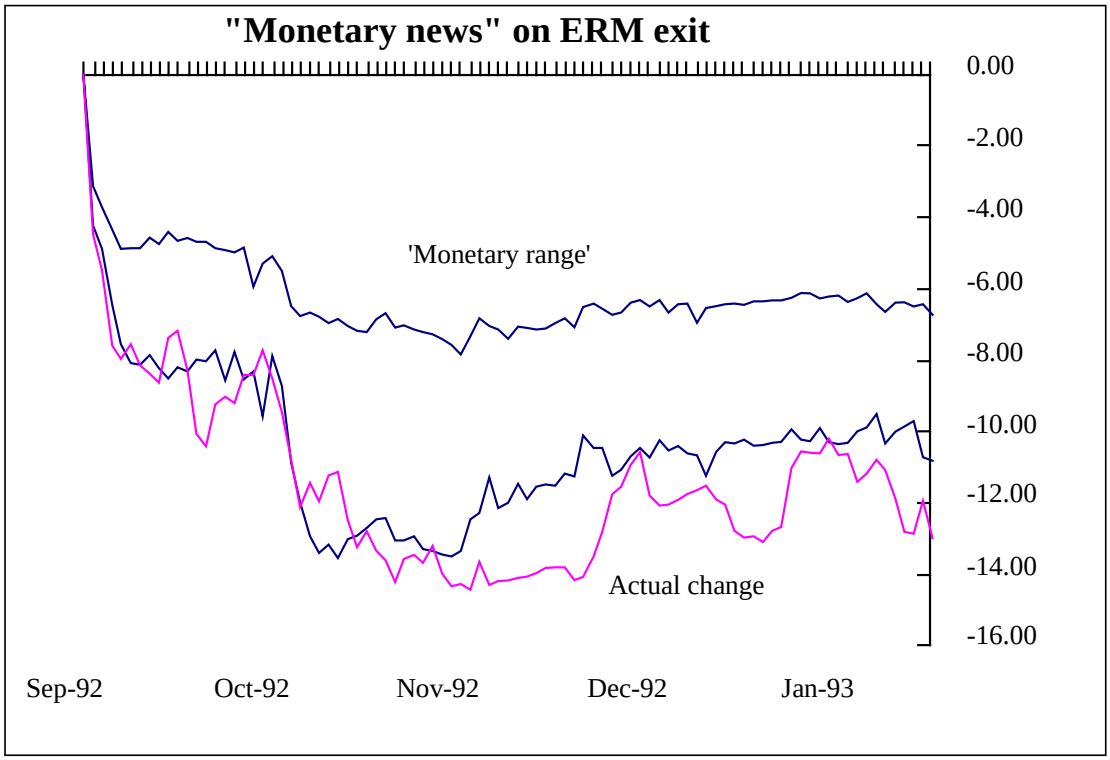
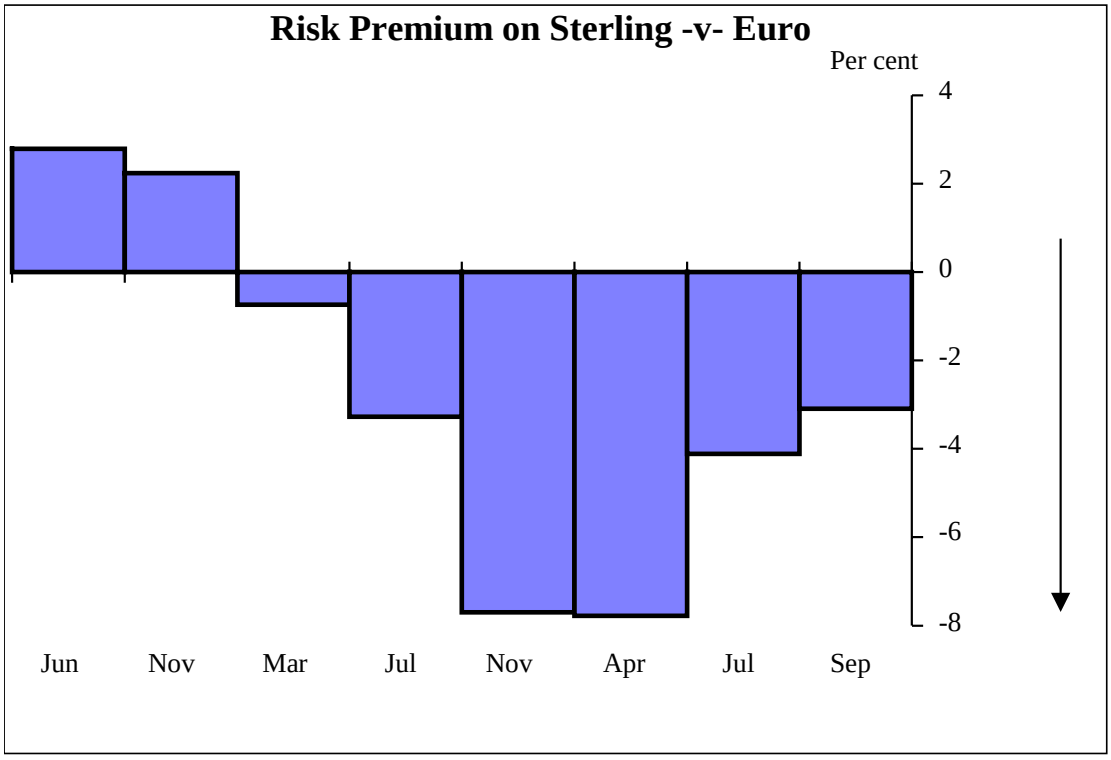


Chart 8:



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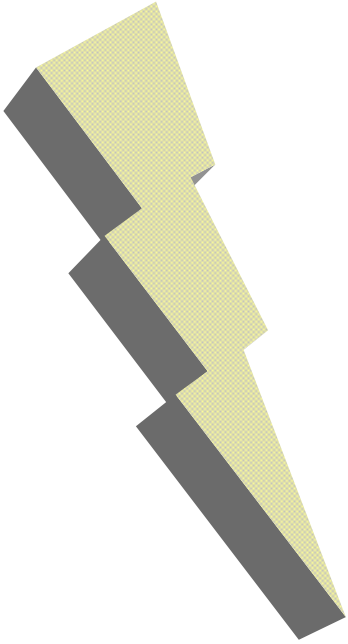


The Czech Approach to Inflation Targeting

Miroslav Hrnčíř and Kateřina Šmídková[1]

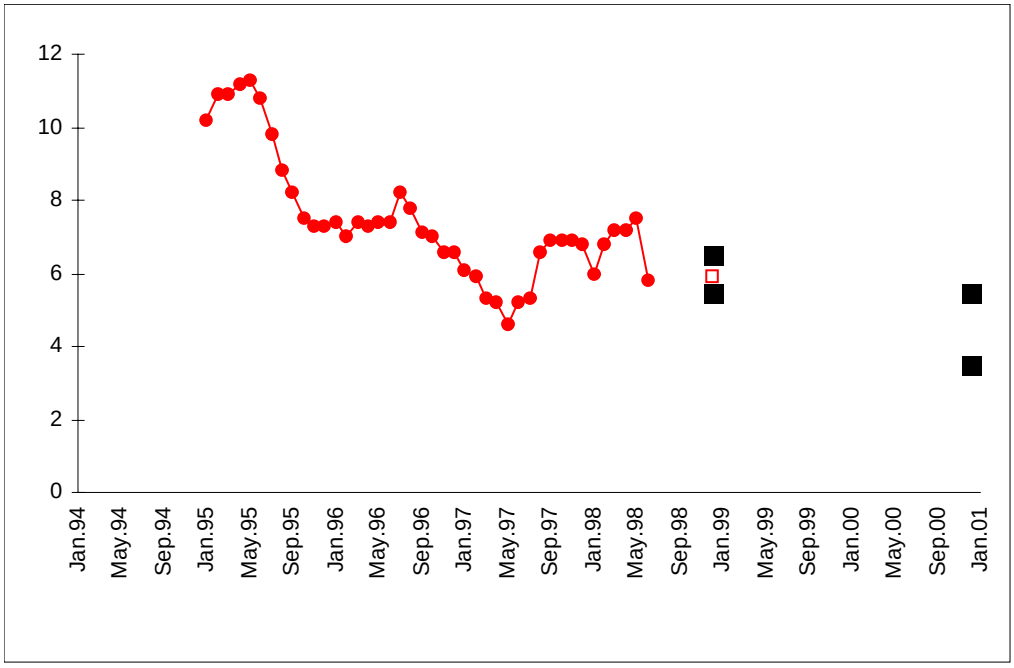
[1] We would like to thank Dana Rottová for her technical support during this project.

1 Introducing Inflation Targeting

In December 1997, the CNB announced that it would switch to inflation targeting. After eight years of relying on intermediate targets, this represented an historic change in the strategy of monetary policy. It is worth noting that price stability has always been the ultimate target of Czech monetary policy.

However, there were different strategies applied to reaching this long-term target. In the framework of inflation targeting, the inflation targets have been explicitly specified in terms of *net inflation* derived from CPI inflation for two time horizons: net inflation to be 6% ±0.5% by the end of 1998 and 4.5% ±1% by the end of the year 2000.

Graph 1 – Inflation Targets Announced in 1997



Note: The historical series of net inflation was calculated backwards in 1997 for the purposes of inflation targeting by the Czech Statistical Office for the period of 1995–1997. The CNB expects that net inflation will be close to the lower edge of the targeted interval by the end of 1998.

1.1 A Short History

The stability of the Czech koruna has been the ultimate monetary policy target of the CNB according to bank law since the very beginning of the bank's existence[2]. In 1993, the Czech Republic had reached the halfway mark in the transitional process and in the process of disinflation. As a consequence, it was necessary to derive the strategy of monetary policy from some concept of medium-term stability. During 1993–1997, before switching to inflation targeting, the CNB had used three strategies. All three were based on working with intermediate targets and were to a significant extent affected by the transitional process.

For example, instruments were being changed quite often as financial markets progressed from an embryonic stage of development to more advanced stages.

The first strategy was used in 1993–1995. The koruna was pegged to a basket of currencies, and the money supply was used as a complementary intermediate target. Each year, the targeted interval was announced for money supply annual growth together with a forecast of CPI inflation that was projected in accordance with both intermediate targets. Table 1 shows that in these years, the CNB was aiming at slow disinflation.

Table 1. Targets and Inflation Forecasts: 1993–1997

	Forecast of CPI Inflation (in %)	Intermediate Target: Money Supply Growth (in %)	Intermediate Target: Exchange Rate Peg	Operational Targets/ Instruments
1993	15 (18)	complementary 16 ±1 (21)	”92” peg band 0.5%	Monetary base
1994	10 (10)	complementary 13.5 ±1.5 (22)	”92” peg band 0.5%	Free reserves
1995	9 (9)	complementary 15.5 ±1.5 (19)	”92” peg band 0.75%	Free reserves with over-writing rule
1996	9 (9)	15 ±2 (8)	”92” peg band 7.5%	Short-term rates REPO rate
1997	8 (9)	10 ±2 (10)	”92” peg band 7.5% May: koruna floats	Short-term rates REPO rate

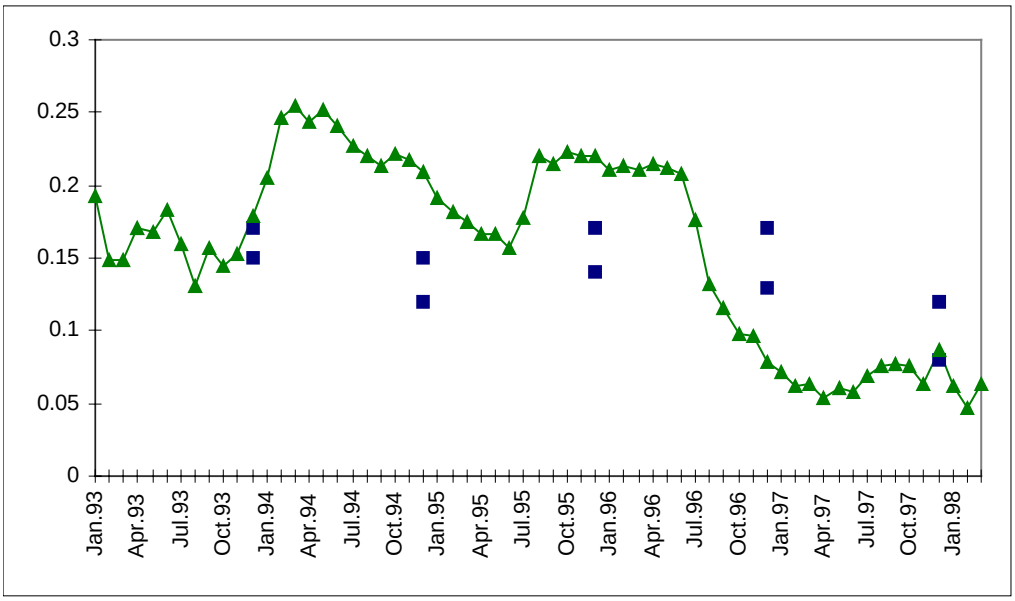
Note: The overview of intermediate, operational targets/instruments and inflation forecasts is based on Annual Reports by the CNB and the annual monetary documents prepared for each year in December of the previous year. Although some targets were modified during the year, we do not report the modifications here for the sake of simplicity. For example, in 1994 due to capital inflow, the target for money supply growth was modified upwards, but the growth exceeded the upper limit. The actual values of respective variables are in parentheses. The actual CPI inflation deviated from the forecast in two periods when monetary policy decisions were subject to transitional uncertainty. In 1993, the VAT reform was an exogenous shock with the impact on CPI inflation higher than anticipated. In 1997, exchange rate turbulence and subsequent exchange rate depreciation were the causes of deviation.

[2] As a consequence of the dissolution of Czechoslovakia, the Czech National Bank was established on January 1, 1993 and became the successor to the State Bank of Czechoslovakia.

In the first years of transition, the pegged exchange rate provided a nominal anchor for the Czech economy and was a key intermediate target for the CNB. Due to the low degree of koruna convertibility, it was possible to work with the money supply as well. This complementary intermediate target was important since due to embryonic financial markets, the only available operational targets were quantitative ones. Also, the target for money supply had its important signalling role, because the credit limits were characteristic features of the previous stages of transition.

In the period of 1993–1995, two operational targets were used simultaneously (monetary base, free reserves), and these targets were compatible with money supply targeting. The main reason for working with volume targets was that the financial markets were in an embryonic stage of development and were too thin to give reliable information on prices. In 1995, when markets became more advanced, the combined operational target was used for free reserves with the over-writing rule for maximum value of the short-term money market rate. The strategy of monetary policy was changed for the first time in 1996. As a response to large capital inflows, financial market developments and liberalisation of capital account transactions, the relative importance of intermediate targets was altered. The koruna was still pegged to a basket, but bands were much wider, and intervention on the foreign exchange market became rare. The target for money supply growth gained significance due to increased autonomy. Graphs 2 and 3 demonstrate the switch in importance of the two intermediate targets.

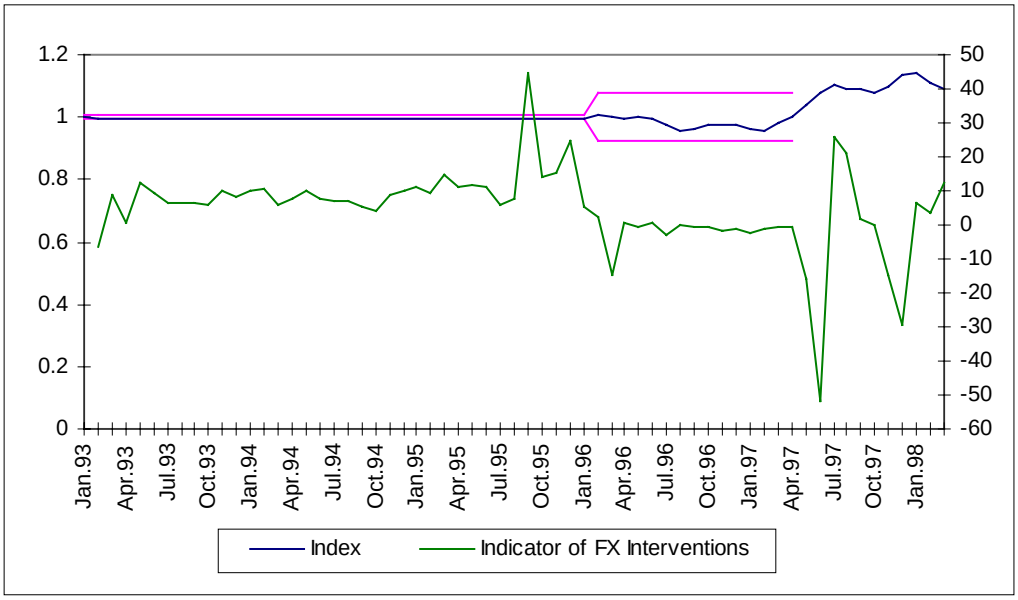
Graph 2 – Intermediate Targets: Money Supply



Note: Annual growth of M2 (in %) is compared to announced intervals for the end of each year in 1993–1997.

The general framework of monetary policy remained the same. For each year, the targeted interval was announced for money supply annual growth together with a forecast of CPI inflation that was projected in accordance with both intermediate targets (See Table 1). Similarly to the period of 1993–1995, the choice of operational targets was mainly determined by the stage of financial market development. In 1996, the short-term rates became an operational target of monetary policy with the repo rate being the instrument.

Graph 3 – Intermediate Targets: Exchange Rate



Note: On the left axis, the exchange rate bands and index are scaled. The bands were abandoned in May 1997. The indicator of foreign exchange rate intervention is scaled on the right axis (billion koruna).

The second change in the strategy of monetary policy before introducing inflation targeting came in May 1997. After exchange rate turbulence[3], the CNB let the koruna float. Hence, the second half of 1997 was a period of "pure" monetary targeting since the target for growth of M2 was not modified and had been reached by the end of the year (See Graph 2). The short-term rates remained the operational target for monetary policy although three months after the attack on the koruna, interest rate levels were predetermined by the strategy of landing.

1.2 Reasons for Introducing the New Strategy

The Bank Board's decision to switch to inflation targeting, announced on December 21, 1997, was the result of an intensive program of studies and discussions within the bank. This program was launched with the aim of overcoming ambiguity in the focus of monetary policy since the discontinuation of the pegged exchange rate regime and the shift to

[3] For more information on the May exchange rate turbulence, see the special working paper *"Koruna Exchange Rate Turbulence in May 1997" Šmídková, Kateřina et al.* We can mention briefly here the main reasons for the turbulence. There were growing internal and external imbalances. Although monetary restriction in mid-1996 was quite significant, it was not sufficiently backed by corresponding fiscal and wage policies. In May, various impulses such as the Asian crisis and domestic political instability triggered an attack on the koruna that was followed by resident panic. After a few days of defending the bands, the CNB and the government let the koruna float.

managed floating at the end of May 1997 left the central bank without a transparent nominal anchor for its policy. Arguments in favour of the adopted decision are explained in the following paragraphs.

Firstly, the key issue has become the challenge of securing effective control over the formation of inflation expectations. Though the Czech Republic was the first transition economy in the region to achieve one-digit inflation in terms of CPI in 1994, some inflation inertia prevailed, and CPI inflation has fluctuated around 9 – 10% since then. Moreover, in late 1997 a new inflation episode had begun to develop. The outlook for the first months of 1998 signalled the acceleration of inflation well above one-digit levels for the first time since 1994.

In the aftermath of exchange rate turbulence, not only did the economy lose its nominal exchange rate anchor of the past eight years, but the experience suggested that the previous strategies were not effective enough to reduce inflation expectations in the changing conditions of the successive transitional stages. In particular, the wage negotiations continued to be based on a double-digit assumption[4] despite the fact that the koruna was pegged to the basket of DEM and USD with no change in central parity up until May 1997. The parallel intermediary target, the money supply in terms of M2, was also met in 1997. The conclusion followed that those frameworks were not capable nor credible enough to affect the expectations, and therefore, could not secure the continuation of the disinflation process.

The strategy of inflation targeting offered an attractive alternative. Unlike previous non-binding annual forecasts, inflation targeting implies the unambiguous declaration of the disinflationary path and explicit quantitative targets of the disinflation process as a public commitment of the CNB. Disinflation became not only a prime objective, but also a direct objective of monetary policy. Accordingly, economic agents were provided with a new medium-term nominal anchor on which they could base their expectations and decision-making processes. This new nominal anchor also supplied economic agents with a longer time horizon than annual forecasts. Moreover, given the solid reputation of the CNB and its independence, this anchor was likely to be more credible than the previous forecasts.

Secondly, the intermediary targets, i.e. the pegged exchange rate and monetary aggregates showed increased inconsistency with the underlying conditions of an advanced stage of financial openness. In its relatively flexible version of a horizontal band of ±7.5%, though, the pegged exchange rate regime proved to be non-sustainable and lost credibility during the exchange rate turbulence in May 1997. The option to reintroduce this peg seemed therefore entirely unfeasible, especially due to two features: (i) the open capital account and liberalised financial markets made massive capital flows possible (both inflows and outflows) which started to dominate exchange rate developments especially in the short run, and (ii) the process of relative price adjustments especially in the segment of still administered prices, such as energy prices for households, rents, transport tariffs and utility prices, was targeted to continue in the forthcoming period.

Accordingly, the option of importing low inflation from abroad via the pegged exchange rate regime could not be expected to be sustainable. The risk of large external imbalances parallel to the developments of 1996 and 1997 would be rather high. The managed float alternative, on the other hand, provided for the flexibility of timely, smooth corrections. In the case of increasing major imbalances, the exchange rate movements would signal inconsistency in the policies. The flexible

[4] In 1993, growth of average nominal wage was 25%, in 1994 17%, 1995 18%, 1996 14% and 1997 12%.

character of the exchange rate arrangement was necessary in a regime of inflation targeting.

As for monetary aggregates and the monetary transmission mechanism, the previous experience had revealed some limitations and weaknesses. The links between money supply (M2) and price developments (CPI inflation) as well as between the intermediate target (M2) and controlled interest rates (REPO rates) did not prove to be predictable nor sufficiently stable. In addition to the constraints observed elsewhere, the conditions of an economy in transition made their application even less reliable. This was due, in particular, to (i) a sequence of price shocks related to transition (corrections of administered prices, tax reforms) which distorted the link between the money supply and price developments, (ii) the institutional features of financial markets going through profound changes within a relatively short time span. This refers also to the operational targets and instruments of monetary policy. In principle, monetary transmission switched from quantities to prices, and (iii) the emergence of new financial assets, as well as new types of transactions and new market players making the demand for money function very unstable. The behaviour of commercial banks, for example, was subject to far-reaching changes in their regulation, in the impact of privatisation as well as in the macroeconomic environment.

Consequently, monetary targeting itself could hardly secure a reliable basis for the medium-term disinflation strategy. Inflation targeting, on the other hand, provided a framework integrating a number of relevant economic indicators (including money supply as an important one). The common focus and the organising criterion for their assessment contributed to the final goal of disinflation.

Thirdly, inflation targeting has provided a scheme for filtering out exogenous price shocks from "standard" inflationary pressures. The adopted concept of net inflation excluded regulated or administered prices as well as the effects of indirect taxes on the prices of the remaining goods and services. Accordingly, net inflation allowed monetary policy to accommodate the primary inflation impulses of transitional shocks such as corrections of administered prices. On the other hand, this framework allowed the central bank to react to their secondary inflationary effects and to prevent a spillover to price level increases.

