CNB CZECH NATIONAL BANK

INFLATION TARGETING IN TRANSITION ECONOMIES:

THE CASE OF THE CZECH REPUBLIC

INFLATION TARGETING IN TRANSITION ECONOMIES: THE CASE OF THE CZECH REPUBLIC

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PREFACE

The Czech National Bank formally adopted an inflation targeting approach to monetary policy on December 21, 1997. The first of its quarterly Inflation Reports was published in April 1998, and a more comprehensive statement of its policy strategy was published in April 1999. Over this period, the CNB has continued its efforts to elaborate and strengthen its approach to inflation targeting. As part of that effort, the IMF agreed to provide a number of experts in various aspects of inflation targeting to consult with the CNB staff. The experts were recruited by Warren Coats, Assistant Director of the Monetary and Exchange Affairs Department of the IMF.

Each expert visited the CNB for a few days in 1999: Daniel Yariv, Assistant Director of the Monetary Department, Bank of Israel (February 1–2, 1999); William T. Gavin, Director of Research, Federal Reserve Bank of St. Louis (March 8–10, 1999); Mario Blejer, Senior Advisor, Monetary and Exchange Affairs Department of the IMF (March 11–12, 1999); Kevin Clinton, Research Advisor, Department of Monetary and Financial Analysis, Bank of Canada (April 26–30, 1999); Paul Mizen, Lecturer, Department of Economics, University of Nottingham (June 8–9), and Douglas Laxton, Senior Economist, Research Department of the IMF (September 6–10, 1999). The core of this book collects the papers written by most of these experts following their visits to Prague. The subjects of each expert's visit and of the papers that appear here were meant to cover the key aspects of inflation targeting in a relatively logical order. While it has not been possible to cover all relevant topics or to give equal or appropriate weights to the coverage of topics, we at the CNB are pleased with the result. Compared with other contributions to the growing literature on inflation targeting, this book addresses those issues of particular relevance to transition economies and especially to the Czech Republic.

In addition to Mr. Coats' introduction, the subject in its transition economy context is introduced and reviewed by a Czech economist, Jiří Jonáš, and the book concludes with an official statement by the CNB and a paper by staff of the CNB.

I would like to thank the International Monetary Fund for sponsoring this work.

Josef Tošovský

Governor

Czech National Bank

March 2000

EDITOR'S NOTE

In the last two years, several transition and emerging market economies have adopted the rapidly evolving art of inflation targeting (Brazil, Chile, the Czech Republic, Israel, Poland, and South Africa). The contributions to adapting inflation targeting techniques to transition economies made by the six experts the IMF sent to Prague in 1999 were just too well presented not to make them available to a broader audience. The "project" of publishing a book based primarily on the visits of these experts to the Czech National Bank had not been planned, and thus the time to produce it had to be taken from here and there. This is not the best way to produce a book, but in the IMF we are used to making the best of the circumstances we are given.

I would like to thank Natalie Baumer, our editor in the Monetary and Exchange Affairs Department, and Rose Mary Sario, my much-appreciated former staff assistant, for their contribution to the completion of this project. Their time was also taken from other projects. I now understand why writers thank so gratefully those who helped.

Warren Coats

Chapter 1

INTRODUCTION

Warren Coats[1]

[1] The author is an Assistant Director of the Monetary and Exchange Affairs Department of the International Monetary Fund.

Economies in transition from centrally planned ones to those focused on market allocation of resources are experiencing changes at a speed unparalleled in history. Central banks can contribute to the transition by providing stable money and by contributing to an environment of financial discipline (hard budget constraints). The allocation of resources through decentralized markets requires good information on the public's demands for goods and services and the resource costs of producing them, together with a profit incentive to respond to that information. Such information is summarized in prices. Stable money and integrated and efficient markets for money and credit (stable prices at the macro level and the rule of one price at the relative price, or micro level) improve the quality of price signals and thus of resource allocation.

The search for a nominal anchor

Central banks in market economies have learned some important lessons since the collapse of the gold standard and the gold exchange standard of the Bretton Woods era. While monetary policy can affect economic activity and employment, the effects are only temporary. In the long run, central banks can only determine the price level. Increasing inflation above what is expected can stimulate the real economy, while reducing it below what is expected tends to do the opposite. Expected inflation adjusts to the information available, such as current and past rates of inflation, the monetary policy framework, the stated goals of monetary policy, and the credibility of the central bank's desire and capability to achieve them.

The 1960s and 1970s were a period of monetary policy activism during which it was believed that monetary policy's short-term influence on the real economy could be exploited to offset or at least moderate the business cycle. Policy fine-tuning ran into several devastating problems. Monetary policy's effect on the economy occurred only with a long and variable lag, though its effects on output and employment tended to be quicker than its effects on prices (hence the source of its short-term influence on the real economy). Long and variable lags made it difficult to know what the appropriate policy was at each moment for the purposes of fine tuning future economic activity. In addition, political pressures tended to emphasize the immediate or short-term benefits of stimulating the real economy at the expense of long-term increases in inflation from such policies (myopia). Even independent central banks tended to give undue weight to already observable, thus past, conditions rather than to the expected future outcome of current policy. The combination of these lags and myopia imparted an inflationary bias to policy with the result that in the long run inflation was higher than it otherwise would have been (with, for example, a money growth rule), with no gain in real output.

In addition to these considerations, the more systematically monetary policy was used to fine-tune economic activity, the more the inflationary consequences of such policies were anticipated. An anticipated monetary stimulus would be passed through immediately to prices with no affect on real output.

Despite (or because of) efforts to fine-tune the economy, business cycle swings got wider and inflation higher in the 1960s and 1970s (and early 1980s). Improvements in economic theory and the experience of that period renewed interest in clear rules for monetary policy rooted in the objective of long-run price stability. If monetary policy could not be expected to dampen business cycles by fine-tuning, it might do so by stabilizing inflation expectations as the result of a clear and credible commitment to a nominal anchor that would stabilize prices on average in the long run. Such a policy has two goals. The first is to provide the market with reliable information on what the rate of inflation will be so that investment, wage setting, and other market decisions can be made with greater confidence in what the future price level will be. The second is to ensure that the

inflation rate is very low in order to improve the quality of price signals, minimize the menu costs of nominal price adjustments and remove the tax on cash, which results in the public's holding smaller cash balances than is optimal. Such a policy might minimize the gaps between actual and expected inflation that spill over to the real economy. By removing the inflation bias of discretionary policy, nominal interest rates would be lower, and by diminishing uncertainty over future price levels, a credible nominal anchor would reduce the inflation risk premium in both nominal and real interest rates.

Fine-tuning failed to dampen business cycles because of opportunistic behavior by central banks that favored short-run stimulus and because the long and variable lags in the effect of policy made it very difficult, if not impossible, to know what short-run stance of policy would be appropriate for the future. Both of these problems call for a clear operational rule by which policy should be conducted. Adjustments in policy motivated by the desire to fine-tune economic activity are given up for a policy stance that at least in the medium to long-term period should produce stable prices. The purest examples of such rules are a fixed exchange rate and a fixed rate of growth in a monetary aggregate. Either rule provides a clear anchor for inflation expectations.

A credibly fixed exchange rate (i.e. one in which other macro policies are subordinate to the preservation of the peg) is the most transparent nominal anchor. The central bank buys and sells foreign exchange for its own currency as needed to maintain the exchange rate. The supply of money adjusts to its demand (given the exchange rate). When capital mobility is high, fiscal policy and institutional factors determine domestic monetary conditions. In the long run, the price level will be determined by the home country price level of the currency pegged to (or to the relative market price of gold or other commodities pegged to).

A floating exchange rate with a money growth rule as the nominal anchor is also easy to monitor, if somewhat more difficult to achieve. The price level in the long run will depend by and large on real income growth (or wealth) and evolving financial sector technology. In both cases (fixed exchange rates or monetary rules), the central bank is freed from the potential distraction of evaluating the future consequences of short-term policy adjustments.

Both anchors suffer, to some extent, from being indirect (intermediate) routes to the real objective of monetary policy (price stability). Targeting the price level directly, however, was generally considered not possible because the linkages between those things central banks directly controlled (policy instruments) and prices (and output) were somewhat uncertain and contained the long and variable lags discussed above. William Gavin in Chapter III quotes one of Milton Friedman's statements of this problem. Even an independent central bank committed to price stability can destabilize the economy if it attempts to target inflation or the price level directly on the bases of already observed data. This possibility becomes a strong probability if the central bank also takes into account other factors such as the output gap or exchange rate. This is barely more than a restatement of one of the problems with fine-tuning discussed above. Policies of fixed exchange rates or monetary growth rates have generally failed eventually as a result of central bank efforts to pursue other objectives (output and exchange rates). The pursuit of multiple objectives has invariably led eventually to policy contradictions that could not be sustained.

Building upon the lessons of the previous four decades, two new factors are bringing about a revolution in the approach to central banking. The first concerns transparency and the second improved forecasting.

Central banking during the fine-tuning days was a secretive affair. In order to stimulate the real economy without creating inflation, the central bank had to trick the market. With the demise of confidence in fine-tuning came the opposite view. Monetary policy would be more effective and risk premiums lower, the more the market knew and the better it understood what the central bank was trying to do (once it was no longer trying to fool the market). Central banks are increasingly publishing information on their policies that they would have considered state secrets only twenty years ago (immediate announcements of changes in policy, minutes of board meetings, policy models, and similar information).

Any move away from fixed policy rules for long periods must face and deal with the long and variable lags in the economy's response to changes in policy stance. Improved modeling and forecasting is giving central banks increasing confidence in basing current policy decisions on expected future outcomes. It was only two or three years ago that Alan Greenspan, Chairman of the Board of Governors of the Federal Reserve System in the United States, raised eyebrows with the announcement that the Federal Reserve was raising the overnight interest rate on the basis of its judgment that such an increase was needed now to avoid an increase in inflation in the future. At the time of the increase, inflation was basically non-existent.

One further factor, when combined with the above developments, has helped to promote a new, still developing, approach to formulating and implementing monetary policy called ***inflation targeting.*** In democratic societies, independent central banks need be held accountable for their performance. It has not been easy to make the usual mechanisms of accountability (e.g. parliamentary and public reports) very meaningful, since central banks have too easily used the alleged need for secrecy and the complexity of the requirements of good policy to hide policy mistakes or the pursuit of other objectives. An explicit and public commitment to a specific inflation or price level target provides a good vehicle for accountability.

Thus inflation targeting has emerged as a promising approach to central banking. Its details are still being developed and refined, but its key features are:

- Central bank commitment to a publicly announced inflation rate or price level target for the medium term, generally supplemented with short-run targets for the next year or two;
- Explicit escape clauses (rules) establishing the circumstances (shocks) under which the targets may be missed (or adjusted);
- Transparency of policy implementation. Public discussion of the central bank's view of the transmission mechanism from its policy instruments to its inflation target and hence of the reasons for adjustments in its instruments; and
- Public dialog over central bank performance.

Special circumstances of transition economies

The lessons outlined above were not lost on the transition economies as they undertook their reforms. However, transition economies faced a somewhat different set of constraints than had the typical market economy.

In the first few years of transition, the goal of macroeconomic stabilization, and price level stability in particular, focused on how to reduce the high rates of inflation that had resolved the monetary overhang problem. The policies that were required to reduce inflation needed to be, and were, broadly supported in most transition economies.

Bringing inflation down to single digit levels was not difficult technically. However, the transition economy central banks faced several difficulties in attempting to implement their price level stabilization goals as their inflation rates came closer to EU rates. They lacked experience with their new powers and instruments[2] and thus the technical ability to implement their policy objectives effectively. The environment in which they had to operate (weak tax systems and fiscal controls, weak banking systems, weak market discipline over the allocation of resources and behavior of firms, and weak legal systems and enforcement of property rights and contracts) was not conducive to the efficient transmission of policy. Moreover, they lacked a track record that might help establish public confidence in the credibility of their policies. The second of these points (underdeveloped market infrastructure and weak corporate governance due to often delayed privatization) weakens the link between monetary policy and prices, distorts relative prices and resource allocation, and also weakens the financial discipline (hard budget constraint) required in order for a country to enjoy the full economic benefits of stable prices. The third difficulty (lack of credibility) results in a slower adjustment of public expectations of inflation, with the result that tightening monetary policy causes higher real interest rates, which remain high longer, and larger temporary reductions in output.[3] In addition to these difficulties, there was a lack of support for reform from some still in positions of power (i.e. a lack of enthusiasm for surrendering power or privileges).

These conditions call for a simple and transparent monetary policy. The simplest and most transparent monetary policy is a fixed exchange rate. A currency board version of a fixed exchange rate is the simplest to implement and carries the highest credibility (if the supporting conditions needed for it to work are in place and are credible). Thus, a fixed exchange rate can be particularly attractive for new central banks with no track record, poor market data, and little technical experience. In addition, because the money supply adjusts in the market to money demand at the fixed exchange rate, it is not important to know the demand for money or whether it is stable.

Unfortunately, a fixed exchange rate is also the policy regime that is most demanding in terms of the other policies (especially fiscal policy) required for its viability. It is the regime most unforgiving of policy mistakes. The difficulties in establishing fiscal discipline and new, market economy taxation systems have been the most serious impediments to macroeconomic stabilization in transition economies (especially in the former Soviet Republics). In addition, the defense of a fixed exchange rate against unjustified (or otherwise) attacks in the market requires sufficient foreign exchange reserves in the portfolio of the central bank. Where fiscal deficits are high and foreign exchange reserves are low, a fixed exchange rate is not a feasible option. The monetary regimes of transition economies that have adopted currency board arrangements (Estonia, Lithuania, Bulgaria, and Bosnia and Herzegovina) have been the most durable and successful, because they leave no possibility for other policies to be inconsistent with the fixed exchange rate.

[2] Almost all transition economies, especial those in Central and Eastern Europe, adopted new central bank laws that established the objective of price stability and gave the central bank complete or considerable independence.

[3] It should be added that to some extent (a rather considerable extent in the former Soviet Republics), the public was unfamiliar with market determination of prices and thus with how to interpret monetary policy pronouncements and actions.

In several Central and Eastern European countries, credibly fixed exchange rates, high domestic interest rates (partly because of the large amount of investment opportunities, and partly because of high fiscal deficits), and improving domestic conditions for investment, induced capital inflows beyond what could be easily or profitably absorbed (via increased imports). This increasingly put the goal of price stability at odds with fixed exchange rate anchors.

The excess capital inflows would expand the money supply if the central bank intervened to defend the exchange rate. If the monetary effects of these interventions were sterilized (as they often were in these countries), the pressure of higher domestic interest rates would be maintained, causing more capital inflows. This same interest rate differential generated large losses for central banks that sterilized their foreign exchange interventions (the foreign exchange purchased by central banks was invested abroad at "low" international interest rates, while the bills issued—or other sterilization tools used—bore the higher domestic interest rates). The high expected profit that attracted foreign capital was paid for by the high cost of intervention by the central bank.

Some countries tried to slow capital inflows with capital controls (e.g. Slovenia and the Czech Republic). As has been the experience in other countries, such controls were of limited effectiveness, especially when balance of payments surpluses where the result of fiscal deficit induced capital inflows. The inflows in the Czech case were induced by the large interest rate differential and by the high credibility of maintaining the peg. The Czech Republic's exchange rate might have survived with a more appropriate fiscal and monetary policy mix. In the end, domestic inflation objectives gave way to exchange rate objectives (Estonia) or pegged rates were replaced with market rates and other nominal anchors (Czech and Slovak Republics).

In the face of the above difficulties, about half of the transition economies were forced to float their exchange rates and most of these anchored their monetary policy with a monetary rule. There are some advantages and considerable risks in this evolution. A more flexible exchange rate eliminated (or reduced) the one way exchange rate bet of international investors and thus removed an artificial inducement for capital inflows. It also allowed monetary policy to focus on domestic price stability.

As most of these countries had stabilization programs supported by the IMF, most anchored their monetary policy to fixed growth rates in central bank (reserve) money. Where the political situation permitted, including the degree of success in containing fiscal deficits, monetary aggregate anchors where very successful in rapidly lowering inflation rates to modest levels. However, the institutional changes which characterize transition economies also made money demand less stable and more difficult to estimate empirically. As a result, monetary rules could not produce stable and predictable inflation rates with much accuracy in the low inflation range. Furthermore, the mismatch between a steady growth in the money supply and volatile money demand subjected the real economy to undesirable stresses.

The traditional anchors for monetary policy and of central bank accountability—exchange rate targets and money aggregate targets—have fallen victim to liberalized capital mobility, rapidly changing financial markets (new financial instruments, technology, financial globalization), and, as a result, unstable money demand. Transition economies also face additional challenges in formulating and implementing monetary policy because of their dramatically changing market structures and the lack of relevant data over a sufficiently long period to conduct econometric analysis.

These features of transition economies are not promising for inflation targeting either. However, for those economies unwilling or unable to adopt currency board or other credible fixed exchange rate arrangements, the more disciplined and structured approach to flexibility offered by inflation targeting has considerable appeal as well as risks. At best, it is demanding of the capabilities of transition economy central banks, as it is of any central bank. At worst, it is camouflage for no anchor at all.

Is inflation targeting a rule or discretion?

The main benefit claimed for inflation targeting is its ability to adjust monetary policy to shocks with minimal real output loss while still anchoring inflation expectations. Inflation targeting regimes vary from adherence to a well defined rule for setting interest rates with adjustments permitted for well defined shocks, to the frequent setting of operating instruments (interest rates) on the basis of all available information so as to move to the inflation target at a rate that may also take into account the effect of policy on the income gap or exchange rate. While there is certainly a difference between these two versions of inflation targeting, it is not necessarily that large. Without a credible commitment by the central bank to its inflation objectives, the benefits of inflation targeting cannot be realized. Thus monetary policy must be bound by a set of rules, though they may be relatively complex. One way of thinking about inflation targeting is that it provides a set of rules for adjusting monetary policy to shocks.

Consider the stricter rule-based approach above as analogous to setting the autopilot on a ship sailing from Lisbon to the New World so as to land at what is now Plymouth Rock, Massachusetts. The rule (or autopilot setting) might be a fixed monetary growth rate, a forecasting equation that takes into account factors other than income that effect money demand and the pace of adjustment, or an inflation forecasting equation that takes a wider range of factors into account. The rudder setting will always be adjusted so as to hit the target on the basis of where the ship is and the values of the other explanatory variables projected on the basis of all of the information available each moment.[4] It is also possible to build in secondary but subordinate criteria, such as maintaining a smooth sail to avoid sea sickness. Such secondary criteria may result in a somewhat longer passage, with a somewhat later arrival, but do not change the ultimate commitment to arriving at Plymouth Rock. The simplest of these rules, the fixed money growth rule, assumes that unexpected winds and currents will cancel themselves out on average over the course of the trip. If the money demand equation on which the rule was based is reasonably stable, the ship should land somewhere near Plymouth Rock.

Compare the above strict end of the spectrum of inflation targeting approaches with the other more discretionary end of the range. Imagine that every morning the ship's captain meets with his officers to review events in order to set the rudder for the day. The evaluation of all evidence by this group will enable them to take into account information that even the most sophisticated models cannot. Imagine yourself sitting at the morning briefing with the captain. What would you do with all of the information available? It will consist of everything that actually happened (wind speed and

[4] Everyone knows that a fixed money growth rule still requires an alert and diligent central bank to preserve reasonable liquidity conditions. Similarly, a fixed autopilot setting does not freeze the rudder. Rather it constantly adjusts the rudder to all shocks in order to maintain the compass setting. What it cannot do is change the compass setting to compensate for drift or other shocks that would change the setting needed to arrive at the targeted spot.

direction, currents, water and air temperature), and new forecasts of future factors of relevance (such as weather forecasts of questionable accuracy). The goal remains to land at Plymouth Rock. Thus the policy instrument (rudder) setting must be based on the transmission mechanism that is thought to link instrument settings to the policy objective. There is no choice but to rely on the "best" forecasting model available, modified as your judgement suggests is appropriate by information that was not reflected in the model (see Chapter VI by Peter Isard and Douglas Laxton, which argues that models should be kept simple—taking explicit account only of the most likely shocks—and adjusted ad hoc in light of the occurrence of less usual shocks). This is not such a large step from the use of an autopilot driven by a relatively sophisticated rule with frequent updates to the data that are fed through the rule. But it may improve on the auto pilot approach. In all cases, any departures from the rule require clear justification that the captain and the public at large can understand and evaluate.

Adjustments to the rules for the reasons discussed above, namely evidence of changes in the parameters in the forecasting equation (e.g. shifts in money demand) or for shocks not reflected in the model, may be contrasted with another reason for departing from the rules that may be more problematic. The captain's briefing team may wish to change the weights assigned to the secondary criteria (smooth sail) in the rule, perhaps following a particularly rough night. These are precisely the types of decisions that should not be made in the moment on the fly for all of the opportunistic, myopic behavior reasons given against discretion in the first place. Like the inflation target itself, the weights to be given to the income gap and exchange rate, for example, should be determined for the medium term on the basis of public debate.

Thus, as with a monetary rule, inflation targeting must be guided and disciplined by a model (though potentially a more complex one than a simple money demand equation) that forecasts the price level consequences of current policy instrument settings. The current stance of monetary policy must be motivated by achieving the inflation target and must be perceived by the public as likely to succeed in that objective. In the end, the credibility of an inflation targeting regime will rest on its success, after the fact, in achieving its stated objective most of the time.

The contribution of policy transparency and accountability to improving central bank performance is very welcome. As with a monetary rule, however, the success of inflation targeting is dependent on the ability of the model on which it is based to forecast inflation correctly. The difficulties in estimating stable money demand as part of a macroeconomic forecasting model in transition economies may exist for inflation forecasting as well.

The universal use of a short-term interest rate as the operating instrument of monetary policy in an inflation targeting regime is not without considerable risk. If inflation forecasts are unstable or unreliable, it will not be possible to determine the interest rate needed now for the inflation target a year or two from now. An error in setting the interest rate and the failure to correct that error in a timely fashion can lead to an explosive self perpetuating inflation or deflation. An interest rate error is not self-correcting in the way an exchange rate error or money growth rate error is self-correcting (by a temporarily higher or lower inflation rate).

This book

The chapters of this book have been written by experts sent by the IMF during 1999 to the Czech National Bank to discuss inflation targeting or by staff of the CNB. The experts and the topics they have contributed to this volume where chosen to cover most of the issues relevant for a

successful inflation targeting regime. Chapters 2 - 6 treat aspects of the subject in a more general way, while the remaining chapters address the subject more specifically within the Czech context.

The second chapter of this book (by Jiří Jonáš) introduces inflation targeting in the transition economy context by providing a summary of the practices and experience of transition economies that have adopted inflation targeting (primarily Poland and the Czech Republic). The chapter examines a number of issues of particular relevance for transition economies. These include the prerequisites that should be met before a central bank should adopt inflation targeting. In brief, these are as follows: public and government support for price stability; sufficient independence of the central bank to pursue price stability; absence of other, potentially conflicting objectives of monetary policy; absence of fiscal dominance (excessive public sector borrowing requirements); sufficiently developed money and financial markets to transmit monetary policy to inflation; and the capacity of the central bank to model and forecast inflation. Another topic is the choice of a disinflation path to the long-run inflation target when starting from high or moderate inflation rates. A related issue treated by the chapter is what to do when inflation opportunistically falls below the short-run target but is still above the long-run target.

Chapter 3 by William T. Gavin presents some model-based evidence that unless monetary policy is focused exclusively on inflation, an inflation target (as opposed to a price level target) does not anchor the inflation rate very well. However, targeting the price level, even with modest weights, does anchor inflation even when the output gap gets considerable weight in the central bank's objective function. Contrary to the findings of backward-looking models, targeting the price level does not seem to increase the volatility of output much.

Chapter 4 by Paul Mizen sets out the principal role of money under an inflation targeting framework. Because of domestic and international reasons monetary targets are regarded as likely to be operationally difficult, so they serve a useful function only as a temporary measure to bridge the gap between credit control and inflation targeting. The reasons are clear: transition economies are experiencing rapid adjustments in the real economy and financial markets, while internationally the euro is a major development that is likely to further destabilise the demand for domestic money. In such circumstances, it is likely that money will have a more useful role as a provider of incremental and corroborative information on inflationary conditions. This chapter explores how monetary conditions could be assessed using the McCallum rule and a measure of monetary disequilibrium.

In Chapter 5, Daniel Yariv develops the methodology for deriving the expected inflation in Israel from interest rates on indexed and unindexed bonds. In general, inflation expectations determined in this way were reasonably close to actual, past inflation. Initially, the announcement of inflation targets in Israel led to a certain reduction of expectations, but thereafter the announcements did not themselves have any real affect on inflation expectations until significant policy measures were instituted to curb inflation.

The current stance of monetary policy needed to achieve a central bank's inflation target must draw heavily on models of the transmission of policy to inflation. The core of the approach is to solve an inflation-forecasting model for the current setting of the operational instruments (usually focused on a short-term interest rate) that produces the targeted inflation rate. The degree of transparency about how the forecast is constructed varies considerably across countries. Over the last several years, the Reserve Bank of New Zealand, which pioneered inflation targeting, has expended considerable effort to develop a consistent forecasting and policy system. To date, New Zealand is the only inflation-targeting country that releases a complete medium-term macroeconomic forecast, as well as the modeling and policy assumptions that are used to construct

it. However, the Bank of England, in response to a parliamentary demand, has published all of its models in detail. Chapter 6 of this volume, by Peter Isard and Douglas Laxton, argues that there may be significant potential benefits from using a consistent model-based projection process to inform policymakers even if considerable judgmental input is required to implement it. The chapter discusses the potential role of modern macroeconomic models in central banks, as well as the pitfalls associated with using different classes of models to analyze the effectiveness of policy rules. The chapter also argues that while it is useful to adopt one model as a basic paradigm to organize the projection process, it is important to consider insights from a range of plausible models in order to quantify the potential uncertainties surrounding the forecast. These points are illustrated with a simple model with parameter values appropriate for the Czech Republic.

The remaining three chapters focus directly on inflation targeting by the CNB. Chapter 7 reproduces an official explanation of the CNB's adoption and use of the framework, while Chapters 8 and 9 present assessments of the specific practices of the CNB by a foreign expert (Kevin Clinton) and by CNB staff (Miroslav Hrnčíř, Kateřina Šmídková) respectively.

Chapter 2

INFLATION TARGETING IN TRANSITION ECONOMIES: SOME ISSUES AND EXPERIENCE

Jiří Jonáš[1]

[1]The author is advisor to the Executive Director of the IMF who represents the Czech Republic on the Executive Board of the IMF. The views expressed here are those of the author and do not reflect the official position of the International Monetary Fund.

With increasing mobility of international capital flows, pegging exchange rates is becoming an increasingly challenging task, and many countries are now adopting inflation targeting as a monetary policy framework. This trend can now be observed in transition economies as well. In 1998, the Czech Republic was the first transition economy to begin inflation targeting. Poland joined later, and other advanced transition economies may follow suit. This chapter discusses some issues of inflation targeting in transition economies and various reasons why inflation targeting could be an attractive option for these countries. It also discusses conditions for successful inflation targeting and to what extent these conditions are met in transition economies. The chapter then considers operational issues of inflation targeting and how the Czech Republic and Poland have dealt with these. It also addresses in more detail the matter of disinflation and the role of central banks and governments in deciding its speed, as well as the merits and problems of opportunistic inflation. The final section makes a brief assessment of inflation targeting in the Czech Republic and Poland and concludes that while inflation targeting in transition economies would be more difficult than in advanced economies, it could still deliver important benefits.

INTRODUCTION

On May 27, the Czech National Bank (CNB) decided to abandon the exchange rate band and allowed the currency to float freely. After several months during which monetary policy was conducted without any formal policy framework in place, the CNB announced in December 1997 that it would start implementing inflation targeting. The Czech Republic thus became the first transition economy to join the small but fast-growing club of countries in which monetary policy is being implemented by directly targeting its ultimate objective, price stability. In September 1998, Poland also adopted inflation targeting as a framework for monetary policy. Slovakia, which abandoned a fixed exchange rate in 1999 and now has a managed float, is also discussing inflation targeting, which could well become an option for other advanced transition economies.