1. 3 Implementation

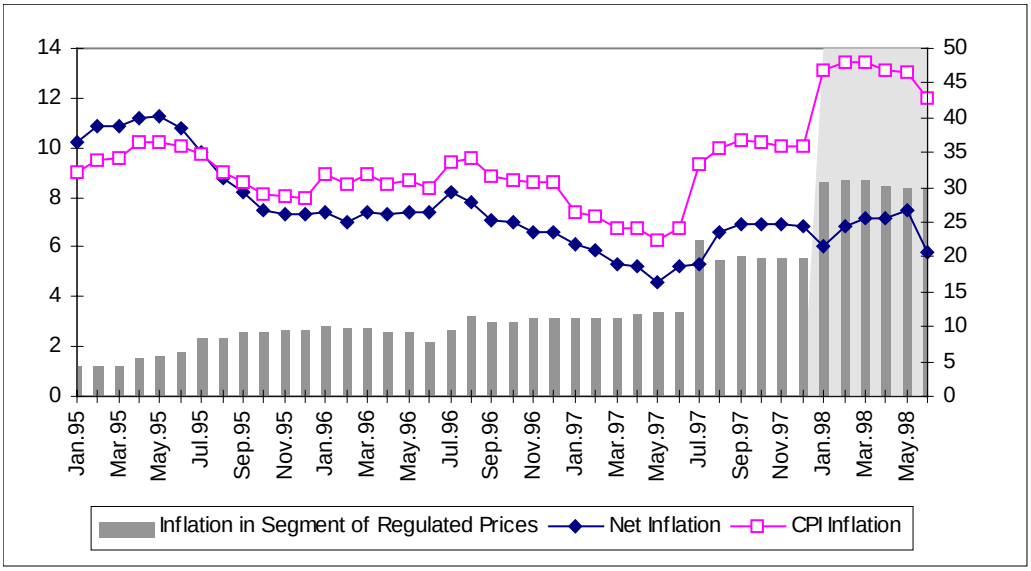
In December 1997, the CNB defined its inflation targets in terms of *net inflation* with the aim of excluding transitional price shocks such as price corrections (sometimes also called price deregulation) and changes in taxes. The net inflation index was calculated backwards for the purposes of inflation targeting by the Czech Statistical Office. The consumer basket defined for the purposes of the CPI was adjusted for items with regulated prices and prices affected by other administrative measures. According to this definition, the net inflation index represents approximately 82% of the consumer price index (it covers 663 of the 754 price items).

The list of items excluded from the total consumer price index was as follows: (i) prices regulated by the Ministry of Finance (e.g. electricity) and prices regulated by local authorities (e.g. taxis) - weight in CPI, 7.4%, (ii) items with semi-regulated prices (e.g. postal service) - weight in CPI, 6% (iii) fees (e.g. TV and radio fees) - weight in CPI, 4.4%. It is worth noting that the index of net inflation can change from year to year due to this definition if there is a change in government strategy. For example, in 1997 taxis became a sector regulated by local authorities. Hence, the prices of taxis were excluded from the net inflation index.

In the next step, the growth rate was calculated for this reduced index and the inflation rate was modified in order to exclude the impact of

changes in indirect taxes (e.g. tobacco tax) or the impact of changes in subsidies. This means that items whose prices change due to tax changes remained a part of the net inflation index, however, the influence of tax changes was eliminated from net inflation. Graph 4 shows the values of three inflation indicators – net inflation, CPI inflation and inflation in the segment of regulated prices. Data for the period of 1995-1997 were available at the time of introducing inflation targeting. It is interesting to note that the pattern of dynamics had changed quite dramatically over time. In 1995, net inflation exceeded CPI inflation due to nearly zero price corrections. On the contrary, the weight of price corrections in CPI inflation was exceptional in the second half of 1997, therefore causing CPI inflation to exceed net inflation.

Graph 4 – Inflation Indicators: 1995–July 1998



Note: Net inflation and CPI inflation are scaled on the left axis (%). Inflation in the segment of regulated prices is a complementary indicator to net inflation with respect to CPI inflation. This is scaled on the right axis. The shaded area shows information which was not available at the time of introducing inflation targeting.

When introducing inflation targeting, the CNB worked with two time horizons. It was not possible to announce a target only in the form of the defined price stability (e.g. 2% inflation with 1% bands) since the economy was on its disinflationary path. Hence, the "key" target was announced for the medium-term: net inflation 3.5–5.5% by the end of 2000. The centre of the targeted interval was specified to guarantee the convergence of net inflation to European inflation before the Czech Republic's entry into the EU. The three year horizon reflected time lags in monetary transmission. The short-term target was announced for the end of 1998: net inflation 5.5–6.5%. This was declared as an "orientation target" that was derived from the medium-term disinflation trajectory. It provided a nominal anchor for economic contracts, the horizon of which usually did not exceed one year. These contracts were linked to previously published annual inflation forecasts.

During the first months of inflation targeting, the CNB explained the strategy of its decision-making process at several press conferences and also via press releases. It has been declared that achieving the net inflation targets will be the ultimate criterion for monetary policy decisions. Decisions will be taken on an ex ante basis when analysing the conditional inflation outlooks and comparing them to targeted intervals. The methods of obtaining inflation outlooks

have been described. The CNB would evaluate both sets of economic indicators[5] as well as rely on model simulations. The following decision scheme was specified: should the inflation outlook deviate from the inflation target, an adjustment of the operational target (repo rate) will be considered.

Inflation targeting has been reflected in the CNB's approach to the general public. In order to increase transparency, the CNB has started publicising the minutes of the board meetings on internet two weeks after a meeting is held with a fairly detailed description of the discussion as well as the reasoning behind monetary policy decisions. At the end of the quarter, the CNB started producing inflation reports that focus on price and monetary developments, inform about real economy and external sector developments and include an inflation outlook together with an explanation of monetary measures.

2 The Decision-Making Process: January–July 1998

Let us now describe the decision-making process in the first seven months of inflation targeting in the Czech Republic. Following this, we will summarise some important features of the process. Our source of information has been the Minutes of the Board Meetings on monetary policy issues. The minutes are officially publicised each month, two weeks after the meeting is held.

In January 1998, the repo rate was left unchanged. During the first month of inflation targeting, the majority of available information was from December. Despite numerous uncertainties, the inflation outlook was in compliance with the inflation target for the end of 1998. However, a high trade deficit in December and the consequences of the Asian crisis were viewed as a potential impulse for weakening the exchange rate. Also, the January price deregulation together with the expected consequences of regular January re-pricing increased the probability that the inflation outlook would be closer to the upper limit of the targeted interval. It was evident that in the first months of 1998, net inflation would increase due to past developments.

In February, the repo rate was again unchanged. However, this time there were two alternatives considered (the other being to raise the repo rate). On the one hand, in this month, the inflation outlook started signalling that net inflation would be in the upper part of the targeted interval by the end of 1998. On the other, an agreement was reached that the decision on raising the repo rate should not be based on the unexpectedly high month-on-month increase in prices. The inflation outlook was modified upwards due to the previously underestimated scope of both the January re-pricing effect and the impact of deregulation on net inflation. An implication for future monetary policy decisions was that inflation expectations should be considered as a very important transmission channel and that there could be increased probability of their acceleration.

In March, by a majority vote, the repo rate was increased by 0.25% to 15%. The newly available February data on inflation confirmed that the risks of higher inflation in the future might outweigh the favourable trends in the economy. Various price indices signalled that without an adequate policy

[5] A set of indicators is formulated in such a way as to cover the main components of inflationary influences, i.e. demand and cost factors, as well as factors related to inflation expectations. The set of indicators includes: specific consumer price indices which cover various items of inflation and indicate inflation expectations; producer price indices indicating cost-related inflationary pressure; exchange rate indices; a complex of indicators characterising monetary development, specifically monetary aggregates and interest rates; a group of indicators expressing the mutual relationship between supply and demand (from which it will be possible to derive demand pressures); indicators of labour market and wage development.

response, net inflation might exceed the upper limit of the targeted interval in December 1998. Moreover, the available CPI forecasts for the end of 1998 (announced by various institutions) suggested that targeted net inflation should be in the middle of this interval rather than approaching its upper band in order to compensate for the higher than expected CPI inflation. The hypothesis of the potential for accelerating expectations formulated during a previous meeting was confirmed by the upward slope of the interest yield curve. According to the slope, inflation expectations exceeded the targeted values. It was said during the discussion that, although the observed exchange rate development supported a gradual reduction in inflation, it would not be desirable to shift the weight of the monetary transmission mechanism from an interest rate channel to an exchange rate channel. Consequently, the modest repo rate increase was mainly designed to affect the economy via the expectation channel.

In April, the repo rate remained unchanged. The inflation outlook for net inflation at the end of 1998 had moved back to the targeted interval. There was new information on the reduction of annualised trade and current account deficits as well as the closing of the gap between productivity and wage increases that was accompanied with the appreciation of the koruna. Also, imported deflation of input prices was reflected in domestic inflation development. At the same time, inflation expectations started decelerating.

In May, the repo rate had again remained unchanged. Similarly to the previous month, the newly available information was favourable. The inflation outlook was in accordance with the targeted interval for the end of 1998. However, it was agreed that to some extent this was the result of external factors. Firstly, the part of slower inflation was imported via input prices (mainly raw materials) that were purely exogenous. Secondly, the situation on both domestic and international financial markets caused the koruna to appreciate. On the one hand, this was partially an endogenous process linked to improving the domestic economic fundamentals. On the other hand, this was a consequence of exogenous factors since crises on some emerging markets made the koruna relatively more attractive to foreign investors. Since the above-listed external factors were viewed as temporary, this exogenous slowed-down in inflation was called “borrowed disinflation”.

In July, the repo rate was cut from 15% to 14.5%. According to the inflation outlook, net inflation was likely to be close to the lower band of the targeted interval by the end of 1998. The newly set repo rate was consistent with the medium-term target for 2000. It was stressed that the latest koruna appreciation was not a reason for cutting rates and that the exchange rate would not be directly affected by this monetary policy decision. The economic situation was characterised by a lower risk premium and a fall in inflation expectations. These were likely to slowly decelerate because of “borrowed disinflation”. Also, one of the main factors – the impact of price deregulation – would have a different impact in July from the one in January since the composition of prices that were subject to changes was different and the impact on net inflation would be smaller due to an income effect.

After describing the decision-making process, the main features can then be summarised. First, all decisions were discussed strictly in the framework of inflation targeting. There was no conflict of targets revealed during the discussions. The repo rate’s level was clearly linked to the inflation target and the inflation outlook. When the inflation outlook signalled a deviation of net inflation from the targeted interval at the end of 1998, the repo rate was changed. It is interesting to note that decisions were symmetrical since the repo rate was increased when the outlook signalled overshooting of

the targeted interval and cut when the outlook signalled undershooting.

Secondly, three periods of the introduction of inflation targeting can be identified. Until March, although the economic fundamentals such as the trade deficit or consumption improved, inflation expectations were not in line with the disinflationary path due to the backward-looking approach as well as to the re-pricing effect, the secondary impact of deregulation and increased exchange rate uncertainty. Up until July, the situation stabilised as expectations were formed more by economic fundamentals. Since July, expectations have been on a disinflationary path to some extent due to the impact of external factors.

Thirdly, it is important to note that the time horizon of the decision-making process did not change, because the weight of the targeted interval for the medium-term had increased gradually. At the same time, the uncertainty linked with external factors forming inflation increased. The problem of "borrowed disinflation" that helped in forming inflation expectations gained importance since external factors could be reversed in the medium-term and destabilise expectations once again.

3 Is a Transitional Country a "Good" Inflation Targeter?

The Czech Republic was the first economy in transition to adopt a regime of inflation targeting as the explicit framework for its monetary policy. Two important questions therefore arise. First, in the Czech case, do underlying conditions which still have specific features of transition allow for the effective implementation of inflation targeting? Second, what are the possible reactions to some transitional challenges within the framework of inflation targeting?

3.1 The Necessary Conditions for Effective Implementation

The first important issue is the emphasis that society puts on price and currency stability. If the priority of stability is high, the central bank's strategy as a whole is supported. The Czech experience suggests that the koruna has enjoyed remarkable stability in the course of past developments. After World War I, the currency of the newly formed Czechoslovak Republic was the only one in the region which had avoided hyperinflation. The relatively modest monetary overhang was a favourable feature of the macroeconomic situation also in the post World War II era. And again, since the start of transition, unlike most other countries in the region which sooner or later adjusted their framework to the requirements of external balance and external competitiveness[6], the priority attached to domestic price stability has remained a distinguishing feature of the Czech transitional strategy[7].

The conclusion follows that price and currency stability are highly respected and supported by society, and therefore have been "built into" Czech economic development and policies. This seems to be the underlying factor which is of utmost importance for the feasibility and sustainability of the inflation targeting regime in the Czech case. In situations where acceleration of economic activity and the disinflation process are discussed in terms of a short-run trade-off issue, the arguments of price stability can find public support.

[6] For example, Hungary and Poland used crawling-peg regimes. Under this scheme, the objective of monetary policy is not unambiguous since the process of disinflation can conflict with the external balance.

[7] Two types of nominal anchors were drawn upon in the course of the transition years in order to affect domestic stability. In the initial stages, this was the exchange rate nominal anchor. Despite persistent real appreciation, the koruna peg to the basket was maintained with unchanged central parity and the horizontal band over the whole period of January 1991 to May 1997. In the aftermath of exchange rate turbulence, the priority of domestic stability continued via the adoption of inflation targeting.

The second important factor is the institutional and economic pre-conditions of the inflation targeting regime. The first institutional requirement to be satisfied was evidently the capability of the central bank to conduct its monetary policy with a fairly high degree of independence. This pre-condition for the adoption of inflation targeting was, without a doubt, in place. According to the Constitution and central bank law, the Czech National Bank (CNB) is independent of the government and has sole responsibility for the conduct of monetary policy. And even more importantly, in the course of the entire transition, this independence was put into practice and demonstrated in the domain of both instruments and goals.

The second prerequisite, related to the real independence of the central bank, was fiscal discipline. With extensive public borrowing from the banking system (involving substantial increases in public debt, with shallow financial markets not being able to absorb the placement of debt instruments and high dependence on revenues from seigniorage), monetary policy would not be in a position to secure the meeting of disinflation targets. In this type of situation inflationary pressures of a fiscal origin would develop, the effectiveness of policies for attaining nominal targets would be undermined, and the central bank would be forced to follow an increasingly accommodative monetary policy. In the case of the Czech economy, the principle of a balanced budget policy was followed throughout the past period, and the public sector borrowing requirement remained moderate. Nevertheless, the revealed "hidden debt" of transformation institutions inflated the previous officially declared debt level.

There are other institutional factors that relate to the issue of inflation targeting. Specifically, a certain level in the development of financial markets is required. With a floating exchange rate, there is a need for a well-developed foreign exchange market that is complex enough to cushion the short-term volatility of capital flows. Also, instruments reducing exchange rate uncertainty should be available to economic agents. Moreover, if inflation targeting is introduced before major changes on financial markets take place, extensive structural breaks would make it difficult to create inflation forecasts or outlooks. Last but not least, it is very important that at the initial stage of introducing the strategy, external factors such as import prices do not damage the credibility of the new framework via significant shock. In the Czech case, the external factors sent favourable impulses and helped set inflation expectations on the disinflationary path.

3.2 Inflation Targeting as a Disinflation Strategy

The Czech approach to inflation targeting has been influenced by the necessity to distinguish between the long-term objective in the form of price stability and the medium-term target of disinflation. Obviously, no threshold inflation rate could be defined as a prerequisite for a viable shift to inflation targeting. Nevertheless, the experience from other countries suggested that this regime had not been introduced in times of high or moderate inflation. Moreover, most countries switched to inflation targeting only after inflation was under control and on a decreasing path. As a rule, the CPI index had one-digit values and in the majority of cases, the central bank was faced with the problem of reducing inflation fluctuations rather than the problem of disinflation.

In the Czech case, the inflation level fluctuated around ten per cent[8] with some inertia for several consecutive years. This level, though moderate, was higher than in other countries when shifting to

[8] There were three detectable inflation episodes. In 1993, the inflation impulse was created by the VAT reform. In 1995, the impact of capital inflow on demand started to affect inflation. In 1997, the exchange rate turbulence and the consequent depreciation of the koruna were significant factors in the development of inflation.

inflation targeting. Moreover, an acceleration of the inflation rate was envisaged for the first months of 1998, and market expectations for the future rate of inflation seemed quite unstable with little confidence from the public that the disinflation process would be reinstituted in the foreseeable future.

Under these circumstances, despite an unfavourable outlook or rather, because of that outlook, the CNB Board did not want to wait to take a clear stand on price stability as the main objective of monetary policy. The public commitment to the explicit disinflation target and the related resolute policy stance were aimed at reversing expectations and at reassuring the markets and the public. Given the situation of increased political uncertainty, highlighted by the resignation of the government, the independent central bank commitment to sound, transparent long-term goals seemed to be of utmost importance, irrespective of the potential swings in political power.

The design of inflation targets has reflected the above-analysed problems. In December, the public announcement of switching to inflation targeting reassured the public that monetary policy is devoted to providing price stability. By specifying the two targets for the short-term and medium-term horizon, the CNB also declared that monetary policy will aim at disinflation in a horizon that is relevant for negotiated contracts. This made the objective of price stability more "actual" since previous strategies did not declare any time horizon for reaching the European level of inflation. Hence, the channel of inflation expectations through which monetary policy affects economic decisions has become more efficient. Moreover, the new strategy probably changed as well the mode in which expectations are formed, from an adaptive mode to one that was more forward-looking. This has been a very important achievement. Should wages be negotiated under a strictly backward-looking mode of expectations, the costs of disinflation would be much higher and the risk of reappearance of the external imbalance would increase.

3.3 Transitional Challenges

The Czech experience in the first eight months of inflation targeting revealed two important challenges for policy makers. It has been necessary to deal with transitional shocks to prices and the consequences of having an emerging financial market. Let us describe the problem of price shocks first since it enters both the decision-making process as well as the process of target specification. Countries that are inflation targeters usually deal with the problem of price shocks by modifying the CPI index or by declaring "caveats". Central banks do not commit themselves to influencing CPI inflation as a whole. Both methods are used to distinguish inflation from primary exogenous shocks to prices in order to avoid a counter-productive reaction of monetary policy.

During transition, this problem is more complex since this reform carries with it a sequence of exogenous price shocks such as tax reform or the so-called deregulation scheme in which relative prices in previously regulated sectors are gradually corrected. As a result, there is a trade-off for policy makers. On the one hand, if the CPI index is modified in order to minimise the risk of a counter-productive reaction of monetary policy or the risk of missing the target, it is necessary to add to standard caveats the expected transitional shocks during transition. In this case, the new index used for specification of the target could become irrelevant to economic decisions since the share of excluded categories is high and CPI inflation might diverge from the targeted inflation[9].

[9] As was shown in Graph 4, two types of divergence are possible. During a period of small-scale deregulation, in which inflation in the segment of regulated prices was lower than inflation in the remaining price segments, net inflation exceeded CPI inflation. Large-scale deregulation caused the CPI to exceed net inflation. Since the scheme of deregulation was usually announced on an annual basis and

Consequently, the transmission channel through expectations is significantly weakened.

On the other hand, if only standard caveats are used, the targeted inflation is more likely to converge to CPI inflation and contracts would be linked to the target. However, during transition the excluded shocks would be quite significant as shown in Graph 4. Consequently, there would be three possible reactions of monetary policy: (i) to compromise on the slope of the disinflationary path and derive its slope from a deregulation scheme with all the disadvantages (e.g. large fluctuations around the disinflation trend caused by changes in government strategy), (ii) to compromise on the credibility of the target itself and allow for missing it in the case of large-scale deregulation, (iii) to rely on the substitution effect between regulated and non-regulated price segments and to accept the costs of non-accommodated supply price shocks.

In the Czech case, the first alternative has been evaluated as less costly. However, the CNB did not use many caveats explicitly when defining net inflation, because net inflation filters out some standard shocks such as the impact of indirect taxes. The majority of excluded items are those in the segment of regulated prices. Hence, one can classify net inflation as a "transitional" concept, and it is likely that in the medium-term, after major deregulation steps are completed, the two inflation rates would converge. Not only is the existence of a deregulation scheme and implied uncertainty a limiting factor when defining the target, it has consequences for the decision-making process as well. As the summary of the minutes of the meeting shows, it has been very difficult to predict the spillover effect from the segment of regulated prices to net inflation due to the unavailability of historical data as well as structural breaks.

The second important challenge for policy makers has been the problem of the existence of emerging financial markets. It is important to note that in the Czech case, the pegged exchange rate played the role of a nominal anchor for the entire period of 1990–1997. In May 1997, the peg was discontinued, and a more flexible regime in the form of managed floating was introduced. This shift was consistent with the requirements of the inflation targeting regime since it is feasible to target domestic inflation only in the context of a flexible exchange rate, otherwise conflicts of commitments to different targeted variables are likely to arise and the effectiveness of inflation targeting is undermined.

The shift to a floating exchange rate notwithstanding, the policy approach to the role of the exchange rate in the new setting remained an issue. Given the small size and the significant openness of the Czech economy, the exchange rate has had a remarkably large and direct impact on the CPI. At the same time, capital flows, much larger and more volatile than trade flows, have increasingly dominated short-term exchange rate developments. Moreover, in a transition economy with still relatively thin markets, wide interest rate differentials and a volatile risk premium, the exchange rate response to various shocks, new economic and political data and to changing perceptions of investors is much more volatile and occasionally even erratic in nature. In the given circumstances, some issues related to the exchange rate within the framework of inflation targeting required clarification – for example, policy stance.

On the one hand, the level of the exchange rate can neither be an explicit nor implicit objective of monetary policy. This is because the control of the exchange rate level is neither feasible in the existing conditions nor consistent with the inflation targeting

was conditioned with political stability, there has been uncertainty for both the scope and the direction of the divergence. Moreover, the index of net inflation itself is subject to uncertainty since the government can theoretically redefine the segment of regulated prices significantly.

framework. Accordingly, problems of external imbalances must be coped with within a broader framework of macroeconomic policies and their combination. The foreign exchange interventions aim at smoothing the moves from one exchange rate level to another and at reducing the volatility and erratic responses in the exposed but still relatively thin koruna foreign exchange market. On the other hand, for a small, open economy, movements in the exchange rate are a significant factor that enters the decision-making process of the central bank. Subsequently, foreign investors tend to guess the reaction function of the central bank and use the implicit bands to reduce foreign exchange risk when speculating on the foreign exchange market.

3.4 Transparency Gain

An important advantage of the shift to inflation targeting was related to the increased transparency of monetary policy. Transparency, in fact, has improved in both specifying the target and decision-making. As far as target specification is concerned, the adoption of an inflation targeting regime introduced a clear-cut focus for monetary policy. It has been a move from ambiguous specification of the disinflationary path to explicit specification of the slope of the path as well as the time horizons.

Moreover, in comparison to the previous situation with two parallel intermediary targets and non-binding inflation forecasts, the potential conflict of criteria that could emerge as a result of various imbalances has been removed. For example, when using two parallel intermediate targets in periods of capital inflow, it was not easy to determine which target should gain more importance in the decision-making process. Excessive monetary growth and an excessive current account deficit put monetary policy into a position in which only one parallel target could be achieved. With the inflation target, the importance of various indicators has been unambiguously (although implicitly) determined by their weight in the transmission scheme from interest rate to inflation outlook.

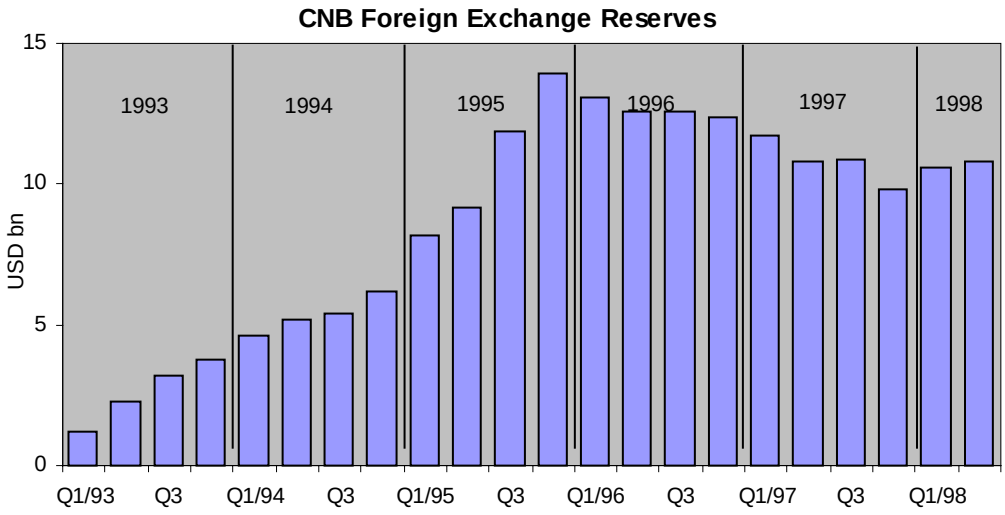
The second important improvement has been an increase in the transparency of the decision-making process itself. The policy steps of the central bank have become smoother and more predictable since with a clearly defined scheme of targets and instruments, the policy rule was now unambiguous. Also, the decision-making process was made transparent due to publicising the minutes of the meetings. By the same token, this process is more exposed to the reactions of professional economists and the general public.

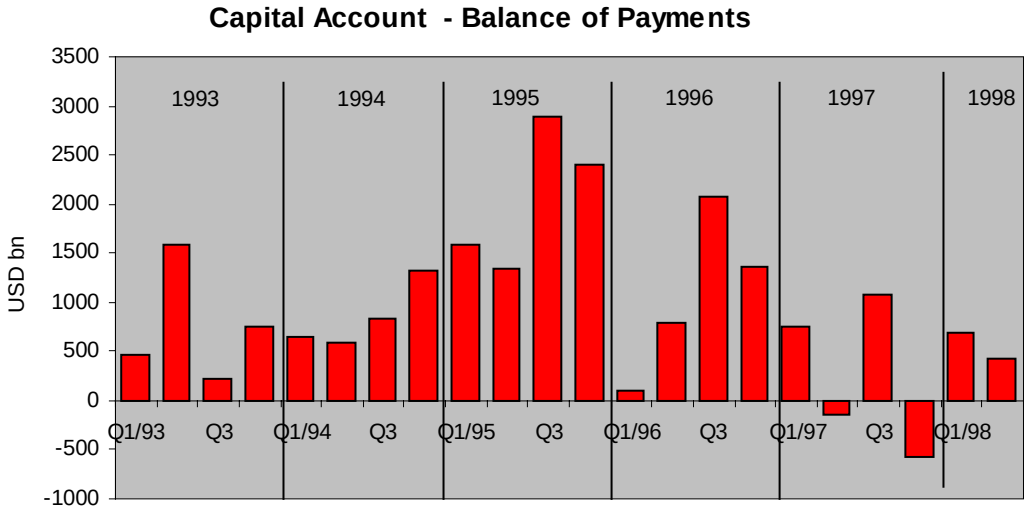
This gained transparency and accountability of monetary policy proved to be beneficial. It has had a positive impact on staff efforts and performance within the bank. It has contributed as well to a better understanding of the problem and to increased and more diversified public involvement. Also, it provided a clear framework for discussions about monetary policy since the target has been defined clearly and the commitment to ensuring disinflation has been explicit. There has been no conflict with other targets such as the external balance. One of the most important benefits has been the successful formation of expectations that have reduced the costs of the disinflation process. Also, an increase in the credibility of monetary policy has reduced the costs of external financing due to lowered risk premium.

Many foreign institutions have looked upon the new strategy as a real achievement. For example, the OECD report states:

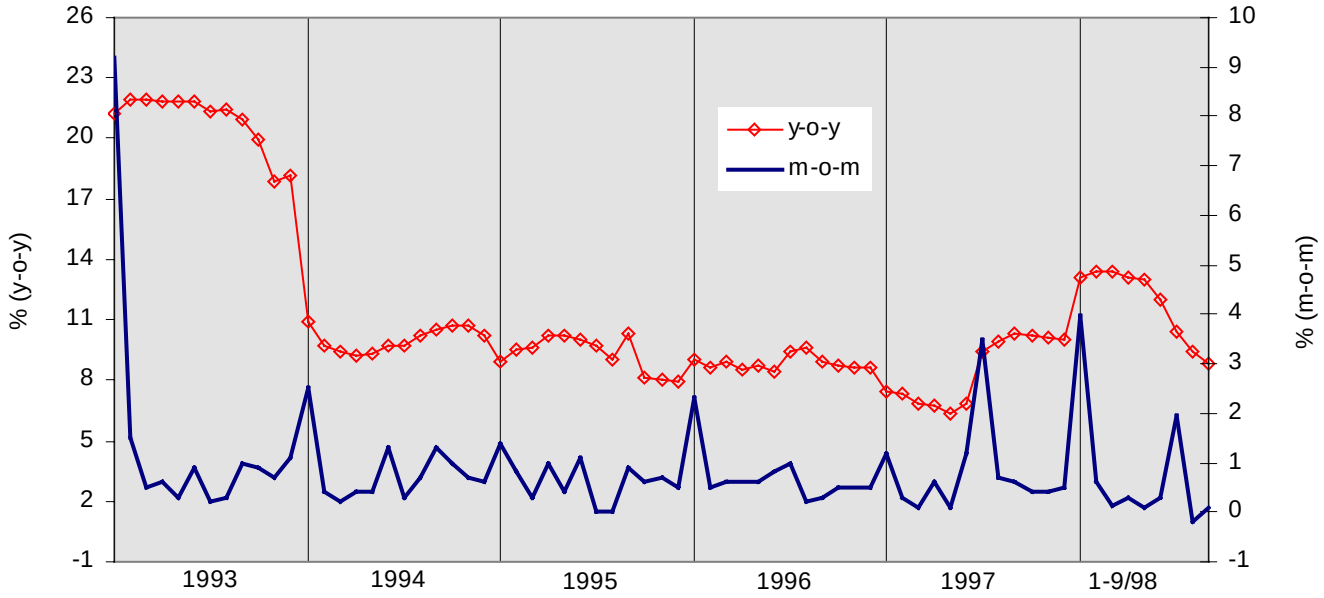
> Globally, monetary policy has successfully negotiated a very difficult period. The decision to abandon the fixed-exchange rate regime was made before too many reserves had been spent and the Central Bank has managed to use the subsequent period to partially restock them. Although subject to volatility emanating from the developments in Asia, there have been no precipitous falls in the currency since the spring 1997 crisis and the depreciation observed in recent months appears to be in line with economic fundamentals. Appropriately, given the still large trade and current account deficits, monetary policy has remained restrictive, while the announcement of a new inflation-targeting framework brought a welcome end to a period of uncertainty as to the main focus of policy.

Appendix: Basic Indicators

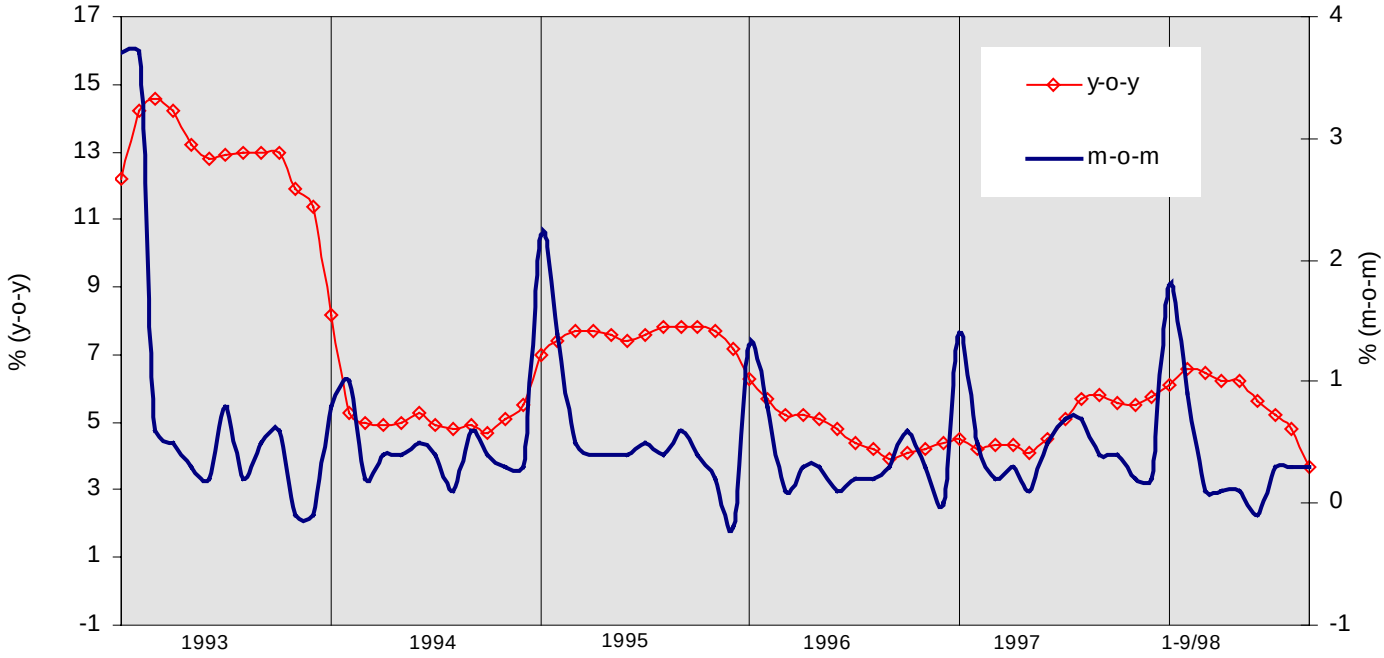




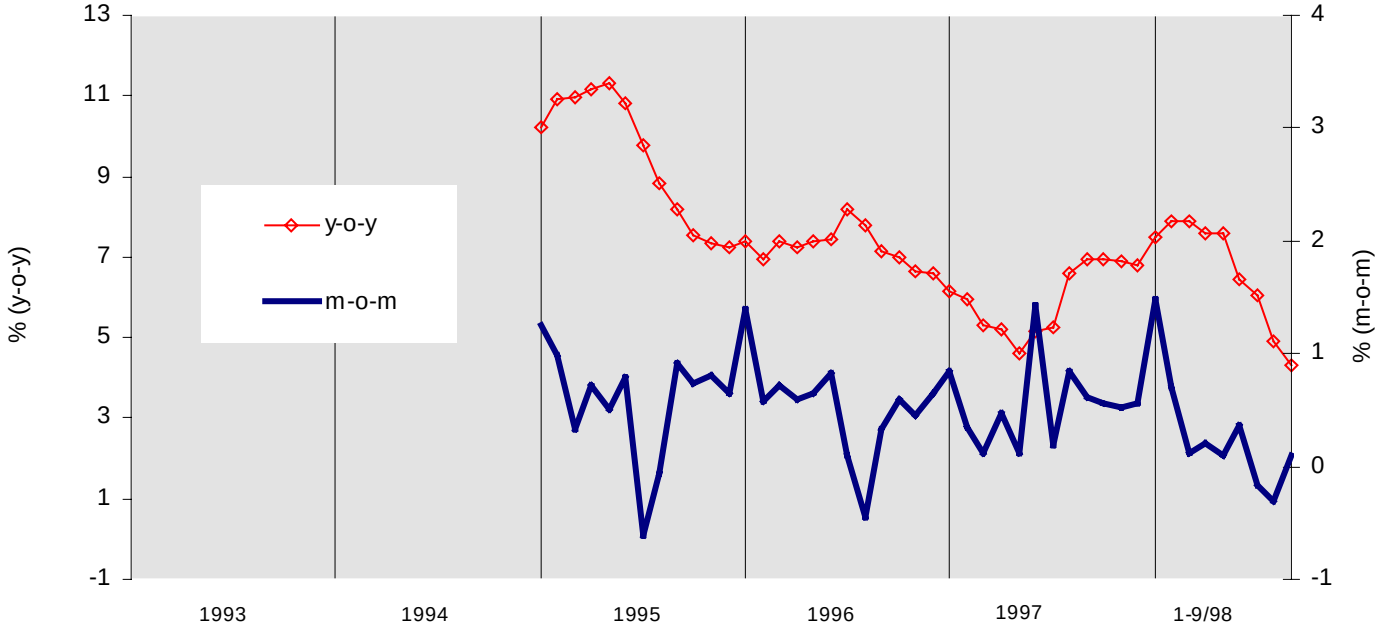
CPI Inflation



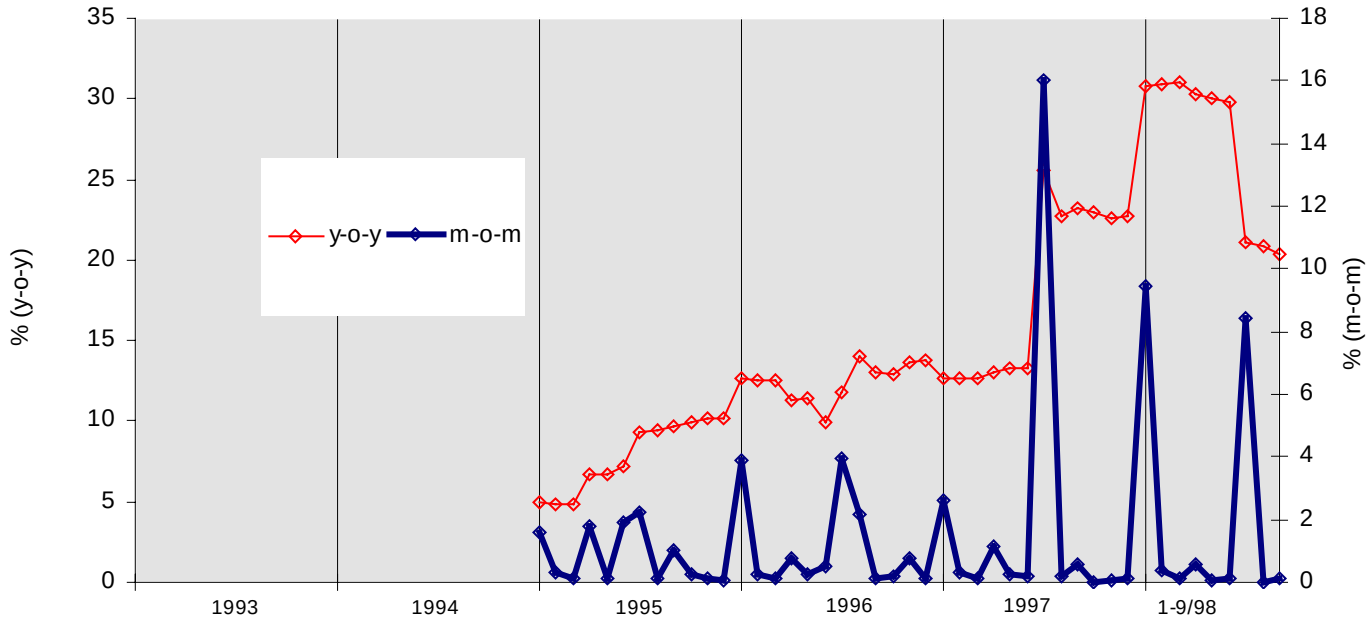
PPI Inflation



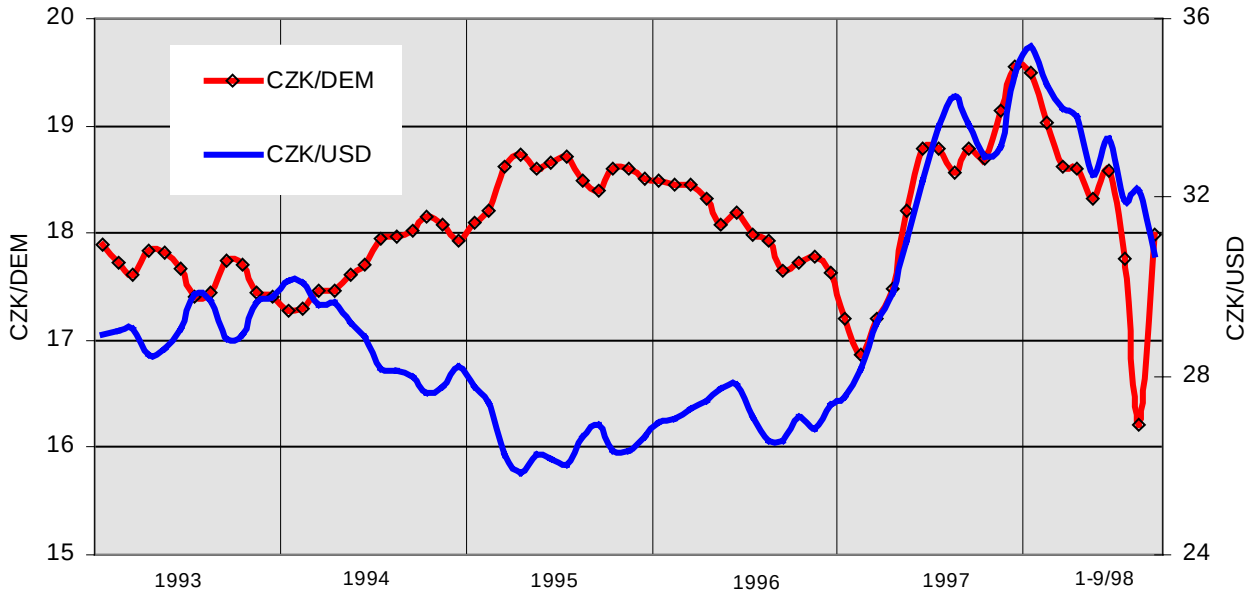
Net Inflation



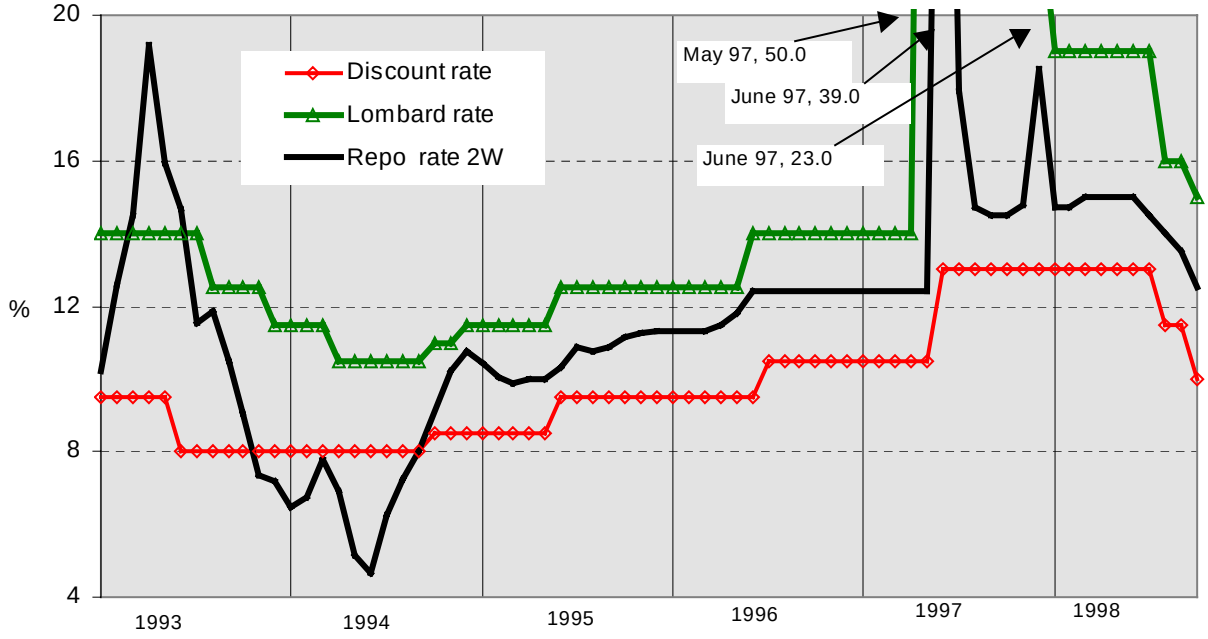
Regulated Prices

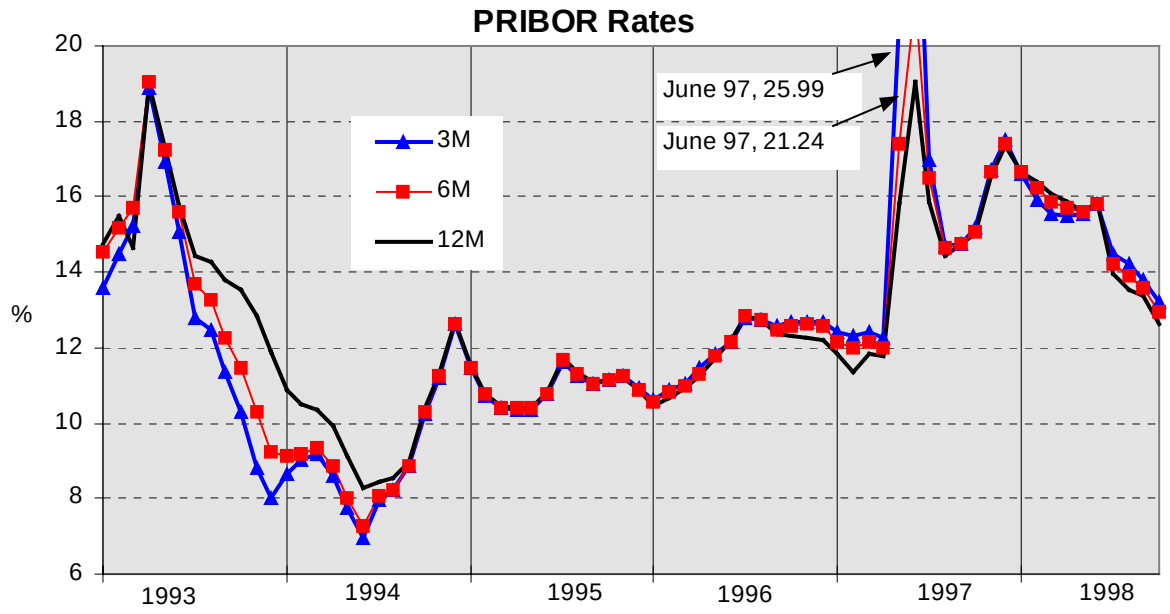


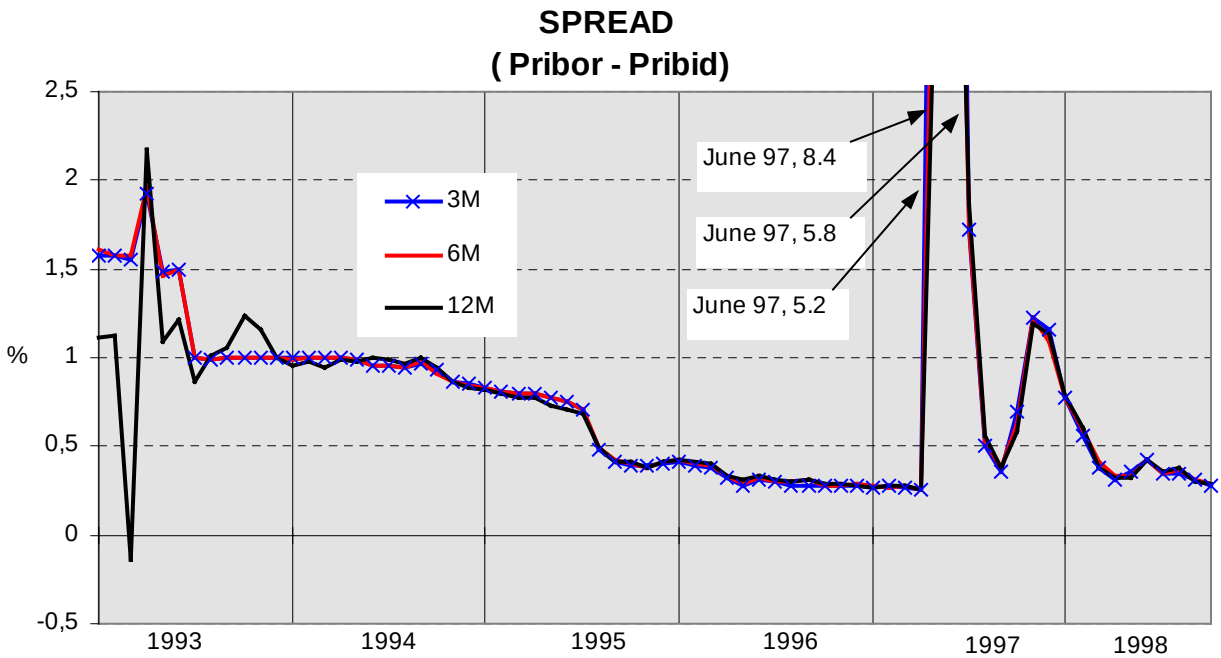
Nominal Exchange Rate
CZK vis-a-vis DEM and USD