There is a growing literature dealing with the issues of inflation targeting in both developed and developing economies. This chapter will focus on the aspects of inflation targeting that may be of most interest to transition economies, using as a reference the experience of the Czech Republic, and to some extent of Poland. Transition economies as a group face certain unique tasks that have implications for monetary policy generally, and for inflation targeting specifically. These include, among others, the stabilization from high or moderate to low inflation, the deregulation and liberalization of prices, the opening of the economies to international trade and capital flows, and the restructuring of large segments of the economy that have become inviable under the market system.

In the second section, we will discuss the reasons that led to the decision to introduce inflation targeting in the Czech Republic and that may prompt other transition countries to follow. In the third section, we will discuss the preconditions for successful inflation targeting and the extent to which they are met in advanced transition economies. The fourth section deals with the problems facing the inflation targeters in deciding on the operational features of inflation targeting and how these problems were addressed in the Czech Republic and Poland. In the fifth section, we will discuss some issues that concern inflation targeting during disinflation. In the sixth section, we ask whether inflation-targeting countries should use use "opportunistic" disinflation. The final section examines the experience with inflation targeting in transition countries thus far and offers some conclusions.

WHY INFLATION TARGETING

Just as financial innovations in the 1980s wreaked havoc with targeting monetary aggregates, increasing capital mobility in the 1990s has forced many countries to abandon a fixed exchange rate as a nominal anchor. Though not without its own problems, inflation targeting now appears to be an attractive alternative to many countries, including transition economies.

The Czech Republic was the first transition economy to introduce formal inflation targeting. It was not a deliberate decision. In May 1997, the currency was subject to a strong speculative attack, and the Czech National Bank (CNB) was forced to abandon the fixed exchange rate (with a large fluctuation band). After the exit from the peg, there was no formal monetary policy framework. The CNB did not want to leave expectations of the future inflation and exchange rate unanchored, and during the year it announced publicly several times what inflation it expected at the end of 1997. However, it was clear that public announcements of its expectations did not constitute a sufficiently robust and credible nominal anchor and that a more formal framework for monetary policy conduct had to be put in place. After analyzing different options, the CNB decided in December 1997 that in the future, monetary programs would be formulated on the basis of inflation targeting.

There were several reasons why the CNB decided to choose inflation targeting.[2] First, after the May 1997 financial crisis, it was not feasible to return to a fixed exchange rate. The experience of the Czech Republic has shown that with a largely liberalized capital flow, it is not possible to pursue exchange rate and inflation objectives at the same time. Furthermore, while it helped to stabilize inflation from a high to a moderate level, the fixed exchange rate did not suffice to bring inflation down from a moderate to a low level. In fact, because of the Balassa-Samuelson effect, it is possible that a nominally stable exchange rate would have become an obstacle to lower inflation.

Second, using monetary aggregates as an intermediate target did not seem feasible either. Experience has shown that the traditional problem of instability of money demand, and therefore an unstable relationship between money growth and inflation, is an equally serious obstacle to targeting monetary aggregates in transition economies. The process of transition is characterized by a sequence of price shocks, including corrections in administered prices and tax reforms, which make the relationship between the money supply and price level very difficult to predict. The instability of money demand and the money-price relationship is further exacerbated by far-reaching changes in the financial sector, including deep institutional changes, and the emergence of new types of financial assets and players. Therefore, relying solely on regulating money growth in conducting monetary policy would be extremely difficult. Most important, this approach is not likely to be very effective in reducing inflation expectations. Similar objections also apply to using nominal GDP as an intermediate target. The relationship between monetary policy instruments, nominal GDP, and the price level are even less stable than between monetary aggregates and the price level.

The CNB could have also applied a "just-do-it" approach to monetary policy, in a similar way as the U.S. Federal Reserve has done.[3] Given the difficulty of establishing a more stable relationship between some intermediate target and price level, some may think that a less formal approach to monetary policy would be advisable. However, while this approach may work in countries whose

[2] See Hrnčíř and Šmídková (1998).

[3] This seems to be the implicit conclusion of those who have criticized the adoption of inflation targeting in the Czech Republic.

central bank has well-established, anti-inflationary credibility and where inflation is low, it is doubtful that this method would work equally well in the Czech Republic and other transition economies. For several years, inflation remained quite high in the Czech Republic, and after the introduction of a float in mid-1997, inflationary pressures further increased. The "just-do-it" approach to monetary policy probably would not be very effective in bringing inflation expectations and actual inflation down. Public announcements by the CNB about its expectations of future inflation would also probably not suffice to anchor inflation expectations and persuade economic agents that monetary policy would be actually conducted with the aim of achieving the announced inflation. Moreover, there would be little basis to assess continuously whether the CNB is implementing monetary policy so as to ensure that this announced rate of inflation is actually achieved.

There was some criticism of the CNB when inflation targeting was introduced. Some analysts and politicians argued that reducing inflation is not a high priority for a transition economy and that the Czech economy could and should accept for a while somewhat higher inflation. However, there is one important additional reason why inflation should be reduced and why targeting inflation may become an attractive choice for the more advanced transition economies: the intention to join the European Union (EU) and eventually the European Monetary Union (EMU). While no Maastricht-type criteria are required for joining the EU, participation in the EMU requires that applicants first join the exchange rate mechanism (ERM II) that allows only a ± 15 percent fluctuation of their currency vis-à-vis the euro. Arguably, this is quite a wide band. But without reducing inflation sufficiently close to the EU level at the time of joining the ERM II, there is a risk that large inflation and interest rate differentials could entail larger exchange rate instability than that permitted by the ± 15 percent fluctuation band. Therefore, for transition economies that would like to join the EMU, a clear target for disinflation will be required, and formalizing inflation targets could facilitate their achievement.[4]

For these reasons, inflation targeting seemed to be an attractive option to the Czech Republic and could also be one for other transition economies. By explicitly committing itself to achieving a certain inflation target over a medium-term horizon, and by establishing firm rules for how monetary policy will be conducted to ensure that this target is met, central banks could more effectively affect inflationary expectations and reduce inflation. The question remains, though, whether transition countries are ready for inflation targeting.

PRECONDITIONS FOR INFLATION TARGETING

Inflation targeting is technically more demanding than other monetary policy frameworks, even though it may not pose such difficult policy dilemmas as does a nominal exchange rate policy. In the literature, several preconditions have been identified that must be met if inflation targeting is to be successful.[5] These include achievement of reasonably low inflation,[6] public support for price stability, a sufficiently independent central bank which has a clearly defined objective of achieving

[4] In the literature, some concern was expressed about the feasibility of simultaneous convergence of inflation in transition economies to the EU level of inflation and observance of exchange rate stability prescribed by the ERM II mechanism. See Masson, P.R. (1999).

[5] See Masson, Savastano and Sharma (1997).

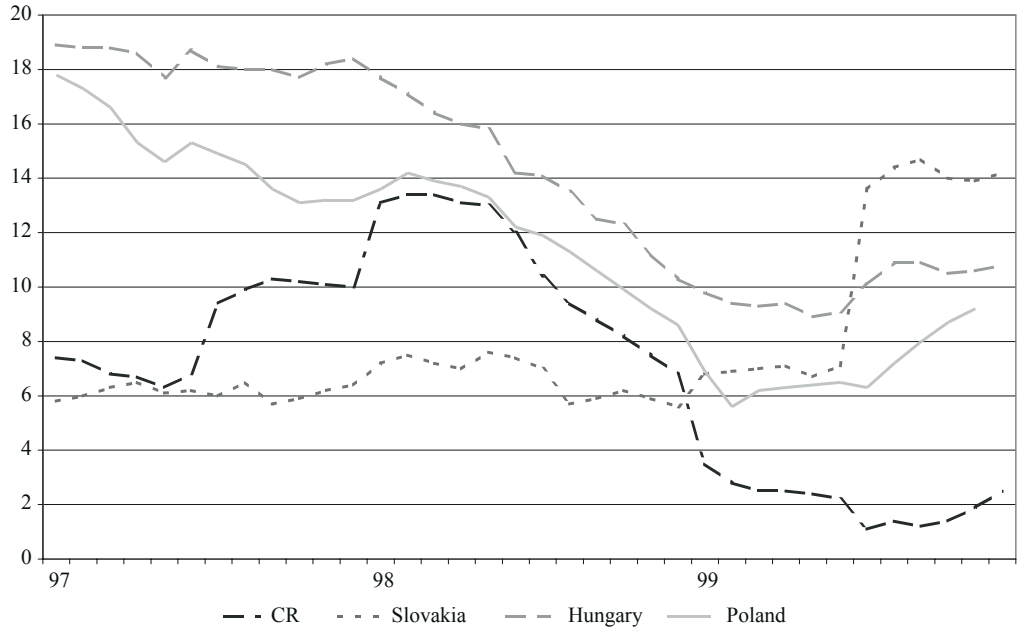
[6] It is not clear, though, what is the maximum level of inflation compatible with the adoption of inflation targeting. We return to this issue below.

and/or maintaining price stability, the absence of other nominal objectives like a pegged exchange rate, the absence of fiscal dominance (i.e. the absence of risk that monetary developments and inflation will be affected by fiscal developments), developed financial markets that allow nonmonetary financing of any government borrowing, well-developed money markets to allow monetary policy instruments to affect sufficiently quickly and robustly monetary conditions and inflation, and the capacity of the central bank to model and forecast inflation.

Admittedly, some of these conditions are not yet fully satisfied in the Czech Republic, Poland and other transition economies that may consider adopting inflation targeting. Even so, it could be argued that successful implementation of inflation targeting in the most advanced transition economies is feasible. Several considerations are discussed below.

First is the rate of inflation in advanced transition economies. As can be seen from Chart 1, advanced transition economies have achieved a significant reduction in inflation during the 1990s. For example, inflation in these economies is close to or lower than inflation in Chile or Israel at the time they adopted inflation targeting. Generally, both politicians and the general population have been supportive of price stability—of course with occasionally different views about the exact definition of price stability or the speed with which it should be achieved. But the most advanced transition economies are no exception to the worldwide trend of pursuing price stability as a worthy objective of economic policy.

Chart 1: Selected Transition Economies: Consumer Price Increase (in %)



Second, closely related to the above issue, central banks in the most advanced transition economies are sufficiently independent to be able to pursue the inflation objective without the risk of undue interference from the government. In the Czech Republic, the CNB has only one objective, to ensure the stability of the currency. It does not pursue other nominal targets that could be

potentially conflicting. Similar provisions apply to the National Bank of Slovakia. In Poland, the National Bank of Poland (NBP) has a basic objective to maintain price stability, and while it should at the same time support government policies, it should only do so insofar as such action does not limit the pursuit of its basic objective.

In Hungary and in Poland, some problems for inflation targeting may arise with respect to the exchange rate regime. In Poland, the crawling exchange rate band could theoretically be inconsistent with an inflation target. However, the band is reasonably wide, ± 15 percent, and the authorities eventually intend to allow the currency to float. In Hungary, the problem is that the central bank is required to maintain both internal and external stability of the currency, but it does not have the freedom to change the exchange rate regime or its level. However, the authorities for the time being intend to keep a crawling peg, with gradual deceleration of the pace of crawl to guide inflation expectations and inflation downward.[7]

As for fiscal policy and seignorage, there is little risk of fiscal dominance of monetary policy in transition economies. Central banks in the most advanced transition economies are not allowed to provide direct financing to the government. The Czech Republic has a tradition of prudent fiscal management, and fiscal dominance does not present a problem. Also in Hungary and Poland, fiscal deficits are reasonably moderate and do not require monetary financing that would compromise inflation targets. In Slovakia, fiscal deficits were recently quite high and rising, but the new government is now taking steps to bring deficits down to a more sustainable level. Furthermore, while somewhat larger than in advanced economies, seignorage is not a major source of government revenue in the most advanced transition economies (see Table 1). Financial markets are reasonably well developed and could thus serve as a source of financing of moderate government borrowing needs without resort to printing money, which would endanger inflation targets.

Table 1. Selected Transition Economies: Seignorage and General Government Balance 1/

	Seignorage			General Government Balance		
	1996	1997	1998	1996	1997	1998
Czech Republic	-3.9	5.9	0.2	-1.2	-2.1	-2.3
Hungary	2.1	2.8	1.1	-3.1	-4.6	-4.6
Poland	1.6	2.6	1.4	-3.3	-3.3	-2.6
Slovak Republic	1.1	1.1	0.8	-1.3	-5.2	-6.0
Advanced economies	0.4	0.3	x	-2.5	-1.3	x

Sources: IMF; data for advanced economies from Masson (1999).

1/ Seignorage equals change in base money divided by nominal GDP; general government balance is in percent of GDP.

[7] On December 30, 1999, Hungarian Minister of Finance Zsigmond Jarai said that the monthly depreciation rate of parity vis-à-vis the euro would be reduced from the current 0.4 percent to 0.3 percent in April 2000, and to 0.2 percent in the second half of the year. In 2001, the crawling peg regime should be phased out and the currency should be fixed to the euro. See Chase Manhattan Global Market Brief, December 30, 1999, page 4.

Fourth, money markets are also reasonably well developed in the Czech Republic, Poland and other advanced transition economies, and could therefore serve as an effective instrument of transmission of changes in short-term interest rates to the economy and price level.

Probably the weakest spot of inflation targeting is the limited capacity of transition economies to forecast inflation. It is argued that successful inflation targeting requires a capacity of the authorities to forecast inflation relatively accurately. This seems obvious, given the fact that the inflation forecast serves as an intermediate target in inflation targeting regimes. However, in transition economies, forecasting inflation (or any other economic variable) is an inherently difficult task.[8] The reason is simple. Transition economies have a relatively brief history as functioning market economies in which prices are free from the control of central planners. At the end of the 1990s, transition economies still had a history as functioning market economies that was shorter than ten years. Furthermore, owing to the large structural changes that are typical for the process of transition, the relationship between changes in price level, money, wages, exchange rate and other economic variables is fairly unstable. Therefore, it is difficult to estimate a structural model of the economy that would allow the prediction of future inflation with a sufficient degree of accuracy.[9] More than usual, in transition economies the past is a very poor guide to the future.

Does the lack of a robust relationship between monetary policy instruments and inflation represent an insurmountable obstacle to inflation targeting in transition economies? Not necessarily. But besides making inflation targeting more difficult, this lack of a strong relationship between monetary instruments and inflation does make missing targets more likely. It also makes the ability of central banks to credibly explain the reasons for missing the targets more important.

The CNB was well aware of these difficulties when introducing inflation targeting. Initially, it decided to use different methods of creating inflation forecasts, relying more on informal methods of generating these forecasts, including expert estimates, while at the same time developing and testing a small macroeconomic model to be used in generating a more formal inflation forecast.[10] In May 1999, the CNB began to conduct regular measurements of inflation expectations in financial markets, using the most liquid segment of the market, the interbank deposit market.[11] It can be expected that as the period of large structural changes ends and as the structure of the economy stabilizes, it will be possible to generate more precise medium-term inflation forecasts than those produced by using less formal methods.

To be sure, there is a risk that an imperfect ability to forecast inflation could result in missing inflation targets by a large amount, which could damage the reputation of the framework. There is even a possibility that it could result in an inadequate monetary policy response that could be damaging to the economy. However, these risks are to be weighed against the difficulties that the policymakers in transition countries would be facing under different monetary policy regimes. For

[8] For a discussion of this issue in the case of Poland, see Christofferesen and Wescott (1999). For Hungary, see International Monetary Fund (1999), Chapter IV. Both publications can be found on the IMF external web site: http://www.imf.org/external/pubind.htm.

[9] The difficulties in forecasting inflation are further multiplied by changes in exhange rate regime, for example by the introduction of a float in the Czech Republic in 1997.

[10] The problems of modeling inflation in the Czech Republic are discussed in more detail in Stavrev (1998).

[11] A preliminary analysis of the results of measuring inflation expectations is reported in Czech National Bank (1999b), p. 4.

example, it is not at all clear that central banks in transition economies would find it much easier to achieve monetary targets, and even if they did, large shifts in velocity produced by monetization and financial innovations would make the relationship between money aggregates and inflation less solid than the monetary policymakers may wish.

Alternatively, owing to large shifts in money demand, pursuing a rule-based policy of constant money growth could produce excessive instability in the real economy. No monetary policy framework can do away with these inherent uncertainties in transition economies.[12] However, the transparency and accountability of an inflation targeting framework can provide better guidance to economic agents about what inflation target a central bank is trying to achieve and how it will proceed in conducting monetary policy in cases where projected (or expected) inflation deviates from targeted inflation. Given the inherent difficulties of inflation targeting in transition economies, doubts will certainly remain whether this framework could produce generally lower and more stable inflation than other monetary regimes. However, there are good reasons to expect that as a minimum it should produce lower and more stable inflation expectations and permit less costly disinflation and achievement of price stability.

OPERATIONAL FEATURES OF INFLATION TARGETING

There are several operational issues that have to be decided before a country adopts inflation targeting. First, price stability has to be defined and quantified. In cases where actual inflation is higher than an inflation rate that corresponds to price stability, the time horizon during which price stability should be achieved must be chosen and the path of disinflation specified. Second, the price index to target must be chosen—whether it is to be an indicator of headline inflation or an indicator of underlying inflation. Third, a choice must be made whether to target a range or a single numerical value of inflation, and how wide the eventual band should be. Fourth, a strategy of communication with the public must be put in place by inflation-targeting central banks in order to keep the public informed about central banks' evaluation of the economic situation, inflation projections and policy intentions. Fifth, it should be decided how to respond when an inflation target is missed, and how central banks should be held accountable for meeting the targets.

Definition of price stability and speed of disinflation

Very high inflation is usually viewed as incompatible with inflation targeting. In most inflation-targeting advanced economies, this framework has been introduced only after price stability has been reached or approached. However, in some countries that have adopted inflation targeting, inflation is still somewhat high. Among the advanced economies, this has been the case in New Zealand and Canada; among the emerging market economies, two notable examples are Chile and Israel. Similarly, in transition economies inflation is still somewhat higher than in advanced economies and must be further reduced (see Chart 1).

[12] A similar point is made by Barry Eichengreen in a discussion of inflation targeting in emerging markets. Specifically, he argues that "fiscal dominance is a critique of excessive deficits, not a critique of inflation targeting," and that "while emerging markets may find it difficult to make inflation targeting work, there are good reasons to think that they will find alternatives like monetary targeting more difficult still." See Eichengreen (1999), which can be found on the web site: http://elsa.berkeley.edu/users/eichengr/htm.

How fast should countries reduce inflation? The experience of other countries that started targeting inflation earlier shows that a relatively gradual disinflation has been the preferred choice. Chile began to target inflation in September 1990, and at that time, annual inflation was about 25 percent. Inflation has been brought gradually and monotonically down to 3 percent in 1999.[13] From 2001 onward, the central bank is expected to target inflation in a range of 2–4 percent. Israel adopted inflation targeting in 1991, when inflation was running close to 20 percent. The current inflation target is 3–4 percent.[14] As in Chile, disinflation in Israel has been rather gradual, but it has accelerated significantly recently on account of positive supply shocks. In New Zealand, inflation was about 7 percent in 1990 when inflation targeting was introduced, and the Reserve Bank targeted a reduction in inflation of 1.5 percentage points each year for a three-year period. Canada adopted inflation targeting when inflation was about 5 percent. It aimed at a two-percentage-point reduction in the first year, and a half-point fall in each of the subsequent 18-month periods.[15]

Transition economies are also approaching disinflation in a gradual manner. In Poland, the NBP first set a short-term inflation target in June 1998 for end-1999 in the range of 8–8.5 percent. At the time of the decision, inflation was still above 11 percent, but declining. Subsequently, inflation continued to fall faster that expected, and in March 1999, when it dropped to about 6 percent, the NBP modified the end-1999 CPI target to 6.6–7.8 percent. At the same time, it kept the medium-term target of CPI inflation at 4 percent in the year 2003.[16] In Hungary, the government is currently projecting that the average annual inflation will be 6–7 percent in year 2000.[17] The IMF suggests that a reasonable medium-term target range for Hungary would be CPI inflation in the range of 3–5 percent, which could be achieved quickly in one to two years or gradually during a period of four years.[18] The IMF recognizes that both gradual disinflation and quick disinflation have their pros and cons.

When the Czech Republic introduced inflation targeting in early 1998, inflation was approaching 12 percent and was still rising, while net inflation was around 7 percent. The CNB initially stated that the disinflation would continue relatively rapidly. In a one-year horizon, monetary policy was to be conducted so as to bring net inflation at the end of 1998 to a range of 5.5–6.5 percent; and in a three-year horizon (i.e. at the end of the year 2000), the target would be net inflation in the range of 3.5–5.5 percent. In its first Inflation Report, the CNB subsequently sought to clarify that the crucial target was the one for the end of the year 2000, and that the 5.5–6.5 percent net inflation at the end of 1998 did not have the same status as the 3.5–5.5 percent target range. The main purpose of setting this short-term target was to help guide inflation expectations.

At the end of 1998, the CNB formulated more precisely its long-term objective of price stability. It suggested that the long-term inflation target should be net inflation in the range of 1–3 percent.[19]

[13] It should be noted that Chile had not always been classified as an inflation-targeting country. The same is true for Israel. One reason is that inflation targets were not announced explicitly, but were implicit in the rate of the exchange rate crawl.

[14] See Landerretche, Morandé and Schmidt-Hebbel (1999).

[15] See Debelle (1997).

[16] See National Bank of Poland (1998).

[17] See National Bank of Hungary (1999).

[18] See International Monetary Fund (1999).

[19] Since price deregulation should be mostly completed by that long-term target (about 2005), headline inflation should be close to net inflation by then.

The CNB noted that this was somewhat higher than the quantified objective of price stability in the European Monetary Union (harmonized consumer price index less than 2 percent), but it explained that that for specific reasons, inflation in transition economies would stay somewhat higher for some time. The CNB suggested that this objective of price stability should be achieved in the year 2005. Given the inflation target for the year 2000 in the range of 3.5–5.5 percent, this implied an average annual reduction in net inflation of 0.5 percentage points.

It is likely that for other countries in transition that decide to implement inflation targeting, desired future membership in the European Union and eventual participation in the European Monetary Union will serve as the main guidance and constraint in defining price stability and deciding on the speed of disinflation. However, there are some doubts whether transition economies joining the EMU would be able to satisfy both the rigorous requirement of price stability (CPI inflation of less than 2 percent) and the requirement of a stable nominal exchange rate as specified by the ERM II mechanism.[20]

What price index to target

In deciding on what price index to target, inflation targeting countries face a tradeoff between transparency and the ability to control inflation. The advantage of broadly defined headline inflation (i.e. the consumer price index) is that it is better understood by the public, but the disadvantage is that its movements could reflect factors other than monetary policy measures and could be a target difficult to achieve. A more narrowly defined measure of inflation that excludes effects of possible supply shocks could be better controlled by a central bank, but at the same time, it could be more difficult for the public to assess the conduct of monetary policy on basis of such measure. Given the emphasis on central banks' accountability and transparency in a regime of inflation targeting, this could potentially be a serious obstacle, particularly for a central bank that still has to earn its credibility. The practice varies among individual inflation-targeting countries, depending on their particular circumstances and the importance of individual factors bearing on the choice of the price index. This is illustrated by comparing the approach of the Czech Republic and Poland.

Poland has decided to target the broad consumer price index. The NBP explained that the CPI had been used extensively in Poland since the beginning of transition, and that it is deeply rooted in public perceptions as the measure of inflation. The CPI provides accurate information about changes in price levels of consumer goods and services. The application of some measure of core inflation would require eliminating from the targeted index some prices of goods and services that strongly affect the public perception of inflationary developments. However, the NBP has started preparatory work for calculating the core inflation index, and it does not exclude the possibility that it will start targeting core inflation in the future.[21]

In the Czech Republic, the CNB has chosen a different approach. For the purpose of inflation targeting, it has introduced a new indicator, so-called net inflation. Net inflation measures changes in the consumer price index excluding the movement in regulated prices and is adjusted for the impact on the remaining items of changes in indirect taxes or subsidy elimination. At the end of

[20] We do not discuss this extremely important issue here in detail. For further discussion, see Masson (1999).

[21] See National Bank of Poland (1998). It is noteworthy that the NBP intends to calculate core inflation itself. Usually, central banks targeting a measure of underlying inflation do not calculate this index. In order to avoid a conflict of interest, they let other agencies, mainly statistical offices, calculate and publish underlying inflation.

1997, the CPI consisted of 754 items, 91 of which had regulated prices, and net inflation measured movements of 663 items, which in terms of weight in the consumer basket represented about four fifths of the total basket.[22]

Unlike central banks in most other inflation-targeting countries, the CNB did not exclude changes in prices of energy and agriculture products from net inflation. The exclusion of both the effect of changes in administered prices and changes in energy prices would make the targeted price index far too detached from headline inflation. The Czech economy is very open, with imports representing more than 40 percent of GDP. Changes in import prices of oil and gas have a potentially large impact on domestic prices. However, for the time being, the CNB considers isolating the effects of price deregulation to be more important than isolating the effects of terms of trade shocks or exchange rate effects. In contrast to industrial countries, many prices were still regulated in the Czech Republic in late 1997. The CNB knew that substantial changes in regulated prices, including rents, would be needed before they reached market-clearing level. As a result, a given monetary policy stance could produce different future paths of headline inflation, depending on the pace of price deregulation or adjustment of administered prices. Exclusion of regulated prices from the targeted index should have provided the government room to proceed quickly with price deregulation without fears that the CNB would react to temporary higher headline inflation triggered by price deregulations by tightening monetary policy. For these reasons, targeting net inflation excluding regulated prices could better suit the specific conditions of economies in transition.

Still, it soon became clear that the omission of external shocks to prices unrelated to monetary policy from a targeted price index could complicate the conduct of monetary policy, and in line with the practice of other inflation-targeting countries the CNB in late 1998 announced a list of factors that could affect inflation, but that would not trigger an offsetting response by monetary policy. To quote from the CNB Inflation Report for January 1999: "Exceptions from meeting the inflation targets are defined as extraordinary and unforeseen factors causing deviations from the inflation target for which the central bank cannot bear responsibility. These factors include: substantial deviations of global prices of raw materials, energy sources and other commodities from the prediction; major deviations of the koruna's exchange rate from the prediction, provided these changes are not connected with economic fundamentals and are not the result of domestic monetary policy; marked changes in the conditions for agricultural production with an impact on agricultural producer prices; and, finally, natural disasters or similar extraordinary events with cost and demand impacts on prices. "[23]

Obviously, being an open economy with a high share of regulated prices in total CPI does not make it easier for the central bank to deal with this tradeoff between transparency and ability to control inflation. Central banks face unattractive options. They can exclude both administered prices and energy prices from targeted inflation and ensure that monetary policy could better control the movement of a targeted price index, while risking that a broader measure of inflation moves in discord with targeted inflation. However, inflation expectations that influence behavior of economic agents are guided more by movements of broad price indices and less by artificially constructed measures of underlying inflation. As one trade union representative put it: "We do not consume net

[22] Other inflation-targeting countries have used price indices that excluded effects of indirect taxes or regulated prices for targeting or monitoring purposes. However, in transition economies, the importance of these factors in movements of headline inflation is significantly higher than in advanced economies.

[23] See Czech National Bank (1999), p. 46.

inflation." An alternative option, the one followed by Poland, is to choose to target a broader price index whose movements are affected by many factors outside monetary policy, including price deregulation, external shocks and changes in the exchange rate. In this case, missing an inflation target would be a frequent occurrence, and the anti-inflationary credibility of the central bank would be put at risk. The NBP is aware of this risk, and intends to comment in detail on external factors affecting the CPI index but not core inflation, so as to explain any discrepancy between the inflation target and the forecasted and/or observed CPI level.

Target point or target range?

The decision whether to target a range or a single numerical value should consider some tradeoffs as well. As in other aspects of design of the operational framework, there is a tradeoff involved in deciding about the width of the band—whether it should be zero (a single point) or several percentage points. A wider band increases the chance that monetary policy will be successful in keeping targeted inflation inside. But a band that is too wide could reduce the ability of inflation targeting to anchor inflation expectations, and it could make it more difficult to establish anti-inflationary credibility. Some argue that a band that is narrow enough to anchor inflationary expectations is likely to be frequently missed, and that it is preferable to target a point and explain the deviations of actual inflation from that targeted point. This could be an especially valid argument for countries in transition, where predicting and targeting inflation is subject to a high degree of uncertainty.

Both the Czech Republic and Poland have opted for a range. In the Czech Republic, the width of the band, two percentage points, seems to reflect the CNB's assessment of the accuracy with which it thinks it can hit its net inflation targets, as well as the past volatility of net inflation. However, particularly in view of the recent volatility of inflation due in part to external shocks, the band is not wide enough to allow the CNB to maintain net inflation inside it for most of the time without undesirable instability of interest rates. Poland originally chose an even narrower target range, just one half of a percentage point, which was subsequently widened to 1.2 points. The NBP explained that before the introduction of inflation targeting, monetary targets in Poland were defined as fixed points, and a wider band could possibly signal to the public a weaker commitment to reduce inflation. It could be argued that under such circumstances, a fixed point could be better than a narrow band, as both are unlikely to be achieved, but the damage of missing a point could be less serious than the damage of missing a band. However, the NBP intends to widen the band in the future.

The use of a target band is one possibility for dealing with with the inevitable uncertainty in implementing monetary policy. Another approach, applied in the United Kingdom, is to present a probable inflation forecast in the form of the now famous fan charts. However, this approach may face serious difficulties in transition economies, since estimating future inflation requires a certain level of understanding of how the economy works. As we have discussed below, this requirement is not yet fully met in transition economies.

Communication with the public

One of the important benefits of inflation targeting is the increased transparency of monetary policy and improved communication with the public. In the past, central banks used to be quite secretive institutions, but inflation targeting has changed this practice in a quite revolutionary way. The success of inflation targeting depends very much on the ability of central banks to establish credibility that its targets are achievable, and on the public understanding how they intend to

achieve them. Inflation-targeting central banks use different tools of communication to achieve this objective, including inflation reports, speeches of central bank officials, articles and testimonies.

In line with the practice in other inflation-targeting countries, the CNB has decided to publish quarterly Inflation Reports, in which it explains to the public its views about past and expected future economic and monetary developments and about its conduct of monetary policy.[24] The first Inflation Report, which was published in April 1998, did not yet include an inflation forecast, but subsequent issues have all included such a section, where the CNB explains in qualitative terms its assumptions about general economic trends and what inflation it expects at the end of the targeted period. However, the methodology of inflation forecasting has not yet been published. The Report also includes minutes from the meeting of the CNB Board, but not how individual votes were cast. In Poland, the NBP also publishes Inflation Reports, initially semiannually, but it intends to publish these reports quarterly in the future. As with the Czech Republic's Reports, the Polish Report includes some assessment of inflation prospects, but without a specific inflation forecast model. Another interesting point is that the NBP intends to publish the voting records of individual Council members.

The CNB has used other communication channels to explain the purpose of inflation targeting and how it functions to the public. Early in 1998, CNB officials published a number of articles in leading economic journals discussing the reasons for its adoption and the mechanism of its operation. In late 1998, the CNB took a further step to take a more active role in affecting inflation expectations. It realized then that a much more rapid than originally expected decline in inflation, together with a great degree of rigidity in nominal variables, could produce undesirable developments in real variables, most importantly in real wages. In fact, this risk, to some extent, had already materialized in the final months of 1998, when rapid disinflation and broadly unchanged growth in nominal wages produced a sizable acceleration in real wage growth. The CNB therefore initiated an informative meeting with the representatives of trade unions and employees to explain what inflation it expected in 1999 to help reduce inflation expectations.[25] This direct approach to affecting the inflation expectations of trade unions through personal persuasion was used again in late 1999.

Accountability

Practice differs in inflation-targeting countries regarding the accountability of central banks for meeting inflation targets. At the one end of the spectrum is New Zealand, where the central bank governor is personally responsible for meeting inflation targets, and if the central bank misses the target he must explain why this has happened. The Reserve Bank Board recommends to the government whether the governor should continue in office or not. Other countries do not have such strict standards, and rely more on a self-disciplining mechanism to ensure that central banks meet

[24] The Reports are published both in Czech and in English on the CNB's web site: http://www.cnb.cz.

[25] These discussions were difficult ones. The trade union representatives agreed that it would not be desirable to aim for higher-than-zero growth in real wages in 1999. The complication was that the trade union's economic experts projected that inflation in 1999 would reach 10 percent, and the trade union representatives therefore demanded a 10 percent increase in nominal wages that in their view would be consistent with zero growth in real wages. Ultimately, inflation in 1999 remained close to 2 percent, and 10 percent nominal wage growth resulted in an overly large increase in real wages. At the end of 1999, when the CNB was again discussing the inflation prospects for 2000 with the representatives of trade unions, the latter seemed to have learned from their previous mistake and expressed more trust in the CNB's inflation forecast for 2000.

their inflation targets. While central banks are not formally accountable to the government for meeting inflation targets, they are informally accountable to the public. The Czech Republic and Poland, relying on the self-discipline of the central bank, have adopted such an approach.

A closely related aspect of central banks' accountability is the way in which inflation targets are established. In cases where inflation targets are set by the government, it is clear that a central bank is accountable to the government for achieving this target. However, in both Poland and the Czech Republic, as in some other inflation-targeting countries, it is the central bank itself that sets an inflation target. It is difficult to see how central banks with goal independence could be held formally accountable by some other body for not reaching an inflation target that they set themselves. These central banks could be seen as being informally accountable to the public, in the sense that they must endeavor to gain and maintain public confidence in the desirability and feasibility of its inflation objective. We discuss the issue of who should set inflation targets in more detail in the following section.

INFLATION TARGETING AND DISINFLATION

As we have noted above, inflation in advanced transition economies is running currently somewhat above the inflation in advanced economies in Western Europe. The authorities in these countries have stated that price stability is the ultimate objective of monetary policy, and this objective is also reflected in legislation specifying the objectives of central banks. While there is not much dispute about the desirability of price stability, there is an intense discussion on how quickly price stability should be achieved and exactly what represents price stability in transition economies. This discussion has been particularly heated in the Czech Republic, where the CNB has been accused of pursuing an excessively ambitious pace of disinflation that has resulted in excessively tight monetary conditions and has plunged the economy into recession. The purpose of this chapter is not to discuss the merits of this argument, but rather to point to the problem that the necessity to decide explicitly on the speed of disinflation in inflation-targeting countries presents for monetary policy.

Theoretically, disinflation could be too rapid, resulting in a high (though, arguably temporary) loss of output and higher unemployment, or it could be too slow, resulting in inflation expectations becoming more entrenched at high levels and subsequently more costly to reduce later.[26] Therefore, it could be argued that there exists an optimal speed of disinflation which would minimize the sacrifice ratio (the ratio of loss of output to disinflation). However, the determination of this optimal speed of disinflation is less a matter of exact science and more a matter of judgment.

Many factors have been identified in the literature that jointly determine the sacrifice ratio, including the structure of the economy, the degree and method of indexation of wages and other nominal variables, the past history of inflation and stabilization, and the credibility of monetary policy. However, while we can identify factors that affect inflation and identify policies that would make disinflation less costly in terms of lost output, economics could hardly provide a justification

[26] It could be argued that lower inflation usually means higher output growth and therefore the sooner lower inflation is reached, the sooner the economy will achieve a higher output growth. But there are also counter-arguments. For example, due to a loss of marketable skills, individuals who could be seen as temporarily unemployed during the period of rapid disinflation could become permanently unemployed, which results in additional loss of output.

for a decision that price stability should be achieved at a particular speed.[27] Given that economics does not provide a hard conclusion about the optimal speed of disinflation, and in view of the important consequences of the decision about the rate of disinflation for the economy and for different groups of the population, societies should pay particular attention to the mechanism of how this decision is reached.

By its nature, the decision about the speed of disinflation is not a purely technocratic decision that could be put in hands of professional economists in the central bank. Because different speeds of disinflation will have different consequences for different groups of the population, this decision is by its nature more a political decision, and the question arises as to whether it should be entrusted to a political body such as the government. This brings us to the issue of central bank independence.

Many economists today agree that central banks should have instrument independence, but not goal independence.[28] That is, central banks should be made independent in pursuing their policy objectives, but these objectives should be agreed upon by politicians. In most circumstances, this arrangement does not cause serious problems, because politicians are unlikely to publicly demand a central bank to pursue an objective that would differ much from a prevailing definition of price stability. However, as we have discussed, there is much less guidance provided by the literature about what the optimal speed of disinflation should be. Therefore, there is more than sufficient room even for reasonable people to disagree. For instance, a government in a transition economy could credibly defend a less ambitious schedule of disinflation than the central bank would wish to pursue, arguing that there are many obstacles to a rapid disinflation in the yet not fully reformed economy and that rapid disinflation would be unnecessary costly.[29]

The experience of the Czech Republic illustrates well the perils of a unilateral decision of a central bank about the speed of disinflation. After the CNB announced its inflation target for 1999 and 2000, and particularly after both inflation and growth declined more than anticipated, the central bank became a target of criticism. According to some, the Czech economy was not yet ready for such rapid disinflation, and the CNB has been accused of excessively tight monetary policy that came with serious costs in terms of recession and rising unemployment. Much of this criticism, however, was directed at the CNB's failure to achieve this target, rather than the pace of disinflation in the target itself.

Public dispute between a central bank and government is not desirable. It undermines the credibility of the inflation targeting framework and could make future disinflation more costly. Clearly, it would better serve the credibility of monetary policy if the rate of disinflation were the joint decision of the central bank and government, though this is not necessarily the practice in all inflation-targeting countries.[30] Such a joint decision would have several advantages. Most

[27] For a more detailed discussion of inflation in transition economies, see Cotarrelli and Szapary (1998).

[28] See, for example, Fischer (1995).

[29] Several arguments are usually made as to why inflation in transition economies should be temporarily higher. One argument is based on the need to complete relative price adjustments, which under conditions of downward nominal price rigidity require higher inflation. A second argument is that the price level in transition economies is much lower and that the approaching price level prevailing in the European Union requires temporarily faster growth in prices.

[30] However, in some countries like Australia where the inflation target is set by the central bank alone, the government subsequently endorses this target publicly.

importantly, it would be more credible. When a government decides (perhaps jointly with the central bank) on the speed of disinflation, it is implicitly committing itself to policies supporting this disinflation objective. The speed of disinflation (co-)decided by the government would be seen by markets as a political decision that takes into account possible short-term tradeoffs, and it would reduce the probability that policies supporting the achievement of targeted disinflation would be challenged on grounds that they do not reflect the preferences of society and that they are unduly costly.

Even in situations where the ultimate responsibility for deciding the speed of disinflation rests with the governments involved, central banks could still provide an important input into this decision by voicing (possibly publicly) their own views about the desirable speed of disinflation. Of course, there is a risk that a government would choose too slow a rate of disinflation. However, it is not clear whether this would impose higher costs on the economy than a unilateral decision by a central bank to pursue a more rapid rate of disinflation that would be subsequently challenged by government as being too ambitious.

There have been many arguments in favor of central banks' independence, reflecting empirical experience that political interference with monetary policy tends to produce higher than optimal rates of inflation. This experience suggests that a central bank should be given a mandate by the political authorities to pursue an objective of price stability, and that it should have the freedom to do so without further political interference. However, it does not necessarily follow that central banks should be entirely responsible for determining the speed of disinflation. The credibility of central banks in transition economies in bringing inflation down to the level prevailing in the countries of the European Union would be increased if the decision on the speed of disinflation were made jointly with the government.

OPPORTUNISTIC DISINFLATION?

The implementation of inflation targeting in the Czech Republic has brought out an interesting problem that could arise in other inflation-targeting economies as well. When the CNB began to target inflation at the beginning of 1998, net inflation was about 7 percent and headline inflation about 13 percent. An inflation target was set for end-2000 for net inflation in the range 3.5–5.5 percent, and an intermediate target of 4–5 percent for end-1999. However, early in 1999, net inflation fell to zero, while headline CPI inflation fell below 2 percent. What should central banks do in such situations? Would it have been appropriate for the CNB simply to lock in the unexpectedly rapid disinflation of the previous two years, and focus its monetary policy on maintaining price stability from then on? More generally, should inflation-targeting central banks try to benefit permanently from temporary shocks that reduce inflation and allow more rapid disinflation than originally was planned?

At first sight, such an option would seem to be attractive. As we have seen, Poland adjusted its original inflation target for 1999 after actual inflation early in the year turned out to be lower than projected. A case could be made for acting opportunistically and using faster-than-expected disinflation to lock in this windfall benefit of lower inflation.[31] It would seem that when inflation has been reduced to less than the central bank's target, but still remains above the level of inflation corresponding to price stability, it would make no sense to let inflation rise again, only to be forced

[31] For example, see Haldane (1998).

to reduce it again later. Disinflation, even at a moderate pace, could be costly, and if a country can avoid the need to disinflate in the future, this could spare the economy some loss of output. Whether past faster-than-planned disinflation was a result of good fortune or mistakenly tight monetary policy may seem not to matter, in that past decisions were made and past costs, if any, might have been incurred, but the objective now is to avoid any unnecessary future costs of disinflation.

In practice, central banks have been treating the bottom sides of the inflation target range in different ways.[32] Some were treating them as seriously as upper sides of a band, and eased monetary policy to bring inflation back up inside the band (e.g. New Zealand in 1991), while others preferred to consolidate the unexpected rapid disinflation (Israel in 1998, Canada in 1992).

In theory, there are several problems with opportunistic disinflation and with treating the bottom of the band leniently. First, there is a possibility that opportunistic disinflation will not find much sympathy with politicians—particularly if the faster than originally intended disinflation coincides with a significant weakening of economic activity. At that point, there would be calls for a relaxation of monetary policy, even if this means a return to somewhat higher inflation. The CNB was well aware of the possible negative reaction of politicians in 1999 and did not even suggest that it could lock in the lower-than-targeted inflation rate. Second, if rapid disinflation is a result of temporary external shocks, like a large price decline in commodities, it would be a mistake to assume that monetary policy could lock in such disinflation forever without large costs. Once these shocks are over, prices of commodities usually do not stay low, but rise again, as global demand recovers. Monetary policy that would try to prevent an accelerated pace of disinflation at times of declining commodity prices or other positive supply shocks would be probably too expansive. In the same vein, monetary policy would risk being too restrictive if it tried to avoid any acceleration of inflation as positive supply shocks were reversed.[33] The CNB and many other inflation-targeting central banks explicitly recognize that monetary policy should not attempt to offset temporary supply shocks that knock disinflation from its projected path.

Third, an opportunistic approach to disinflation could undermine the credibility of an inflation targeting framework. By setting medium-term inflation targets, central banks attempt to establish a predictable environment that would allow economic agents to plan for the future. Even though there could and will be deviations from the target, credible inflation targeting would lead the agents to expect that a central bank would do its best to return actual inflation to the targeted path. Attempts at opportunistic disinflation could increase the uncertainty because it would make monetary policy less predictable. For example, economic agents could expect that central banks might also adjust an inflation target upward in case of a negative shock.

Although under some circumstances, the case against opportunistic disinflation is weaker, consider a situation where an excessively restrictive monetary policy, rather than external supply shocks to inflation, has contributed to somewhat more rapid disinflation than originally targeted. Should an excessively tight monetary policy that resulted in an underutilization of resources now be replaced by an excessively unrestrictive monetary policy that would create pressure on resources

[32] See Clifton (1999).

[33] If positive price shocks were permanent, perhaps as a result of sudden increase in productivity, it would be appropriate to accept the effects of such shocks on inflation. But this does not seem to be the case in the Czech Republic, where the positive shocks to inflation resulted to a large extent from lower imported inflation that was likely to be reversed.

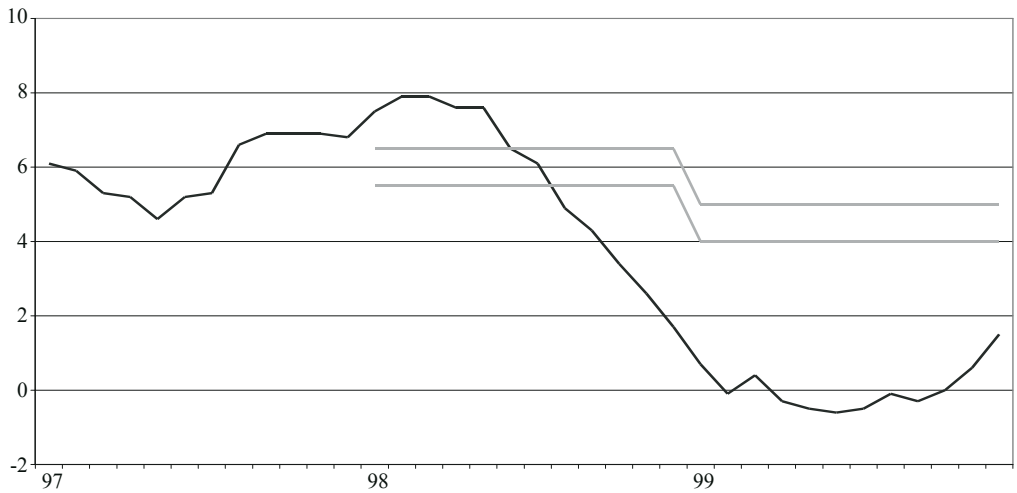
and rise inflation? Not necessarily. Whatever is the practical usefulness of this concept in transition economies, monetary policy should try to keep the utilization of resources (actual output growth) close to potential, and not to offset a mistake in one direction by an offsetting error in another direction. One year of an overly restrictive monetary policy and another year of an excessively unrestrictive monetary policy would not make on average two years of the right monetary policy.

As another example, a situation may arise where the path of disinflation has been set incorrectly. For example, competitive pressures in the economy, due to liberalization, privatization and a more open trade policy would produce a faster disinflation for a given monetary policy stance that originally expected. To maintain the original disinflation target could in such a case require an overly expansionary monetary policy. Thus it would seem to be more appropriate to accept in such a case a faster than originally intended disinflation.

PRELIMINARY RESULTS OF INFLATION TARGETING AND CONCLUSIONS

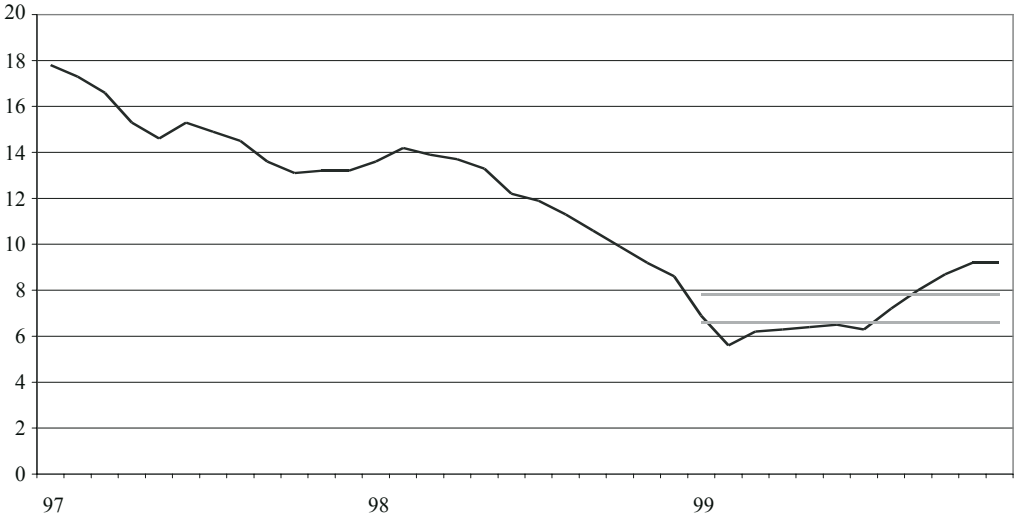
Charts 2 and 3 summarize the brief history of inflation targeting in the Czech Republic and Poland. These two charts tell a different story. At the end of 1999, consumer price inflation in Poland was above the target range, while net inflation in the Czech Republic was significantly below the target range. A faster-than-expected decline in inflation prompted the National Bank of Poland (NBP) to reduce its target for end-1999 early in the year, a step that in retrospect may seem to have been somewhat premature. If the NBP had maintained its original target of 8–8.5 percent, it would have missed it by only a very small margin. In the Czech Republic, in contrast, net inflation at the end of 1999 was 1.5 percent, well below the target range of 4–5 percent. At the same time, the CNB expects that at the end of 2000, net inflation will be at the lower end of the 3.5–5.5 percent range. For a detailed analysis of the causes of the higher-(lower-)than-targeted inflation in Poland (Czech Republic), the reader is referred to the Inflation Reports of the NBP and the CNB.

Chart 2. Czech Republic: Net Inflation and the Inflation Target (in percent)



Here, we would just note several points. First, the CNB calculations suggest external factors had a sizable effect on net inflation: the CNB estimates that in 1998, these factors reduced net inflation by 2–3 percentage points.[34] In the absence of these shocks, net inflation at the end of 1999 would have been close to the bottom of the target range. There were also other structural shocks that contributed to the lower-than-projected inflation. Among the most important was the unexpected continuing decline in foodstuff prices in 1998 and 1999.[35] Second, while inflation in Poland declined significantly as well during 1998 and 1999, in the Czech Republic inflation declined faster and the decline lasted longer than in Poland. The result was a growing difference between the inflation rates in these countries during 1999. A relatively rapid rise in domestic demand, an increase in import prices and the monopolistic structure of some industries all resulted in the reversal of disinflation in Poland in the course of 1999. On the other hand, weak domestic demand, together with a strong koruna and strong competitive pressures in the domestic economy resulting from the penetration of the Czech market by foreign distributors continued to keep inflation low in the Czech Republic, even after the effects of external price shocks began to disappear.

Chart 3. Poland: The CPI and the Inflation Target (in percent)



The short history of inflation targeting in the Czech Republic and Poland does not allow any far-reaching conclusions about inflation targeting in transition economies thus far. In the Czech Republic, the target for 1999 was off significantly. However, the last two years were characterized by significant turmoil in the world economy and a deep recession in the Czech economy, which made inflation targeting particularly difficult. The experience of the Czech Republic does not disprove the possibility of inflation targeting in transition economies. But it illustrates the particularly difficult task that inflation-targeting central banks in transition economies face. The increased uncertainty prevailing in transition economies makes it especially difficult to predict

[34] See Čapek (1999), p. 9.

[35]See for example Čihák and Holub (1998), who argue that after the decline in 1997, it was unlikely that foodstuff prices would continue to decline. Yet decline they did.

inflation sufficiently well ahead, as required by the forward-looking nature of the inflation targeting approach. In view of that problem, and given the possibility that transition countries will be more frequently hit by shocks that could divert inflation from the targeted path, missing the inflation target is far more likely in transition economies than in the more advanced economies.

This does not imply that monetary policy targeting other nominal variables like the money supply would make the task of controlling inflation easier. Even though inflation targeting in transition economies is more difficult than in advanced economies, it could still bring significant benefits. It should be clear, though, that central banks should not focus too much on hitting their inflation targets at any price at all times. Such an effort could produce a significant instability of monetary policy instruments, damaging economic performance. The focus of inflation-targeting central banks should be on the medium term to ensure that disinflation remains on track and that inflation converges to levels deemed consistent with price stability. Alongside this trajectory, there inevitably will be deviations from the targets, possibly sizable. Thus, the onus is on central banks' ability to communicate clearly to the public the limits and possibilities of inflation targeting in transition economies, and if an error in targeting occurs, to explain credibly and openly why the inflation targets were missed. After all, the purpose is to anchor expectations and reduce inflation by establishing credibility in its policies, not to make a particular inflation target every year at any price. Inflation targeting is not a shooting contest.

REFERENCES

Begg, D., 1998, "Pegging Out: Lessons from the Czech Exchange Rate Crisis," *Journal of Comparative Economics,* Vol. 26, pp. 669–690.

Bernanke, B. S., T. Laubach, F.S. Mishkin, and A. S. Posen, 1999, *Inflation Targeting. Lessons from the International Experience* (Princeton: University Press).

Brada, J. C., and A. M. Kutan, 1999, "Monetary Policy and the Rate of Inflation in Transition Economies," mimeo (Phoenix: University of Arizona).

Brash, D. T., 1999, "Inflation Targeting: An Alternative Way of Achieving Price Stability," Keynote address on the occasion of the 50th anniversary of central banking in Manila, January 5.

Čapek, A., 1999, "Udržet inflaci pod kontrolou bude stále obtížnější," *Hospodářské noviny,* 22. října.

Christofferesen, P. F., and R. F. Wescott, 1999, "Is Poland Ready for Inflation Targeting?" IMF Working Paper 99/41 (Washington: International Monetary Fund).

Clifton, E. V., 1999, "Inflation Targeting: What is the Meaning of the Bottom of the Band?" IMF Policy Discussion Paper, 99/8 (Washington: International Monetary Fund).

Cottarrelli, C., 1998, *Moderate Inflation. The Experience of Transition Economies*, ed. By G. Szapary (Washington: International Monetary Fund).

Czech National Bank, 1997, Monthly Bulletin, May.

1998a, Monthly Bulletin, January.

1998b, Inflation Report, April.

1998c, Inflation Report, July.

1998d, Inflation Report, October.

1999, Inflation Report, January.

1999b, Inflation Report, October.

Čihák, M., and Holub, T., 1998, "Cílování inflace v ČR: staré víno v nových lahvích," *Finance a úvěr, č. 4,* pp. 223–236.

Debelle, G., 1997, "Inflation Targeting in Practice," IMF Working Paper 97/35 (Washington: International Monetary Fund).

Eichengreen, B., 1999, "Solving the Currency Conundrum," paper prepared for the Council of Foreign Relations Study Group on Economic and Financial Development, New York.

Fischer, S., 1995, "Modern Approaches to Central Banking," National Bureau of Economic Research (NBER) Working Paper Series, No. 5064 (Cambridge, Mass: MIT Press).

Haldane, A., 1998, "Pursuing Price Stability: Evidence from the United Kingdom and Other Inflation-Targeters," in the Czech National Bank Workshop on Inflation Targeting (Prague).

Hrnčíř, M., and Šmídková, K., 1998, "The Czech Approach to Inflation Targeting," in Czech National Bank Workshop on Inflation Targeting (Prague).

International Monetary Fund, 1999, *Hungary - Selected Issues*, IMF Staff Country Report No. 99/27 (Washington: International Monetary Fund).

Jonsson, G., 1999, "The Relative Merits and Implications of Inflation Targeting for South Africa," IMF Working Paper 99/116 (Washington: International Monetary Fund).

Kysilka, P., 1998, "Nezdravý růst dlouho nevydrží." *Ekonom*, Vol. 4, pp. 10–12.

Landerretche, O., F. Morandé, and K. Schmidt-Hebbel, 1999, "Inflation Targets and Stabilization in Chile," Central Bank of Chile Working Papers, No. 55.

Masson, P. R., M. A. Savastano, and S. Sharma, 1997, "The Scope for Inflation Targeting in Developing Countries," IMF Working Paper 97/130 (Washington: International Monetary Fund).

Masson, P. R., 1999, "Monetary and Exchange Rate Policy of Transition Economies of Central and Eastern Europe after the Launch of EMU," IMF Policy Discussion Paper 99/5 (Washington: International Monetary Fund).

National Bank of Hungary, 1999, *Monetary Policy Guidelines for 2000* (Budapest).

National Bank of Poland, 1998, *Medium-Term Strategy of Monetary Policy* (Warsaw).

Narodnowy Bank Polski, 1999, *Raport o Inflaciji*, III Kwartal 1999 (Warsaw)

Organisation for Economic Cooperation and Development, 1998, *OECD Economic Surveys: Czech Republic* (Paris: OECD).

Šmídková, K., and M. Hrnčíř, 1998, "Přechod na strategii cílování inflace," *Finance a úvěr, č.4*, pp. 205–222.

Stavrev, E., 1998, "Inflation Forecasting Using a Small Macro-Economic Model," in Czech National Bank Workshop on Inflation Targeting (Prague).