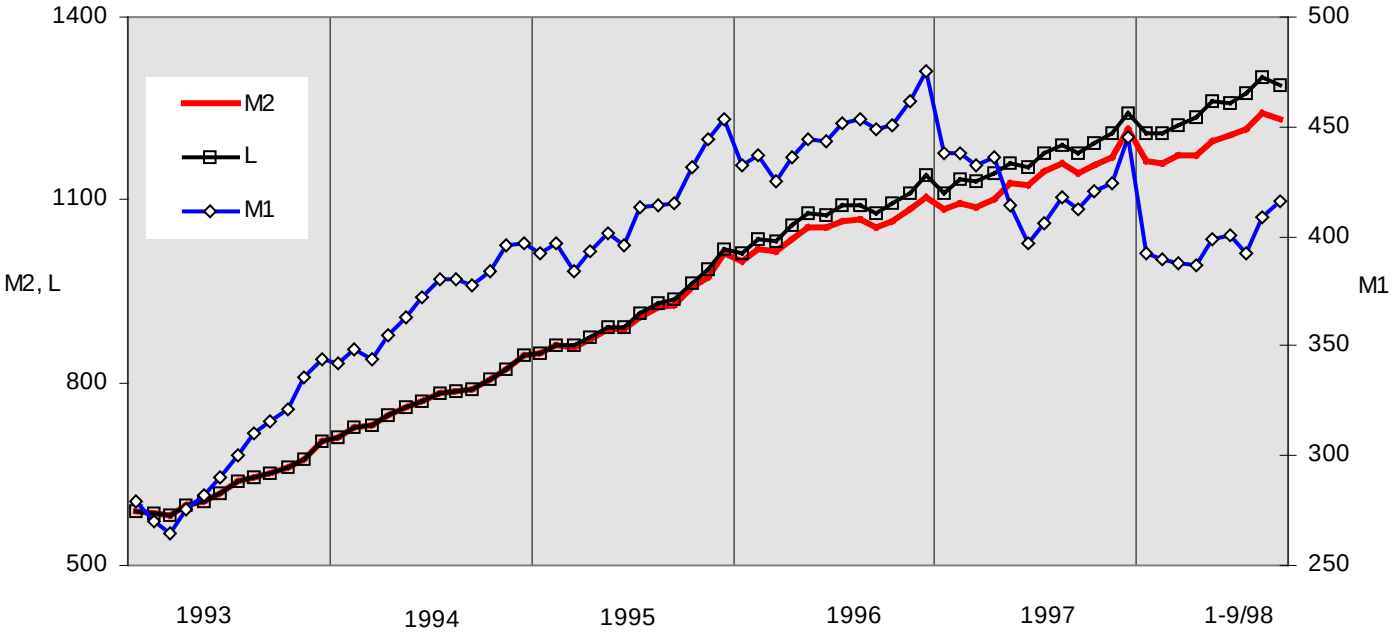
Key Rates




PRIBOR Rates
20
18
16
14
12
10
8
6
%
1993
1994
1995
1996
1997
1998
3M
6M
12M
June 97, 25.99
June 97, 21.24

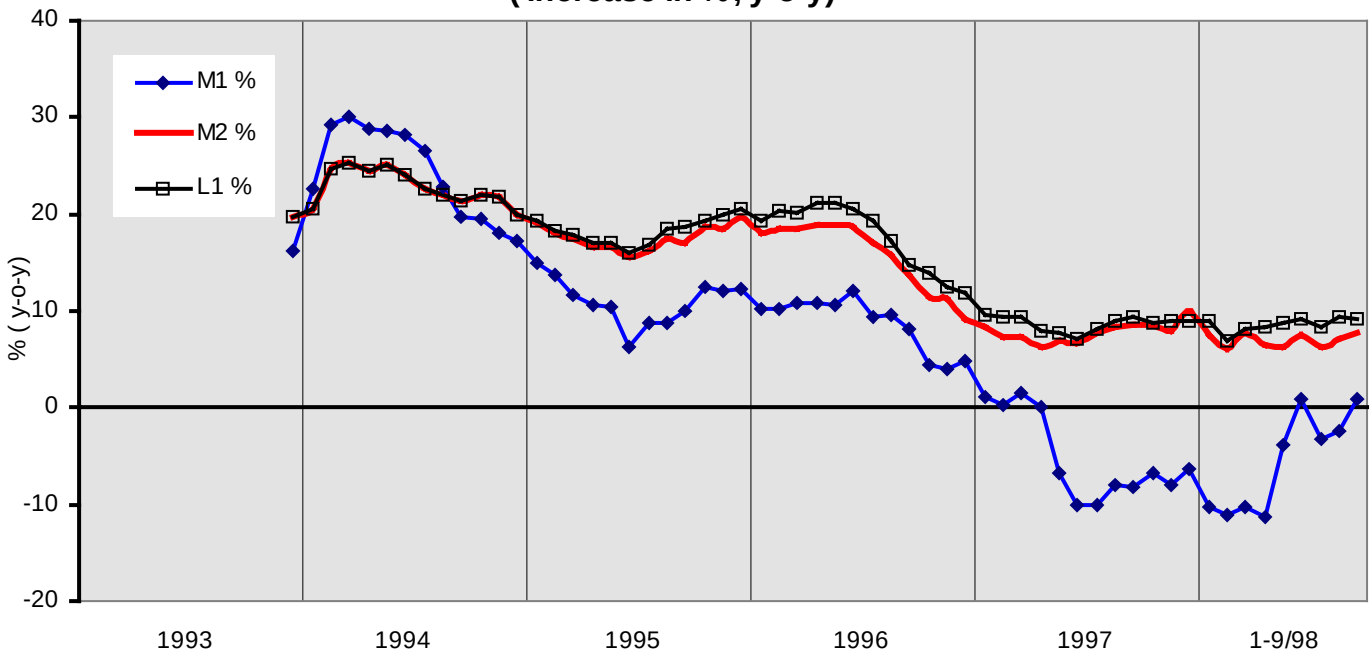

SPREAD
(Pribor - Pribid)
2,5
2
1,5
1
0,5
0
-0,5
%
1993
1994
1995
1996
1997
1998
3M
6M
12M
June 97, 8.4
June 97, 5.8
June 97, 5.2

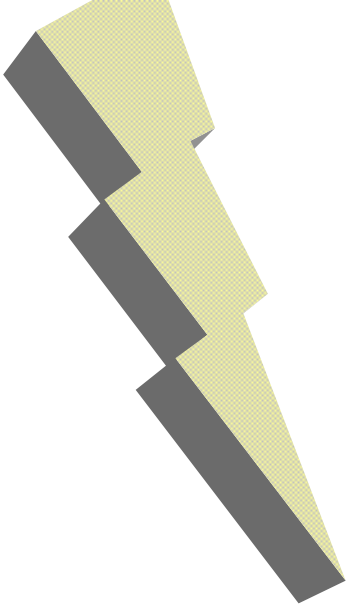
Monetary Aggregates M1, M2 and L
(CZK bn, end of period balance)



M1 = currency + demand deposits
M2 = M1 + CZK time deposits + foreign currency deposits
L = M2 + T-bills + CNB bills + NPF bills in the portfolios of domestic non-banking subjects

Monetary Aggregates M1, M2 and L
(increase in %, y-o-y)





Forecasting in a Central Bank[1]

Lavan Mahadeva

[1] This article is preliminary and should not be quoted without permission. The views in this paper are solely those of the author.

1 Introduction

In the past decade, an increasing number of central banks have been granted control of their countries' monetary policy[2]. But even if these central banks are more committed to price stability than their predecessors as monetary policy makers, we still observe that monetary policy is subject to much imprecision. A central bank's policy instruments have to filter from the money markets through to other financial and goods markets of the economy before they exercise their full effect on the ultimate and most important goal: inflation. Policy effects are uncertain and can even take years to be realized. During this horizon, many other relevant changes are likely to affect prices and the central bank must classify as well as quantify future developments. For example, the first-round effects of an improvement in productivity may not merit a response whereas as an expected increase in nominal earnings growth (above the rate of labour productivity growth) may need to be offset by a tighter monetary policy. Because they are constrained to operate over an uncertain horizon, central banks, like all monetary policy makers, have to explicitly or implicitly make a forecast (Budd 1998(I), Blinder (1998)). In this article, I discuss central bank forecasting and try to distinguish it from forecasting for other purposes. With more definition, I also discuss how forecasting varies between central banks depending on how the forecast contributes to the policy process[3].

[2] The central banker as god, The Economist, November 14th 1998, pages 25–29.

[3] Much of the material for this article refers to the experience of the Bank of England with forecasting and inflation forecast targeting. More details of the role of the forecast in the Bank of England monetary policy process can be found in Britton, Fisher and Whitley (1998), Budd (1998(II)) , Budd (1998(I) and other articles in the November 1998 Economic Journal's Policy Forum on The New Monetary Policy Framework in the UK, Haldane (1997), Vickers (1998) and Whitley (1997).

2 Why is it Difficult to Forecast? Because of Structural Breaks

Any discussion of macroeconomic forecasting should be conscious that it is much maligned for its usefulness in the face of sizeable inaccuracies. In order to understand what this means for forecasting, we need to first understand what causes macroeconomic forecast errors.

Clements and Hendry (1995) decompose the error at any point in the future forecast into:

Structural Breaks: Errors due to changes in the true Data Generating Process (let's say in the true parameters and intercepts) which occur outside the sample (that was available when the forecast was made).

Model Mis-specification: Errors that were made because the model was not specified correctly within the sample.

Estimation Uncertainty: Errors due to uncertain econometric estimates of the parameters and intercepts within the sample.

Initial Condition Mis-measurement: Errors due to mis-measured data on the variables within a sample (for example revised data).

Error Accumulation: Errors due to past errors not averaging to zero.

Intuitively, if not formally (see Wallis and Whitley (1991)), structural breaks and mis-specification seem to be the main sources of error among these categories. One reason why forecast errors from structural breaks are large is that many structural breaks lead to non-zero or even non-stationary errors in the forecast. For example, a break in the parameter describing the rate of technical progress of the economy – and many commentators felt that this could have recently happened to the US economy – can lead to non-stationary forecast errors as it multiplies a time trend.

I would like to argue that in practice, errors arising from mis-specification are difficult to separate from those due to the model being prone to out-of-sample structural breaks. Despite efforts to develop a judgement-free methodology to select models, finding a tractable formalisation of the economy in-sample to forecast out of sample always involves a great deal of arbitrary choice (about the lag length, functional form, variables and so on). Part of this choice will be over selecting a model that is robust to future structural breaks. Many structural breaks are typically preceded by some in-sample evidence (see for example Hendry and Ericsson's (1991) discussion of financial innovation in the UK and the US). For example a more flexible nominal wage culture will first be visible in some sectors of the economy before becoming gregarious. With the sectoral evidence in hand, a correctly specified model that would be robust to more flexible economy-wide wage-setting could have been developed ex-ante. But reaching the conclusion that would be correct after the event depends on having chosen one particular interpretation of the sectoral wage behaviour from what could be many plausible alternatives. Thus, as in this example, in practice it is difficult to distinguish errors due to mis-specifying the model to those arising from structural breaks and so, I shall refer to both as structural breaks.

So forecasting is a seemingly insurmountable enterprise precisely because our economies are continually subject to changes in the true data generating process. But given that the central bank has to make a forecast under these conditions, I will turn to what is the best strategy to follow. Before that though, it is necessary to lay out the other possible constraints for a central bank's forecast.

3 What else do we want from a forecast? To help with transparency and acquiring credibility

A central bank may also publish its forecasts of inflation to guide the expectations of the public. In many economies, centralized wage negotiations and widespread indexation mean that the central bank has to set out its stall as to the future course of inflation. But more generally, wage and price setters as well as participants in the financial markets need to believe that monetary policy will stabilize inflation before inflation will be stabilized (or at least stabilized without less employment and output costs than otherwise). The purpose of an externally explicit forecast is then not only to accurately predict future events but also to help make monetary policy more transparent and acquire credibility.

A forecast can do this in several ways:

– By making its forecast explicit, policy makers explain their thought processes. They are not just explaining what the current state of the economy is, they are giving some guide as to what they think could happen in the future (possibly whilst being explicit about the associated uncertainty) and moreover explaining how policy is set to respond. Comparing the current forecast with past forecasts means that the policy makers can explain why policy has been revised and, crucially, where the past mistakes in policy came from. The framework of a forecast helps the public follow the central bank in identifying what's happening to the economy and judging the appropriate policy response so that they are closer to understanding that that monetary policy makers are committed to their objectives.

– An explicit forecast disciplines the central bank to make sure that the understanding of the economy on which its policy is predicated is consistent. This is because creating a forecast means that the central bank has to quantify its interpretations. As a simple example, intuitions about future consumption, investment, government spending, stockbuilding and the balance of payments have to be squared against a forecast of GNP. Why is it so important that the

policymakers' decisions are consistent? After all, in many applied sciences, practitioners use inconsistent but effective rules of thumb. This depends on the nature of the job: rules of thumb can be applied successfully and without explanation if their worth can be judged solely by the results. In contrast, many central banks need to acquire credibility and in an uncertain world, looking at what happened may not unequivocally prove whether or not the central bank was committed. From not having done so before, the public may grow to trust a central bank which explains much, and emphasising consistency can then gain credibility.

Making a forecast can ensure internal focus. A forecast provides a framework by which the opinions of the central banks' policymakers are quantified and made consistent. This is especially important when decisions are made by a committee. The forecast need not be used to produce a single consensus view but serves to efficiently focus the debate. Also, the discipline of forming a regular forecast means that each policy decision can be more easily related to previous decisions; the central bank's policymakers can pose themselves the question each round "What has happened to revise our previous forecast?" As the monetary policy process typically comprises what can only be a few individuals analyzing a large quantity of data, this can be an efficient *modus operandi*.

To illustrate this, Table 1 depicts the forecast round schedule of the Bank of England in 1998.

Table 1: A Typical Bank of England Monetary Policy Committee Timetable in 1998 (in Inflation Report Months) (Budd (1998 (II))

Approximate Time to Inflation Report Publication	Inflation Report	The Forecast
	MEETINGS TO DISCUSS THE KEY ISSUES FOR INFLATION	
6-5 Weeks	1st Draft	Meetings with MPC on assumptions & risks. Forecast Team map decisions of the MPC onto a central projection and a risk distribution.
3 Weeks	2nd Draft	Meetings with MPC on first draft of forecast.
		Forecast team review mapping, incorporate new data and requests for changes.
2 Weeks	3rd Draft to MPC	Meetings with MPC on further versions of forecast (includes adjustment in response to market-related data up to monthly MPC meeting).
1 Week	MPC Committee meets	
	4th Draft	Meetings with MPC on final version of forecast (reflects any interest rate changes made by the committee in that meeting).
	Conclusions finalised	Forecast signed off
	Publication of Inflation Report	

The table demonstrates how the forecast in the Bank of England interacts with the Monetary Policy Committee decision and the Inflation Report. What it also illustrates is that putting together the forecast in a central bank need not just be a one-off mechanistic process, it can involve iterative rounds of communication, discussion and consistency checks.

4 The central bank's forecast also depends on the structure of the economy and the intermediate target

How the forecast is carried out will also depend on the nature of the transmission mechanism. For example, an important reason why the Bank of England forecasts inflation up to two years ahead is "there is believed to be a lag of about two years between a change in interest rates and its major effect on inflation.[4]" If there are less wage and price contracts that are fixed in nominal terms, then the horizon over which the central bank can operate may be much shorter. *Ceteris paribus,* forecasting to guide and explain monetary policy becomes in this sense an easier exercise. But also important are the uncertainties associated with monetary policies that may be greater in economies with less-developed financial markets.

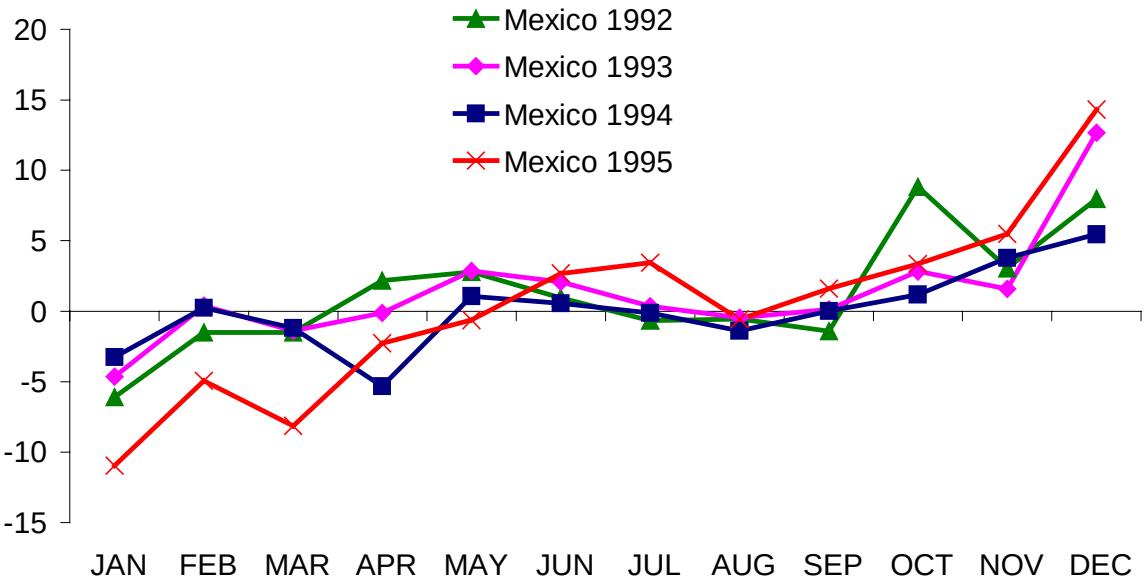
A central bank's forecast also depends on its monetary policy regime. Fixing the exchange rate means that credibility is associated with its effort to keep the exchange rate within a band. The public and financial markets are to understand that adhering to the exchange rate regime will bring about price stability, and as long as the central bank is successful in that, there is less *onus* on the central bank having to be explicit about its forecast for inflation.

Similarly targeting money aggregates that are closely related to the central bank instruments could suggest that forecasting the target variable is a much simpler exercise. But that depends on the scale of the shocks that affect the target. Charts 2 and 3 plot the percentage monthly increase in M1 in Mexico and the Czech Republic for a sample of years during the 1990s. The charts show that there are some potential intermediate targets (in particular narrow money aggregates) which can be relatively difficult to forecast[5].

[4] Budd (1998 (II))

[5] See also Goodhart (1994) "the public's demand for cash…is both strongly seasonal and somewhat unpredictable."

Charts 1 and 2. Monthly Change in M1 in Mexico



...And in The Czech Republic

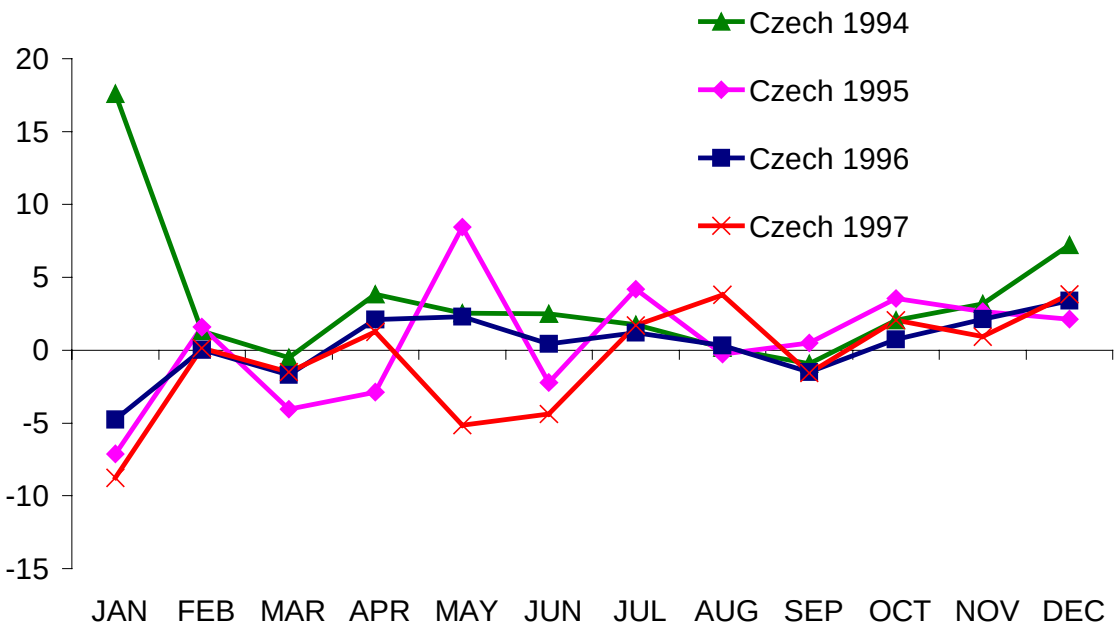
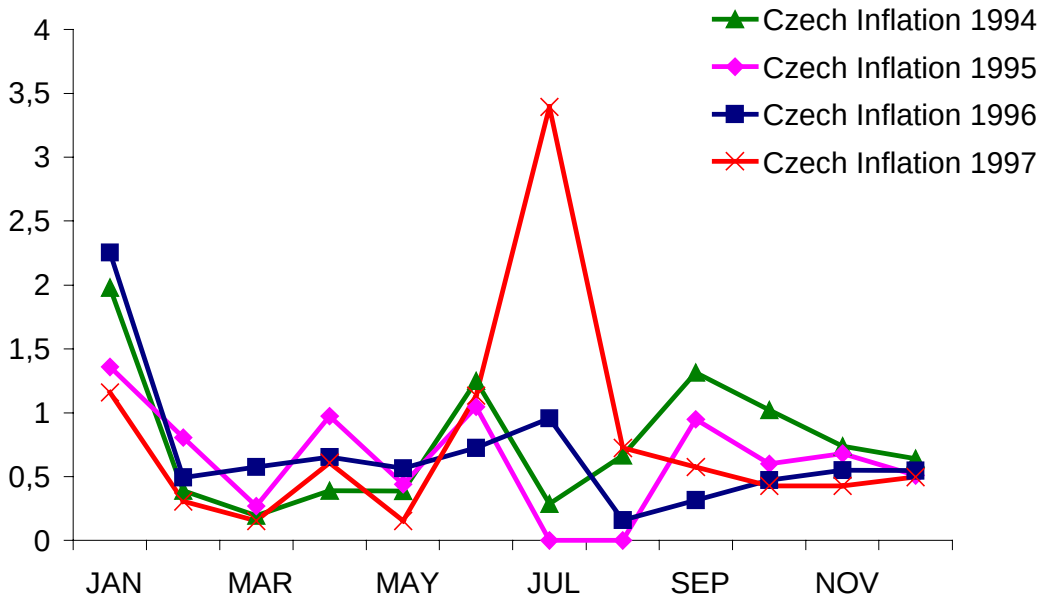


Chart 3. Czech Monthly Rates of Inflation



Also, in order for these variables to serve as intermediate targets, they have to have a stable relationship with inflation. Even central banks which do not target an inflation forecast have to be concerned with how their targets affect inflation. The Czech narrow money aggregate in 1997 followed a very similar pattern to previous years and so would not have helped explain exceptionally volatile Czech consumer price inflation in that same year (see Chart 3 up):

Similarly the IMF monetary framework, which is adopted by many countries under IMF programmes, requires the central bank to estimate money demand but then use targets of inflation and output to derive planned monetary growth (IMF (1987)). The Bundesbank has to set an inflation goal in order to derive its monetary target (Clarida and Gertler (1996)). And fixed nominal exchange rate regimes will be vulnerable to crises if the domestic tradable goods rate of inflation is persistently much higher than those of its trading partners. So although it is true that if the central bank does not target an inflation forecast it is likely to place less emphasis on an explicit inflation forecast as a guide to wage and price setters, the central bank may still forecast as it has to be aware of its ultimate goal: future inflation.