Chapter 3

CONTROLLING INFLATION AFTER BRETTON WOODS: AN ANALYSIS BASED ON POLICY OBJECTIVES

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This chapter reviews the inflation experience in the post-Bretton Woods era in the context of alternative central bank objectives. It summarizes research on inflation targeting issues, especially those associated with stabilizing the price level. Generally, inflation targeting schemes do not provide a nominal anchor unless the central bank is focusing strictly on the inflation target and ignoring unemployment and the business cycle. Research summarized in this chapter suggests that the most important step a central bank can take to improve policy is to decide on a long-term path for the price level. Being explicit about the desired path for the price level not only reduces inflation variability at all horizons, but also gives the policymaker more flexibility to pursue output stabilization goals.

INTRODUCTION

The Czech Republic and other economies in transition are facing the same problem that western democracies faced in 1973 when the international monetary system based on a modified gold standard collapsed. These countries are now learning how to develop and maintain an efficient paper money standard in order to find a way to anchor the purchasing power of their currency. When the Bretton Woods System broke down, the West went through a long cycle of rising, then falling, inflation. Was this a one-time learning experience? Will the transition economies learn from the mistakes of the United States and other western countries? Have western countries learned how to prevent such cycles from recurring?

These are questions without clear answers, despite an abundance of research on changes in monetary regimes and specific monetary policy rules. The main problem is that most of this research does not address the issue of the nominal anchor directly. This chapter summarizes research on the degree of price stability implied by alternative monetary policy regimes.

The best option for a small open economy like the Czech Republic may be to tie its monetary policy to a larger trading partner. Certainly, the idea of fixing the Czech koruna to the European euro is one possibility. But exchange rate rules are not considered here. Rather, this chapter examines issues that arise when a country adopts an independent monetary policy. Using a common framework, this analysis compares actual outcomes to those that might be expected under alternative assumptions about central bank objectives.

Section II reviews the inflation experience in the post-Bretton Woods era. Section III summarizes our research on issues in inflation targeting, especially those associated with stabilizing the price level.[2] Section IV investigates the improvement in price stability that can be achieved by adding a long-term price-level objective to an inflation targeting regime. Section V presents results from our model calibrated to time series data for selected countries and periods. Section VI concludes the analysis.

THE INFLATION EXPERIENCE IN SELECTED COUNTRIES

Since the end of Bretton Woods, most discussion about price stability has been in terms of inflation, not the price level. This section reviews inflation in the key currency countries—Germany and Japan, and the United States—as well as in two large economies that had relatively high inflation after March 1973, Italy and the United Kingdom. Before Bretton Woods ended, inflation

[2] This chapter draws heavily on research by Dittmar, Gavin and Kydland (1999a and 1999b), as well as work by Dittmar and Gavin (1999).

rates were relatively low and close together. By March 1973, all of the countries, except Germany, began to experience higher and more variable inflation. While there were a variety of monetary policy experiments in these countries, all adopted some form of monetary targeting. Of these five, only Germany continues to advocate monetary targeting as a framework for achieving and maintaining price stability. (Interestingly, Bernanke et al. (1999), who advocate inflation targeting, list Germany as a country that implicitly targets inflation even though it announces targets for the monetary aggregate, M3, and has never adopted short-run targets for inflation. Also, Clarida and Gertler (1999) describe German policy more as an inflation targeting regime than as a monetary targeting policy.)

Monetary targeting was most prevalent from 1973 through 1985, the period when inflation was highest and most volatile. Although common behavioral patterns are evident in the countries under review, greater detail in the inflation rate (measured by the CPI) can be seen in the accompanying graphs (see Figures 1a through 1d) where the CPI for Japan, the United States, the United Kingdom, and Italy is shown against that of Germany, which had the lowest inflation rate for the 40-year period from 1958 through 1998.

Figure 1a: CPI Inflation in Germany and Japan

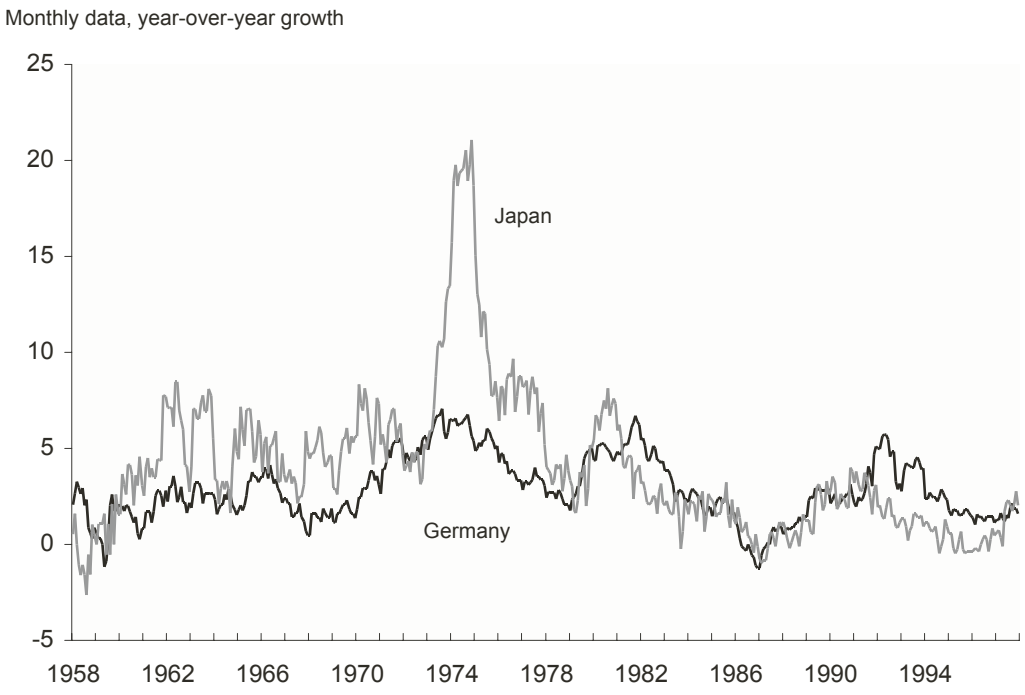
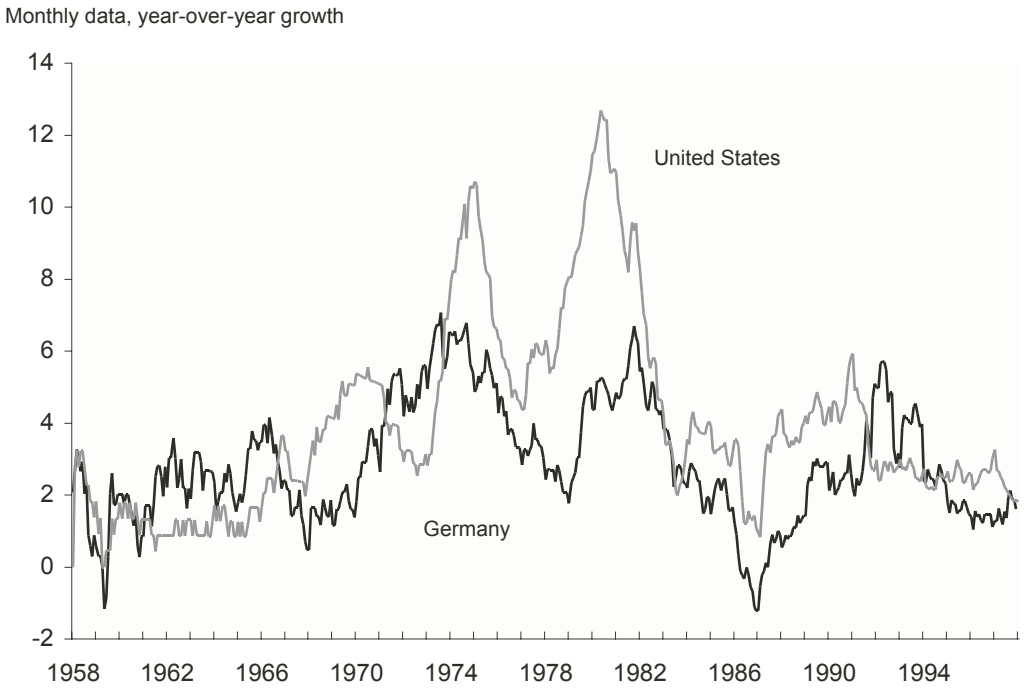


Figure 1b: CPI Inflation in Germany and the United States



The countries are ordered by their success in getting control over inflation. Although Japan and the United States had the same average inflation throughout the 40-year period, Japan is placed first because Japanese monetary authorities were several years ahead of the United States in getting control over the inflation. Initially, Japan reacted to the quadrupling of the world oil price in 1973 by allowing the inflation rate to soar above 20 percent per year. Japanese inflation remained in double digits throughout 1973 and 1974. By 1977, inflation began to come down. Since 1980, Japan's average inflation rate has been lower than Germany's (see Figure 1a).

The U.S. government adopted wage and price controls in conjunction with an expansionary monetary policy in the early 1970s. In 1973, inflationary pressures associated with rising world oil prices brought an end to price controls and a rapid acceleration of inflation (see Figure 1b). Monetarists in academia and at the St. Louis Federal Reserve Bank argued for stricter monetary targeting—keeping money growth closer to the target in the short run and achieving the average target growth rate over a longer horizon (eliminating the year-end drift in the base of the target). Such stricter monetary targeting practice implied less emphasis on keeping output at its full-employment potential and smoothing short-term interest rates.

The U.S. Congress passed a resolution in 1975 advising the Federal Reserve to set targets for monetary and credit aggregates. In 1978, it passed a law requiring the Federal Reserve to set annual targets for money and credit. Although it appeared that the Federal Reserve had gained control over inflation in 1975–76, both monetary growth and inflation surged upward with the 1979 oil price shock.

On October 6, 1979, the Federal Reserve System announced the beginning of a new resolve to reduce inflation by restricting the growth of the monetary aggregates. New procedures were adopted that set weekly targets for a monetary reserve aggregate rather than an interest rate. The policy led to high and volatile ex post real interest rates, but no significant decline in monetary growth. Despite the failure of monetary aggregates to slow, inflation (as measured by the CPI) fell sharply from a 15 percent annual rate in the first quarter of 1980 to less than 2 percent in the last quarter of 1982.

The pattern of inflation in the United Kingdom was much the same as in the United States, but the average rate was somewhat higher (see Figure 1c). In Italy, the CPI inflation rate remained in double digits until 1985 (see Figure 1d). By then, all five countries appear to have gained more control over inflation. The period following 1984 appears to be one of relatively stable inflation, more like the period under the Bretton Woods Agreement.

Figure 1c: CPI Inflation in Germany and the United Kingdom

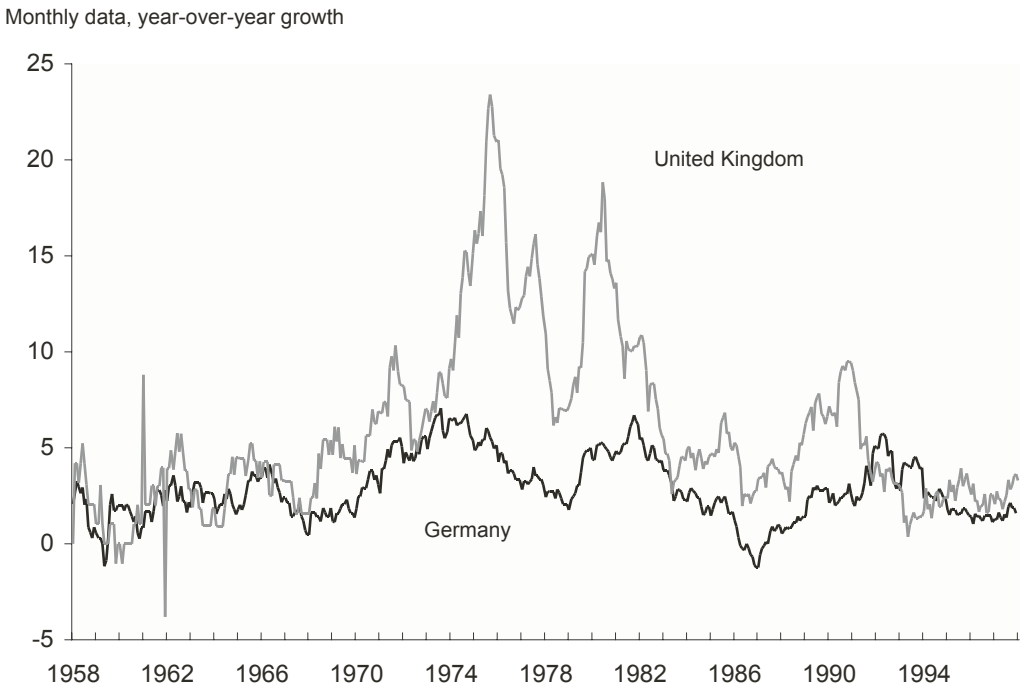
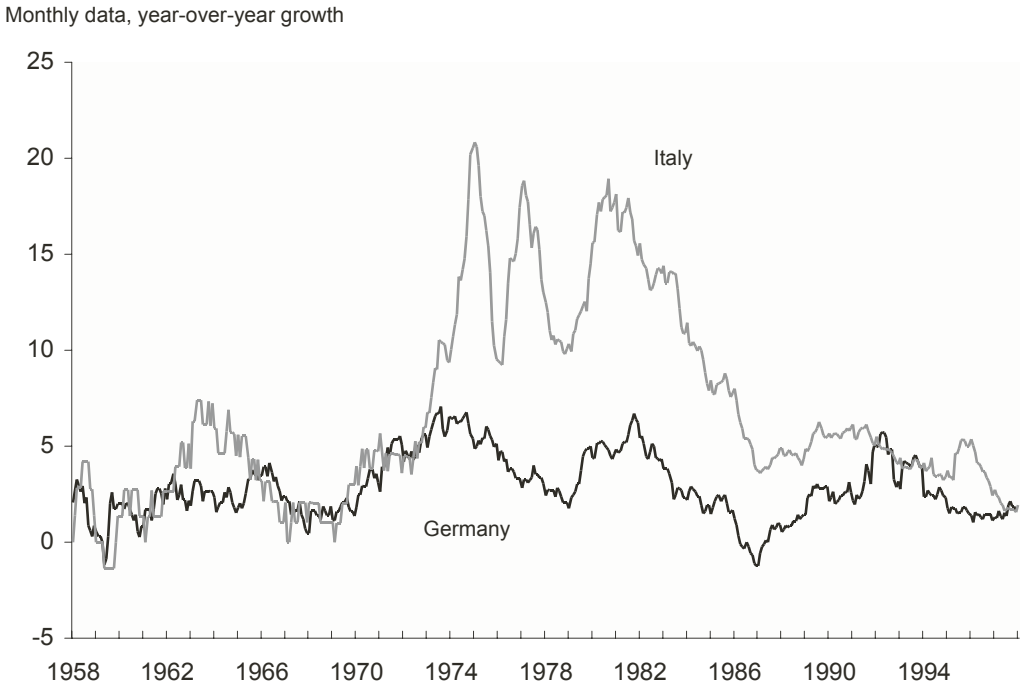


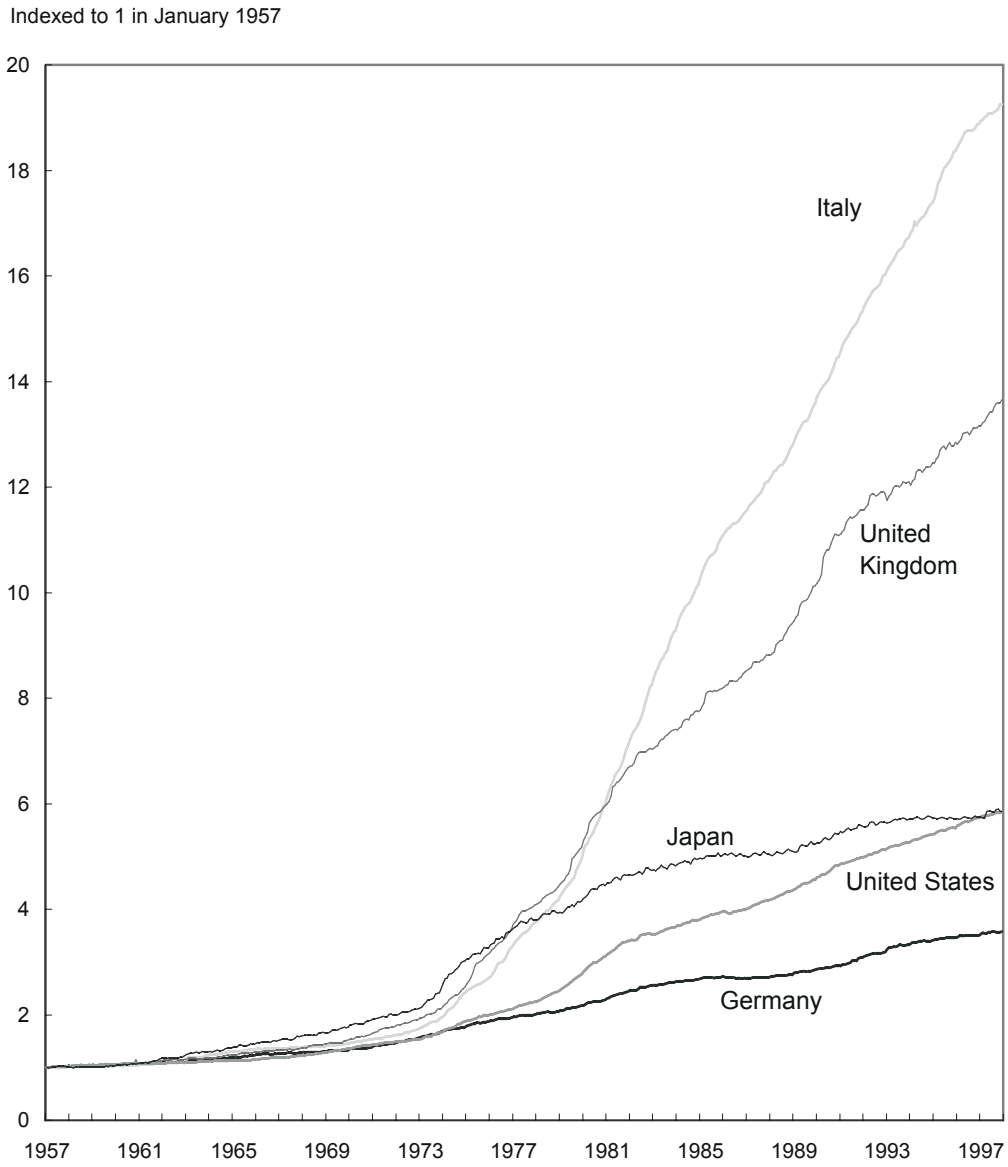
Figure 1d: CPI Inflation in Germany and Italy



The unweighted average CPI inflation rate in these five countries for this 40-year period was 5.4 percent, and the standard deviation of quarterly inflation was 5.1 percent, both at an annual rate. In the period following the breakdown of the Bretton Woods Agreement, average inflation rose to 9.8 percent and the average standard deviation rose by one half of a percentage point to 5.6 percent. Since the end of 1984, the average inflation rate has dropped dramatically to 3.3 percent, somewhat below the average during the period of Bretton Woods. The average standard deviation of inflation also has been much lower at 2.6 percent.

The inflation rates were originally associated with widely varying behavior of price levels. Figure 2 shows the Consumer Price Index (CPI), normalized to one in January 1957, for each of the five countries. Italy had the highest average inflation (7.8 percent at an annual rate) throughout the last 40 years, more than 2 percentage points above the average. The lowest average inflation was in Germany where the inflation rate averaged 3.2 percent during the full period, more than 2 percentage points below the average. The broad range of experience in Figure 2 is shown to provide a benchmark for considering the magnitude of uncertainty about the price level implied by alternative monetary policy regimes.

Figure 2: The CPI for Selected Countries



INFLATION TARGETING AND PRICE-LEVEL STABILITY

Would a price-level objective destabilize the economy?

The idea of inflation targeting is appealing both to those who think that having a target for inflation focuses policymakers' attention on the inflation objective, as well as to those who want rule-like policy, but believe that the central bank can still achieve multiple objectives. The problem

with inflation targeting is that it does not tie down the price level. It does not provide a nominal anchor. If a nominal anchor is the goal, why not target the price level directly? Fischer (1994), Cecchetti (1998) and Kiley (1998) offer intuitive explanations—based on analysis of a single price shock—about why attempting to achieve a price-level objective would increase the variability of inflation and output. Milton Friedman made perhaps the most influential objection to price-level targeting in his December 1967 presidential address to the American Economic Association. In recommending how monetary policy should be conducted, he explains why he would not target a price level:

> Of the three guides listed, the price level is clearly the most important in its own right. Other things the same, it would be much the best of the alternatives—as so many distinguished economists have urged in the past. But other things are not the same. The link between the policy actions of the authority and the price level, while unquestionably present, is more indirect than the link between the policy actions of the authority and any of the several monetary totals. Moreover, monetary action takes a longer time to affect the price level than to affect the monetary totals and both the time lag and the magnitude of the effect vary with circumstances. As a result, we cannot predict at all accurately just what effect a particular monetary action will have on the price level and, equally important, just when it will have that effect. Attempting to control directly the price level is therefore likely to make monetary policy itself a source of economic disturbance because of false stops and starts. Perhaps, as our understanding of monetary phenomena advances, the situation will change. But at the present state of our understanding, the long way around seems the surer way to our objective. Accordingly, I believe that a monetary total is the best currently available immediate guide or criterion for monetary policy—and I believe that it matters much less which particular total is chosen than that one be chosen.[3]

This was written before the Rational Expectations revolution had taken hold. Our understanding of monetary phenomena has advanced since then. We now know that the immediate effect of a monetary policy action on anything will vary with circumstances. The way to evaluate policy strategies is not to look at the effect of a single action, but rather to examine the implications of alternative rules in dynamic model economies.

This section summarizes research that uses a dynamic framework popularized by Lars Svensson (1997, 1999). Svensson (1999) showed that, for the case with a Neoclassical aggregate supply function and a persistent output gap, a price-level targeting regime would result in less short-run inflation variability than an inflation targeting regime. Using a simplified version of Svensson's model, Dittmar et al. (1999a) then derived inflation-output variability tradeoffs (Taylor Curves) for inflation targeting and price-level targeting regimes.

This simple policy model has two components. One is a central bank objective function,

$$L = \sum_{t=0}^{\infty} \beta^t \left(\lambda y_t^{\,2} + (\pi_t - \pi^*)^2 \right) \qquad (1)$$

[3] See Milton Friedman (1968), p.15.

where y_t is the deviation of output from the target level (which we assume is the underlying trend in real output) and $(\pi_t - \pi^*)$ is the deviation of inflation from the central bank's inflation target. The central bank discounts future variability in the output gap and inflation by the factor β. The parameter, λ, relates the central bank's preference for output stability to its preference for inflation stability.

The other component is a short-run aggregate supply curve with persistence in the output gap:

$$y_t = \rho\, y_{t-1} + \alpha(\pi_t - \pi_t^e) + \varepsilon_t \tag{2}$$

The introduction of a lagged output gap in this equation is important in comparing inflation and price-level targeting. Conceptually, the lag will be introduced any time some friction prevents instantaneous and complete adjustment of output to unexpected changes in the price level. This friction could be induced by incomplete information, wage contracts, menu costs, transaction costs, incomplete markets, capital adjustment costs, etc. Dittmar and Gavin (1999) show that the introduction of lagged output tends to make the Neoclassical aggregate supply function look more like the New Keynesian supply functions described in Roberts (1995).

With this aggregate supply curve and rational expectations, that is, $\pi_t^e = E_{t-1}\pi_t$, the central bank's optimization problem implies a tradeoff between output and inflation variability.[4] Minimizing this loss function—subject to the aggregate supply curve—leads to a rule for inflation that is contingent on the size of the output gap.

$$\pi_t^A = \pi^* - \frac{\alpha\lambda\rho}{1 - \beta\rho^2}\, y_{t-1} - \frac{\alpha\lambda}{1 - \beta\rho^2 + \alpha^2\lambda}\, \varepsilon_t \tag{3}$$

where the superscript A indicates that the variable is determined by the inflation targeting rule.[5] The inflation rate in each period is set equal to the inflation target, with countercyclical adjustments proportional to the lagged output gap and the current technology shock. Note that this stylized model assumes that the central bank can control the inflation rate directly. Thus, we cannot address questions involving the slippage between changes in central bank instruments and its effect on inflation uncertainty. The issue of how a central bank controls inflation is irrelevant in comparing inflation and price-level targeting. One step ahead, the control problem is identical. An appendix in Svensson (1997) shows that introducing money with a control error in the inflation equation would not change his results.[6]

[4] Taylor (1979) showed that, in macroeconomic models with Rational Expectations, there was no tradeoff between the mean growth rate of inflation and the level of output, but there was a tradeoff between the second moments.

[5] See the Appendix in Dittmar et al. (1999a) for solution details. Note that the central bank is assumed to take expectations as given. There is no attempt to manipulate the public's expectations.

[6] We could follow the example of Clarida et al. (1999) and use a two-step procedure to derive interest rate rules. First, they solve a model like ours for the desired output. Then, in a second stage, they substitute the decision rule for output into an IS relation to find the interest rate rule. We do not think that this would affect any of our conclusions about the relative desirability of inflation vs. price-level targeting.

If the central bank cares about deviations of the price level rather than the inflation rate, the natural logarithm of the price level, p, will replace the inflation rate in the loss function. For price-level targeting, we reformulate the objective function as

$$L^B = \sum_{t=0}^{\infty} \beta^t \left(\lambda y_t^2 + (p_t - p_t^*)^2 \right) \tag{4}$$

The target path for the price level may be constant or may be rising at a constant rate. The superscript B indicates that the loss function is for the case where the central bank has a price-level objective.

The central bank's rule for achieving the target path is given by

$$p_t^B = p_t^* - \frac{\alpha\lambda\rho}{1 - \beta\rho^2} y_{t-1} - \frac{\alpha\lambda}{1 - \beta\rho^2 + \alpha^2\lambda} \varepsilon_t \tag{5}$$

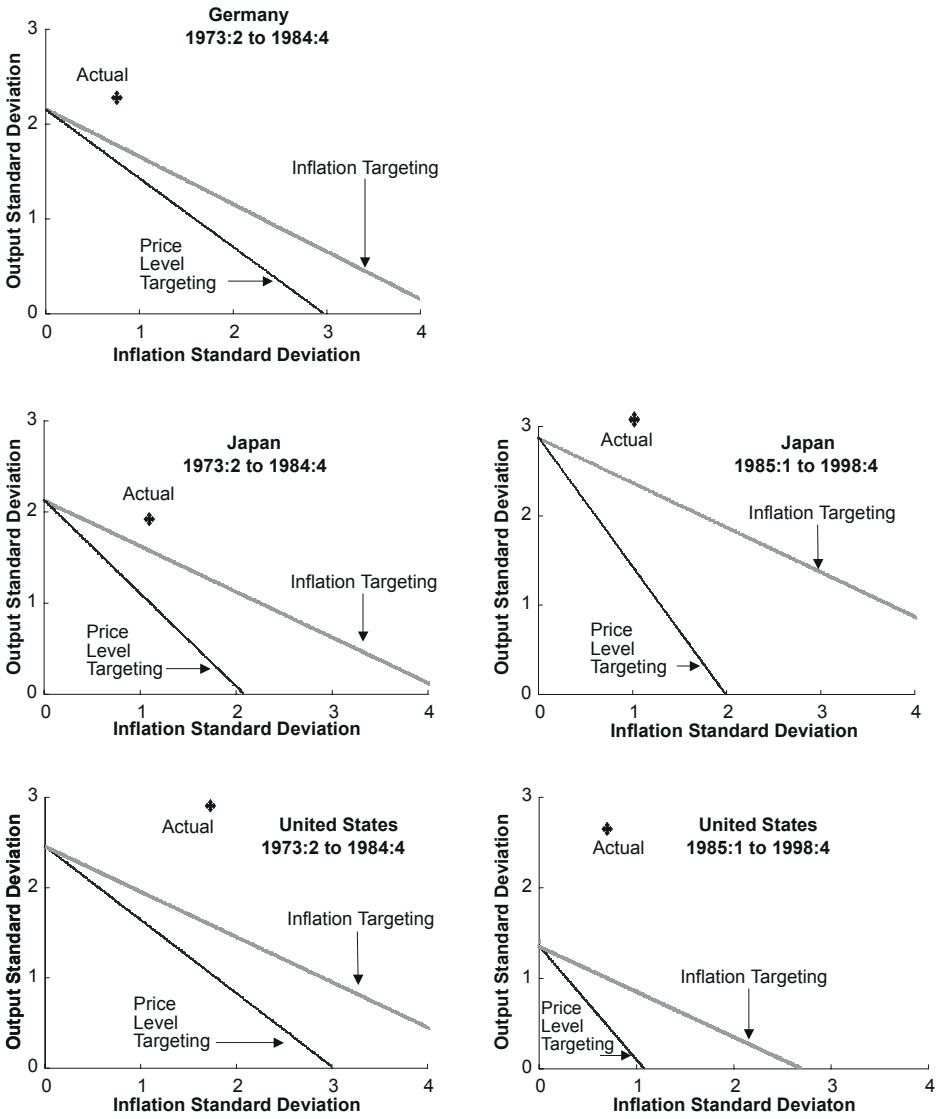
implying the following rule for the inflation rate:

$$\pi_t^B = p_t^B - p_{t-1} = \pi^* - \frac{\alpha\lambda\rho}{1 - \beta\rho^2}(y_{t-1} - y_{t-2}) - \frac{\alpha\lambda}{1 - \beta\rho^2 + \alpha^2\lambda}(\varepsilon_t - \varepsilon_{t-1}) \tag{6}$$

The price-level target, p_t^*, is given by $p_t^* = \pi^* + p_{t-1}^*$. With the price-level target, the central bank's reaction function (6) has three elements on the right-hand side. The first is the steady-state inflation embodied in the target path for the price level. The second and third are proportional, countercyclical adjustments to the change in the output gap from period t-2 to period t-1 and the change in the technology shock from period t-1 to period t, respectively.

As Svensson (1999) explains, the relative variance of inflation under inflation and price-level targeting rules depends on whether the output gap itself is more or less variable than its rate of change. If the output gap is highly persistent ($\rho > 0.5$), the output gap itself will be more variable than its rate of change and the inflation rate will be more variable under an inflation targeting regime. The answer to the question opening this section is no, stabilizing the price level should not destabilize short-run inflation or the real economy. In the commonly used aggregate supply framework, the price-level target actually results in less short-run volatility, not more. The better performance expected under price-level targeting can be seen in the Taylor curves for inflation and price-level targeting in Figure 3. There we used the Neoclassical aggregate supply function with ρ calibrated to persistence in the different countries (always greater than 0.5). We return to this figure in Section V.

Figure 3: Taylor Curves for Selected Countries



Kiley (1998) objected to the use of the Neoclassical aggregate supply curve and suggested that one based on New Keynesian theories would be more realistic and less likely to favor the price-level target. Dittmar and Gavin (1999) modified this framework to incorporate a New Keynesian aggregate supply function. They derived results showing that price-level targeting is preferred over inflation targeting in the New Keynesian case for all values of the central bank's preference parameter, λ, and all values of ρ.

It is important to derive the dynamic properties of economies when comparing alternative regimes. Our results are derived in model economies with forward-looking expectations. This is a critical choice. Simulations of econometric models typically find that targeting the price level is a bad idea. Economists have attributed this result to the presence of nominal rigidities such as wage contracts or price adjustment costs. Yet in these econometric experiments, it is also true that inflation expectations are almost always backward-looking. For example, Haldane and Salmon (1995) use a small econometric model with adaptive inflation expectations to examine whether monetary policy targets for price stability should be expressed in levels or rates of change. They find that price-level targeting results in higher short-run variability for both inflation and output growth. These results are typical of econometric model simulations with backward-looking expectations.[7]

Two notable examples use econometric models modified to include forward-looking behavior in the financial sectors. Black, Macklem and Rose (1997) look at rules that combine a long-term price-level objective with a short-term inflation targeting rule. The presence of an error-correction term guarantees the eventual return of the price level to its long-run target path. For values of the error correction parameter between 0.1 and 0.125, they derive a Taylor Curve that is better than with the inflation rule alone. Using a policy model estimated at the Board of Governors of the Federal Reserve System, Williams (1999) finds "interestingly, targeting the price level rather than the inflation rate generates little additional cost in terms of output and inflation variability. Under price-level targeting, the expectations channel helps stabilize inflation, thereby eliminating much of the output stabilization costs that would otherwise be associated with reversing deviations of the price level from its target." Williams confirms the view that price-level targeting fares so badly in econometric simulations because this is exactly the type of exercise for which the Lucas Critique is likely to be most relevant. The policy rules that were most efficient in reducing inflation and output variability when the model assumes forward-looking expectations turn out to be the worst when fixed adaptive expectations are assumed. And vice-versa, policies that are efficient when expectations are assumed to be adaptive do poorly when expectations are forward looking.

Does inflation targeting anchor the price level?

Adoption of a long-run price-level objective would probably enhance the short-run stabilization options facing central banks. But the reality is that central banks are adopting inflation targets, not price-level targets. The question that arises is how much slippage of the nominal anchor is allowed under an inflation targeting regime—and how much would we have to change current policies to eliminate some of the slippage? Dittmar et al. (1999b) address this question by conducting 40-year experiments using the models presented above. They find that the price level and inflation are inherently uncertain in current proposals to target inflation. The degree of price-level uncertainty depends largely on how aggressively the central bank tries to stabilize the real economy.

To calculate the price-level uncertainty expected under inflation targeting regimes, we ran the model repeatedly under alternative assumptions about the model parameters. In the computational experiments, ρ was set equal to 0.9 and α equal to 0.5. We assume that the interest rate is 4 percent at an annual rate, so the quarterly discount factor is approximately 0.99. The standard deviation of the random error in the aggregate supply function (2) is assumed to be 0.75 percent at a quarterly rate. The two most important parameters in this model are the degree of persistence in the output gap, ρ, and the central bank's relative preference for output stabilization, λ. The values for ρ and the

[7] See Haldane and Salmon (1995) for further references.

standard deviation of the random error in the aggregate supply function are chosen to approximate estimates for the U.S. economy.

The experiment is run here using four alternative values of λ: 0.5, 0.33, 0.25, and 0.1.[8] The upper panel in Table 1 reports standard errors for deviations of the average inflation rates from the central bank's target. The model was run for 160 periods (corresponding to quarters). There were 100 replications in each experiment. Each experiment was started with the same random number seed, so that the same series of random errors was used in each column of the table. There were 100 prices saved for each period. Trimming 16 2/3 percent off each tail of the distribution of prices in each period produced the data in the table. Because the samples were relatively small, the distributions were not perfectly symmetric. The standard deviations reported are the averages of the absolute deviations associated with the upper and lower tails. The average inflation rates were calculated from the beginning to the reported horizon. The standard deviation of the price level from its expected path for the reported horizons is shown in the bottom panel of Table 1.

Table 1: Uncertainty about the Price Level and Inflation with Inflation Targeting

	Standard Deviation of Average Inflation Deviation from Target (in percent)			
Years	$\lambda = .5$	$\lambda = 1/3$	1.3	$\lambda = .1$
1	2.1	1.6	1.9	0.6
2	3.1	2.4	2.0	0.9
5	3.2	2.4	1.7	0.9
10	2.7	2.0	1.3	0.8
20	2.1	1.6	1.2	0.6
40	1.9	1.4		0.5
	Standard Deviation of Price-Level Deviation from Target (in percent)			
Years	$\lambda = .5$	$\lambda = 1/3$	1.3	$\lambda = .1$
1	2.1	1.6	3.9	0.6
2	6.2	4.8	9.9	1.8
5	16.0	12.2	16.5	4.6
10	26.6	20.4	26.0	7.7
20	42.0	32.2	46.5	12.2
40	74.9	57.4		21.7

The two most important results are: 1) inflation targeting does not pin down the price level, and 2) the weight the central bank puts on output stabilization really matters. With $\lambda = 0.5$, the standard

[8] Cecchetti et al. (1999) estimate the value of our preference parameter, λ, for a number of European countries and conclude that it is often found to be around 0.33.

deviation of the inflation rate is 3.2 percent at a five-year horizon. If the central bank targets inflation at 2 percent, we would expect the actual five-year-ahead inflation rate to be greater than 5 percent or less than –1 percent one-third of the time. In calculating the inflation risk associated with a 20-year investment, we would expect the average inflation rate to be greater than 4 percent or less than zero percent one-third of the time. If the inflation target were the 40-year average of the five countries shown in Figure 1, 5.4 percent plus and minus one standard deviation of the average inflation expected over 40 years nearly includes the 7.75 percent inflation of Italy and the 3.2 percent inflation in Germany. The bottom panel shows that with $\lambda = 0.33$, there is still an enormous range of uncertainty about the price level at a 40-year horizon (±57.4 percent).

McCallum (1997) compares the log of the price level that follows a pure random walk to a preset target path. He assumes that the random walk has an unpredictable component at the quarterly frequency that is approximately equal to the standard deviation of one-step-ahead forecast errors for the United States throughout 1954–91 (0.0045 percent at a quarterly rate). With this pure random walk assumption, the 20-year-ahead price level has a standard deviation of only 4 percent. Compare this to the 32 percent standard deviation for the 20-year-ahead price level that is implied by the typical inflation targeting rule when the value of λ is as high as 1/3. Even setting λ as low as 0.1 results in three times more uncertainty about the price level than is implied by the standard deviation in the case of the random walk. So the answer to the second question of this section is no, the typical proposal to target inflation does not provide a nominal anchor.

MONETARY POLICY WITH A PRICE-LEVEL OBJECTIVE

Dittmar et al. (1999b) also show that if central banks want to both stabilize business cycle fluctuations and achieve price stability, they may find it useful to adopt a long-term objective for the price level. One way to do this is to follow Black, Macklem and Rose (1997) and write down an inflation targeting rule with an error-correction term for the deviation of the actual price level from the long-term path implied by the inflation target. Another way is to suppose that there is a policymaking committee that includes a mixture of policymaker types, A and B. Type A policymaker's loss function is given by L^A and type B policymaker has a loss function, L^B. The monetary policy rule can be rewritten approximately as a combination of the two rules:[9]

$$\pi_t = \delta \pi_t^A + (1 - \delta)\pi_t^B \tag{7}$$

When $\delta = 1$, policymakers all want to target inflation and the central bank follows the rule given in equation 3. When $\delta = 0$, nobody wants to target inflation, and the central bank follows a price-level rule. When δ falls between 0 and 1, there are policymakers of both types on the committee and the central bank follows a combination rule that is equal to an inflation targeting rule with an error-correction term on the deviation of the price level from a target path. To show this, we substitute equations 3 and 5 into 7 to get

$$\pi_t = \pi^* - \frac{\alpha\lambda\rho}{1 - \beta\rho^2} y_{t-1} - \frac{\alpha\lambda}{1 - \beta\rho^2 + \alpha^2\lambda}\varepsilon_t + (1 - \delta)(p^*_{t-1} - p_{t-1}) \tag{8}$$

[9] The exact solution for the combined model is more complicated because people take account of both objective functions when solving the model.

Equation 8 has the same form as equation 3 except for the addition of the error-correction term. This general form of the model is used to examine the effects of changing the relative weight on the alternative rules.

Table 2 presents the results of running the inflation-targeting experiment for our combination rule. Here, we assumed the value of 1/3 for the central bank's preference parameter, λ. The first column of Table 2 merely repeats the second column of Table 1, where there was no price-level targeting involved. Here the 20-year-ahead inflation rate had a standard deviation of 1.6 percent around the target. Putting just a small, 0.01, weight on the price-level deviation reduces the standard deviations by 25 percent. Putting one-tenth of the weight on the price-level deviations reduces the standard deviations by 75 percent. As the table shows, even when the error-correction parameter is as large as 0.1, the uncertainty about the price level at relevant horizons is still almost twice as great as McCallum's random-walk example.

Table 2: Uncertainty about the Price Level and Inflation with Inflation Targeting and a Long-Term Price Objective ($\lambda = 1/3$)

	Standard Deviation of Average Inflation Deviation from Target (in percent)			
Years	$\delta = 1$	$\delta = 0.99$	$\delta = 0.95$	$\delta = 0.9$
1	1.6	1.1	1.0	1.0
2	2.4	1.9	1.8	1.6
5	2.4	2.2	1.6	1.2
10	2.0	1.7	1.1	0.8
20	1.6	1.2	0.6	0.4
40	1.4	0.8	0.3	0.2
	Standard Deviation of Price-Level Deviation from Target (in percent)			
Years	$\delta = 1$	$\delta = 0.99$	$\delta = 0.95$	$\delta = 0.9$
1	1.6	1.1	1.0	1.0
2	4.8	3.9	3.5	3.3
5	12.2	11.0	8.2	6.1
10	20.4	17.1	11.5	7.9
20	32.2	24.8	12.6	7.5
40	57.4	30.5	13.1	8.0

MONETARY POLICY IN SELECTED COUNTRIES

In this section, we compute the Taylor Curves implied by calibrations based on data from the five countries selected earlier. The Taylor Curves show a frontier of minimum combinations of standard deviations for inflation and the output gap that would be achievable according to our simple model. We do not look at counterfactual experiments or examine the expected consequence of the combination policies. Doing so would require more rigorous empirical research than is presented here. The effects of monetary policy operate through expectations about how policy will be conducted in the future. In the best of circumstances, these expectation channels are difficult to identify in empirical work. Complicating this task is the evolution of macroeconomic theory and shifting priorities among policymakers and the general population that occurred during the post-Bretton Woods period.

Simulations of the model result in a strong and stable relationship between output and inflation. In the model, the central bank can control output at short horizons. This assumption is probably not true, but is implied by most of the models, both theoretical and empirical, that are used by central bank economists and their private-sector counterparts. Aggregate supply relations are not identified in any of the five countries.[10] In this section, we simply assume that the aggregate supply parameter, α, is equal to 0.5.

The output gap was calculated by regressing the logarithm of real GDP for each of the five countries on a quadratic time trend. The standard deviations of the output gap and inflation are reported for each period in the bottom panel of Table 3. They are also shown as points in each of the panels of Figure 3, which shows the Taylor Curves for the individual countries. The quarterly standard deviation of inflation here is based on the change in the logarithm of the GDP deflator (Table 1 reports CPI statistics).

Table 3: Statistics Used in Calibrations of Taylor Curves

Standard Deviations of Inflation (at quarterly rates) and the Output Gap (in percent)					
1973:2 to 1984:4	Germany	Japan	United States	United Kingdom	Italy 1976:3 to 1984:4
Output Gap	2.3	2.0	2.9	2.9%	2.3%
Inflation	1.4	1.3	0.6	1.8%	1.1%
1985:1 to 1998:4					1985:1 to 1998:2
Output Gap		3.1	1.8	2.7%	1.5%
Inflation		1.0	0.3	0.7%	0.5%

[10] The macro data on GDP and the CPI used in this paper were series published by the IMF's *International Financial Statistics* for each of the countries.

First-Order Autocorrelations (estimates of ρ)					
1973:2 to 1984:4					1976:3 to 1984:4
Output Gap	0.76	0.88	0.81	0.89	0.95
1985:1 to 1998:4					1985:1 to 1998:2
Output Gap		0.94	0.92	0.90	0.87
Standard Deviation of Output and Velocity Shocks (at quarterly rates) (in percent)					
1973:2 to 1984:4	Germany	Japan	United States	United Kingdom	Italy 1976:3 to 1984:4
Output Gap	1.47	1.01	1.44	1.36	0.87
1985:1 to 1998:4					
		0.98	0.53	0.74	0.65

The policy model developed above is calibrated to the five countries: Germany, Japan, the United States, the United Kingdom and Italy. We estimate values for the first-order autocorrelation in the output gap. The equation used to estimate ρ is given as

$$\Delta y_t = c + \rho\, y_{t-1} + \sum_{t=1}^{5} \phi_i \Delta y_{t-i} + e_t$$

The properties of the distribution for this estimate were discussed in Dickey and Fuller (1981). The equations used to estimate the autocorrelation parameters also yield estimates of the variance of the output shock for each country. The standard error of the output shock used in the calibrations is calculated as the standard deviation of the sum of two last terms in the equation,

$$\sum_{i=1}^{5} \phi_i \Delta x_{t-i} + e_t$$

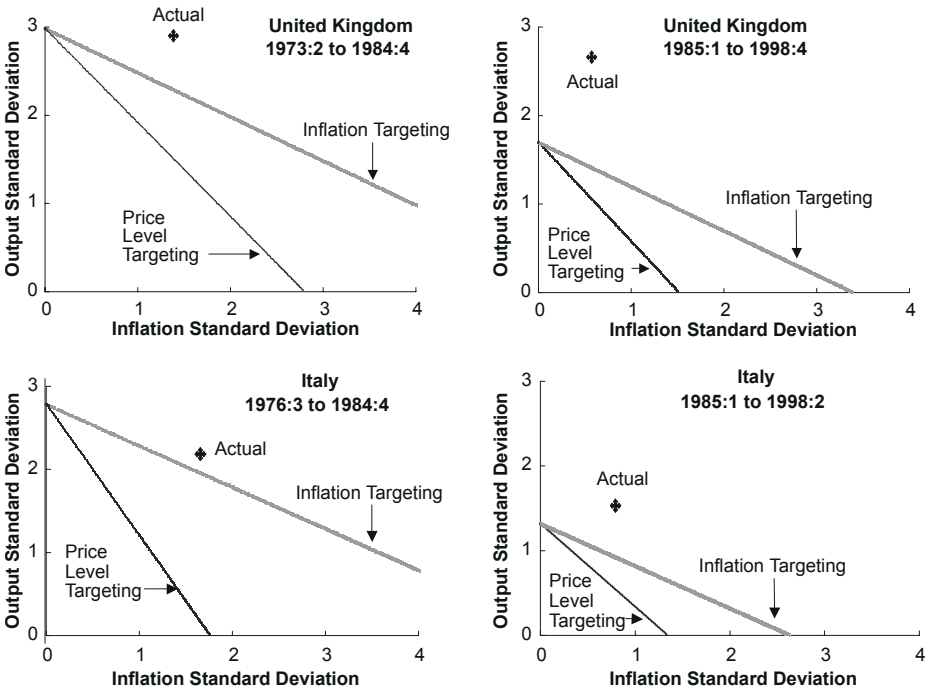
This was done because cyclical components in output are not adequately captured by our simple model.

The post-Bretton Woods period is split into two parts, 1973: Q2 to 1984: Q4 and 1985: Q1 to 1998: Q4. In the earlier period policy seemed to be more erratic with rising inflation in all countries but Germany. In the latter period, these countries all found a way to stabilize inflation. Table 3 shows the estimates of the autoregressive parameters calculated for the output gap for each period. The table also reports the statistics used to calibrate the models that generate the Taylor Curves in Figure 3.

For Germany, only the first-period results are reported because the data available did not adequately adjust for the effect of the unification on GDP and the monetary aggregates. The values used to calibrate the Taylor Curves for Germany (see first panel in Figure 3) are shown in the first column of Table 3. The standard deviation of the output shock was in the low end, equal to Italy's and somewhat greater than Japan's, but less than estimates for the United States and United Kingdom. However, the estimate of the persistence in the output gap was the lowest for all countries in either period. Since we are using Svensson's Neoclassical supply function, the relatively low persistence of the output gap means that the Taylor Curve for price-level targeting is not so far below the one for

inflation targeting. The location of the actual value of the output variance, 2.3 percent, is above the highest value suggested by the Taylor Curves generated from inflation-targeting and price-level targeting regimes.

Figure 3: Continued Taylor Curves for Selected Countries



Japan is a very interesting case because it is the only one in which the Taylor Curves shift rightward in the second period. The scales in the panels of Figure 3 are all the same so that the curves can be more easily compared. Note, however, that the comparisons across time for each country are more relevant than the comparisons between countries. The reason is simply that measurement methods may be so different that cross-country comparisons are suspect. In Japan's case, the standard deviation of the output shock is only slightly lower in the second period, while the persistence of the output gap is much closer to unity.

In the United States, the standard deviation of the output gap declined by about two thirds from the earlier to the latter period. Although there was a substantial increase in the persistence, there was still a large downward (leftward) shift in the Taylor Curves in the second period. The Taylor Curves for the United Kingdom in the earlier period look similar to the curves for Japan in the second period. In the United Kingdom, the standard deviations of both shocks fell by about half, and there was little change in the autocorrelation estimate for output. Italy is an interesting case because it has a relatively low standard deviation of the shock to the output gap, but has the highest persistence, so the Taylor Curves are not much different than those for the United Kingdom. The big leftward shift in the United Kingdom was associated with a lower error variance, while in Italy, it was a combination of a lower variance and a lower estimate of the persistence in output.

One common aspect of all selected countries is that the inflation variances are smaller in the second period, even in Japan, where the output variance is 50 percent larger than in the earlier period. In almost every case (the exceptions are Japan and Italy in the earlier period), the actual values for the standard deviations of the output gap lie above the maximum value for the standard deviation of output found on the Taylor Curves for inflation and price-level targeting. One explanation for this is that the model is too optimistic about the central bank's ability to control output. Perhaps the output variance is given by nature (or some other aspect of economic policy), and all monetary policymakers can do is stabilize the inflation rate. Indeed, some analysts have argued that the main service provided by explicit inflation targeting is to give central banks the political cover to ignore the output gap. The Taylor Curves shown in Figure 3 were calculated from pure policies. In future work, we intend to consider combination policies like those considered in the previous section.

CONCLUSION

Our research shows that commonly proposed rules for targeting inflation generate an enormous amount of uncertainty over the long run. Inflation targeting schemes do not provide a nominal anchor unless the central bank is focusing strictly on the inflation target and ignoring unemployment and the business cycle. Inflation has been unexpectedly stable in the 1990s. This may be partly because central banks have used inflation targeting as cover to ignore the real side. But, with the exception of Japan, it is also true that output fluctuations in these countries have been smaller in the 1990s than they were on average for most of the last half century.

The international monetary arrangements agreed to at Bretton Woods in 1946 reflected policymakers' confidence that they could build a system of fiat money standards that would provide price stability. For a variety of reasons, the system failed. The most important lesson that the Czech Republic, and all of us, can take from this experience is to focus on the inflation objective. Central banks focusing more sharply on inflation objectives have delivered lower and more stable inflation.

Research summarized in this article suggests that the most important step a central bank can take to improve focus on the inflation objective is to decide on a long-term path for the price level. Being explicit about the desired path for the price level not only reduces inflation variability at all horizons, but also gives the policymaker more flexibility to pursue output stabilization goals.

REFERENCES

Bernanke, Ben S., Thomas Laubach, Frederic S. Mishkin, and Adam S. Posen, 1999, *Inflation Targeting: Lessons from the International Experience,* (Princeton: Princeton University Press).

Black, Richard, Tiff Macklem, and David Rose, 1997, "On Policy Rules for Price Stability," Presented at a Bank of Canada Conference, *Price Stability, Inflation Targets and Monetary Policy* in Ottawa on May 3–4.

Cecchetti, Stephen G., 1998, "Policy Rules and Targets: Framing The Central Banker's Problem," *FRBNY Economic Policy Review* (June), pp. 1–14.

Cecchetti, Stephen G., Margaret M. McConnell, and Gabriel Perez Quiros, 1999, "Policymakers' Revealed Preferences and the Output-Inflation Variability Trade-off: Implications for the European System of Central Banks," unpublished manuscript, Federal Reserve Bank of New York, (February), New York.

Clarida, Richard, and Mark Gertler, 1999, "How the Bundesbank Conducts Monetary Policy," in *Monetary Policy Rules*, ed. by John B. Taylor, (Chicago: University of Chicago Press), pp. 363–406.

Clarida, Richard, Jordi Gali, and Mark Gertler, 1999, "The Science of Monetary Policy: A New Keynesian Perspective," *Journal of Economic Literatur*e, Vol. 37(4) (December), pp. 1661–1707.

Dickey, David A., and Wayne A. Fuller, 1981, "Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root," *Econometrica*, Vol. 49 (July), pp. 1057–72.

Dittmar, Robert, and William T. Gavin, 1999, "What do New Keynesian Phillips Curves Imply for Price-Level Targeting?" Working paper 99-021A, Federal Reserve Bank of St. Louis, (August).

——— and Finn E. Kydland, 1999a, "The Inflation-Output Variability Tradeoff and Price-level Targets," *Review,* U.S. Federal Reserve Bank of St. Louis, (January/February), pp. 23–31.

———, 1999b, "Price-Level Uncertainty and Inflation Targeting," *Review,* Federal Reserve Bank of St. Louis, (July/August 1999), pp. 23–33.

Fischer, Stanley, 1994, "Modern Central Banking," in *The Future of Central Banking: The Tercentenary Symposium of the Bank of England,* Forrest Capie, Charles Goodhart, Stanley Fischer, and Norbert Schnadt eds. (Cambridge: Cambridge University Press), pp. 262–308.

Friedman, Milton, 1968, "The Role of Monetary Policy," *American Economic Review,* Vol. 58 (March), pp.1–17.

Haldane, Andrew G., and Christopher K. Salmon, 1995, "Three Issues on Inflation Targets," in *Targeting Inflation: A Conference of Central Banks on the Use of Inflation Targets organized by the Bank of England,* ed. by Andrew G. Haldane, (London: Bank of England), pp. 170–201.

Kiley, Michael T., 1998, "Monetary Policy under Neoclassical and New-Keynesian Phillips Curves, with an Application to Price Level and Inflation Targeting," Board of Governors of the U.S. Federal Reserve System, Working Paper 1998–27, (May) (Washington).

McCallum, Bennett T., 1997, "Issues in the Design of Monetary Policy Rules," NBER Working Paper 6016, (April).

Roberts, John., 1995, "New Keynesian Economics and the Phillips Curve", *Journal of Money, Credit, and Banking*, Vol. 27:975–984.

Svensson, Lars E.O., 1997, "Optimal Inflation Targets, 'Conservative' Central Banks, and Linear Inflation Contracts," *American Economic Review,* (March), pp. 98–114.

———, 1999, "Price-level Targeting versus Inflation Targeting: A Free Lunch?" *Journal of Money, Credit and Banking, Part I* (August), pp. 277–95.

Taylor, John B., 1979, "Estimation and Control of a Macroeconomic Model with Rational Expectations," *Econometrica,* Vol. 47 (September), pp. 1267–86.

Williams, John C., 1999, "Simple Rules for Monetary Policy," Board of Governors of the U.S. Federal Reserve System, Working Paper 1999–12, (February).

Chapter 4

MONEY IN AN INFLATION TARGETING FRAMEWORK

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INTRODUCTION

What role is there for money to play in the transition economies? In many transition economies, the initial reforms to the financial sector required the creation of a two-tier banking system for which the challenge was to control the growth of credit to industry; for many countries the control of public sector financing of private sector activity involved a significant uphill struggle. Having restrained credit to some degree, most countries adopted monetary targets as a means of providing a nominal anchor to tie down inflation expectations and to limit the extent to which the public finances can be monetized. In these countries money occupies the principal position for monetary policy making, since the target is specified in terms of the growth rate in a chosen monetary aggregate. Some countries, most notably the Czech Republic, have abandoned monetary targeting in favor of inflation targeting so that money has a subordinate role to the future expected path of inflation, which is the target. Given the proven record of inflation targeting in the OECD countries, which contrasts favorably with the experience of the major monetary targeters, this is a welcome step. Alternatives do exist, such as the exchange rate targeting proposal of McKinnon (1998), but in the medium to long term they deliver the same policy objective of price stability. When money is not the target, the question posed at the beginning must then be amended to read "what role *remains* for money to play in the transition economies?"

In this chapter, we argue that money can still play a role as an important indicator variable through the corroborative and incremental information it contains on inflationary conditions. But before we reach that conclusion we show that monetary targeting is inherently difficult to master due to domestic and international sources of instability. The literature on money demand instability teaches clear lessons for transition economies that attempt to use monetary targets as anything more than a constraint on public finances and inflationary expectations. Money demand functions are too unstable to be relied upon for targeting purposes. International pressures from the use of the euro will also undermine the stability of the demand for money function in transition economies, making monetary targeting extremely difficult. The pressure in this dimension comes from the network advantages of a large currency domain and the incentives towards currency substitution.