It is true that the manner in which central banks use forecasts varies greatly across countries. But what I want to emphasize is how this can depend on their concerns about its transparency and credibility. The key issues in producing a central bank forecast are to deal with structural breaks whilst enhancing the transparency and credibility of monetary policy.

5 What would be the best modelling strategy to follow?

The consensual answer would seem to be that **incorporating judgement** is the best strategy to cope with structural breaks (Wallis et

al (1986), (1987), Hendry and Clements (1994)). To formalise this, we can define using judgement as adjusting the forecast to incorporate off-model information. There are many potential sources of information that cannot be costlessly endogenised into the model but can nevertheless still be validly taken account of in the forecast (for example survey-based information and the results of other models). There are many ways of technically carrying out these adjustments. But in principle, this should depend on what off-model information is available and what is the source of the model's potential forecast error that it is meant to offset. For example Clements and Hendry (1994) show that using the information from past forecast errors (leading the forecast back to track) can be effective against the structural breaks that produce autoregressive forecast error.

The opposite strategy to incorporating judgement would be to explicitly endogenise more behaviour into a model in an effort to predict the structural break: **make the model larger**. For example, further disaggregation can, under certain conditions, help predict structural breaks. In order to understand this with an example, let's assume that the increasing role of services in the UK economy is mis-measured by aggregate GDP and that the service industry is more inflationary than the rest of the economy. Then, disaggregating services from the rest of the economy in a model will improve its forecasting performance by predicting how the fundamental shift in UK output patterns affects inflation.

But our experience of the large macroeconometric models of the 1970s[6] is that their forecast errors were similarly dominated by structural breaks. The lack of success of larger models could in part be attributed to a lack of parsimony; a more extensive parameterization can incorporate redundant information. In our service sector example, this disaggregation would only have been usefully incorporated if both the assumptions about mis-measurement and differing behaviour were valid in the future[7],[8].

And whilst a large model's forecasting performance may not be significantly better, its forecasting errors can be more difficult to explain. In this sense, large models can be less transparent for policy making. We can conclude that judgement could be a valid strategy if we believe that there is much useful information that can only be endogenised at the cost of overwhelming complexity; this would follow if we recognize that any one model, especially if it is to be transparent, can at best be a stylised description of the economy.

Another dichotomy that we can make in modelling strategy would be between atheoretical and theory-based forecasting. The idea behind the **atheoretical-based forecasting** is to use a model which is as compatible with as many theories as possible and so immune to the risk that any one theory will be wrong. Data-based macroeconomic forecasting typically employs atheoretical VARs that impose only the minimum of linearity, a lag length and a choice of relevant variables. But the evidence is that

[6] In the UK in the mid 1970s, macroeconometric forecasting models were documented as involving from 500 – 1000 equations (Whitley (1997)).

[7] Julius (1998) sets out what the service sector could actually mean for UK monetary policy.

[8] Analysing sectoral behaviour can still be useful for monetary policy even if a changing sectoral composition contains no direct implications of inflation. This is because it may indicate the presence of a structural change (for example a rise in the long-run rate of productivity growth) which also affects inflation. Under these circumstances, the disaggregated analysis can contribute some useful off-model information to affect the forecast.

atheoretical VARs do not forecast significantly better than other approaches over the horizons (of at least a year) that are required for monetary policy forecasting. This could be partly because even the little theory embodied in atheoretical VARS is too much to protect their forecasts from structural breaks. And given that this is true, the absence of theory becomes a hindrance to transparency: a data-based model provides little economic explanation of why its forecast was wrong.

The polar case would be **theory-based modelling**. Many central banks are now using calibrated models with equations derived from maximisation problems and parameters related to "deep" behaviour[9]. With a few notable exceptions (see for example Black et al (1994), Coletti et al (1994) and Brayton, Flint and Tinsley (1996)), these models have not been used to forecast by themselves; rather they have been used to explain in-sample regularities. It largely remains to be seen whether they will prove more robust to structural breaks. There are some grounds to speculate that they may be successful: it may be that structural breaks and parameter movements (for example shifts in tastes and technology) can best be understood with reference to deeply micro-founded theory. Indeed an important use of theory-based models has been to discriminate by checking for the consistency of different explanations of developing structural breaks[10]. Theory-based models help transparency because they can explain in more economic terms what contributed to a forecast's errors after the event. For example, Bernanke and Mihov (1995) by using the theoretical restrictions on the response of US monetary policy variables to other variables, were able to quantify how shocks to inflation can be attributed in part to shocks in monetary policy.

But there are also reasons to anticipate that a theory-based methodology in unadulterated form will not by itself improve on current forecast errors. The problem here seems to be in finding relevant theories; i.e. theories which relate to monetary policy problems; which are transparent and which make falsifiable predictions. As an example, there are few rigorous theories that explain the extent of price dynamics we typically observe (at least in developed country data), and models that are welded only to rigorous theory will consequently forecast poorly.

And although allowing for theory in forecasting models can improve transparency, this is not always the case. Most rigorous micro-founded models are non-linear and contain forward-looking expectation terms and have to be either linearised or solved by numerical algorithm before they can forecast. The mapping between forecast errors and model parameters can become difficult to discern and to interpret and this may detract from the transparency of their forecast.

Central bank forecasters would typically combine the best elements of my polar characterisation of these strategies. For example, currently the most popular form for a forecasting model is one that resembles a Vector Error Mechanism, with a largely atheoretical data-determined short run and a crucial role for theory in determining the long run. Much promising work is currently being done to improve on and to formalise the combining of modelling strategies (see for example Clements and Hendry (1995) and Pesaran (1997)).

[9] These models are often referred to as Computable General Equilibrium models.

[10] Whitley (1997) illustrates how a micro-founded optimising model can distinguish between job insecurity caused by a change in general risk aversion and that caused by more idiosyncratic risk.

6 Conclusions

But, leaving aside these developments, what broad conclusions can we draw from this discussion?

– There is a role for judgement in the central bank's forecasts. But judgement can be motivated by a recourse to other modelling strategies or less formally-treatable but equally valid information.

– Which other strategy to use depends on the problem at hand. Some issues require theory-based models.
Other issues on which theory is relatively silent may be formalised by recourse to more data-based methodologies.

– As judgement is important in characterising central bank forecasting, so are transparency and credibility.

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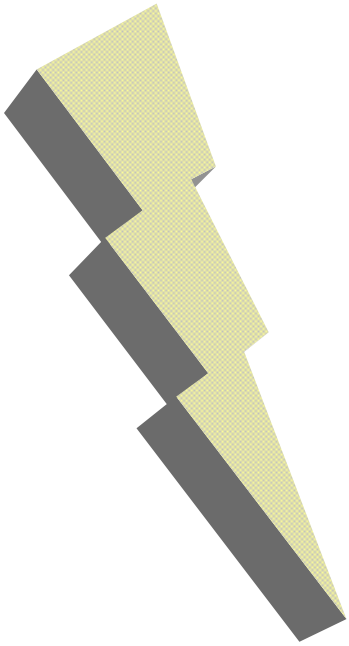

The Western Experience with a Strategy of Inflation Targeting

David A. Mayes

The organisers have given me an ambitious title. However, only eight countries are usually credited with following inflation targeting prior to our hosts: Australia, Canada, Finland, Israel, New Zealand, Spain, Sweden, and the UK (see Haldane 1995, for example) and none of these has been doing so for a decade.[1] So in one sense experience is relatively limited. Table 1, from Siklos (1998a), summarises the position.

We are not even clear how far that experience is going to develop. Finland and Spain have virtually got to the point where they are no longer running an independent monetary policy. It is yet to be revealed whether their successor organisation, the ESCB, is going to run inflation targeting, money targeting or some combination thereof. Whichever conclusion they come to it seems clear that money aggregates will play a greater role in decision-making than has been the case in the eight countries I have listed.

It is sometimes claimed (Bernanke and Mishkin, 1992) that other countries such as Germany or even the United States are in effect inflation targeting. Hence the set of countries listed may be too small but I shall avoid getting dragged into that debate. Let me just observe that if a monetary authority is not targeting the exchange rate but is following an objective of price stability under low inflation and fairly stable economic growth then the practice of a number of targeting regimes will be relatively similar.

Analysis is assisted by a burst of interest in inflation targeting. In the last couple of years the US macroeconomics profession has taken up inflation targeting as an important policy issue and as the conference discussions at Stanford in February (Rudebusch and Walsh, 1998a,b) and the Sveriges Riksbank in June (see Svensson (1998b) for example) indicate there is widespread support, particularly on the basis of theoretical models, for inflation targeting as an approach to monetary policy for both the US Fed and the ESCB. The Reserve Bank of Australia's 1997 annual conference (Lowe, 1997) also focused on the same subject as did the Bank of Canada (1997).[2]

1 Key Features

Perversely, I want to start with two conclusions.

- Inflation targeting has been successful in the sense that inflation has fallen to low levels and remained low and stable in the inflation targeting countries thus far.
- No inflation targeting country has yet given up inflation targeting as a failure.[3]

Thus while it may be too early to say how far inflation targeting has been responsible for this success there is no great wealth of results among the inflation targeting countries to suggest that the policy is misguided.

There are also two observations we can put on the other side of the account.

- The inflation targeting countries all started with a history of inflation and a wish to give a clear signal that the regime had changed in order to try to bring expectations of inflation down.
- Other countries have been very successful in achieving price stability in recent years.

[1] OECD (1996) suggests that Italy has also been inflation targeting in recent years. In one sense this has been true for the EU countries as a whole that have been seeking to bring inflation down into a band within 1.5% of the performance of the best 3 countries in order to meet the Maastricht Treaty criteria. However, at the same time they have had some limitation on the permitted fluctuation in the exchange rate, although not very much if the 15% band since 1993 is interpreted literally.

[2] Haldane (1997) in the Australian conference volume sets out a clear discussion of the issues to be borne in mind in designing an inflation-targeting regime.

[3] Although Finland may have decided to go into Stage 3 of EMU, as it sees that as a better way of achieving economic prosperity and price stability than through an independent monetary policy, the Bank of Finland remains firmly in favour of a policy of inflation targeting for the euro area as a whole (Mayes and Castren, 1998; Castren, 1998).

Thus we might wish to conclude that other regimes could also have been successful in achieving price stability and that it was the general environment lower inflation round the world that enabled the various regimes to succeed. The contrast between the experience of the inflation targeting countries and the others is shown clearly in Siklos (1998a), shown here as Fig. 1.

It is difficult to produce a yardstick against which to measure success. Siklos (1998a) chooses the route of comparability with countries applying different regimes over the same period, while Mishkin and Posen (1997) compare recent performance with a simulated extension of what would have happened had past relationships continued.[4] Neither of these is really an answer to the questions we want to pose. How does inflation targeting compare with what would have happened if other means of achieving price stability had been applied over the same period? This is impossible to answer. It requires comparing actual experience with the hypothetical and we do not know how much of the rest of behaviour we should assume would be unchanged in order to do it. We can try to box the answer in by making a range of plausible assumptions and comparing the results.

However, I am going to avoid that route and pose a different question. How much can the success of inflation targeting be affected by how we go about it? This still faces the same problem of a yardstick but we do have a little more evidence. There has been a learning process that has two aspects. Individual inflation targeting countries have changed their means of operation as time has passed in the light of experience. New countries have taken up inflation targeting and they have emulated some of the facets of the existing countries, not followed others and introduced new ideas of their own.

It is also appropriate to begin with a proviso about the likely quality of any analysis. The experience of the inflation targeting countries has not been without difficulty and most have experienced considerable swings in their exchange rates and in their economic performance. However, inflation targeting and associated changes in the monetary policy regime have usually been only one of a number of responses to economic difficulty. Regulatory and fiscal changes have also been undertaken to varying extents. Indeed if monetary policy is assigned too great a role in the achievement of stabilisation and is not supported by other macroeconomic and structural policies it is likely to fail to achieve its objectives.[5] It is therefore difficult to disentangle the effects of inflation targeting and other changes in the monetary policy regime from the rest of the changes.[6]

In Finland, for example, substantial structural change was necessary following the collapse of trade with the former Soviet Union and the banking crisis of the early 1990s. Membership of the European Economic Area and then the EU in 1995 have involved wholesale change in the regulatory structure of the country, which has had substantial effects on industry despite the fact that Finland had already been in a free trade area in manufactured products with the EU. If that were not enough Finland has become one of the founder members of Stage 3 of EMU and as part of that has met the qualifying criteria set out in the Maastricht Treaty. More than that it was one of the three lowest inflation countries, kept the debt to GDP ratio below 60%, the deficit to GDP ratio below 3% and converged to the German interest rates from below. With less than one complete economic cycle since adopting inflation targeting Finland does not offer a very helpful case study even though growth

[4] Hutchison and Walsh (1998) also employ a longitudinal approach and seek to show how behaviour in New Zealand has changed over recent years focusing primarily on the output inflation trade-off or "cost of inflation".

[5] As has been graphically demonstrated in Russia in recent weeks.

[6] Unfortunately this is often also true in the public perception and the central bank can be blamed for outcomes stemming from other parts of the programme well beyond its control and responsibility (Mayes and Razzak, 1998).

rates are second only to the Irish Republic in the EU and has seen unemployment drop by nearly 8 percentage points in five years.

We can find similar reasons for having reservations about using some of the other countries and might wish to discount some of the very recent experience of both Australia and New Zealand as the Asian crisis unfolds because it is too soon to tell with any accuracy how the situation will evolve. Nevertheless a number of key features have emerged.

1.1 Four Contributions to Credibility

Rather than cover the entire range of issues I want to focus on just four related key areas where I think we have something to learn from experience and let the rest of the workshop handle the remainder. The general theme that I want to follow is credibility.[7] To a large extent monetary policy regimes succeed because those involved, financial markets in particular, believe they will be successful. If people expect the regime to fail, the costs of policy are greatly enhanced and, largely as a result, the chances of failure are increased. To take an extreme example, Lars Svensson (1998b) has argued that the Bundesbank has succeeded in achieving price stability "in spite of" adopting money targeting not "because of" it. Because the bank has had very high credibility it has been able to miss its monetary targets more often than not (Mishkin and Posen, 1997) and yet continue to achieve its objective without any obvious risk premium.

On the whole the inflation targeting central banks have not got such a fortunate history of credibility to trade on and indeed have adopted inflation targeting in part as a means of achieving it. The first area I want to cover therefore is the contribution that the *institutional and regulatory framework* within which inflation targeting is undertaken can make to achieving credibility. A good design can provide a substantial measure of credibility even before an institution starts to implement policy (see Mayes (1997) for a discussion in relation to the European Central Bank). We now have a range of choices to observe, all of which have diverged from the original New Zealand model. I want to explore why and draw some conclusions.

The second aspect of credibility I want to explore is the definition of price stability itself. If the target for policy is too hard to achieve it will either not appear credible from the outset or the experience of the policy will be characterised by a number of "failures" and experience will lower the credibility of the regime. On the other hand if the target is too soft it will not convince people and again credibility will be weak and inflation expectations will remain high. However, this is more than a pragmatic concern for what will work best in each particular country and I want to focus on what is in fact meant by "price stability" in terms of *how much variation in the price level can be tolerated.*

The third striking feature of inflation targeting to my mind is the role of *communication*. Many of the inflation targeting countries have felt the need to open the black box and be very open about the way in which they decide upon the stance of policy and how they view the working of the economy and the prospects for the future. This is very much in contrast to the traditional secrecy that surrounds many central banks. Both decisions are based on a view of credibility. In the first case policy is not thought credible unless it can be understood. More importantly policy will be less costly if it is predictable and people can work out what the central bank will want when the various unforecastable shocks hit the economy. The advantages of this

[7] I interpret credibility to mean that expected inflation is equal to the central bank's target (Hutchison and Walsh, 1998). However, we can recast this in terms of a risk premium or an expected deviation in the monetary reaction function (Mattila, 1998; Vilmunen, 1998).

predictability extend not merely to financial markets and the private sector but also to government in setting the rest of macroeconomic policy. In the second case the worry is that the central bank may be seen to be fallible and ignorant. Popular perceptions often attribute far more certainty and precision in the execution of policy to central banks than those on the inside believe they have. This misperception is valuable, even if undeserved, as it helps credibility. It would seem foolish to throw it away. In practice all central banks draw a line. Some describe it as "optimal obfuscation", illustrated well by a remark attributed to Alan Greenspan "if you understood me then I wasn't clear enough". I want to explore where the line might best be drawn.

This leads me directly to my last issue, *forecasting*, which could be seen as a subset of the previous topic. Good forecasting is key to a successful monetary policy yet the future is unknowable with certainty. The inflation targeting central banks vary very considerably in their transparency and in the public use they make of forecasting.

2 Measuring Credibility

I suggested earlier that a measure of credibility might be whether inflation expectations and the target coincided. If the central bank is taking proper account of all the other challenges to the economy in its own assessment of inflation prospects then this could be achieved. Discrepancies might occur if the central bank values the political risk differently, for example. It is very unlikely, for example, that the central bank would want to discuss the possibility that the target might be changed except in a way that would enhance credibility. However, there are other sources of country risk. New Zealand and Australia are more open to shocks from commodity prices than some other countries. Finland has a larger trade share with non-euro countries than most of the rest of the zone. It has a long border with Russia. New Zealand is in an earthquake zone and so on.

It is difficult to disentangle the sources of risk.[8] In the case of exchange rate targeting economies the difficulty is usually referred to as the "peso problem". There is a small risk that the regime will have to be changed radically, i.e. there is a small risk of a large shock. From the point of view of modelling this, the important question is the choice of the equation in which to embed this risk. The other sources of country risk I have described are in effect supply or demand shocks and should be assigned to the respective equations. The credibility element needs to form part of the monetary policy reaction function. In the work we have done thus far at the Bank of Finland (Vilmunen, 1998; Mattila, 1998) this has taken the form of a money supply equation, which is not relevant for inflation targeting. The risk has been treated as a Poisson process. In the case of inflation targeting the risk needs to be entered into either an interest rate or exchange rate reaction function.[9] The model has presented estimation problems involving the use of two sets of expectations (Saikkonen, 1998) and thus far has only reached the stage of simulation.

In the discussion that follows, therefore, I have restricted consideration to stylised facts rather than in the more explicitly modelled framework I prefer.[10] Let me illustrate the problem for the case of New Zealand. In mid-1994 long-run interest rates

[8] While Hutchison and Walsh (1998) argue that it is possible to observe a "credibility bonus" in the case of New Zealand, it would be even more difficult to assign portions of that gain to different causes.

[9] The RBNZ (Black et al, 1997, Nadal De Simone et al, 1996) has tended to use an exchange rate basis whereas the interest rate basis (Svensson, 1998a) is more commonly adopted in the literature.

[10] Some authors such as Archer (1995) have expressed some scepticism over the importance of the credibility of monetary policy. Given the difficulties of measurement it could easily be that much of it is a chimera but it is one to which central banks attach a lot of importance and a hypothesis they are understandably reluctant to test.

were the same as in the US. The yield curve was smooth, with a gentle upward slope, and inflation seemed fairly stable at around 1%. Although the economy was apparently growing around 1% faster than the longer-term average of previous performance, this was interpreted at the time as the characteristics of a successful regime change (RBNZ, 1994) and as an economy in reasonable equilibrium.[11] History since then has led to a reappraisal. Monetary conditions have always been tighter. Even now in the face of the Asian crisis and even recession for a few quarter at least real interest rates are clearly in excess of what a 3.5% world rate and forecast domestic inflation of around 1.5% would lead one to expect (Fig 2, 3). Haldane (1998) suggests that at 160 basis points the 10-year bond differential for New Zealand was the largest of the inflation targeting countries.[12] Various special factors can be advanced to help explain some of the experience, such as the substantial turn round in fiscal policy and the period of sales of public sector assets to foreign companies but the conundrum remains. The Governor of the Reserve Bank has been attributing it to New Zealanders' love affair with housing (Brash, 1997). They are just not as prepared to save in the form of financial assets as in other countries. That is clearly the result but it is difficult to interpret the decision as not involving some lack of credibility.

[11] Sustainable faster than average growth made sense because New Zealand had been growing very slowly for a decade, productivity levels were noticeably below the OECD average, the country had relatively underexploited natural resources and net immigration that was focused on high skilled workers.

[12] Differentials from the average of US and Germany (reduction since start of inflation targeting) Australia –0.50 (1.85), Canada 0.30 (1.39), Finland –0.10 (3.84), NZ 1.60 (1.83), Spain 0.84 (2.35), Sweden 0.92 (2.74) UK 1.22 (1.00). Differentials have of course changed in the last year.

3 Institutional Arrangements

There is considerable variety among the inflation targeting central banks over who defines price stability and the exact degree of independence they have (see Table 1, Briault *et al.* (1996), Castren (1998)). However, New Zealand alone has gone for a direct contractual relationship between the government in the person of the minister of finance and the governor of the central bank.[13] The practice of the way this has turned out and the fact that others have not adopted it are instructive.

The contractual arrangement implemented in New Zealand is a straightforward response to the usual principal-agent problem. How can the government make sure that an independent central bank will actually do what has been asked of it? By arranging monitoring by the Reserve Bank's Board and the sanction of potential dismissal for poor performance against a clearly specified target this provides an arrangement that has been described as near optimal in the circumstances (Walsh, 1995). The more normal approach has been to follow something closer to the "conservative central banker" idea advanced by Rogoff (1985) inter alia and appoint someone with a prior reputation that would lead most people to expect them to strive for price stability. Monitoring or "accountability" is achieved in a more arms length manner through parliament or other less explicit means.

Secondly, rather than spelling out in detail how the target is to be defined a common approach has been to leave this to the central bank but to try to set up a structure such that the definition is likely to be widely accepted and durable.

[13] In this and the succeeding discussions I have drawn heavily on my own experience in New Zealand and Finland. That seems only common sense and I make no apology for it. However, in many respects New Zealand is the natural choice as a comparator. Not only did it start down this road first so others have made their decisions in the light of their

Although the goal of price stability may have emerged and been developed differently in the various countries the generalised intention has been that it should be a generally agreed objective in society. Thus in the New Zealand case a lot of store was set by the fact that nobody in parliament voted against the Reserve Bank Act of 1989. One of the main objectives of the arrangement is to try to counter the incentives for time inconsistency by governments (Kydland and Prescott, 1977). Although both governments and oppositions can agree in advance on the importance of price stability there is always the danger that at election time a government will be tempted into expansionary (and hence inflationary) measures in order to increase its chances of re-election. Although in a transparent framework the electorate ought to be able to see through this, in practice they might not so a government might think it worth having a try. Indeed, it is not even necessary for governments to exercise this option for costs to be imposed on policy. People merely have to believe that they might and hence it will be factored in to their expectations of inflation.