INSTABILITY IN THE DEMAND FOR MONEY

Domestic instability

Consider the broader picture in the industrialized countries in the late 1970s and early 1980s. Up to the mid-1970s there was a consensus that the demand for money could be accurately represented by a long-run equation denoting equilibrium and a process of partial adjustment to describe the dynamics. The model was estimated using both annual and quarterly data for both the United Kingdom and the United States from the beginning of 1970s and it performed well, fitting the data within the sample and predicting accurately out of the sample. Laidler and Parkin (1970) and Goodhart and Crockett (1970) were the first to use the partial adjustment model in the United Kingdom, followed by Goldfeld (1973) in the United States, and initially these models appeared to perform well. Other studies for both countries showed the negatively signed interest rate coefficient was again confirmed, although there was much more disagreement over its magnitude. The short-run model provided the necessary information required for monetary policy, and so stable was the relationship that the "Goldfeld equation" became the standard framework. This was the position up to the early to mid-1970s.

The United States and the United Kingdom were then both about to experience two periods of change that would profoundly affect the demand for money function. The source of the first change

was the higher and more volatile inflationary environment as a result of the Vietnam war in the United States, the demand management policies of the Heath Government in the United Kingdom and the worldwide oil shocks in the mid-1970s and early 1980s. At the same time many credit controls on banks and individuals began to be circumvented and new institutional arrangements were introduced to attempt, unsuccessfully as it turned out, to create offsetting distortions. Later, in the 1980s, deregulation and innovation in the financial sector would create another change as interest bearing accounts, new financial products, new technological development and increased competition between traditional banks and thrifts would lead to a changing velocity of circulation. It was unknowable at the time that these would prove to be so unsettling for monetary policy.

With the benefit of hindsight, we can see that two features did point to later difficulties in the mid-1970s, when the model appeared to falter and ultimately broke down. In the first place, there was an inconsistency between the quarterly and the annual demand for money results. The annual studies assumed that there was full adjustment within a single year (one observation), and when quarterly data were introduced it became possible to put this assumption to the test by examining the speed of adjustment parameter, which quantifies the amount of adjustment taking place in each of the four quarters. The results suggested that the actual speed of adjustment was less than fifty percent, and occasionally as low as fifteen percent, of the difference between the actual and the desired level of money balances in one year. The adjustment to equilibrium took much more than one year. Lags of this length surprised many economists, since they implied that the money market was more sluggish than initially had been thought.

The second inconsistency appeared in the estimated interest rate elasticities. Theory suggested that it was reasonable to expect close substitutes to have high interest elasticities, since only a slight change in interest rates ought to provoke a redistribution of portfolios. Evidence from the short-run money demand studies indicated that the reverse was the case. Longer-term securities appeared to have higher interest rate elasticities with money despite the fact that they might be considered to be poorer substitutes. The statistical reason for this result was the lower amplitude of the cyclical fluctuations in interest rates on longer-term assets compared with short rates. Expectations of future short-term rates are generally considered the dominant influence on the yield curve, but the authorities tend to conduct transactions at the shorter end of the market. Therefore, the functional form that implies interest rates determine money balances exogenously and with a long lag will be called into question.

In Britain, it was the work of Haache (1974) that showed conclusively that the partial adjustment model was unable to predict accurately outside of sample for the period after 1971, recording significant negative forecasting errors for broad, narrow and sectoral aggregates. In the United States, Goldfeld (1976) came to the same conclusion showing that his model broke down from 1974, overpredicting money balances and implying that there was some “missing money” the existence of which had yet to be explained. Despite considerable effort on both sides of the Atlantic the model was not easily corrected to account for the inexplicable events of the period.

Initial attempts to understand the episode focused on the unusual monetary conditions that had led to greater financial innovation. Haache experimented with the yield on certificates of deposit as an additional explanatory variable in an otherwise unchanged partial adjustment model, restoring some of the predictive performance of the money demand function. Investigation by Artis and Lewis (1976), however, concluded that in experiments with different aggregates in real, nominal and per capita terms, even excluding CDs altogether, it was not possible to reverse the conclusion that the partial adjustment model suffered from serious prediction errors. Goldfeld, in the United States, added the interest on NOW and thrift accounts to the otherwise standard money demand

function, and, while he did remove the over-stated predictions to some degree, he remained unconvinced that this was the root cause of the problem. These unexplained patterns of behavior in the 1970s introduced a new agenda for empirical studies of the demand for money, which had ceased to be much more than routine applications of the accepted Goldfeld model. Both Goldfeld (1976) and Artis and Lewis (1976) concluded that the theory behind money demand estimation needed overhauling and in many respects the research agenda of the next 25 years was set by the breakdown of the partial adjustment theory.

Two research programs began to correct for the effects of expectational errors arising from volatile economic conditions and the process of financial innovation. The first attempted to capture the effect of volatility and shocks on money demand functions through the concept of money as a buffer stock. Money should then be thought of as an inventory that could temporarily depart from its desired level. The second examined the effects of higher inflation and financial innovation on the construction of monetary aggregates. The simple-sum aggregates used up to this point could be the cause of inferior performance in the money demand function, requiring reforms to the aggregation procedure. The outcomes of these research processes were synthesized into two main classes of models: the Buffer Stock models and the Divisia models.

Buffer stock models

In a far-sighted comment on Goldfeld's paper which exposed the breakdown in the United States, Brainard (1976) suggested an explanation for the "missing money" episode where "money balances serve as a buffer stock, or a temporary abode of purchasing power, and one would expect the transitory income to be absorbed passively in money holdings in the short run." (See Brainard, 1976, p. 735). If we were to recognize that there could be departures from equilibrium in the money market based on commonly accepted microeconomic principles, then money would act as a buffer stock. The idea that all individuals hold their long-run desired money balances at all times and are continuously on the LM curve would be replaced by the more realistic view that temporary departures can be rational and optimal.

Four groups of models emerged from this reasoning. First, *flow disequilibrium models* questioned the direction of causality between money and other variables, reversing the money demand relationship to make money balances exogenous and some other variables, such as prices, income or interest rates, endogenous (Artis and Lewis, 1976; Coats, 1982a and 1982b; Laidler, 1982). Second, *shock absorber models* introduced expectations into the analysis and allowed unexpected and anticipated events to affect the money demand function in different ways (Carr and Darby, 1981; and Carr, Darby and Thornton, 1985). The third group of models extended the shock absorber principle to an infinite horizon of future events, creating *forward-looking buffer stock models* (Cuthbertson, 1988 and 1991; Cuthbertson and Taylor, 1987 and 1992; and Mizen, 1994). Lastly, a separate group of models based on different microeconomic foundations gave a type of model based on inventory management (Miller and Orr, 1966; Akerlof, 1979; Akerlof and Milbourne, 1980).

In various ways, these models all treat money as an inventory for purchasing power, and by doing so recognize that departures from long-run equilibrium are both possible and optimal from the individual point of view. Money departs from equilibrium in the short run to ensure optimal intertemporal adjustment. For each individual agent it is optimal to hold balances that deviate from the long-term desired level over the short term rather than allow adjustments in other assets and real expenditure on goods and services at greater cost. The argument states that because money is by definition the most liquid asset, and therefore the least costly to adjust, portfolio reallocation and

expenditure patterns should be more sluggish than changes to money balances. Smoothing of adjustments is used to overcome the costs that would otherwise be incurred when alterations are required to less liquid balances and expenditures. The important point to note is that adjustment of money balances is determined according to an optimal rule derived from a cost-minimization exercise and any departure from desired balances, m*, is not a mistake or an error but a sanctioned and rational cost-minimizing option chosen by the individual.

The interpretation as a buffer stock has some very useful features. Two empirical puzzles are cleared up by this approach, since a) it reconciles the slow adjustment speed detected empirically by treating money balances as the least-cost repository for expected and unexpected changes to liquid assets, and b) it allows money to overshoot its long-run value by a practical mechanism that can be supported by empirical evidence. Success comes from the ability to "mop up" the excesses and deficiencies in liquidity observed over short periods in a more flexible way than other models, most notably the Goldfeld model, were able to do. They have worked particularly well in the countries that experienced significant instability in the money demand function due to unexpected shocks. Carr and Darby (1981), Coats (1982a and 1982b), Cuthbertson (1988, 1991), Cuthbertson and Taylor (1987, 1992) and Mizen (1994) all document improvements in the dynamic money demand function for the United Kingdom and the United States.

Divisia models

Divisia aggregates are based on the construction of optimal weights based on index numbers, and ultimately microeconomic consumer theory. Before Divisia approaches were widely known, conventional demand for money functions had been augmented by a set of dummy and other variables to allow for financial innovations (see Taylor, 1987; Hall, Henry and Wilcox, 1989), but this approach was always regarded as ad hoc. It simply assumed that all the components within the monetary aggregate should have the same weights in the aggregation process, and by implication would all be affected in the same way by financial innovation.

William Barnett (1980) has taken issue with this and a number of other assumptions in the models of the demand for money based on simple-sum aggregates, on three counts:

- The conventional approach assumes all assets are perfect substitutes with each other, regarding the components as equally liquid, yet at the same time quite different from the excluded items, which flies in the face of the evidence on the substitutability between components (Belongia and Chalfant, 1989; Belongia and Chrystal, 1991).

- The conventional aggregates ignore shifts between the components, so that components can vary over time without changing the total value of the aggregate. The equal weighting on each component gives each part an equal "price."

- If the assets are not perfect substitutes, contrary to the implicit assumptions, then there is no way of distinguishing between income and substitution effects on monetary asset components. A "good" aggregate should measure income effects but be unresponsive to pure substitution effects, yet a simple sum aggregate does not allow this.

The assumptions underlying simple-sum models may have been innocuous at first, but once the process of financial innovation and deregulation began, this undermined the reliability of the assumptions. Barnett's contribution to monetary economics has been to consider a class of aggregates that might overcome these problems and satisfy ideal or "superlative" properties for the

aggregation function. When a Divisia approach is used, the demand for money function should be more stable than its simple-sum equivalent and suffer less from the problems that plagued the Goldfeld equation. Through its ability to account for the gradual shift out of certain asset components into others, the Divisia is well placed to deal with financial innovation (see Mullineux, 1996). The variation in the weights is able to deal with changes to the monetary environment and the additional information, on the direction of flow of assets out of one component into another, is valuable.

The evidence for a more stable demand function when Divisia aggregates are used is compelling, suggesting that inappropriate methods were responsible for a lot of the instability in the Goldfeld equation. Chrystal and MacDonald (1994) and Belongia and Chrystal (1991) report results to show that the Divisia model out-performed conventional aggregates in the United States, Australia, Canada, Germany, Switzerland, Japan and the United Kingdom using standard diagnostic tools. The Divisia aggregate is shown to have desirable properties as a leading indicator to predict nominal output and inflation in a test against a St. Louis equation for the United Kingdom, Australia, Germany, Switzerland, Canada, Japan and the United States. The superior performance derives from the elimination of distortions due to financial innovations in the late 1970s and early 1980s and the extra information on substitution and income effects, gained by weighting components differently (see Barnett, 1980; Barnett, Offenbacker and Spindt, 1984: Belongia and Chalfont, 1989).

Transition economies

It is clear that over a period of two decades the United Kingdom and the United States experienced significant financial market changes. These greatly altered the relations between the money supply and the determinants of the demand for money, unsettling the relations that had been presumed to be stable. Although these two countries did not move from centrally planned economies to a free market, there are many similarities to be drawn between their experiences and those of the transition economies. The most striking difference, however, is the sheer speed with which these events have taken place in the transition economies.

It is no surprise to find that money demand functions in transition economies estimated by time series methods do not exhibit stable properties given the short sample of data due to the change in regime. We would expect them to face the same kind of instabilities that the industrialized countries experienced in the 1970s and 1980s, but an order of magnitude larger given the speed and scope of transition. Reforms have been large and rapid, and it would be odd if they did not have an effect on the demand for money and the relations underlying monetary control. The scale of transformation required to take an economy from a centrally planned organization based on the Soviet model to a free market economy with an orientation towards the West is colossal and the accompanying reforms to the financial sector are bound to be equally dramatic.

For transition economies the problem of instability is a pressing problem. The question is what can be done to ameliorate its effects. Papers that include sample data from pre- and post transition are more readily available (see Charemza and Ghatak, 1990; Chawluk and Cross, 1994; and Nijsee and Sterken, 1996; for examples), but these cannot necessarily tell us a great deal about the short period since transition began. Yet there is insufficient time series data to estimate highly sophisticated empirical models in place of the relatively simple short-run equations for the period since transition. So the solutions worked out over the last two decades may be applicable and useful for industrialized countries, but, without sufficient data, the functional forms cannot be estimated for transition economies, because they are more data-intensive than other methods. This leaves little

option but to attempt to estimate money demand functions with the time series data that are available, but to be wary of attaching too much precision to the results until such time as the estimated elasticities settle down and the forecast performance improves. Simple error feedback models can be estimated, but these stretch the cointegration methodology to the limit, as they typically work with small samples of monthly data of at best seven or eight years and often much less than that. It seems that until a longer time series is collected we will be unable to make corrections to the short-run money demand function to account for the effects of unexpected shocks and financial innovations in this way. This does not bode well for monetary targeting, as we will discuss later.

One option that is available is to use pooled or panel data from a range of transition economies. This ensures that there are a sufficient number of observations to estimate a demand for money function, but when the transition economies borrow information from each other there are a number of qualifications that must be borne in mind. First, the domestic reform programs and experiences of transition economies have all been different and therefore the properties of the demand for money in one country are not strictly comparable with the properties of the demand for money in another. Second, some economies have made more progress in reforming the centrally planned structures which had formerly existed than others. This means that the extent to which there have been reforms to soft budget constraints and credit control, financial markets, and industrial organization all differs between countries. Nevertheless, group effects can be used in order to isolate country-specific effects in the intercepts to provide a means of dealing with these differences. Begg et al. (1996) report "tolerably good" demand for money functions estimated using M2 data from 13 transition economies. Although there is evidence that velocity was changing over the sample within countries, the estimated equations were able to capture a stable relationship. While these provide a starting point for monetary targeting, Begg (1997) notes that there is still a requirement to forecast real output and prices before a sensible target for money can be determined. Determining the level of production relative to capacity and the evolution of prices makes this a formidable task.

It appears that the empirical problems at the domestic level stack up when we attempt to estimate money demand functions for the purposes of monetary targeting. The next section explains that there are just as many reasons to believe that the international environment is equally unpredictable.

International instability

The reasons given above relate to the unpredictability of the demand for money due to domestic developments. This section considers external events that could further exacerbate the instability in the demand for money. The argument is based upon the observation that some currencies emerge as international currencies with significant use by third parties in transactions that do not involve residents of the issuing country on either side of the transaction. These vehicle currencies can greatly undermine the stability of demand for money of near neighbors. The use of the vehicle rather than the domestic currency unit may be more desirable as the network of users increases. With the euro on their doorstep it is likely that the transition economies will be affected by this phenomenon, and the result will be further instability in the demand for money.

The euro as an international currency

The euro is likely to emerge as an international currency, and this will create instability in the demand for money in transition economies. Crucial to the analysis is the effect of the scale of the markets and the low-inflation environment expected to prevail in the EU-11 area, (Mundell, 1998).

In terms of Mundell's four features, the euro appears to have the necessary characteristics of an international currency. It has a sizable network (or domain) defined by the combined GDP of the EU-11 countries—this is close to the U.S. GDP of $6.8 trillion and encompasses a larger population of 289 million residents. If we consider the possibility of enlargement or the scope of the markets with which the EU trades imported or exported goods, the network could extend to a much larger market.

Likewise on stability the EU looks set to fulfill the criteria for an international currency. The European Central Bank (ECB) has shown that it intends to use monetary and inflation targeting to achieve low inflation and low price variability to match the performance of the Deutsche Mark, making the euro a suitable currency for pricing contracts. Mundell concurs with these views, although he is less than convinced that the euro has the political stability and fall-back value to attain a true international currency status. There are reasons to disagree with his conclusions, however. The euro has the political backing of its member states and that is likely to be sufficient to support it in the absence of a central state. The economic incentives for countries to "make it work" would seem to be sufficient: one cannot otherwise explain the continuation of the European Monetary System after the disastrous experience of exchange rate targeting in the Exchange Rate Mechanism (ERM) during 1992–93. On the question of the fall-back value, it can be pointed out that none of the international currencies of the post-war period has a fall-back guarantee, since they are all fiat moneys built on trust. In the absence of this characteristic, a constitutional commitment to inflation control appears to have reassured wary investors that the purchasing power is not likely to be jeopardized.

If the euro does become an international currency, then what will encourage its use beyond the borders of the EU-11? We advance some reasons why the transaction costs and network externalities central to the emergence of international currencies will encourage the use of the euro by residents outside the EU area, and particularly in transition economies. On January 1, 1999, residents of the EU-11 countries found their diversified deposits redenominated into euros. Swoboda (1969) has shown, by an application of the Baumol-Tobin square root rule, that it is more efficient to hold deposits in one currency than in many, in proportion to the needs of trade and inversely with the relevant opportunity cost. The existence of a single currency would increase efficiency by reducing the total level of balances required. The reduction in the optimal balance required overall will cause an excess stock of euros in the initial stages to be offloaded in other assets or goods.

Ultimately, to offload the deposits the euros will need to be exchanged for assets and goods priced in other currencies, so the euro may depreciate. The economization of liquid balances, the reduction in the costs of currency management, and the lower staffing levels associated with foreign exchange management for the members of the EU-11 will put them at an advantage compared to those outside the euro area. The excess (the difference between the original diversified deposits and the new, lower, optimal level of deposits in euros) and savings from economization could be reallocated into less liquid interest-bearing assets, earning a higher rate of return, or simply be spent on goods and services. These advantages may persuade those outside the EU-11 to hold deposits in euros rather than in domestic currency, so that they also gain from the reduction in total liquidity.

In the first instance, multinational firms will reap the benefits of many economies through more efficient foreign exchange management. Anecdotal evidence suggests that changes are already under way to ensure that they are exploited. The toolmaker Trumpf (Germany), cited in the *Financial Times*, December 17, 1998, suggests that although conversion will involve costs of installing new software and currency management systems amounting to a one-off payment of DM

2 million, they will save DM 1 million annually from the reduction in staff costs and payments made to banks for currency conversion. If these figures are representative, a payback period of two years provides a good incentive for companies to make the conversion to handle euro deposits and price in euros rather than in national currency.

Trade patterns, externalities and currency usage

If the introduction of the euro is to have a major effect on the holdings of currency and deposits, then it is likely to operate through trade patterns and invoicing behavior. Firms that have substantial bi-directional trade with EU-11 countries may prefer to invoice in euros: survey evidence suggests that up to half of sales to the EU will be invoiced in euros, and many sales outside the EU will be invoiced in euros to make pricing more transparent. The dividing line is likely to be between large companies, which will probably handle receivables in euros, and small or medium-sized enterprises, which will continue to pay for goods and services in domestic currency. On the basis of the 1997 direction of trade statistics, if half of the exports to the rest of the EU from euroland countries are invoiced in euros, then this would amount to $540 billion in trade, while if importers from the rest of the EU insist on paying in euros this would amount to another $417 billion. By holding the proceeds in euro (transaction) accounts rather than in other currencies (that will later need to be transferred back to euros at a future, uncertain exchange rate), firms will reduce their transaction costs in the foreign exchange market and their exposure to currency risk.

In an interview with the *Financial Times*, deputy head of Imperial Chemical Industries (ICI) Peter Everett indicated that the euro is likely to be the normal transactions vehicle for trade between ICI and its customers and suppliers in the United Kingdom, Denmark, Sweden and Greece as well as the EU-11. There is no reason why this could not also be true for transition economies. While the customers may not always be invoiced in euros, suppliers are likely to be paid in euros under the "no compulsion, no prohibition" ruling that companies can usefully use to make payments of invoices in euros to facilitate a hedging operation against the large euro takings from elsewhere in Europe. The network externalities to customers and suppliers in these countries will be large, and even for countries outside of the EU such as Switzerland, which imports $58.3 billion of goods from the EU and exports $45.3 billion to the EU, the rewards for using the euro could be considerable. The export/import trade of the transition economies is also large.

Financial markets

The European capital market is about as large as the U.S. market. At the end of 1995, the EU-11 area had total trade in bonds, equities and bank assets of $21 trillion versus the United States at $23 trillion. The market for futures and forwards is more skewed toward the United States, since the derivatives trade in Europe represented only 36 percent of the U.S. level according to 1995 figures (Thom et al., 1998). Accounting for the total trade within Europe, the capital market will be very large, but much of this trade will fall off now that intra-EU trade has been eliminated by the single currency. However, the deeper capital market (with lower transaction costs of operating through euros versus the dollar or the yen) may gain trade for the euro, which may offset the reduction due to monetary union (Hartmann, 1996). Financial institutions that do not deal in the euro will lose credibility and therefore business. Recent estimates by Morgan Stanley Dean Witter suggested that up to $1300 billion of new money would flow into new equities in euros from fund managers alone in the next ten years. Many investors have begun to treat financial markets as if they were pan-European, even though this is some way off, by no longer conducting operations on a national level but adopting a new sectoral basis for investment. Companies now work to raise finance on a continental level in larger markets and bid-ask spreads are likely to fall in Europe as a result.

Restructuring of financial arrangements will help remove segmentation in the market and improve competition through transparency, first of all at the corporate level, but subsequently for the retail sector. The outlook for some small traders with specializations in niche markets is therefore bleak. The markets for debt are likely to experience some redenomination into euros as banks issue debt in euro to buy back current debt in dollars (McCauley, 1997).

It will take some time for the euro to establish its own credentials as a suitable international currency, but it will certainly assume a second-place position to the dollar for two reasons. First, the euro is a direct replacement for the second placed international currency, the Deutsche Mark. This means that the domestic markets of Germany and the other EU-11 countries will all adopt the euro as their domestic currency. The euro will have considerable network externalities in their wider export and import markets and this will create incentives for residents of those countries to use the euro as a transaction vehicle for the reasons outlined above. We agree with Gebhard (1998) that the euro will take on the transaction-vehicle role of the Deutsche Mark, but the euro will also have a significantly wider market, comprising a share of world trade at least as large as that of the United States (a share equal to a quarter of world trade) according to estimates by Hartmann (1996). Second, the ECB has shown that it has no intention of abandoning the low-inflation reputation of the Bundesbank, but rather, as an institution without a history, intends to reap as much credibility as possible by emulating the Bundesbank's monetary policy stance. This ought to provide a sound footing for the euro as a currency in which to conduct trade. Together these features will create a large demand for the euro as a transaction vehicle outside, as well as inside, the EU-11.

These reasons suggest that the nonbank private sector of transition economies has good reason to consider using the euro, and these will induce changes in the level of demand for domestic currency that will be sure to lead to further volatility in the demand for money. The extent to which transition economies are dollarized gives an indication of the readiness with which a stable international currency is already used as a vehicle in place of the domestic currency unit. The result is that any policy regime that relies on the stable relationship between money and a small number of explanatory variables is liable to experience a considerable upset. Much of the money supply is unrecorded and beyond the control of the national central banks; with the euro on the doorstep it is likely that this component will continue to grow. We conclude that international financial developments make monetary targeting unworkable just as much as the domestic reasons discussed above.

MONETARY TARGETING

The experience of monetary targeting in industrialized countries is mixed. The United States and the United Kingdom both experimented with different forms of monetary targeting and abandoned the attempt after they experienced a lack of control over the key aggregates. In the United States under Chairman Paul Volcker, the Federal Reserve attempted to target nonborrowed reserves during the period 1979–82. The annual growth of the money supply showed some reduction as a result, but the short-term (quarter to quarter) growth rate of money increased dramatically. In part, this was due to events beyond the control of the Fed, such as credit controls and financial innovations implemented by the government and banking sectors. It also reflected the instability in the money demand function and in particular the increase in the incidence of unexpected changes to the money supply. In the United Kingdom, the new Conservative government under Prime Minister Thatcher introduced a medium-term financial strategy (MTFS) in 1979 with targets assigned for sterling M3 for the next four years. A number of unexpected events such as the oil price shock, the increase in indirect taxes and misaligned exchange rates undermined monetary control. In 1985, after a period in which the MTFS was effectively ignored, the United Kingdom adopted an exchange rate target.

German policy operated by the Bundesbank, by contrast, has always been regarded as the paragon of monetary targeting experience by outside observers. It has been argued that the demand for money is more stable in Germany than elsewhere, possibly because of the lack of significant bursts of financial innovation. The benign environment might explain the better relative performance, but there has not been unqualified success. A review of the annual performance of the Bundesbank by Schmid (1998) reveals that in 22 years of monetary targeting there were as many years of failure as there were of success. It has been argued by Artis et al. (1998) that the Bundesbank was able to excuse itself for missing the monetary targets on the grounds of its low-inflation performance. The Bundesbank may have been inflation targeting all along, adopting monetary reference values for cosmetic reasons.

Table 1. Monetary Targets and their Implementation

	Target growth of the central bank Money stock or M3* (percent)			Actual growth (rounded figures) (percent)		
Year	In the course of the year†	On an annual average	Concretizing of target in the course of the year	In the course of the year†	On an annual average	Target met
1975	8	-	-	10	-	No
1976	-	8	-	-	9	No
1977	-	8	-	-	9	No
1978	-	8	-	-	11	No
1979	6 to 9	-	Lower Limit	6	-	Yes
1980	5 to 8	-	Lower Limit	5	-	Yes
1981	4 to 7	-	Lower half	4	-	Yes
1982	4 to 7	-	Upper half	6	-	Yes
1983	4 to 7	-	Upper half	7	-	Yes
1984	4 to 6	-	-	5	-	Yes
1985	3 to 5	-	-	5	-	Yes
1986	3 ½–5 ½	-	-	8	-	No
1987	3 to 6	-	-	8	-	No
1988	3 to 6	-	-	7	-	No
1989	5	-	-	5	-	Yes
1990	4 to 6	-	-	6	-	Yes
1991	3 to 5	-	-	5	-	Yes
1992	3 ½–5 ½	-	-	9	-	No
1993	4 ½–6 ½	-	-	7	-	No
1994	4 to 6	-	-	6	-	Yes
1995	4 to 6	-	-	2	-	No
1996	4 to 7	-	-	8	-	No
1997§	3 ½–6 ½	-	-			

Source: Schmid (1998).

* Since 1988: M3.

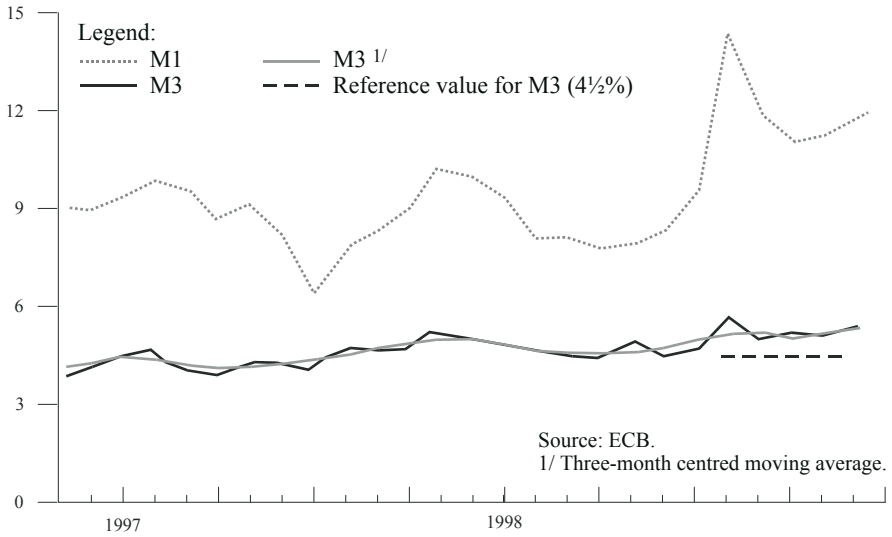
† Between the fourth quarter of the preceding year and the fourth quarter of the current year: 1975: Dec. 1974 to Dec. 1975.

‡ According to the adjustment of the monetary target in July 1991.

§ Embedded in a two-year orientation for 1997/98 of about 5% per year.

In recent months the ECB has attempted to reap the benefits of the Bundesbank's history by establishing a monetary reference value of 4.5 percent alongside a target for inflation. The experience of monetary policy making to date shows that since January 1, 1999 the growth of the broad money measure has exceeded the reference value (Figure 1). In fact, it would be necessary to go back to 1997 to find a rate of growth that was near to the reference value of 4.5 percent. In reality, it seems that other measures of the monetary stance offer a more pressing concern than the monetary reference value (despite protestations to the contrary).

Figure 1. Monetary Aggregates in the Euro Area (annual percentage changes)



Both the Bundesbank and the ECB refer to the monetary indicator as a "reference value," not a target; it is reasonable to assume that a reference value is a guide to policy setting that can be missed by over- or under-shooting of the ranges. Rather than interpret these deviations as indications that the monetary references were failing, perhaps they should be thought of as short-term variations in relation to a desirable long-term value for money growth consistent with velocity. Bennett McCallum has continued to discuss the view that money growth should have a monitoring range for this purpose—not necessarily as a target but as a means of determining the growth of money against a desirable range—defined by the McCallum rule (McCallum, 1988). The McCallum rule defines the instrument of monetary policy as the narrow money base, *m0*. The rule is written as

$$m0_t = k_{t-1} - v_{t-1} + \theta\ (z^* - z)_{t-1}$$

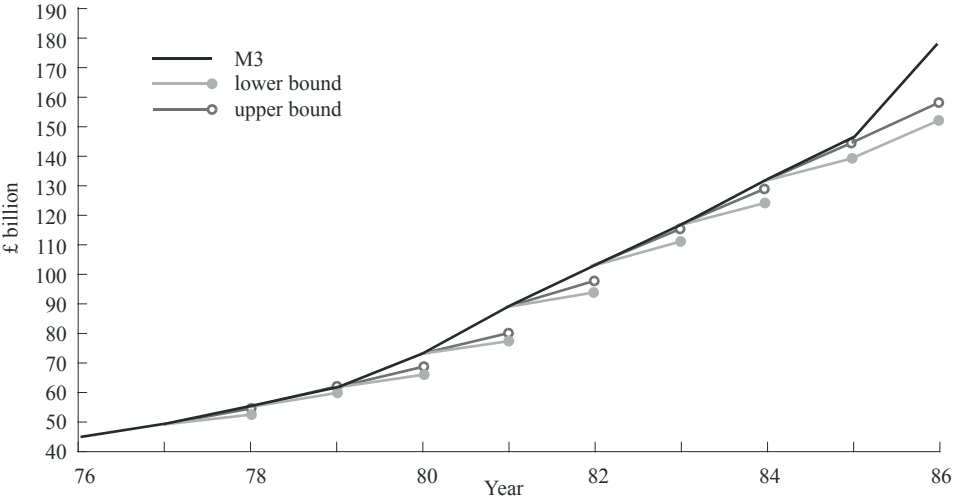
where $m0_t$ is the growth rate of nominal narrow money supply, k_{t-1} is a target level of money growth, v_{t-1} is a lagged 16-month moving average of velocity growth, and $(z^* - z)_{t-1}$ is the deviation of a nominal income growth from the target rate, z^*. The parameter weight is θ, and t is a time subscript; all variables are in natural logarithms. Strictly speaking, this is a form of nominal income target rather than a monetary target, but it does prescribe a reference value for the narrow money measure that, if adhered to strictly, would be a monetary target. If the economy is at the target growth rate for output and money demand equals its desired level (i.e. $v_{t-1} = 0$ and $(z^* - z)_{t-1} = 0$), then $m0_t = k_{t-1}$.

Thus, in a dynamic sense, McCallum's rule approximates a Friedman money-growth rule, where k_{t-1} is the growth rate. This interpretation has led many economists to consider the McCallum rule as a dynamic monitoring range for narrow money, which is endogenously supplied by the central bank. Even under an inflation targeting regime, this could be used as a reference value to determine whether monetary growth is excessive in relation to the optimal rule. We will consider the informational role of money in the next section.

Together, these observations on the conduct of policy from the United States, the United Kingdom, Germany and Europe offer mixed advice on the usefulness of a reference value. We should add that whenever monetary targeting has been attempted historically, Charles Goodhart has observed that no matter how regular a relationship may appear at first, "any observed statistical regularity will tend to collapse once pressure is placed upon it for control purposes" (Goodhart's Law, Goodhart, 1984). Clearly, even if a stable and reliable relation between money and real output did exist in transition economies, it would be liable to break down once the authorities relied upon it for policy making. This has been the experience of both the United Kingdom and the United States, although the instability of the basic function and the exposure of their economies to significant shocks could hardly have been a good starting point for their monetary targeting experience. Perhaps Goodhart was right to describe his law as a mixture of the Lucas critique and Murphy's law!

Monetary targeting is a strict framework for monetary policy because it requires two conditions to be met. First, the central bank should be able to exert close control over a monetary aggregate of its choice, whether this be a narrow or a broad measure, and second, there should be a reasonable connection between the chosen aggregate and nominal income. The first condition was plainly violated in all cases, but most blatantly in the United States and the United Kingdom, as Figures 2 and 3 demonstrate.

Figure 2

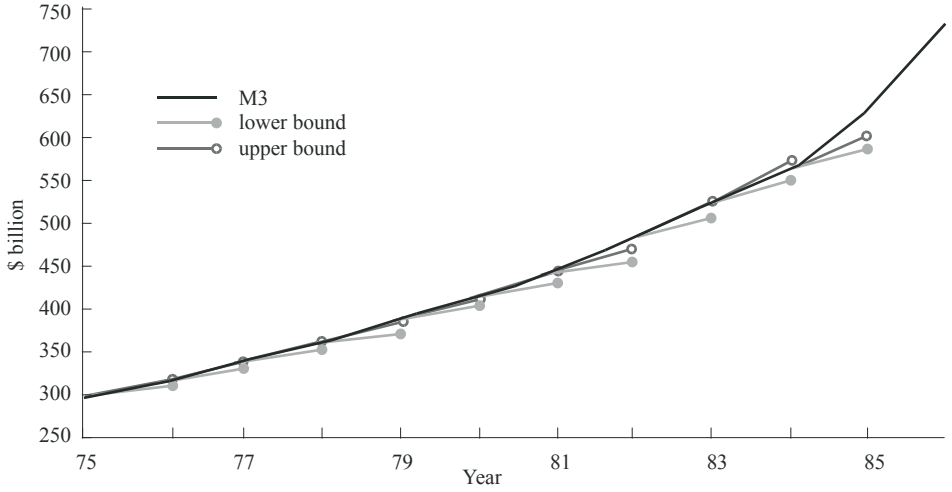


The method of targeting M3 changed in 1985 from the use of cones to the use of tram lines, as shown above.

Source: Bank of England Quarterly Bulletin (1986) p. 500.
Goodhart, 1989

For the latter to hold, a stable and predictable money demand function is required. Judd and Scadding (1982) argued that a money demand function useful for policy should be a) statistically predictable, b) a simple relation between explained and explanatory variables, and c) clearly influential over real variables. In the period of the late 1970s and early 1980s, this could not have been further from the experience of most of the industrialized countries that adopted monetary targets, with the exception of Germany. The experiences of the industrialized countries twenty years ago are not isolated events; they are in fact our most closely examined practical guides to the way that countries perform under monetary targeting.

Figure 3



During the 1970s the annual targets were rolled over quarter by quarter. This ceased in 1978. To simplify the chart the Q4-Q4 target ranges for those earlier years are shown.

Source: Federal Reserve Bulletin, various issues, e.g. April 1978, p. 267; April 1985, p. 179. Goodhart, 1989

Transition economies have also failed the test of monetary targeting under similar circumstances. There is limited ability to control monetary aggregates to the fine degree required by monetary targeting. Table 1 shows that, excepting Poland and the Czech Republic, broad money growth has been high and volatile. Although these countries and other transition economies have an improving record on monetary control, the inflation rate has declined much more than the money growth rate, which suggests that monetary targeting may not have played a significant role in this process. This has not prevented many of these countries from attempting to set targets for money growth or kept them from continuing to do so, since these countries may have good reasons based on the restraint of inflationary pressures. We do not have counterfactual information on the growth rates that might have occurred without targets to constrain inflationary expectations and public finances. Given the experience of volatility, we can only claim that the monetary targeting policy has been useful in that it has helped to restrain excess rather than to finely adjust monetary conditions.

Table 2. Broad Money Growth
(percent change per annum)

	1991	1992	1993	1994	1995	1996	1997
CEE Countries:							
Albania	104.4	152.7	75.0	40.6	51.8	43.8	41.3
Bulgaria	110.0	53.6	47.6	78.6	39.6	124.5	359.3
Croatia*	n/a	n/a	n/a	111.9	24.6	37.9	20.9
Czech Republic	26.8	20.7	19.8	19.9	19.8	9.2	10.1
Estonia	n/a	71.1	86.5	31.0	30.5	36.6	40.4
FYR Macedonia	n/a	n/a	n/a	n/a	0.3	0.5	8.0
Hungary	35.7	27.3	15.7	13.0	20.1	22.5	19.4
Latvia	153.0	169.9	84.1	47.7	-23.1	19.9	38.7
Lithuania**	143.0	245.3	100.4	62.9	28.5	-3.5	34.1
Poland	37.0	57.5	36.0	38.2	35.0	29.3	29.6
Romania	101.2	79.6	141.0	138.1	71.6	66.0	48.9
Slovak Republic**	n/a	n/a	16.8	20.1	19.2	16.5	8.9
Slovenia	n/a	131.6	64.2	50.7	30.2	19.4	22.6
CIS Countries:							
Armenia	n/a	n/a	n/a	684.0	68.7	35.1	20.6
Azerbaijan	n/a	n/a	685.9	486.1	122.2	25.8	14.3
Belarus	n/a	n/a	n/a	181.8	173.7	52.4	111.4
Georgia	n/a	464.0	4319.0	2229.0	146.4	41.9	29.0
Kazakhstan	211.0	391.0	692.0	576.0	103.8	14.7	12.9
Kyrgystan	84.0	428.0	180.0	125.0	76.7	22.4	19.9
Moldova	n/a	361.7	320.2	115.7	65.2	15.3	25.7
Russia	125.9	568.1	425.8	197.5	127.5	33.7	30.0
Tajikistan	68.0	579.0	1429.0	159.0	413.0	144.0	112.3
Turkmenistan	n/a	n/a	n/a	984.0	448.0	429.0	82.0
Ukraine	n/a	n/a	758.0	573.0	117.0	35.0	28.0
Uzbekistan	n/a	468.0	784.0	680.3	158.0	100.0	34.6

Source: EBRD
* = M1, ** =M2.

There is instability in the short-run money demand function that makes econometric identification difficult. This may simply be due to the short data sample from which the estimates are derived. Alternatively, it may be because the observations at the beginning of the sample come from a distribution very different from the ones at the end of the sample, and each successive observation adds more information from the latter. If this is so, the solution is simply to wait for data to accrue and to be wary of coefficient estimates based heavily on behavior in the early stages of transition. Whatever the true reason, the short-run money demand function is highly unreliable—with a number of economic factors all contributing to a shifting money demand function: the rapid innovation in credit and financial markets, the reform of pricing structures, the variation in output due to the reorganization of production, and a host of reforms to exchange rate arrangements. Money demand functions of transition economies in recent years have been equally difficult to predict, owing to the internal and external shocks that have buffeted their economies in the wake of the Asian crisis, and for this reason have not been sufficiently stable to be relied upon for policy purposes.

MONEY AS A CORROBORATIVE AND INCREMENTAL INDICATOR

What role is left for money under these circumstances? In an inflation targeting framework, money growth can serve as a corroborative and incremental indicator of inflationary conditions. Data on the growth of the money supply may be useful as a reference value if the structure of the economy ensures that inflationary impulses and pressures are observed in monetary data first. Thus, money may be a good leading indicator because it corroborates information that will be observed elsewhere at a later date. The information content of money is important in this case as a corroborative measure of inflationary pressure that will ultimately be confirmed in other data collected at a lower frequency, and as an incremental variable that adds information on the current conjuncture. For this reason, money retains a central place in an inflation targeting approach; even if it is not the final target of policy, it is an important indicator.

Monetary growth figures are a central part of this information set. As we have already argued above, money growth in relation to a reference value may have some value as an indicator of the inflationary stance of the economy for the operational side of a central bank's activities, even if the reference is not a target as such. An alternative to a reference value is a measure of the extent to which the stock of money departs from its equilibrium level. This view assumes that money markets do not clear within the typical period of measurement for empirical work so that departures of money balances held (m_t) from their desired long-term level (m_t^*) persist. A justification for this view can be found in the concept of money as an inventory of purchasing power, or a buffer stock notion of money (Laidler, 1982).

This view immediately raises the question of how should we define equilibrium? Defining m_t^* to correspond to a full equilibrium situation means all forcing variables in the function determining m_t^* would need to be at their steady state for equilibrium to result, and all expectations should equal their actual values. Not only is it difficult to agree on a measure of the steady state value of the forcing variables, but it is the exception rather than the rule. If m_t^* is defined in this way, m_t will depart from m_t^* most of the time and disequilibrium will be the norm. Perhaps a better definition of m_t^* is as an equilibrium that is dynamically consistent with the behavior of m_t. Allowing m_t^* to be a well defined, stable function of a small number of forcing variables is the conventional approach, just as the summary of the money demand literature by Judd and Scadding (1982) asserts. The money demand relation has been much more stable in the long run, as tables of historical estimates of these functions demonstrate (see Artis, M. J., P. D. Mizen and Z. Kontolemis, 1998), so a measure of m_t^* based on a stable long-run money demand relation would be appropriate and feasible. In view of the statistical advances that have been made in treating the properties of economic series that are non-stationary, these relations have been confirmed as meaningful statistical relations and not spurious ones. We can conclude that a useful empirical concept of m_t^* is the cointegrating relation between m_t and weakly exogenous forcing variables in the long run. The measure (m_t - m_t^*) is then a stationary variable by definition that explains the mean reverting behavior of money balances. From the Granger Representation Theorem we know that this will be systematically related to the change in money balances over the short term, explaining the dynamic evolution of money balances. Even with the relatively short spans of data available in transition economies a simple cointegrating relationship may be discernible.

If we adopt a measure of disequilibrium, we will have a clearer view of the level of unwanted balances held. But the interpretation of deviations of m_t from m_t^* is not straightforward either. There are many reasons for m_t to deviate and for m_t^* to change from a value that would ensure $m_t = m_t^*$. Variations to m_t^* may arise owing to adjustments to money balances for transaction reasons arising from future increases in expenditures because of growth in income streams; adjustments to money

balances for precautionary reasons arising from uncertainty about the future requirements for money balances; or adjustments to money balances for speculative reasons arising from news or information that changes expectations about portfolio arrangements.

These amount to permanent shocks to income, interest rates, risk assessments and inflation expectations over the forecast horizon. To avoid simply matching these changes, one must assume that there is some sluggishness in the adjustment of m_t. If an inherited level of money balances from the previous period has not been fully adjusted towards equilibrium, this amounts to a view that money balances are autocorrelated owing to the impact of transactions or search costs. But m_t* may adjust slowly if there is a permanent change to *expected* future receipts to money balances (adjustments are made to balances held for transactions purposes in the light of known receipts); if a temporary change to *expected* future receipts to money balances is smoothed (adjustments are made to balances held for transactions purposes in the light of known requirements); or if money balances rise owing to *unexpected* receipts (balances held are held as a buffer stock). The first case would constitute the effect of an expected permanent shock to future money balances. It originates in a change in the expected future evolution of m_t* and is transmitted to m_t because the costs of adjustment to a new level of desired money balances can be minimized by anticipating the future requirements. The second case, refers to a temporary but expected change in m_t*, which may result in a smoothed path for m_t. It will entail less disruption than the first case simply because it is temporary. Finally, the last case is an unanticipated shock to money balances. The excess balance would be held in liquid form to avoid adjustment costs.

A disequilibrium due to any of these reasons is difficult to interpret as a signal of future inflationary behavior because it could arise for many different reasons. Consumers may be reluctant to spend owing to an uncertain economic environment or they may have built up a stock of resources in anticipation of the need to spend in excess of the long-term level in response to imminent events. In the first case, there would be a dampening effect on the real economy, with an expectation of a more placid inflationary outlook, while in the second, where the anticipated need to spend is a signal that the imbalance in outstanding balances will shortly be run down by spending on other assets or goods (i.e. a forewarning of inflationary pressure). The use of a disequilibrium measure on its own is useful only in conjunction with other information from other indicators. However, the use of impulse response functions and the reduction of the change to m_t* into contributions from the constituent components would help to assess the underlying reasons behind shifts in (m_t - m_t*), if there were no other information to rely on.

Nevertheless there is a sense in which it is better to look at (m_t - m_t*) rather than just money growth. This can be explained in terms of the parallel between money and inventories. When we consider the effect of innovations to inventory management in industrialized countries we will note that optimal inventories of finished goods in the United States and United Kingdom have fallen steadily as a result of computerized management (just-in-time technology). This means that the growth rate of inventories is below trend because the level of inventories has been run down systematically over the period. Management processes have reduced the optimal level of inventories. We should assess the (falling) optimal level and monitor the deviation of the actual level from it to get a clear picture of inventory patterns at a time when the desired level was not a fixed notion.

The analysis above implies that we should look at (m_t - m_t*) as well as the growth of m_t during periods of financial innovation. Clearly, some aggregates will be more affected by financial innovations and economic transition than others. Velocities may be unstable and difficult to assess

in transition economies, but we are better off knowing where aggregates lie in relation to m_t* than if we remain ignorant about the evolution of desired balances.

CONCLUSIONS

This chapter has set out the principal role of money under an inflation targeting framework. For domestic and international reasons, monetary targets are regarded as likely to be as unstable as they were in the experience of the industrialized countries in the late 1970s and early 1980s. It is possible that the instability could be worse, since the transition economies are experiencing much more rapid transition in the real economy and financial markets than any of the industrialized countries. At the same time, the most dramatic experiment in monetary policy design is being engineered on their doorstep as the euro is adopted as the common currency of the EU countries.

While we have argued that these countries would be unwise to follow monetary targeting if a viable alternative exists, we have not suggested they should ignore money altogether. Rather, to answer the question of what role *remains* for money to play in the transition economies, we have suggested that money has a key role as a provider of incremental and corroborative information. This chapter has made the case for a careful assessment of monetary conditions through the analysis of the growth of monetary aggregates in relation to a reference value given by a McCallum rule. It has also argued that a simple notion of the optimal dynamic equilibrium for money balances would help to determine where in relation to that level money balances lie. These would be a useful input to the assessment of inflationary conditions in the economy, along with other vital economic indicators, as part of the policy of inflation targeting.

REFERENCES

Akerlof, G. A., 1979, "Irving Fisher on His Head: the Consequences of Constant Target-Threshold Monitoring of Money Holdings," *Quarterly Journal of Economics*, Vol. 93, pp. 169–87.

———, and R. Milbourne, 1980, "The Short-Run Demand for Money," *Economic Journal*, Vol. 90: pp. 885–900.

Artis, M. J. and M. K. Lewis, 1974, "The Demand for Money: Stable or Unstable?" *The Banker*, Vol. 124, pp. 239–47.

———, 1976, "The Demand for Money in the U.K.,1963–73," *Manchester School*, Vol. 44, pp. 147–81.

———, 1981, *Monetary Control in the United Kingdom,* (Oxford: Phillip Allan).

———, 1984, "How Unstable is the Demand for Money in the U.K.?" *Economica*, Vol. 51, pp. 473–76.

———, 1991, *Money in Britain: Monetary Policy, Innovation and Europe* (Oxford: Philip Allan).

Artis, M., P. Mizen, and Z. Kontolemis, 1998, "Inflation Targeting: What Can the ECB Learn from the Recent Experience of the Bank of England?" *The Economic Journal*, Vol. 108, pp. 1810–25.

Barnett, W. A., 1980, "Economic Monetary Aggregates: An Application of Index Number and Aggregation Theory," *Journal of Econometrics*, Vol. 14(1), pp. 11–48.

———, 1997, "Which Road Leads to Stable Money Demand?" *Economic Journal*, Vol. 107, pp. 1171–85.

Barnett, W. A., D. Fisher, and A. Serletis, 1992, "Consumer Theory and the Demand for Money," *Journal of Economic Literature*, Vol. 30(4), pp. 2086–2119.

Barnett, W. A., E. K. Offenbacher, and P. A. Spindt, 1984, "The New Divisia Monetary Aggregates," *Journal of Political Economy*, Vol. 92(6), pp. 1049–85.

Begg, D., 1997, "Monetary Policy During Transition: Progress and Pitfalls in Central and Eastern Europe 1990–96," *Oxford Review of Economic Policy*, Vol. 13(2), pp. 33–46.

———, L. Hesselman, and R. Smith, 1996, "Money in Transition: How Much Do We Know? Evidence from Central and Eastern Europe," European I Department, IMF mimeo, (Washington: International Monetary Fund).

Belongia, M. T., and J. A. Chalfant, 1989, "The Changing Empirical Definition of Money: Some Estimates from a Model of the Demand for Money Substitutes," *Journal of Political Economy*, Vol. 97(2), pp. 387–97.

———, and K. A. Chrystal, 1991, "An Admissible Monetary Aggregate for the United Kingdom," *The Review of Economics and Statistics*, Vol. 73(3), pp. 497–502.

Brainard, W., 1976, "Comments and Discussion on Goldfield, 1976," in *Brookings Papers on Economic Activity*, Vol. 3, pp.732–36.

Carr, J., and M. R. Darby, 1981, "The Role of Money Supply Shocks in the Short-Run Demand for Money," *Journal of Monetary Economics*, Vol. 8, pp. 183–99.

Carr, J., M. R. Darby, and D. L. Thornton, 1985, "Monetary Anticipations and the Demand for Money: Reply," *Journal of Monetary Economics*, Vol. 16, pp. 251–57.

Charemza, W., and S. Ghatak, 1990, "Demand for Money in a Dual-Currency Quantity-Constrained Economy: Hungary and Poland, 1956–1985," *Economic Journal*, Vol. 100, pp. 1159–72.

Chawluk, A., and R. Cross, 1994, "Zloty and Dollar Balances in Poland 1965–92," *Manchester School (supplement)*, Vol. 62, pp. 41–66.

Chrystal, K. A., and R. MacDonald, 1994, "Exchange Rates and Financial Innovation: the Sterling Dollar Rate 1972–90," *Federal Reserve Bank of St Louis Review.*

Coats, Warren, 1982a, "Interest Rate Consequences of Targeting Money," *IMF Staff Papers*, Vol. 29, No. 1. (Washington: International Monetary Fund).

———, 1982b, "Modeling the Short-Run Demand for Money with Exogenous Supply," *Economic Inquiry,* Vol. 20, No. 2.

Cuthbertson, K., 1988, "The Demand for M1: A Forward-Looking Buffer Stock Model," *Oxford Economic Papers*, Vol. 40, pp. 110–31.

———, 1991, "The Encompassing Implications of Feedforward Versus Feedback Mechanisms: A Reply to Hendry," *Oxford Economic Papers*, Vol. 43, pp. 344–50.

———, and M. P. Taylor, 1986, "Monetary Anticipation and the Demand for Money in the U.K.: Testing Rationality in the Shock-Absorber Hypothesis," *Journal of Applied Econometrics*, Vol. 1, pp. 355–65.

———, and M. P. Taylor, 1987, "The Demand for Money: a Dynamic Rational Expectations Model," *Economic Journal*, (Supplement), Vol. 97, pp. 65–76.

———, and M. P. Taylor, 1992, "A Comparison of the Rational Expectations and General-to-Specific Approaches to Modelling the Demand for M1," *Manchester School*, Vol. 60, pp. 1–22.

Gebhard, C., 1998, "The Evolution of the Deutsche Mark as an International Currency," in *Inside the Bundesbank*, eds. S.F. Frowen and R. Pringle, (London: Macmillan).

Goldfeld, S. M., 1973, "The Demand for Money Revisited," *Brookings Papers on Economic Activity*, Vol. 3, pp. 577–638.

———, 1976, "The Case of the Missing Money," *Brookings Papers on Economic Activity*, Vol. 3, pp. 683–739.

Goodhart, C. A. E., 1984, *Monetary Theory and Practice*: *The U.K. Experience* (London: Macmillan).

———, 1989, *Money, Information and Uncertainty* (London: Macmillan).

———, and A. D. Crockett, 1970, "The Importance of Money," *Bank of England Quarterly Bulletin*, Vol. 10, pp. 159–98.

Haache, G., 1974, "The Demand for Money in the U.K.: Experience Since 1971," *Bank of England Quarterly Bulletin*, Vol. 14, pp. 284–305.

Hall, S. G., S. G. B. Henry, and J. Wilcox, 1989, "The Long Run Determinants of U.K. Monetary Aggregates," Bank of England Discussion Paper, No. 41 (London).

Hartmann, P., 1996, "The Future of the Euro as an International Currency," *LSE FMG Special Paper,* No. 91 (London: London School of Economics).

Judd, J., and J. Scadding, 1982, "The Search for a Stable Demand for Money Function: A Survey of the Post-1973 Literature," *Journal of Economic Literature*, 20(3), pp. 993-1023.

Laidler, D. E. W., 1982, *Monetarist Perspectives* (Oxford: Philip Allan).

———, and J.M. Parkin, 1970, "The Demand for Money in the United Kingdom, 1955–67: Preliminary Estimates," *Manchester School*, Vol. 38, pp.187–208.

Lewis, M. K., and P. D. Mizen, 2000, *Monetary Economics*, (Oxford: Oxford University Press).

McCallum, B. T., 1988, Robustness Properties of a Rule for Monetary Policy," *Carnegie-Rochester Conference Series on Public Policy*, Vol. 29: 173–204.

McCauley, R., 1997, "The Euro and the Dollar," *BIS Working Paper No.* 50 (Basel).

McKinnon, R. I., 1998, "Toward Virtual Exchange-Rate Stability in Western and Eastern Europe with the Advent of EMU," mimeo, Stanford University.

Miller, M. H., and D. Orr, 1966, "A Model of the Demand for Money by Firms," *Quarterly Journal of Economics*, Vol. 80, pp. 413–35.

Mizen, P. D., 1994, *Buffer Stock Models of the Demand for Money in the U.K.,* (London: Macmillan Press).

Mizen, P., 1997, "Microfoundations for a Stable Money Demand Function," *Economic Journal*, Vol. 107, pp. 1202–12.

Mullineux, A., 1996, *Financial Innovation, Banking and Monetary Aggregates*, (Aldershot, England: Edward Elgar).

Mundell, R., 1998, "What Makes a Great Currency?" *Central Banking*, pp. 35–42.

Nijsee, E., and E. Sterken, 1996, "Shortages, Interest and Money Demand in Poland 1969–95," CCSO mimeo, (Groningen, Netherlands: University of Groningen).

Schmid, P., 1998, "Monetary Policy: Targets and Instruments," in *Inside the Bundesbank*, ed. by S.F. Frowen and R. Pringle (London: Macmillan).

Swoboda, A., 1969, "Vehicle Currencies and the Foreign Exchange Market: The Case of the Dollar," in *International Market of Foreign Exchange*, ed. by R. Alliber (New York: Praeger).

Taylor, M. P., 1987, "Financial Innovation, Inflation and the Stability of the Demand for Broad Money in the U.K.," *Bulletin of Economic Research*, Vol. 39, pp. 225–33.

Thom, J., J. Paterson, and L. Boustani, 1998, "The Foreign Exchange and Over-the-Counter Derivatives Markets in the United Kingdom," Bank of England Quarterly Bulletin, 38(4), November, pp. 347–60.

Chapter 5

MARKET-BASED INFLATIONARY EXPECTATIONS AS AN INDICATOR FOR MONETARY POLICY: THE CASE OF ISRAEL

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The object of this study is to estimate the public's inflationary expectations for the period 1988–98, by means of prices of CPI-indexed (Consumer Price Index) and unindexed bonds. The financial markets in Israel enable inflationary expectations and expected real interest rates to be derived for periods up to one year without making strong assumptions. In the model described, it is assumed that in this time scale there is no risk premium, and hence neither the trend of expectations, nor their level, is biased significantly. Inflationary expectations serve as an important indicator in determining monetary policy, even more so in recent years when policy has been based on setting inflation targets.