The normal response has been to give the central bank a substantial degree of independence and to try to ensure that it is able to distance itself from the immediate problems of elections. The structure of the European Central Bank reflects this clearly with the appointment of the President and the Executive Board (after the initial round) for a period of eight years that is not renewable. The Board can then take its decisions on the basis of the terms of reference with rather less fear for the consequences to their personal careers or family fortunes than is the case in some countries, where the governor can realistically expect unpleasant retribution. Independence is never total in practice whatever the letter of the constitutional arrangements.

assessment of its experience but in many respects it has taken a stand at one end of the spectrum.

New Zealand, however, both limits the independence of the central bank rather more than many of the others and makes the accountability of the governor for his decisions more explicit. The nearest equivalent is probably the Bank of England.[14] It is the government that decides how price stability is to be defined and incorporates this in a Policy Targets Agreement (PTA) that is signed when the governor begins his five-year term. Five years is itself relatively short in this context but the practice in New Zealand has been that each new administration has wanted to sign a new PTA. In 1990 the new government wished to slow down slightly the rate at which price stability was to be achieved. In December 1996, however, the new coalition government decided it wished to widen the band from zero to two to zero to three percent. This was a clear compromise between the two parties. The larger (National) party that had formed the previous government alone did not want change, whereas the smaller party (New Zealand First) had been advocating a higher rate of inflation as the target[15].

As I explain in the next section, no particular justification for this change was offered at the time, although the Reserve Bank interpreted it as a wish to see policy be a little less harsh in bringing inflation back into the middle of the target range after a shock (Brash, 1996). However, raising the mid-point of the range from 1% to 1.5%, while trivial in quantitative terms was much more significant in indicating that the view as to what constituted price stability was not shared among all politicians at least. The original

[14] New Zealand also takes the attempt to reduce the time consistency problem further than other countries in the case of fiscal policy through the provisions of the Fiscal Responsibility Act 1994. Public accounting not only has to be on clear generally accepted accounting principles but the longer term objectives and sustainability of the measures have to be set out (Britton, 1998). This is also a precept that the UK has been following through the 1998 Finance Act and earlier measures to improve the transparency of public accounting.

[15] A rate of inflation similar to that in New Zealand's trading partners was advocated before the election.

intention had been to try to get this discussion in some sense "above politics". If it becomes normal for the incoming minister of finance to expect to sign a new PTA then there is a danger that inflationary expectations will rise if the time consistency problem is thought to be increasing in potential importance. Bond rates in New Zealand have been persistently above those in the US and Europe since 1994 and with New Zealand's commitment to low definition of price stability and good record in achieving it (Fig. 1) one might have expected to see lower real rates.[16]

New Zealand is unique not merely in having the governor personally responsible for monetary policy decisions but in having no externally appointed members to its advisory body on monetary policy, the Monetary Policy Committee. As described in some detail in Mayes and Razzak (1998) the Monetary Policy Committee, chaired by a Deputy Governor so that the Governor can listen and participate without having to direct the discussion, is composed of the three governors, the chief managers of the three policy departments (Economics, Financial Markets and Banking System), four senior advisors and others invited for specific topics. It has no footing in the statutes of the Bank and the governor is at liberty to operate whatever advisory arrangement he finds most helpful. While the members of that body will be held responsible for the advice they give by the governor under normal contractual terms, the meetings are held in secret and no minutes or papers are published. The committee does not vote although the governor will routinely ask for expressions of opinion round the table before announcing his decision. The Committee meets weekly on a Tuesday afternoon[17] and more frequently as needed. Only as recently as 26th May 1998 did the Bank announce that in future it would normally only announce changes (with immediate effect) at 9am on the day after the meeting (normally Wednesday).

The Bank's Board, which meets monthly (except January), plays a supervisory and advisory role, laid down by the Reserve Bank Act. It is composed of the Governor, who is also the Chairman, the Deputy Governors and between four and seven non-executive directors, each appointed for five years by the minister of finance.[18] In addition to the usual exclusions on grounds of convictions, bankruptcy, mental ill-health and conflict of interest, MPs and employees of the registered banks and other employees of the Reserve Bank are excluded from membership. The current non-executive directors include a senior economics professor and six well-known business people drawn from across the country. The Board keeps the performance of the bank and the governor "under constant review" and determines whether the *Monetary Policy Statements* meet the requirements of the PTA.

Most other central banks not only restrict their formal decision-making meetings to monthly intervals but also have some form of responsibility for all the members both severally and jointly for decisions. The membership is usually chosen on some representative basis (from fit and proper persons) and their position has some statutory backing. The ECB, Federal Reserve and Bundesbank have a regional element in the membership for example, whereas the Bank of Finland has a balance across the political spectrum. In each case a careful attempt is made to try to make the membership representative in some sense that can allow it to extend for more than one parliamentary election or government. In the US with the separation of powers and long terms of office the Federal Reserve Board can readily play that role. In other jurisdictions the decision-making Board may be responsible to the parliament directly. The Bank of

[16] Sheer arithmetic will have meant that the high short rates of recent years will have dragged bond rates with them.
[17] Or whatever is the second working day of the week.

Finland Board reports to a parliamentary supervisory committee not to the government and the members of the Board are appointed by the President of the Republic not the Prime Minister.

The Bank of England has an interesting combination of both regimes. The government sets the target. It remains to be seen whether successive governments will seek to change the target or whether the definition that has been lighted upon receives widespread and continuing support. In any case the electoral cycle in the UK is five years compared with three years in New Zealand, which should give policy a longer-run flavour.[19] I discuss the merits of various targets in the next section of the paper. However, the responsibility for meeting that target is not simply assigned to the Governor of the Bank but to a Monetary Policy Committee whose members are individually appointed to the committee by the government. Half are office holders within the Bank and the other half, professional economists from outside, all of whom have strong professional credentials for being able to undertake the task. There are no explicit requirements for any spread of doctrinal views in economics, political affiliations, regional representation, etc. but presumably people who objected to price stability as a target or inflation targeting as a means of achieving it would not have been selected. Because the members of the Committee are responsible not just as a group but as individuals for their contribution to the overall decision-making (and some of their contribution is made public knowledge through the publication of minutes and the voting record) there are strong incentives for the highest professional standards.

The importance of this arrangement and indeed most of the arrangements is not just the formal rules of behaviour but the nature of the actual practice. Even if a government has the right to fire people or change the arrangements if the record of what is being done is public there will be a big loss of credibility if short–run political needs are met by changing the framework or conscientious individuals within it. When the deliberations are in private and the members have no outside recourse then conflicting views can be silenced. As I explore in more detail later, one of the big advantages of the British system is that extent of division of opinion is obvious. On the whole decision-making in monetary policy committees is straightforward – there is either strong agreement or little new information that would lead anyone to change their position (there is no contested vote in the large majority of FOMC meetings for example). Disagreement is not only a more credible outcome in difficult circumstances in a trivial sense but it gives reassurance to those outsiders who disagree with the decision that there was at least a proper debate. It also enables the committee to change its mind credibly even though the balance of evidence may change only slightly. Recording a clear view one way one month and then an equally clear view the other way the next in these circumstances does not make the Bank's statements more credible. It leads people to question the confidence with which all statements are made.[20]

The Bank of England arrangement therefore seems a viable alternative to having a representative committee from the point of view of acceptability of the decision-making process to those who are out of government at the time as well as to those who are inside it. It will therefore tend to lead to durability of the framework and hence to credibility as reversals of behaviour appear less likely to occur.

[18] Their periods of office are spread over the various years so a majority of the Board would not be appointed within the three-year parliamentary electoral cycle.

[19] However, the holding of elections in mid-term is more common in the UK than in New Zealand. In any case most of the early elections in the last 50 years have occurred because the government thought that their chances of winning were increased, not because they lost a vote and were forced to resign.

[20] Merely reporting that there is a wide range of uncertainties on each occasion does not solve the problem.

The New Zealand system cannot readily achieve the same result although the Reserve Bank like other central banks no doubt strives to get the highest professionalism in its staff. The outcome is one person's decision and disagreements would not reach the public ear. Only the extreme option of resignation is open. The system therefore tends to rest on a narrower basis of confidence centred more on the individual than on the surrounding framework.

Most frameworks require a measure of accountability as a counter-weight to independence for the central bank, without adopting the very explicit arrangement of the RBNZ. That said however, the formal routes of accountability, through Humphrey-Hawkins testimony or appearance before a parliamentary committee, are not normally the most effective forms of "discipline". They are formal occasions at which the central bank can present its case and prepare answers for all the likely questions. It is financial markets and the media that provide the real discipline. Central banks can do a lot to affect their credibility but it is the market that decides what that credibility actually is. Much as one might want to rail against the "stupidity" of public views they are a fact and have to be answered (or preferably pre-empted). As I explore further in the section on communication the media and the public will judge the central bank's actions and intentions on whatever basis they think fit. To some extent the structure of the central bank's operations can help shape that basis. If the system is set up so that the decision is clearly professional not political that will affect the tenor of the debate. If the debate is depersonalised and focused on the issues then this may help (unless of course the credibility stems from the person).

4 Inflation Bands

There is a surprising reticence among inflation targeting central banks to rationalise some aspects of the target they have for price stability. Before the changes of December 1996 the New Zealand zero to two-percent band was easy to rationalise. Measurement error in the price index was thought to result in increases between zero and one percent a year being recorded on average even when there was no actual movement. Since the decision was made relatively quickly and without major public debate it was not possible to have the benefit of the careful analysis that has surrounded the Boskin Report (1996) but a value of one percent was thought to be the nearest round number.[21] After the event this seems to have been the approximate finding elsewhere (Crawford *et al.* 1998). The range of zero to two percent, extending one percent either side of this actual stability was thought to be the narrowest range in round numbers that was practicable for the central bank to achieve and would be thought credible by outside observers. While it was possible to observe the degree of success that had been achieved by other countries and by New Zealand in the past this was not the result of some extensive simulation exercise with econometric models.

The aim in choosing this sort of definition of price stability was very much along the lines that have been attributed to Alan Greenspan – to take general inflation out of consideration in formation of contracts that last several time periods. Careful analysis of what the general public regards as price stability was not conducted and limited discussion suggested people had a lot of difficulty distinguishing relative from general price movements – all price rises were disliked by purchasers! It is very difficult to decide what level of inflation is "optimal" and as soon as discussion is focused on "how much" as opposed to how to define "none" the outcome is likely to be rather arbitrary.

[21] The Government Statistician has since suggested that this may be too high (Mayes and Chapple, 1995).

Much of the subsequent discussion has been ex-post rationalisation. The lower limit of zero was not especially influenced by concerns of asymmetry in wage bargaining. The conclusion that in practice nominal wages received are sufficiently flexible downwards came later (Cassino, 1995).[22] In a very open economy in which primary products play a key role, downward as well as upward movements in prices and incomes are a common experience. Similarly, in a small open economy with a floating exchange rate, concerns over downward flexibility of nominal interest rates were discounted.

It was felt intuitively obvious by politicians that everybody normally thought of the CPI when discussing inflation and hence wider concerns of what index was appropriate from the point of view of welfare did not feature strongly in the discussion. Much greater effort was expended on the appropriate response of the central bank to shocks and to a problem that was particularly acute in the New Zealand CPI, namely that changes in interest rates had a substantial and immediate effect through house prices and credit charges. Hence tightening monetary conditions in the face of impending inflationary pressure would itself tend to raise the price level, albeit temporarily.

Since the appropriate treatment of supply shocks is the subject of a separate paper at this workshop I shall not pursue this further, except to note that it is the appropriate explanation of this area that has been the main subject of change in successive PTAs. It is only with the most recent PTA, signed on the reappointment of the Governor for a third five-year term in December 1997, that the phraseology could be finally tidied up. Up till that point the Reserve Bank had gone to great lengths to focus people's attention on "underlying inflation", which it defined as the inflation rate after allowing for the "caveats" or permitted exclusions under the PTA. Now fortunately it has been possible to focus on a CPIX very much akin to the RPIX used in the UK target and to have that produced, independently, by Statistics New Zealand as a headline number.

There have been outside model-based assessments of the minimum plausible bandwidth that the RBNZ could achieve (Turner, 1997) and similar analyses have been applied to other countries (Amano *et al.* 1998 for Canada and de Brouwer and O'Regan, 1998 for Australia). Ironically these have suggested that the possible band is wider than has actually been achieved. One reason for being able to adhere to a narrow band, shown clearly in the case of Canada, is that the bandwidth falls if forward-looking expectations and a monetary policy reaction function are included in the model. The second is that the estimates are based on data for the past and the introduction of inflation targeting could itself be expected to increase credibility and hence reduce fluctuations in inflation in response to shocks.

There tends to be suspicion when a central bank either calculates the target series itself or seeks to alter an existing series, even though the Bank itself will be thoroughly convinced of its integrity and lay its methodology open to outside scrutiny (as in the case of the RBNZ). There has been debate in Australia, where the Reserve Bank excludes about half of the items in the CPI in its definition of underlying inflation (Edey, 1998). However, a key feature that governs the acceptability of these exclusions is whether the resultant series diverges from the CPI in the long run. In the Australian case (Wilkinson, 1995) it is clear that there is no such divergence.

Australia provides an interesting counter example to many of the definitions of price stability that have been used. In the first place it does not place

[22] Although it is unusual for the nominal wage rates for any individual continuing in the same job without technical change to fall, there is sufficient scope for turnover in the labour market, variation in hours and technical change for this to be little hindrance when large changes are not required.

any explicit limit on the fluctuations that can occur in any particular year. Secondly, it looks through the cycle and seeks to get inflation on average to be between 2 and 3 percent. Thus unlike any of the other inflation targeting countries Australia has a limit on "drift". In literal inflation targeting bygones are bygones. If inflation is too high at one period there is no attempt to provide a deliberate offset later, policy just continues to try to keep future inflation within the target range.[23] As is clear from (Fig. 2) New Zealand has never managed to get inflation below the mid-point of the range, as a result there has been noticeable drift in the price level. Secondly the definition of underlying inflation chosen, although neutral in theory has been lower than actual inflation most of the time, thereby adding to the drift. Of course, by comparison with other countries New Zealand has been highly successful both in keeping inflation low and in restricting its variance. Nevertheless these outcomes help explain why inflation expectations have always tracked above the middle of the target.

One of the reasons often put forward to object to inflation bands is that many people expect that actual inflation will then track just below the upper bound. Several reasons are offered, the natural "inflation bias" among policy makers – the level of complaint is lower if policy is easier – inflation surprises are more likely to be positive than negative or the asymmetry in the responsiveness of the economy to monetary policy means that it is harder to offset upward shocks. Even if none of these is correct the belief will nevertheless weaken the credibility of policy. In practice inflation bias is a contested issue (Haldane, 1998). There is no clear evidence that inflation surprises are asymmetrically distributed although Ball and Mankiw among others offer suggestions as to why this might be the appropriate reaction by price setters to shocks.[24] However, the evidence for asymmetry in the responsiveness is strong (Razzak for New Zealand, Rose et al and Mayes and Viren (1998) for almost all of the EU countries).

It would therefore have been a legitimate response by the New Zealand government to introduce an asymmetric band, permitting wider fluctuations in a more upward than a downward direction.[25] Such a band would have permitted the Reserve Bank to be symmetric in its use of the instruments of monetary policy but accept that asymmetries in the Phillips curve would result in more excursions above the target of one percent than below it and hence higher average inflation than the mid point of the original zero to two percent range. However, since the Bank was not in the earlier period following a policy of asymmetric responses to offset the asymmetry in the Phillips curve that might have looked too much like validating existing policy than heralding a change.

The asymmetric Phillips curve was only formally incorporated in the setting of policy in New Zealand when the new Reserve Bank model FPS was launched in June of 1997. However, these properties had been known for at least a year before that (Mayes and Riches, 1996; Mayes and Razzak, 1997) and may well therefore have influenced policy setting over that

[23] The Australian approach shows a possible way of getting round the problem that any attempt to combine an inflation target (i.e. a limit on variance) with a limit on drift runs the risk of being too complicated to be effective in reducing credibility. Simplicity and the ability to sell the idea to the general public were important arguments behind the design of the New Zealand target.

[24] One line of argument is simply that even with slow general inflation a downward relative price shock will be eroded eventually if the price is left unchanged, whereas with an upward price shock the price has to be raised otherwise the price setter will have a permanently reduced margin.

[25] The main opposition (Labour) party had suggested a symmetric widening of the band from –1 to 3% rather than the asymmetric change as this would maintain the original price stability target as the middle of the range but merely permit the increased range of flexibility that appeared necessary. This might have helped keep price expectations a little lower but it is not clear how credible the scope to

period. The Bank was aware of the article by Clark *et al* (1995) that suggested that even if it were impossible to obtain evidence that enabled one to decide whether the Phillips curve was linear or asymmetric,[26] the central bank should respond on the assumption that it was asymmetric as the costs of that as a wrong decision were lower and could more readily be offset than the costs of making the assumption of linearity wrongly.

However, the RBNZ learnt one other important lesson (Mayes and Riches, 1996), that running policy by trying to avoid moving outside the bands was too risky and that the only sensible strategy was to focus on achieving the centre of the band all the time.[27] This was a simple lesson from experience. In the period up till the end of 1994 the Bank was successful in keeping inflation within the band. Up till then it had run policy on the basis that unless inflation threatened to get within 0.2% of the edge of the band within the forecast horizon (which was a year at that point) it would leave the settings of monetary policy unchanged. Otherwise, despite the vagaries of forecasting, it thought it would be able to react in time to prevent a breach of the target. The Bank interpreted the PTA as expressing indifference as to where inflation should be within the band and therefore opted to allow market forces to determine monetary conditions within the acceptable range and to avoid intervening if that were possible (Nicholl, 1995). The Bank was very alert to the message from the fine-tuning debate that public authorities could readily do more harm than good by trying to smooth business cycles by anything other than simple forward-looking reactive rules.

Even after the change in policy implementation the Bank did not require too close adherence of inflation to the midpoint of the range over the policy horizon. This is illustrated in the latest projections (August 1998, shown in Fig. 2). Inflation 6 to 8 quarters ahead varies between 1.6% and 1.2% between the last quarter of 1999 and the first quarter of 2001, which is the end of the period shown.[28] However, from some time in 1996/7 the RBNZ ceased to show any great difference in behaviour from a central bank targeting a mid-point with a permitted range of fluctuation either side.

The theoretical literature insists (Svensson, 1998a, etc) that all inflation targeting central banks place at least some weight on smoothing output fluctuations as well as achieving price stability. Some like the Reserve Bank of Australia actually have such a commitment written into their objectives (Edey, 1997). However, the Reserve Bank of New Zealand did not discuss output as an objective. In reacting demand shocks the Bank would need to moderate fluctuations in the output gap (in the context of other influences on inflation) and hence ex-post it might appear that this had been the intention. Since the models used tend to simplify the transmission mechanism the output term might easily pick up other sources of variation not properly captured by the specified form of the reaction to forecast inflation.

In any case since the Reserve Bank operated with "tolerance" bands both between forecasts and, as I have mentioned, in deciding whether to alter the settings of policy, by only requiring inflation to be in

allow the price level to fall would have appeared as a practical opportunity.

[26] Nonlinearity and asymmetry are not necessarily the same thing. Mayes and Riches (1996) argued that not only was the cost of reducing inflation by a given amount greater than the equivalent gain from raising it but also that as the reduction (increase) needed to return to the middle of the target range grew the cost (benefit) would rise more (less) than proportionately.

[27] To use a motoring image that was common at the time the switch was akin to trying to follow the white line down the middle of the road in conditions of poor visibility instead of trying to keep out of the gutter.

[28] Since the projection shows monetary conditions tightening after the first quarter of 2000 this would be consistent with forecast inflation rising late in 2001 and on into 2002. The model will have been run a lot further ahead without reporting the results but its properties (Black et al 1997) would suggest that in the absence of any further shocks would converge fairly rapidly on 1.5% thereafter.

a relatively vague "in the middle of the target range" 6 to 8 quarters ahead, this will give the impression of what Svensson (1998a) describes as "flexible inflation targeting".

The tolerance bands between forecasts are unusual and reflect a combination of the history of the way in which the instruments of monetary policy were developed in New Zealand and a preference for allowing scope for market information in the setting of monetary conditions. They are not therefore particularly generalisable to other inflation targeting countries that use different instruments.

Although the RBNZ describes monetary conditions in terms of the 90-day bill rate and the trade-weighted exchange rate in a similar way to the Bank of Canada (Freedman, 1994; Mayes and Razzak, 1998) its lever over the market is actually a quantity – the amount of settlement cash available each night. However, the setting of that lever is rarely changed. It was last changed in August 1995 and before that in early 1993. It is only changed if the Bank's requirements for monetary conditions cannot be achieved purely by the *Statement* it publishes every three months when releasing its projections for the economy and rare statements in the intervening period announcing a change of view. It is a measure of the Reserve Bank's credibility and the success of its open approach to policy (described in more detail in the next section) that these so-called "Open Mouth Operations" (Guthrie and Wright, 1997) are normally quite sufficient to achieve desired conditions.

However, the Bank does not prescribe a narrow band for monetary conditions, being content for them to vary up or down by up to the equivalent of 50 basis points on the 90-day bill rate at the time the *Statement* is released and by up to around 100 basis points immediately before the next *Statement* (Brash, 1997). This willingness to accept variation reflects at least five factors:

- The market may have superior knowledge to the Bank
- There will be small shocks to the economy during the interval between forecasts whose impact on inflation cannot readily be assessed
- The Bank's model of the economy is an imperfect and approximate tool and it would make little sense to attempt to fine tune to its projections
- Limited divergences from an optimal path can easily be offset at negligible cost when monetary conditions are reset at the next quarter in the light of better information
- The PTA requires outcomes to be in the target range not "as close as possible to the centre of the range" so a modest measure of latitude in the expected outcome combined with the impact of the probability distribution of shocks over the future will still be consistent with it.

There is some evidence that in practice the Bank prefers to smooth the path of "instrument" changes over the cycle (Svensson, 1998a). This will also show up as an element of flexibility in inflation targeting.

There are therefore two contrasting elements to the existence of inflation bands. One is a wish to restrict fluctuations because this is a requirement for prices actually to be regarded as stable. The second is that some scope for variation is actually desirable for a variety of reasons – not least because it is unavoidable. While not mentioning a permissible range may help focus attention on the mid-point it also leaves the effective extent of inflation fluctuations that a central bank is prepared to tolerate or cannot in practice avoid as a subject for speculation. Indeed, it may make it more difficult for the market to decide whether a large fluctuation is unavoidable or whether, whatever the Bank says, in practice it has changed the inflation target. "Hard"

inflation bands may work in a manner similar to exchange rate bands (Tetlow and Williams, 1998). When the edge of the bands is approached there may be a "halo" effect that stems from credibility. If the central bank's commitment to the edges of the band is credible then expectations of a wider fluctuation will tend to fade away as the edge of the band is reached.

It is clear that many people in New Zealand (and elsewhere) thought the band was very hard-edged. There are several articles (Siklos, 1998b, for example) that state that the governor is liable for dismissal if the band is breached. Clearly no governor would want to find out how hard-edged the band is in practice because that would only be established by the minister of finance's action. Breaching a "hard-edged" band will tend to be more damaging to credibility than reaching the same level of inflation with either a soft-edged band or where there is no stated band.

The Bank of Finland has not been explicit in quoting a range for acceptable inflation although it has made clear the form of underlying inflation it is targeting. The 2% target has effectively been a maximum with a wish to keep deviations to a minimum. As is clear from Table 1 most other inflation targeting central banks try to keep inflation within a range of 2 percentage points. In general, however, the rationale for any such band (or lack of it) does not seem to be firmly rooted in a concept of price "stability" but rather in terms of practicalities and concepts of low inflation.

5 Communication

In this section I consider just two aspects of a communication strategy to achieve greater credibility, the publication of "Inflation Reports" to achieve greater understanding of the intentions of monetary policy and Monetary Conditions Indexes to make the stance of policy clear in a small open economy. However, the whole range of communication has a role to play including the use of lobbying and speeches up and down the country to win "hearts and minds" (Siklos, 1998b).

5.1 Inflation Reports[29]

Most of the inflation targeting central banks produce some sort of inflation report at regular intervals. On the whole these are backward-looking documents covering not just the recent evolution of inflation and its components but a description of the main events in the economy and related to it that have contributed to the inflation outcome. They also include a record of their actions. The degree to which they include analysis and a forward look varies, as does the degree to which they use or discuss formal models. On the whole the choices of what to include, how frequently to present and the readership at whom to aim has been their own. Even the Reserve Bank of New Zealand, which has a statutory requirement to produce at least one report every six months explaining its actions and in particular explaining any deviations from the target and how it intends to return inflation inside the target, is largely unconstrained. The backward-looking explanation is more aimed at fulfilling obligations of accountability, whereas the forward look is aimed primarily at affecting expectations and increasing the effectiveness and decreasing the cost of monetary policy. My concern is therefore primarily with the forward look.[30]

While the RBNZ is scrupulous in meeting the legal requirements (this is one of the few issues on which the Bank's Board passes formal resolutions) the report is really aimed primarily at market analysts. It is the analysis of the problems confronting monetary policy and the explanation of the way that the Bank sees itself addressing these problems that is

[29] This section draws on earlier work (Mayes and Castern (1998) for example) considering a *Price Stability Report* for the ESCB.

at the heart of the report. The English-speaking inflation targeting countries are at an advantage in that they can address financial markets round the world in their own language. Spain, Norway and Sweden also produce reports in English while the Bank of Finland produces a separate Bulletin in English and publishes almost all of its research in English.[31]

In most of these reports it is the backward look and the discussion of the current monetary and economic position that dominates. Both the Norges Bank and the Sveriges Riksbank show scenarios, based on models that indicate the quantitative importance to monetary policy of risks that face the economy. The Bank of England is alone in presenting a probability distribution of outcomes for both inflation and the real economy.[32] Furthermore the record of the meetings of the Monetary Policy Committee give a clear digest of the concerns about the future. A good case can be made for being right down the open end of the scale.[33] The dividing line for openness needs to be drawn before the extra information starts making the central bank look indecisive or the message becomes muddled in the mind of the receivers. Where this occurs will depend in part upon history and the framework society is used to for communication.

My impression from reading some of the debates over where to draw the line is that there is a confusion in terminology rather than substance that hinges on the meaning of the words "clarity" and "transparency".

All central banks want to give clear messages. However, these can be achieved by a number of routes:

- By actions in setting interest rates, reserve requirements, intervention in markets
- By structures and by pre-commitment to a set of rules and responses (as discussed in section 2)
- By explanation.

All of these have their difficulties and inflation targeting can put a considerable burden on the last of these. Certainly in so far as credibility can be achieved by routes other than explanation the burden is eased.

Transparency, however, is a different issue. One can be clear without being transparent. A central bank is transparent if outsiders can understand what it is doing and be able to predict with reasonable accuracy what it is going to do. This almost certainly involves being clear but the clarity necessary to achieve transparency in a complex world does not necessarily equate with simplicity. One of the great advantages often attributed to money targeting is that it involves both a simple rule and a simple readily observable means of verifying whether it has been followed. In one sense therefore it is clear. However, if the mechanism by which such an intermediate target is translated into price stability is not spelt out then it is not likely to be very transparent.

Regrettably for most monetary policy regimes the transmission mechanism from monetary policy into price stability and the requirements that known events and the uncertainties of the future place on the central bank are not easy to explain. In Mayes and Castren (1998) we set out some of the messages that need to be put across successfully to enhance credibility (Table 2) and also suggested what the requirements might be for communicating them (Table 3).

[30] Clearly the backward look can also contribute to credibility.
[31] Very little research is published in Finnish.
[32] I note in the next section a concern about the form of these distributions.
[33] Although, as Archer (1995) notes, to some extent this may be a one-way street. It is easy to increase openness but outside comment may make it more difficult to decrease the amount of information

Table 2: What is needed

- The public announcement of a quantified definition of the final objective of price stability in order to enhance the transparency and credibility of the central bank's strategy
- The public announcement of a specific target (or targets) against which the performance of the central bank can be assessed on an ongoing basis by the general public, thereby enhancing accountability
- The demonstration of a clear understanding of how the country's economy works
- A believable analysis of the future for inflation and the shocks that the economy may face
- A credible statement of how the central bank can affect that outcome and the policy settings it is choosing in order to maintain price stability
- An acceptable explanation of actual progress and, when necessary, of why actual outcomes were not consistent with the target and what is being done to correct matters

Table 3: The Information Required for Transparency

- Background papers on the transmission mechanism, the models used, how policy is set and implemented and a wide range of issues relating to the price setting process will help
- A set of position papers on recent information and expected developments to inform the decision-making
- Regular Monetary Policy Reports containing forecasts, assessments of risks, decisions for setting monetary policy and explanations of past actions and performance
- Explanations of decisions from policy meetings
- Regular reporting and explaining in public such as at hearings of the legislature
- An active communications programme domestically and internationally
- The encouragement of an active professional debate on monetary policy, including the funding of research to encourage the development of new ideas and better conclusions from the available evidence

These suggestions were intended to be uncontroversial and do not for example contain the suggestion that verbatim minutes of decision-making meetings be published. It would be difficult to publish such details as either the meetings would tend to become largely ritualised and the real discussion taking place elsewhere or people would be reluctant to explore other hypotheses, playing the role of devil's advocate, etc.[34]

The Bank of England compromise of a summary seems a very sensible way to explain that a range of views is not only reality in central banks but a respectable way to try to reach decisions. It also makes it easier to change the aggregate mind of the committee in an evolutionary manner rather than by apparent reversal (King, 1998).

5.1 Monetary Conditions Indexes and Giving Clear Signals

Most of the inflation targeting countries are small open economies. They are certainly all open. This means that the exchange rate will play an important role in the appraisal of the impact that monetary policy will have on inflation. This adds a significant complication to the communication of the needs of policy (Mayes and Razzak, 1998; Mayes and Viren, 1998). The central bank can no longer incorporate all that it wants to say about the setting of policy in a single indicator, such as a representative interest rate. This may put inflation targeting at a disadvantage compared with money or exchange rate targeting where there is usually just a single intermediate target. There are wide issues at stake

[34] One of the roles of the Chief Economist in the RBNZ was to ensure that the Monetary Policy Committee was confronted with the full range of plausible policy choices and not to eliminate them and just produce a single recommendation (Mayes and Razzak, 1998).

here but I merely wish to illustrate the dilemma that can be faced. It is difficult to make contingent statements. If the appropriate setting for the interest rate that the central bank can control is dependent upon the reaction of the exchange rate then the central bank is faced with a choice. It can try to spell out that dependency or every time the exchange rate moves sufficiently it can reset interest rates. For countries that observe quite a lot of volatility in the exchange rate that can result in what appears to be a very active monetary policy. Part of the communication problem is for the bank to explain that it is not seeking to change the level of the bite of monetary policy but it needs to change the interest rate because the move in the exchange rate has in practice altered that level. There are therefore likely to be two sorts of messages, those that realign interest rates because of changes in the mix of interest and exchange rates and those that realign them because the bank wishes to change the level. If the central bank does not want to act frequently the chances are that whenever it does want to make a change the explanation will involve a combination of the two factors.

Canada, New Zealand, Sweden, Finland (and Norway) have all had concerns about how to communicate the needs of monetary policy in these circumstances. If markets confuse the two messages then this may harm the credibility of policy if a change in mix is interpreted as a change in level and hence as a change in enthusiasm in the fight against inflation. As part of the solution these countries have made use of the concept of an MCI (Monetary Conditions Index (or Indicator)) that combines the impact of the interest rate and the exchange rate into a single measure.

However, MCIs present problems of their own. There are substantial econometric problems in their construction (Ericsson et al., 1997). This means that not only may markets be a little sceptical over the validity of the weights being used but the central bank itself may also be a little unsure. The central bank then faces a trade-off between clarity of the message and oversimplification of the position. Until recently only the Bank of Canada had made substantial use of the MCI as a communication tool (Freedman, 1994), however, since December 1996 the Reserve Bank of New Zealand has also published an MCI (following two years development explained in Mayes and Razzak (1998)).

In the New Zealand case the main purpose of publication was to increase the chance that the Bank would not have to take monetary policy actions between its quarterly *Statements* unless there was a significant shock to the economy where the Bank's required reaction appeared unclear. It wanted to set out for the market how changes in the mix of interest and exchange rates would be required to avoid changes in the level of monetary conditions in response to market variations – what has been described as "portfolio shocks". Prior to the MCI (Mayes and Riches, 1996) the market appeared to have misinterpreted the Bank on some occasions. However publishing an MCI has also made it much more apparent how large the swings in interest and exchange rates have been (Fig. 3).

6 Forecasting

One of the key features that has distinguished the New Zealand approach has been the willingness to publish a detailed forecast. All central banks need to base their actions on a forecast of the future as policy takes some time to have its effect but most have been rather cautious about how much they reveal about their views of the future. The source of the reservation is simple. Forecasting is a fairly hit and miss activity. There are all sorts of unforecastable shocks that can hit the economy after the forecast has been published that will make the explicit numbers that have been produced differ from the actual outcomes, however

sophisticated the forecasting method.

Of course, forecasters are not so naïve as to produce unconditional forecasts and forecasts, whether published or not, are hedged by a long list of assumptions. However, ex-post assessments of forecasts do not normally pay much attention to this qualification. The NZ Institute of Economic Research publishes a list of the main forecasts of the New Zealand economy and while detailed reading may reveal some of the big differences in assumptions in practice the public disregards them.

Until relatively recently public sector forecasters were at a disadvantage in that the "rules of the game" meant that they had to produce forecasts on the basis of unchanged policy. Thus a Treasury would be understandably disinclined to publish a forecast that showed its own ministers' policy being reversed. It would be even less likely to publish a forecast that showed them losing the next general election even if it were not far ahead and the government were doing very badly in the opinion polls. This tended to make such forecasts of limited value and mean that public sector bodies did rather poorly in any ex-post assessment of forecasting performance.

6.1 Obtaining a Fair Assessment of the Central Bank's Performance

One worry for central banks is that they will be damned publicly when there is popular dislike of the performance of the economy irrelevant of whether poor decision-making by the Bank was a contributory factor. Furthermore such criticism may be harmful both to price stability, threatening the framework, and to credibility and hence the costs of monetary policy. Wishing to be assessed fairly adds a further reason to the more obvious forward-looking motivations for publishing coherent forecasts driven by econometric models.

The assessment of forecasting performance was a key element in the RBNZ Board's review of the Governor's performance when the RBNZ first announced that it expected to breach the inflation target (Mayes and Razzak, 1997). It was concerned with three features of the forecasting performance:

- accuracy in absolute terms,
- accuracy relative to other forecasters, but
- most importantly the question of whether anyone else had been consistently promoting a reasoned course of action at the time that prima facie would have resulted in a better inflation performance than the Bank was achieving.

The first of these is the easiest to handle. If the Bank were unable to forecast, after allowing appropriately for artificial conditionality, with a degree of accuracy that would enable it to set policy so that there was a "reasonable" probability of achieving the inflation target then the exercise would be misconceived. In practice, even ignoring the conditionality (Brooke, 1995) the bank was able to produce forecasts two quarters ahead within a 0.2% interval either side of the actual outcome 95% of the time and 0.5% eight quarters ahead. It only requires a brief look at the inflation experience to realise that this was not a very harsh requirement. From 1991 inflation has remained in a band 1.4% wide (according to the target definition).[35] Since the central bank is trying to control the outcome and has considerable ability to do so it is not surprising if there is a high degree of forecasting accuracy.[36] Thus a central bank that is good at controlling inflation will be "good" at forecasting. Ipso facto the reverse will also tend to be true, although the logical connection is rather different. Furthermore a central bank that can get credibility for its forecasts will by definition find

[35] Headline inflation, which includes the impact of interest rate changes and supply shocks, has varied more widely.

[36] Forecasting inaccuracy peaks around five quarters ahead and then remains roughly constant as the horizon is extended. This is clearly at variance with the sort of probability distribution for outcomes published by the Bank

the process of inflation control easier and less costly in terms of output (or welfare) foregone. There is thus a sense in which a bank can move towards self-fulfilling prophecies. But if at any stage one were to attempt to "live off" credibility either by being less careful in forecasting or worse still by forecasting what one hoped would happen then the costs once the credibility was lost could be very large indeed.[37]

In practice the RBNZ came out very well in terms of relative forecasting ability. No other forecaster was consistently better at forecasting inflation. However, given the resources put into forecasting, compared with most organisations in the private sector and its information advantages from both contacts with industry and government it ought to be right at the top of the quality distribution.[38] There is a more straightforward reason. The Reserve Bank is a Stackelberg leader both in the forecasting profession and in the formation of inflation expectations. There is clear Granger causality between the Reserve Bank's forecasts and surveyed inflation expectations (Mayes and Razzak, 1998). Since the Reserve Bank's forecasts are backed up with a policy action on their release it is perhaps not surprising that they should also lead to changes in private sector forecasts.

The Reserve Bank, of course, has knowledge not just of other forecasts and the inflation forecasts implicit in market prices but also of surveyed expectations. There could therefore be a further circularity in the forecasting process if the Bank took these into account in formulating policy and indeed a danger of instability and multiple equilibria, as outlined by Bernanke and Woodford (1997). Herein lies one of the advantages of basing forecasts on a model. The expectations the Bank uses in producing its forecast are model consistent rather than surveyed. Although it sets out the forecasts of others and expectations when presenting its forecasts internally these are used more in the form of a check. If the Bank's forecasts disagree with those of the market then the Bank has to be very clear about how it is going to explain that disagreement. It will want to try to convince the market and shift expectations towards its view. The Bank also needs to be able to assess how markets are likely to react when the forecast and policy stance is announced in order to fine tune its stance.[39]

However, the key concern for the Board was not so much the quantitative position but the story being told about the evolution of the economy. The main forecasting error made by the Bank that resulted in the overshoot of the inflation target was to underestimate the growth in the economy. The same mistake was made by other forecasters as well and the Bank was tending to produce the highest consistent economic growth forecasts during 1994. It is slightly less clear how much the Bank led the market in tightening monetary conditions during the period (Fig. 3) as much of the tightening came through a progressive appreciation in the exchange rate, given the Bank's "rule" for exchange rate forecasting during the period – initially that the nominal exchange rate would move by the difference between forecast domestic and foreign exchange rates.[40] Although

of England in its *Inflation Reports* that show increasing variance as the time horizon is extended.

[37] This is not a fanciful suggestion as governmental fiscal forecasts are frequently made on "optimistic" bases and the nature of the revisions in the light of experience shows clear "biases".

[38] The Reserve Bank has actually published its objectives for forecasting accuracy in its Annual Plan. In addition to quality requirements it set itself the target of being above the median in terms of accuracy in inflation forecasting up till 1995. That was then changed to "among the best" as defined by the NZIER.

[39] If the forecast comes as a surprise then the market may react by disbelief, in which case the Bank may have to take further action to enforce its view of the appropriate monetary conditions. Or the market could overreact and reappraise further than the Bank – possibly on the grounds that central banks tend to be cautious. In any event a surprise may very well generate a sequence of events and not just a one-step adjustment (Mayes and Riches, 1995).

[40] Later amended to the difference between the forecast foreign inflation and the middle of the target range. The previous rule had the unfortunate characteristic that if the

interest rates doubled from 4.5% in mid-1994 to 9% the specific way in which policy is implemented in New Zealand means that it is very difficult to say what proportion was due to the Bank's actions and what proportion due to the market.[41] The Bank does not set an interest rate, although it can control the amount of cash in the overnight market so as to move interest rates where it wants to see them. It is the market that determines the rate and the Bank only reacts if the rate set is leading to monetary conditions that might threaten the inflation target. In practice therefore the Bank permits a much wider range of monetary conditions than most central banks – equivalent to 100 basis points on the 3-month rate at its narrowest (Mayes and Razzak, 1998). Hence if the Bank wants to see conditions tighten and the market tightens conditions at the same time (even if the reasoning is totally different) the Bank will have no need to act.

It did not appear that the Bank had been dilatory and only one suggestion was made that would have resulted in tighter policy, namely that the target should be changed to domestic inflation from the overall CPI measure explained in the Policy Targets Agreement. Ironically the suggestion was made because it was anticipated that this change in the target would lead to less fluctuation in monetary conditions.

This does not mean that the RBNZ publishes absolutely everything that it has computed regarding the future. In common with other central banks the RBNZ produces a more extensive internal document as a background to the three monthly decision-making related to the publication of the forecast, the associated *Monetary Policy Statement* and the decision on the setting of monetary conditions for the ensuing quarter.

The Bank of Finland, for example, has a much more detailed forecasting model, BOF5 (Willman *et al.*, 1998) than the RBNZ's FPS, which has been published.[42] Internal forecasts are far more detailed than those in New Zealand. In part this is a function of the availability of a wider range of information in Finland and the ability to estimate economic relationships more reliably.

6.2 Overcoming the Fear of Being "Wrong"

Central banks are frightened of being shown to be "wrong". The fear is that if their forecasts are shown to be at variance with outcomes this will call into question the validity of their policy prescriptions as well and hence weaken their credibility. Of course, the opposite might be the case. A bank might lose credibility because it does not appear to have enough confidence in its forecasts to publish them.

However, I would suggest that this argument is misguided because it focuses on specific point estimates. What is required for policy is a realistic assessment of the likely range of things that could occur in the future and a setting of monetary conditions that will maximise the chance of keeping to the target in the light of that uncertainty about the future. This view is well articulated by the Bank of England, which does not produce point forecasts but an assessment of the distribution likely outturns for inflation and economic growth. While it may be possible to object to the specific way in which this is done (Sgherri and Wallis, 1997) the principle is clearly the correct one. Monetary policy is about decision-making under uncertainty. While the RBNZ may produce specific numbers it goes to some lengths to spell out the uncertainties that surround them and explain not just how those uncertainties should be

forecast for domestic inflation were to rise this entailed that projected monetary conditions would ease as the exchange rate path would be lowered. A good illustration of the difficulty of working with such artificial rules.

[41] This is elaborated further in the Section on inflation bands.

[42] Although the form of publication only allows the reader to understand the model, not to use it.

faced in the present but to outline what they might mean.

To give an example, the current preoccupation in New Zealand is with the possible impact of the Asian crisis. The RBNZ does not claim to have superior knowledge about developments in Asia and has based its forecasts on the *Consensus Forecasts.* In the August 1998 *Monetary Policy Statement* the RBNZ shows how much that consensus has moved over the last year, from a forecast of 4.5% growth in 1998 to a decline of 1%. It then illustrates what the implications would be for monetary policy if growth in 1999 were to be 2% below the current *Consensus Forecasts* (200 basis points).[43] Knowing that this is expected to depress the monetary conditions the Bank would want to be over 100 basis points for over 2 years and reaching 200 basis points a year ahead gives a message of considerable economic worth.

7 Concluding Remarks

In view of the burgeoning literature on inflation targeting I have set myself the limited task in this paper of reviewing some of the lessons from experience that have been learned by central banks for increasing credibility through the design of an inflation-targeting strategy. These lessons are very much in the form of context-dependent case studies rather than strong econometric evidence that runs across countries. Despite these qualifications I think we can draw a number of conclusions. They include the following:

- The initial design of framework by committing the central bank to particular forms of action in advance plays an important role in influencing expectations of future inflation from the early days of its inception and before any track record can be established.
- If the time-consistency problems are to be overcome effectively the framework needs to find some way of transcending the wishes of individual governments and lead people to believe that it will be in place in the long term.
- Despite an important improvement in credibility, the framework in New Zealand seems to lack credibility compared to many other countries. While some of the problem may be due to the greater openness of New Zealand to external shocks, it seems likely that some is also due to the framework of monetary policy itself, particularly in regard to:
- The frequency of revision of the target.
- The lack of independence of the Reserve Bank.
- The personalisation of responsibility on the Governor rather than on a Board representative of professional or other wider opinion in society.
- Many inflation-targeting countries have targets not clearly based on literal “price stability” but on some concept of low inflation.
- Where there is no clear basis to the target the chances of an upward drift in the price level and lower credibility are increased.
- There are attractions to targets that both limit drift in the price level in the longer term and variation in inflation along the way.
- The extent of price stability in practice suggests that some prior fears about the plausibility of narrow inflation bands may have been exaggerated.
- However, the size of the fluctuation in monetary conditions in some open economies may lead to the thought that a reformulation of the regime might reduce the real costs to the economy.
- In general both transparency in the way the central bank views the challenges for policy in

[43] Foreign prices and interest rates are also adjusted to make this a scenario that hangs together.

the future and clarity in describing the required policy will tend to increase credibility.

- Central banks face a difficulty in avoiding confusion in the public mind between optimal policy in an uncertain world and uncertainty within the bank that may lead to increased inflation.
- Many existing "Price Stability Reports" offer scope for providing less historical statistical material and more clarification of the view of the future, particularly the assessment of "risks".
- Monetary Conditions Indicators offer some scope for increasing understanding of the joint role of the exchange rate and interest rates in monetary policy in open economies.
- Publishing forecasts increases the chance that the Bank's record will be judged on professional criteria and reduce the chance that the credibility of the framework for price stability will be damaged by weak economic performance stemming from other causes.
- Openness by the central bank increases the chance that the debate about policy will be a constructive process trying to improve decisions rather than a combative exchange with those who feel excluded or ignored.
- Explaining uncertainty allows decisions to evolve in a credible manner over time rather than incurring accusations of inconsistency. Publishing the range of views over the future and an explanation of the debate in Monetary Policy Committee meetings can help achieve this.

Table 1: The Basic Ingredients of Inflation Targets

	Inflation Objective	Index Targeted	Calculation Period	Contingencies for Breaches of the IT	Targeting Horizon?	Is the Target Legislated?	Adoption Date (dd/mm/yy)	Separate Inflation Report?	Who Sets the IT?	Does Central Bank Publish Inflation Forecast?
Australia	Average of 2.0–3.0%	CPI	Over the cycle	• Mortgage interest • Government-controlled prices • Energy prices	None	No	01/01/93	No[7]	Government	No
Canada	• 2.0–4.0% by the end of 1992 • 1.4–3.5% by mid-1994 • 1.0–3.0% Dec.1993 to Feb. 1998[1]	CPI[2]	Annual	• Indirect taxes • Food and energy prices	Yes	No[5]	26/02/91	Yes	Joint	No
Finland	2.0% from 1995	CPI	Annual	• Housing capital costs • Indirect taxes • Government subsidies	No	No	02/02/93	No[8]	Central bank	No
New Zealand	• (1) 3.0–5.0% (Dec. 1990); 2.5–4.5% (Dec. 1991) • (2) 1.5–3.5% (1992 Q1–Q4) • (3) 0–2% (1993 Q1) • (4) 0–3% (1997 Q1) • (5) 0–3% (1997 Q4)[3]	CPI[4]	Annual	• Commodity prices • Government-controlled prices • Interest, credit charges	Yes	Yes	02/03/90	Yes	Joint	Yes

	Inflation Objective	Index Targeted	Calculation Period	Contingencies for Breaches of the IT	Targeting Horizon?	Is the Target Legislated?	Adoption Date (dd/mm/yy)	Separate Inflation Report?	Who Sets the IT?	Does Central Bank Publish Inflation Forecast?
Spain	2%[6]	CPI	Annual	• Mortgage interest	Yes	No	01/01/95	Yes	Central bank	No
Sweden	• 2% • 1.0–3.0% since 1995	CPI	Annual	• Nominally none but conditional on indirect taxes, subsidies	No	No	15/01/93	Yes	Central bank	Yes
United Kingdom	• 1.0–4.0% until June 1997 elections • 2.5% since June 1997	Retail Price Index *ex* mortgage interest payments	Annual	• Mortgage interest	No	Yes[9]	08/10/92	Yes	Government	Yes

[1] 1.0–3.0% Feb. 1998 to end 2001
[2] Although the target is formally specified in terms of overall CPI, the Bank focuses on the CPI excluding food, energy, and the effects of indirect taxes.
[3] The term of the new PTA coincides with the current term of the Governor which expires 31 August 2003.
[4] Since December 1997, the CPI excluding credit services is targeted. Prior to that date, overall CPI was targeted.
[5] The target represents an agreement between the Minister of Finance and the Governor of the Bank of Canada and is not enshrined in the Bank of Canada Act.
[6] Between 1995 and 1997, the aim was to reduce inflation to the 2% range. In 1998, the aim is to keep the annual inflation rate "…close to 2%..." during the year.
[7] The Governor is, however, "available" to report on the conduct of monetary policy twice a year to the House of Representatives Standing Committee on Financial Institutions.
[8] Finland reports quarterly on the inflation outlook in its *Monthly Bulletin*.
[9] Only since 12 June 1997

Sources: Siklos (1997), www.rbnz.govt.nz, Bank of England Quarterly Bulletin (May 1998), www.bof.fi, www.bde.es, www.rba.gov.au, Siklos (1998a)

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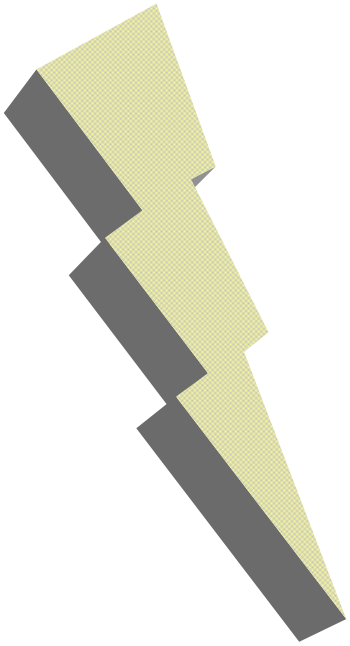

Inflation Forecasting Using a Small Macro-Economic Model

Preliminary Version: May 1998

Emil Stavrev[*]

Abstract

This paper presents a small macro-econometric model which is further used to predict inflation and produce different monetary policy simulations concerning inflation targeting in the Czech Republic. The problems connected with inflation targeting for transition economies are discussed as well as the different modelling approaches suitable for policy simulation and inflation forecasts.

The views expressed in this paper are those of the author and not necessarily those of the Czech National Bank.

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1 Introduction

At the end of 1997, there was an intensive discussion at the Czech National Bank on the effectiveness of the existing monetary policy. The previous monetary policy regime with money supply targeting was evaluated, and an inflation targeting regime was introduced. As a result of these heated discussions, which weighed the advantages and disadvantages of both policy regimes, it was decided that inflation targeting was more suitable for the Czech Republic. Thus, at the beginning of 1998, the CNB switched over to a system of inflation targeting. Implementation of the new monetary policy regime not only required from the CNB short-term predictions of inflation, but medium-term predictions as well. Obviously, the methodology used to predict inflation during the previous system was not suitable for inflation targeting. The CNB used short-term inflation forecasts (up to one year) based on expert estimation. On the contrary, inflation targeting requires inflation forecasts for a longer period (two to four years). Medium- and long-term prediction of inflation is hardly possible without using an appropriate macro-model which captures the main characteristics of the transmission mechanism and describes the different channels of monetary policy. The above requirements led to the development of the small macro-model which is discussed in this paper.

In this work, the theory of inflation targeting is used to construct a small econometric model for the purposes of predicting price changes in the Czech Republic and making monetary policy simulations. At this time, work is still in progress. Therefore, the structure of the model presented here will be improved upon, and the appropriate econometric methods will be applied to obtain better econometric results. Implementation of inflation targeting requires the central bank to use a reliable model which gives the policy makers information about the probability distribution of predicted inflation and thus allowing them to make sound inflation forecasts.[1] The central bank's inflation forecast becomes an intermediate target. This is why a reliable central bank structural model for inflation prediction and for understanding the transmission mechanism of monetary policy is of crucial importance.

2 The Model

This section presents a small four equation quarterly macro-econometric model constructed with the aim of predicting net inflation in the Czech Republic. There are three behavioural equations in this model – equations (1), (3) and (4). Equation (4) is a "version" of the uncovered interest parity condition and is calibrated. The problems connected with this equation will be discussed in the next section.

Equation (2) and all equations connected with it are definitions. They are used in order to connect total inflation, net inflation and inflation of regulated goods. All variables in small letters are expressed in logarithms. The sign of the parameters is assumed to be positive unless otherwise specified.

Net Inflation Equation

(1)

$$\pi_t^x = \alpha_1 \pi_{t-4}^x + \alpha_2 z_{t-4} + \alpha_3 (\pi_t^* + \Delta e_t) + \varepsilon_t^\pi$$

where π_t^x is net inflation in the Czech Republic, π_t^* is foreign inflation[2] and z_t is deviation of actual real GDP growth from "potential growth". "Potential growth" is defined as a percentage change of the trend in real GDP in the Czech Republic.

[1] For an extensive discussion of inflation targeting, see Haldane (1995), Ammer and Freeman (1995) and McCallum (1995).

[2] Foreign inflation is taken as an exogenous variable. It is constructed as a weighted average of US and German inflation with weights 0.35 and 0.65, respectively.

The econometric estimates showed that for the period from the first quarter of 1993 to the fourth quarter of 1997, the mean value of the percentage change of the real GDP trend is 3.5% per year, and Δe_t is the relative annual change in the nominal effective exchange rate.

The nominal effective exchange rate is constructed as a weighted average of the exchange rate of the Czech koruna with respect to the US dollar and German mark with weights 0.35 for the US dollar and 0.65 for the DM.

Total Inflation Equation

$$\pi_t = \varpi_t^x \pi_t^x + \varpi_t^R \pi_t^R \qquad (2)$$

In order to obtain equation (2), the Consumer Price Index definition given below is used:

$$CPI_t = \varpi_B^x CPI_t^x + \varpi_B^R CPI_t^R \qquad (2.1)$$

where ϖ_B^x and ϖ_B^R are constant weights of the indices of non-regulated and regulated prices, and CPI^i_t for $i = x, R$ are indices of non-regulated and regulated prices with 1993 used as the base year.

The change in prices in the two groups of goods (non-regulated and regulated) is defined as follows:

$$\pi_t^i = \frac{CPI_t^i - CPI_{t-4}^i}{CPI_{t-4}^i}, \qquad \text{for } i = x, R. \qquad (2.2)$$

Total inflation is defined as a relative change in the CPI as follows:

$$\pi_t = \frac{CPI_t - CPI_{t-4}}{CPI_{t-4}} \qquad (2.3)$$

Furthermore, equation (2.1) is plugged into equation (2.3), and after simplifying, the following equation for total inflation is obtained:

$$\pi_t = \varpi_B^x \frac{CPI_{t-4}^x}{CPI_{t-4}} \left| \frac{CPI_t^x - CPI_{t-4}^x}{CPI_{t-4}^x} \right| + \varpi_B^R \frac{CPI_{t-4}^R}{CPI_{t-4}} \left(\frac{CPI_t^R - CPI_{t-4}^R}{CPI_{t-4}^R} \right| \qquad (2.4)$$

Using equation (2.4) above, formulas for the changing weights are obtained in the following form:

$$\varpi_t^i = \varpi_B^i \frac{CPI_{t-4}^i}{CPI_{t-4}}, \qquad \text{for } i = x, R \qquad (2.5)$$

Output Equation

$$z_t = -\gamma_1 (i_{t-4} - \pi_{t-4}) + \gamma_2 (\pi^*_{t-4} + \Delta e_{t-4} - \pi_{t-4}) + \varepsilon_t^z \qquad (3)$$

where i_t is the one week PRIBOR. The first term of the above equation, $(i_{t-4} - \pi_{t-4})$, captures the effect of the real interest rate and the second term, $(\pi^*_{t-4} + \Delta e_{t-4} - \pi_{t-4})$, captures the effect of the real exchange rate.

Exchange Rate Equation

$$\Delta e_t = -\beta_1(i_t - i_t^*) + \beta_2(\pi_{t-4} - \pi_{t-4}^*) + \varepsilon_t^e \quad (4)$$

where i_t^* is the foreign interest rate constructed as a weighted average of US and German interest rates. As mentioned above, this equation is a modified version of the uncovered interest rate parity condition which later for simulation purposes was calibrated in such a way that an acceptable in-sample fit was obtained for inflation predictions using the model. The inflation differential is used as a proxy for the risk premium.

3 Estimation and Simulation Results

The above model was estimated, equation by equation, using Ordinary Least Squares (OLS). Estimation results are given in Table 1 below. Due to the short time series, it was not possible to estimate the model as a system using some simultaneous econometric techniques like Full Information Maximum Likelihood (FIML) or Seemingly Unrelated Regression (SUR). The results given in Table 1 show that the values of the t-statistics for the estimated parameters and goodness of fit for both estimated equations are acceptable.

The value for Durbin-Watson statistics for equation 3 shows the presence of positive autocorrelations. To solve the problem, the Prais-Winsten transformation (PWT) was applied [3]. Both results are given in Table 1 below. In the table below, ρ is the coefficient of autocorrelation estimated by regressing residuals from the OLS estimation of equation (3) on their lagged values.

The value of the coefficient α_3 is restricted to 0.6 based on previous studies related to the effect of the exchange rate on inflation. The Czech economy is a small, open economy. The shares of imports and exports in GDP are in the range of 0.55 to 0.65.

Table 1 – Econometric Results

Equation	Coefficient	Value	t- statistics	R^2, DW
1	α_1	0.64	25.3	0.72, 1.99
	α_2	0.28	3.44	
	α_3	0.60	restricted	
OLS estimation 3	γ_1^{OLS}	0.29	2.89	0.78, 0.74
	γ_2^{OLS}	0.18	2.18	
PWT estimation 3	γ_1^{PWT}	0.48	4.95	0.83, 2.16
	γ_2^{PWT}	0.35	2.08	
	ρ	0.54	1.61	
4	β_1	0.38	calibrated	
	β_2	0.98	calibrated	

[3] See Kmenta (1986) for a description of the Prais-Wiston transformation.

Equation (4) is the most problematic equation in this model. As mentioned above, a "version" of uncovered interest rate parity is used here. According to the interest rate parity, spot exchange rates should move to just offset differences in nominal interest rates; countries with high nominal interest rates should experience depreciation, and vice versa. Froot and Thaler (1990) have conducted a research survey concerning this matter and summarise that industrialised countries with high nominal interest rates usually have appreciating currencies. They survey seventy-five studies and point out that the average coefficient on the interest rate differential is -0.88, instead of being +1.

The model for the period from the first quarter of 1995 to the fourth quarter of 2000 has been simulated. Simulation results are given in Table 2, Table 3, Figure 1 and Figure 2 below. Two scenarios have been constructed below. Scenario 1, called the "Basic Scenario", is presented in Table 2 and Figure 1. The second scenario, called "Relaxing of Monetary Policy", is given in Table 3 and Figure 2. All variables presented in Table 2, Table 3, and both figures are in percentages.

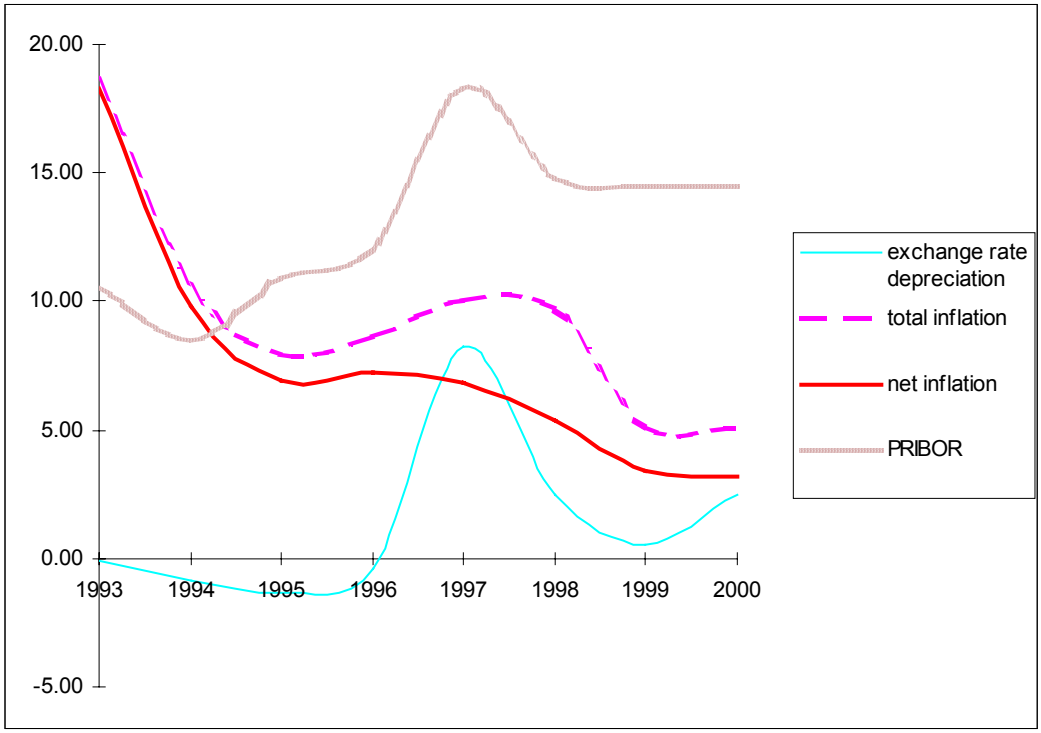
Scenario 1 — the "Basic Scenario"

In Scenario 1, the instrument variable was the one-week PRIBOR taken at its average value for January–July 1998. For the next two years, the PRIBOR was frozen at 14.5 per cent. It is clear from the results presented in Table 2 that the predictions about inflation for 1998 and 2000 are within the band announced by the CNB in its monetary programme for 1998. The model gives marginal growth of the real GDP for this period of about 0.5–1 per cent.

Table 2 – Simulation Results for the *"Basic Scenario"*

Year	Exchange rate depreciation	Total inflation	Net inflation	Inflation in regulated goods	Deviation of real GDP growth from "potential growth"	Real interest rate	PRIBOR
1993	*-0.11*	*18.70*	*18.26*	*30.12*	*-2.90*	*-8.10*	*10.60*
1994	*-0.90*	*10.54*	*9.79*	*18.49*	*-0.80*	*-2.10*	*8.44*
1995	*-1.31*	*7.94*	*6.94*	*12.30*	*2.90*	*2.93*	*10.87*
1996	*-0.42*	*8.60*	*7.20*	*14.42*	*0.40*	*3.45*	*12.05*
1997	*8.25*	*10.04*	*6.80*	*22.64*	*-2.50*	*8.27*	*18.31*
1998	2.50	9.70	5.35	22.00	-2.53	5.05	14.75
1999	0.50	5.15	3.41	10.50	-2.45	9.35	14.50
2000	2.50	5.06	3.21	10.40	-3.35	9.44	14.50

Figure1



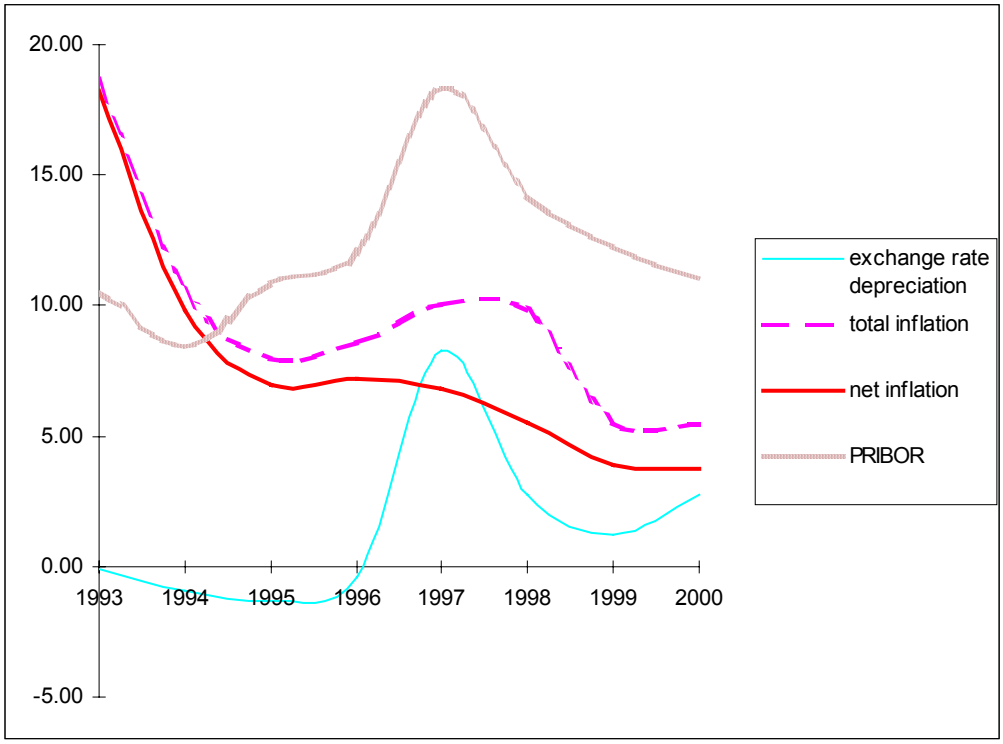
Scenario 2 — "Relaxing of Monetary Policy"

In this scenario, the selected policy variable is 0.5 percentage points lower in 1998, 2.25 percentage points in 1999 and 3.5 percentage points in 2000 than in the first scenario. The idea here is to study the effect of monetary policy relaxation on the target variable (net inflation) and other macroeconomic variables.

Table 3 – Simulation Results for the *"Relaxing of Monetary Policy"*

Year	Exchange rate depreciation	Total inflation	Net inflation	Inflation in regulated goods	Deviation of real GDP growth from "potential growth"	Real interest rate	PRIBOR
1993	*-0.11*	*18.70*	*18.26*	*30.12*	*-2.90*	*-8.10*	*10.60*
1994	*-0.90*	*10.54*	*9.79*	*18.49*	*-0.80*	*-2.10*	*8.44*
1995	*-1.31*	*7.94*	*6.94*	*12.30*	*2.90*	*2.93*	*10.87*
1996	*-0.42*	*8.60*	*7.20*	*14.42*	*0.40*	*3.45*	*12.05*
1997	*8.25*	*10.04*	*6.80*	*22.64*	*-2.50*	*8.27*	*18.31*
1998	2.75	9.79	5.48	22.00	-2.53	4.46	14.25
1999	1.25	5.49	3.87	10.50	-2.24	6.76	12.25
2000	2.75	5.45	3.73	10.40	-2.48	5.55	11.00

Figure 2



The results given in Table 3 suggest that according to the model, the CNB is still able to reach the goals announced for 1998 and 2000.

4 Problems

The problems with modelling economies in transition could be divided into two parts: a) relatively short time series, and b) possible instability of the coefficients which may arise from the continuously changing environment. Since the end of the centrally planned period, these countries have been introducing huge changes in their legislation. During the transition period, economic agents have been gradually adapting to the new conditions and thus changing their behaviour.

The problem with short time series is, for the time being, of greater importance. Complete data are not available, and appropriate econometric tests for stability of the coefficients as well as tests for model specification cannot be performed. In an attempt to solve the problem of possible parameter instability, the Kalman filter technique is employed.

5 Other Approaches and Further Work

Taking into account the problems discussed in Section 4, there are several ways of dealing with the problem of modelling inflation targeting in the case of the Czech Republic. First, macro-econometric models will be further constructed and developed. Despite data difficulties, econometric models for predicting inflation and different policy simulations will continue to be built. This work is more long-term in nature since the outcome of it will be more reliable in the future when there will be enough time periods

for obtaining more statistically stable results. It is expected that the quality of the model and its estimates and predictions will improve in time. Secondly, work will continue on short-term econometric models based on microeconomic foundations (such a model at the Division for Economic Modelling already exists; it is used for short-term inflation forecasting). Thirdly, there are plans to use the VAR method in order to obtain better information about the functioning of the Czech economy. Fourthly, it would be beneficial to use stylised macro-models based on microeconomic theory with calibrated parameters for policy simulations. These models are resistant to the Lucas critique, and they appear to be more relevant for policy simulations[4]. Finally, research on the formation of expectations in the Czech Republic will be conducted because of their importance for the development of the exchange rate and inflation and its crucial role in modelling the economy.

6 Conclusions

This paper presents a relatively simple, small macro-econometric model and shows how it can be used for simulating different monetary policy scenarios in the Czech Republic related to inflation targeting. Despite its simplicity, the model captures the main characteristics of the monetary transmission mechanism and gives plausible values for the key macroeconomic variables in the simulation period (1995 - 2000).

Finally, the most important conclusion is that there is much work to be done in studying and analysing the Czech economy. The results of these studies are very important for constructing appropriate models that can be used for reliable inflation forecasting and policy simulations.

[4] For extended discussion concerning the Lucas critique, see Fair (1984) and Whitley (1994).

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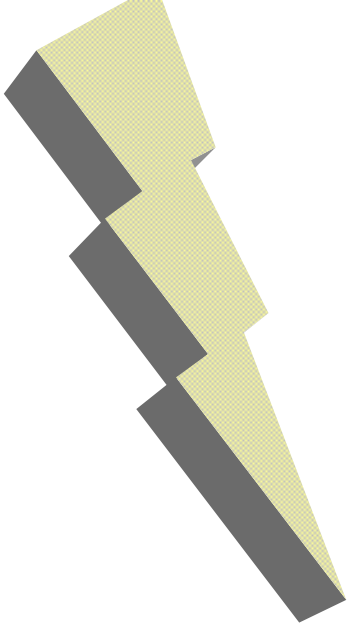

PANEL DISCUSSION

The workshop was concluded with a panel discussion. The following questions were used as a framework for the discussion:

1. **How do you define the target for a period of disinflation? When do you switch to a horizontal band?**
2. **Do inflation expectations switch to a "horizontal" regime?**
3. **Are there waves common when disinflating? Is fast inflation followed by a period of inflation?**
4. **What are the choices of targets (point target versus interval)?**
5. **Does a central bank lose its credibility if a target is under shot?**
6. **Under what circumstances does a central bank not lose credibility when missing the target?**
7. **How do you react to large exchange rate movements when targeting inflation?**
8. **How do you respond to supply shocks, and how do you identify them?**
9. **How often do you react with interest rates (frequent and smooth versus rare and large changes)?**

We hope that this edited record of discussion will provide you with additional views and insight to those already expressed in the presentations.

Panel Members:

Andrew Haldane (Bank of England)

Miroslav Hrnčíř (Czech National Bank)

Leonardo Leiderman (Bank of Israel)

Lavan Mahadeva (Bank of England)

David Mayes (Bank of Finland*)*

Zdeněk Tůma (EBRD)

Abbreviations

BOC	Bank of Canada
BOE	Bank of England
BOF	Bank of Finland
CNB	Czech National Bank
CPI	Consumer Price Index
CPIX	Consumer Price Index, excluding credit services
ECB	European Central Bank
EMU	Economic and Monetary Union
ERM	European Exchange Rate Mechanism
ESCB	European System of Central Banks
FOMC	Federal Open Market Committee
GDP	Gross Domestic Product
GNP	Gross National Product
IMF	International Monetary Fund
MCI	Monetary Conditions Index (Indicator)
MPC	Monetary Policy Committee
OECD	Organization for Economic Cooperation and Development
PRIBOR	Prague Inter-Bank Offered Rate
PTA	Policy Targets Agreement
RBNZ	Reserve Bank of New Zealand
Repo	Repurchase Agreement
RPIX	Retail Price Index, excluding mortgage interest payments
VARs	Vector Auto-Regressive Models
VAT	Value Added Tax