In general, inflation expectations were reasonably close to actual past inflation developments. Initially, the announcement of inflation targets led to a certain reduction of expectations, but thereafter the announcements did not themselves have any real affect on inflation expectations until significant policy measures were instituted to curb inflation. The contractionary monetary policy adopted toward the end of 1994 and toward the end of 1998 in the wake of the surges in inflation reversed the trend of inflationary expectations, indicating that the public accorded credibility to the policymakers' determination to fight inflation.

INTRODUCTION

Inflationary expectations are vital for understanding the public's behavior in the money, capital, and nonfinancial markets; they also play a major role in the determination of monetary policy. This paper sets out to estimate inflationary expectations by means of the prices of indexed and unindexed bonds, since they help to explain the public's behavior and Israel's monetary policy. This applies particularly to the last few years, when this policy was based on an inflation target. The gap between inflationary expectations and the announced inflation target can serve as a guide regarding monetary policy required to achieve the target. The reaction of inflationary expectations to monetary and/or fiscal measures may indicate the credibility with which the measures are perceived. In a number of industrialized countries the use of variables of expectations—derived from the behavior of the financial markets—as indicators of appropriate monetary policy has become widespread.

The estimate of inflationary expectations is derived from market prices of securities, and this is the source of its robustness. It could be obtained by polling the general public or relevant groups. Such an estimate, however, which bears no penalty for error, cannot be compared to one that is employed, after due consideration, in buying or selling indexed and unindexed assets, when a mistaken estimate can cause considerable loss. Banks, institutional investors, and the general public make great efforts to estimate the Consumer Price Index (CPI) in order to trade in securities and treasury bills, hence information derived from market prices should constitute a reliable indicator of inflationary expectations. Another advantage of market prices is that they reflect a weighted average of these expectations, and under conditions which will be specified below, price differences between indexed and unindexed securities reflect, mainly, inflationary expectations.

Unlike earlier assessments of inflationary expectations, which assumed the real interest (Yariv, 1990), or which were based on expectations for a period of one month only (Yariv, 1993), this chapter deals with estimates of expectations for periods of between one month and a year. In the process of estimation, both inflationary expectations and real interest rates are obtained simultaneously.

The development in recent years of trading markets for unindexed securities for periods of up to a year, together with the existence of trade in indexed bonds for the same length of time, enables inflationary expectations to be derived without making any assumptions about real interest, a fact which makes the estimates more robust. An analysis of the results shows that inflation expectations were quite close to actual past inflation developments. Sometimes, however, actual inflation differed

from that expected for a given period; notable instances of this were the unexpected downward movements in 1992 and 1998, and the unexpected rise in inflation in 1994. Nevertheless, in the last few years the public has become more aware of the effect of monetary policy on inflation. For example, in 1998, following the rise in inflation expectations in the wake of the increase in the exchange rate, expectations fell again after the increase in the Bank of Israel interest rate.

The announcement of an inflation-rate target at the end of 1991 helped to reduce inflationary expectations at that time, but the announcements of the targets for 1993–95 did not give rise to any significant change in expectations. It seems that the announcement of a target initially contributed to the reduction of inflationary expectations and the confirmation of trends evident at that time; thereafter, only announcements that were accompanied by significant policy measures encouraged stability and reduced expectations.

Several estimates of inflationary expectations used in various countries based on indexed securities are described in the second section. The third section describes the model and the derivation of the estimates, and formulates the assumptions required to obtain numerical results. The fourth section discusses the significance of the various assumptions, particularly those regarding the tax factor and the risk premium. The final section presents the main findings regarding the development of inflationary expectations in 1988–98, concentrating on those periods in which there was a significant difference between the paths of actual and expected inflation. The policy of inflation targets, its announcement, and the market reaction to it, are discussed separately below.

Inflationary Expectations and Indexed Bond Markets

Many studies have tried to estimate inflationary expectations. This paper uses the existence of markets for indexed and unindexed securities in Israel for this purpose. Although indexed markets develop in countries with persistently high inflation, the functioning of the unindexed capital market is impaired, making it difficult to derive expectations. Countries with low inflation usually have only an unindexed capital market, on the basis of which attempts are sometimes made to derive inflationary expectations. These involve making relatively strong assumptions about real interest rates and the risk premium.

Pioneering studies have been carried out in Israel by Cukierman (1973), but at that time the empirical results were meager due to the absence of a significant unindexed market. In a study undertaken in the mid-1980s (Yariv, 1990), inflationary expectations during disinflationary economic programs were estimated by identifying the nominal component of indexed bond contracts. An estimate was obtained for 1984–87 that was appropriate for expectations during a relatively rapid rise in prices, since it was based on indexation loss close to the date of maturity, which increases when inflation rises. The latter study requires that an assumption be made regarding the real rate of interest, but for a period of high inflation this does not adversely affect the quality of the estimates. Note that as a result of the acceleration in inflation, the extent of unindexed contracts fell steeply, and expectations were estimated by a method appropriate only to the Israeli bond market.

The decline in inflation in Israel and the development of trading markets for unindexed bonds of up to one year to maturity currently makes it possible to derive inflationary expectations for longer periods. The present paper gives estimates for 3, 6, 9, and 12 months by extending the study of one-month inflationary expectations (Yariv, 1993). The reader will see that the estimates are particularly robust as no assumptions need to be made concerning real interest rates. Moreover, the fact that there are two markets enables inflationary expectations and real interest rates to be derived simultaneously.

England began developing the market for indexed bonds in 1982, and inflation expectations were estimated both for purposes of empirical research and by the Bank of England, which used inflation expectations as an important monetary indicator (see Deacon and Derby, 1994, and the Bank of England Inflation Reports). There is a problem in estimating expectations in England owing to the indexation lag, which can be as long as eight months. This issue is dealt with by using a dynamic model which assumes the same rate of inflation—also for a period in which there is no compensation for price increases. Another difficulty arises from the relative paucity of series of indexed bonds; this is tackled by calculating the yield curves of nominal and real returns and simultaneously deriving the inflation expectation curve.

After more than ten years of discussions and preparatory work by the U.S. Treasury and the Federal Reserve, indexed bonds were first launched in the United States at the beginning of 1997, for periods of five, ten and thirty years. One of the objectives was to provide estimates of inflation expectations and of real interest from the capital market. Due to liquidity problems in the developing market for indexed bonds, and particularly compared with the high liquidity in the conventional bonds market, the spreads of real and nominal returns reflected the liquidity premiums that the market required from the indexed market, as well as inflation expectations. For the time being, this greatly limits the use of estimates of both inflation expectations and real interest (this factor is added to the risk premium component, which, for long periods, is not insignificant). It is reasonable to expect that as the market develops with proper attention being paid to the risk premium, the use of these estimates in economic analysis and in the formulation of monetary policy will increase. In Canada, a number of indexed bonds were issued at the beginning of the decade, although it is uncertain whether this practice should continue in the light of the negative implications for the battle against inflation.

THE MODEL

The model is based on Fisher's equation in which expected inflation is (approximately) equal to the difference between nominal and real interest rates. The former is obtained from the unindexed bond market, and the latter from the indexed bond market. The existence of these two distinct markets for parallel periods of up to one year makes it possible to derive inflationary expectations and their yield curves (as well as their respective real interest rates).

Note that in estimating expectations there is an underlying assumption that the two markets are comparable (i.e. that the difference between them is due mainly to inflationary expectations) and that other factors are either irrelevant or constant over time and may therefore be ignored. The significance of these assumptions is discussed below.

The method of deriving expectations is as follows. If indexation were implemented daily and there were no lag in the publication of the inflation rate, inflationary expectations could be derived according to the customary formula, with real interest being obtained from a simple calculation of real yield to maturity. However, this is not the case.

In order to calculate the real yield to maturity of bonds, three distinct periods in the life of a bond regarding indexation differences must be considered. They are represented by the following:

a – the period when price increases for the previous month have occurred but have not yet been published (when expectations are calculated);

b – the period in which the bond provides full compensation for inflation; and

c – the period close to maturity of the indexed bond when inflation is not compensated for.

The nominal yield of a bond over *n* months is defined as the sum of the expected nominal receipts to maturity relative to the market price of the bond.

To obtain the real yield of that bond, the indexation differentials which will be accrued must be imputed to the nominal receipts, while price increases up to its maturity must be deducted.

The following are used:

r_j – real interest to the appropriate time (j = a, b, c).
n – the number of months fully compensated by the indexed bond.
A_n – the known nominal indexation differentials accrued on indexed bonds.
R – the final coupon to be received on maturity (after tax).
B_n – the market price of a bond appropriate for measuring price increases over *n* months.
EP_j – expectations of the increase in prices to time *j* (*j = a, b, c*).

The real yield[2] of the bond from the date of measurement until maturity may be represented as follows:

$$(1 + r_{(b+c)}) = \frac{A_n(1+R)(1+EP_a)(1+EP_b)}{B_n(1+EP_b)(1+EP_c)} \quad (1)$$

By simplifying equation (1), the real yield for the period of estimating inflation (b) can be shown as:

$$(1 + r_b) = \frac{A_n(1+R)(1+EP_a)}{B_n(1+EP_c)(1+r_c)} \quad (2)$$

As stated above, expected inflation is defined as nominal interest, derived from the Treasury bill market, (i_b*), divided by* real interest as shown in equation (2).

$$(1 + \mathrm{EP_b}) = \frac{(1+\mathrm{i_b})}{(1+\mathrm{r_b})} \quad (3)$$

[2] The real yield of a bond is actually the real yield corrected for two factors: ($(1 + EP_a)$, the current, as yet unpublished, increase in prices, and $(1 + EP_c)$, the increase in price on maturity, for which there is no compensation. Note that bond traders may assess these variables differently.

Substituting equation (2) in (3), we obtain

$$(1+EP_b)=(1+i_b)\frac{B_n}{A_n(1+R)}.\frac{(1+EP_c)(1+r_c)}{(1+EP_a)} \tag{4}$$

Multiplying real interest by the nominal factor in the period close to maturity gives nominal interest for that period. We assume that the required nominal yield in that period is the same in both markets, and hence equation (4) can be shown as:

$$(1+EP_b)=(1+i_{(b+c)})\frac{B_n}{A_n(1+R)}\cdot\frac{1}{(1+EP_a)} \tag{5}$$

All the variables on the right side of the equation are known from the market, except for the last rate of increase in prices which has occurred but has not yet been published. Expectations regarding the CPI may be derived in a similar manner by the use of two bonds, one indexed and the other unindexed, with just one more index increment, EP_a due to accrue to the indexed bond (Yariv, 1993).

In other words,

$$(1+EP_a)=(1+i)\frac{B_1}{A_1(1+R)} \tag{6}$$

where *i* is the yield on a treasury bill for the same period as the bond due to one more monthly index increment.

Real interest is obtained by using the nominal yield in the treasury bill market and expected inflation derived from equation (5), and subsequently putting these in (3). This real interest is clearly the real yield required in each market.

MAIN ASSUMPTIONS

Several assumptions which must be made in order to obtain numerical results are discussed below, and an attempt is made to assess their effect on the quality of the estimates. They relate to general principles of taxation affecting market participants, the risk premium required by the market because of uncertainty regarding inflation, and substitutability of the markets.

Taxation

Taxation affects the expected return in both the indexed and the unindexed market, so that it warrants careful attention in order to identify the main players in the market—specifically, what is their tax status. Income on treasury bills is tax-free; therefore the tax status is irrelevant. Investors in indexed bonds, however, break down into three types: those liable to tax on the coupon regardless of the holding period (gross return); those such as provident funds taxed relative to the holding period till the next coupon payment (relative gross return); and investors, mainly individuals and mutual funds,

liable to a limited and final tax rate of 35 percent on the coupon (net return). The problem of taxation and its effects on inflation expectations is not peculiar to Israel; in England, for example, two estimates of inflation expectations are published based on different assumptions regarding tax rates and the market's reaction to them.

Holdings of indexed bonds in Israel have also changed significantly. Until the beginning of the 1990s, mutual funds were the main investors in the market; this was particularly marked regarding their share in trading (especially in the short term relevant to our estimations). In the last few years, the investment of the provident funds has been the most notable, accounting for more than 50 percent of the holdings of indexed bonds in the market, although they do not always undertake large-scale trading in these bonds.

In the past, the real return was taken to be determined by the net return (and an earlier version of this paper was published which followed that line). Since the mid-1990s, the basis of the estimate has changed, and the estimate of real return refers to the relative gross return. Bond coupons go up to 4.75 percent, and the tax rate is 35 percent, so that the gap between gross and net expectations for a year can reach 1.7 percent. The trends of the two estimates will be similar—the difference between them being reflected by the level of inflation expectations and the level of expected real interest. In estimates of inflation expectations with a one-year horizon, which serve as an indicator for monetary policy, the gross return and the relative gross return are quite close to each other, so that this assumption does not create a substantial difference between the revised estimate and that based on the gross return.

Risk premium

It is assumed that the risk premium is constant and equal to zero, i.e. the public does not demand compensation for holding nominal assets exposed to the uncertainty arising from future inflation of an unknown rate. Fischer (1984) and others have shown that when uncertainty regarding inflation prevails, nominal interest rates incorporate a risk premium for inflation.

It may be claimed that the absence of a specific reference to the risk premium creates an upward bias in estimated expectations. Although in the theoretical consumption model the sign of the premium is not known at the outset, it is reasonable to assume that in Israel, where there is considerable uncertainty regarding inflation, the premium would be positive.

It is difficult to assess the extent of changes in the risk premium in the period reviewed, and this subject warrants separate study. It is reasonable to assume that the downward inflation trend, its volatility, and that of the exchange rate affected the changes in the size of the risk premium. In this context, the following points are relevant:

- As far as monetary policy is concerned, even if the rise in estimated expectations is based on an increase in the risk premium, the policy measures required are similar to those needed in the event of a rise in actual expectations. Hence, identifying changes in the risk premium may help monetary analysis, but is not essential for preventing bias.

- Regarding the actual level of expectations, the estimates obtained from the model are not significantly different from alternative estimates derived from the CPI-indexed options contracts offered by some banks (see Fiszman, 1995). It may be inferred from this assumption that the absolute level of the risk premium is not high, and apparently was relatively stable in the period under review,

(except perhaps during the end of 1998) and hence it is unlikely that the trends of inflationary expectations are biased.

- It is not certain that the premium required by the market is positive for all periods of expectations. Most short-term contracts are probably nominal, so it is these that are definite, and in this case the risk premium required for indexed contracts is positive. In 1988–94 inflation ranged from 10 to 20 percent, and in this period, despite Israel's history of inflation, no positive premium may have been required in short-term contracts (say less than six months). Note that with regard to the risk premium in long-term nominal markets such as the US, in which bonds may be for as long as 30 years, the risk component is very high, and its weight may be equivalent to that of real interest or expected inflation.

- There is no generally agreed-upon risk-premium model, and even if there were, it would still be problematic to make a quantitative estimate.

Substitutability between markets

The following discussion on substitutability between markets focuses on the structural aspects of both markets regarding their participants, fees and efficiency. Since 1987, treasury bills have been traded on the stock exchange, and the total amount held by the public has risen significantly in real terms, to about NIS 20 billion in 1998. The individual series are quite large, about NIS 2.0 billion. The existence of series with similar periods to maturity, differing by between one week and one month, increases tradability. However, the fees paid by the public are generally lower (0.1 percent at maturity) than those in the indexed bond market (0.2–0.5 percent). Members of the stock exchange, brokers and mutual funds active in these markets pay considerably lower fees.

The total value of the bond market in 1998 was some NIS 90 billion; the value of one-year bonds varies, but sometimes reaches or even exceeds NIS 5 billion. Despite the considerable extent of the market, individual series are not highly tradable. Sometimes a particular bond series is not tradable, and its price fluctuates widely on a daily basis. The series with the highest market value were chosen, with a uniform coupon as far as possible. Owing to the problem of liquidity of one single bond, two additional bonds whose maturities were within one month of that of the estimation horizon were included, reducing the estimated daily volatility (as a result of the paucity of series, with regard to expectations for a one-year horizon, bonds with maturity within two months of the estimation period have been included since mid-1998).

The activity of mutual funds in the short-term bond and treasury bill markets at the beginning of the 1990s was noteworthy. Their level of sophistication is very high. With respect to arbitrage, it is sufficient for a few traders to treat these markets as highly substitutable for market prices to be used to estimate inflationary expectations.

Regarding the extent of substitutability between the markets, it is sometimes claimed that inflationary expectations cannot be derived from the treasury bill market when there are sharp fluctuations in the securities markets in general, and in the stock market in particular. It has been argued that extensive withdrawals from mutual funds result in a large supply of treasury bills, and the rise in yields is mistakenly interpreted in the model as higher inflationary expectations. This cannot be the case, however, because even if yields in the treasury bill market rise as a result of large withdrawals from mutual funds or sales in the stock market in general, the same phenomenon occurs in the short-term bond market, so that the real yield rises in both markets. In this case, there will be no

change in estimated inflationary expectations, but real interest, or the required real yield, will rise, as in fact happens in the market when holders of securities attempt to sell.

A similar phenomenon occurs when a devaluation is expected. The existence of an alternative yield in the form of foreign-currency linkage raises the required yield in other markets. In this instance, yields rise in the treasury bill and short-term bond markets, but this does not necessarily lead to an increase in the derived estimates of inflationary expectations.

ANALYSIS OF THE FINDINGS

The operational assumptions of the model

Expectations from January 1988 to December 1998 were estimated.[3] Treasury bills and indexed bonds for up to one year have been traded since 1988. The estimates were compiled on each trading day, and the data presented are weekly or monthly averages based on daily observations (months being from the 16th of one month to the 15th of the following one). For example, from August 16 to September 15, daily expectations of annual inflation were estimated, relating to expected inflation over the next twelve CPI announcements (i.e. August of the subsequent year compared with August of the current one). The most appropriate bond for estimating annual inflation is the one that will benefit from the August index, maturing after the publication—on September 15—of the August CPI (i.e. maturing end-September).

Note that the period under review is slightly more than a year (12.5 months on average). Therefore the yield on treasury bills was extrapolated for a longer period on the assumption that the slope of the yield curve for 9–12 months would also apply to a period of more than a year. For periods of less than one year there is no need to extrapolate the yield on treasury bills, and series were chosen whose maturity dates were closest to that of the indexed bond. In the second half of the 1990s, as the slope of the curve flattened and even became negative, the return on one-year treasury bills was assumed also for longer periods.[4]

Between December 1993 and June 1994 there was no regular pattern of bonds maturing, so that for this period estimates of inflationary expectations could not be obtained for all periods. Estimates for relatively long periods—six months and longer—were obtained using series close to maturity, assuming, for example, that price increases over 11 months would be similar to the expected price rise in the 12th month; this procedure was adopted in order to obtain consistent series for the periods selected. When the gap between the period of the estimate and the one-year bond period was greater than three months, bonds of 13 and 14 months were used, assuming that the yield on treasury bills for

[3] The calculations are all based on data published by the Tel-Aviv Stock Exchange (bond prices) and the Central Bureau of Statistics, Israel (CPI index).

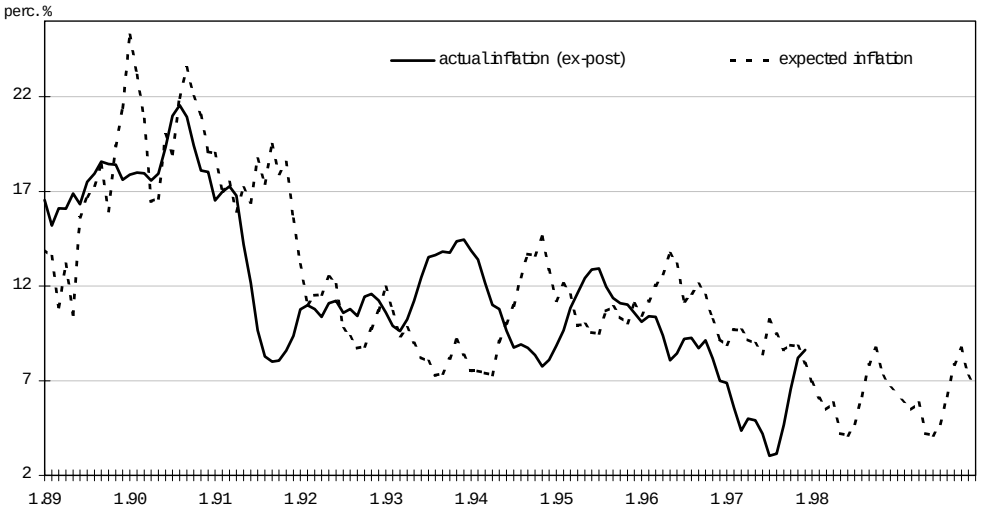
[4] On July 1, 1993, a shift was made in estimated inflation one month forward to series in which the coupon was 4.75 percent, and not 3 percent as hitherto. It was found that from then, estimates obtained under the assumption that the market consists of gross and net returns in equal measures are more reasonable. This assumption is made on additional economic grounds and on information provided by those active in the market. On July 1, 1997, the tradable redemption of bonds ceased, and the one-month estimate was calculated from the expected rate of inflation for the previous month, taking monthly seasonality into account. Since August 1998, the current index has been chosen according to the average of inflation forecasters' predictions, and the estimates from this source have been found to be quite accurate, and free of systematic bias.

that period would be an extension of the treasury bill curve. The validity of the data was checked by converging from a longer period and from a shorter period than the measured one, and similar estimates were obtained.

Inflationary Expectations and Expected Real Interest

Although inflationary expectations since 1989 have been basically the same as actual inflation, there have also been periods in which they differed considerably (Figure 1).[5] From 1989 until mid-1991, expected and actual inflation were markedly similar—between 15 and 20 percent. During 1992 the unexpected reduction in inflation was clearly reflected by the gap between expected (18–20 percent) and actual inflation (only 12 percent), the latter apparently associated with both the increased labor supply resulting from immigration from the former Soviet Union and the fall in housing prices and prices abroad. This is borne out by unindexed assets, whose proportion of the portfolio (except for shares) increased only in 1993, a development which may be expected at a time of a move to a lower inflationary environment.

Figure 1. Yearly Expected and Actual (Ex-Post) Inflation (12 Months 1989–98)

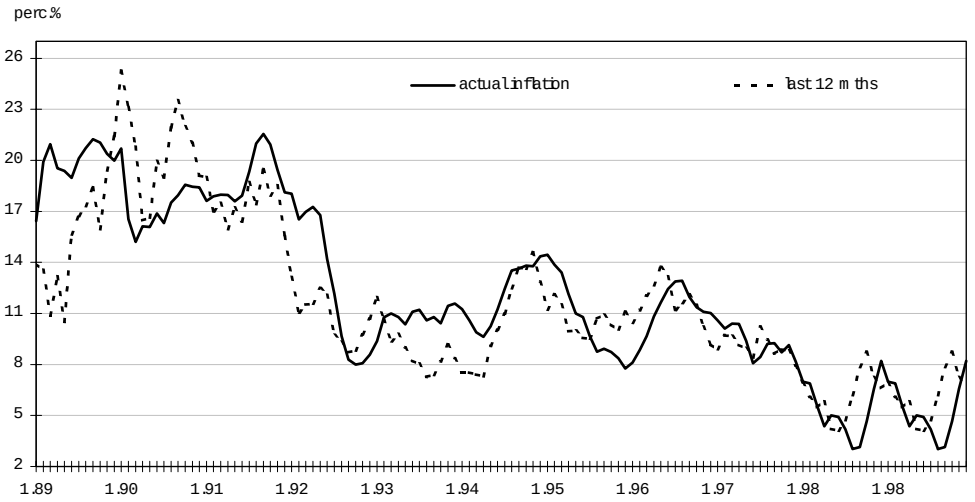


Toward the end of 1993 and at the beginning of 1994 the gap between expected and actual inflation widened again. Expectations remained at the level of the previous year's inflation (10–11 percent), while actual inflation rose from 10–15 percent. There was another surprise in 1998, mainly in the first half of the year, when the public did not foresee the reduction in inflation that derived from the slowdown in economic activity and the reduction in world prices of raw materials. A closer examination of the correlation between inflation in the last twelve months and expectations is enlightening. It seems that the process of forming expectations is to a considerable extent adaptive (see Figure 2), as expectations are adjusted only after a new level of inflation has been experienced

[5] 12-month expectations have been analyzed since 1989 because 12-month treasury bills were launched then, and expectations prior to that date had been based on shorter-term treasury bills.

for a while. Only in exceptional circumstances (e.g. the 1985 economic stabilization program) was there a change that stemmed from declared policy measures rather than from the actual measures themselves.

Figure 2. Inflationary Expectations and the Last 12 Month Inflation Rate (1989–98)



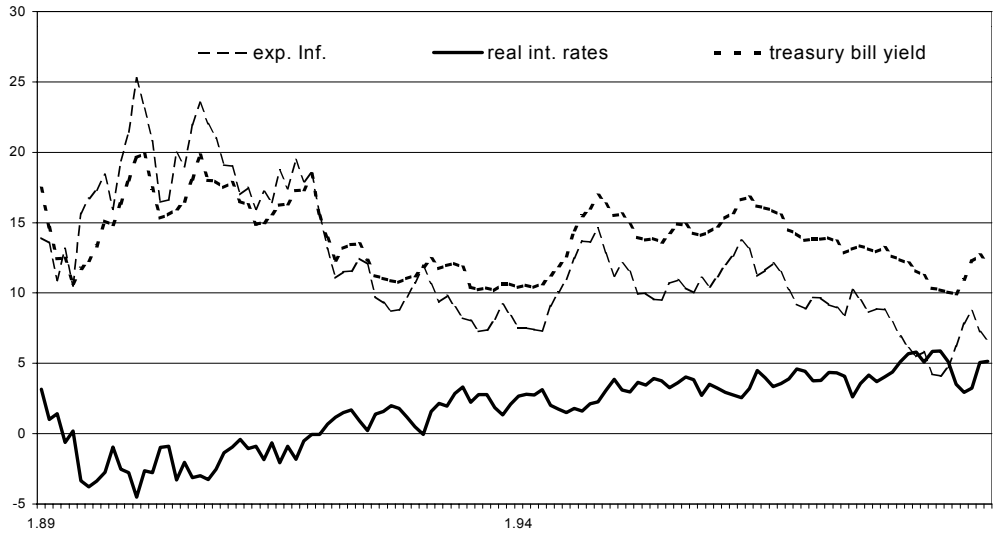
When a limited package deal was implemented late in 1984, a learning process also became evident. This arrangement involved an agreement between the employers, the government and the unions to freeze (or to preset a slow change for) several controlled prices and wages. Inflationary expectations fell only after relatively low increases in the CPI had been published, confirming the success of the policy measures. The experience gained from the 1984 package deal assisted the adjustment of expectations when a broader stabilization program was implemented in mid-1985.

The identification of the causes of changes in nominal interest is of great relevance, and is closely linked with the implementation of monetary policy. Is the change perceived as a change in inflationary expectations or does it stem from changes in real interest? Fama (1975) examined this question, focusing on nominal interest as an indicator of inflationary expectations, and on the stability of real interest. A partial answer to this question is provided by Figure 3, which gives the yield on 12-month treasury bills, inflationary expectations and real interest over a given period, and shows that most of the changes in nominal interest arise from changes in inflationary expectations. Note that real interest for one year, as derived from the model, correlates closely with the trend of the yield to maturity of 3- and 10-year bonds.

An analysis of expected real interest in the period under review shows that the level of real interest rates continued falling from 1989 to 1991 (Figure 3). This is connected with the reduction of interest from the high level prevailing after the stabilization program of 1985–87, and was achieved slowly, through the liberalization of the capital market among other considerations. In 1992–94 real interest on treasury bills stabilized close to zero, fluctuating by about one percent in each direction. Alongside the rise in nominal interest from about 10 percent at the end of 1993 to some 15.5 percent in September 1994, there was an increase in inflationary expectations, with no significant change in expected real interest rates. Only toward the end of the year was the rise in interest perceived as an increase in real interest, indicating a determined implementation of monetary policy. The rise in real

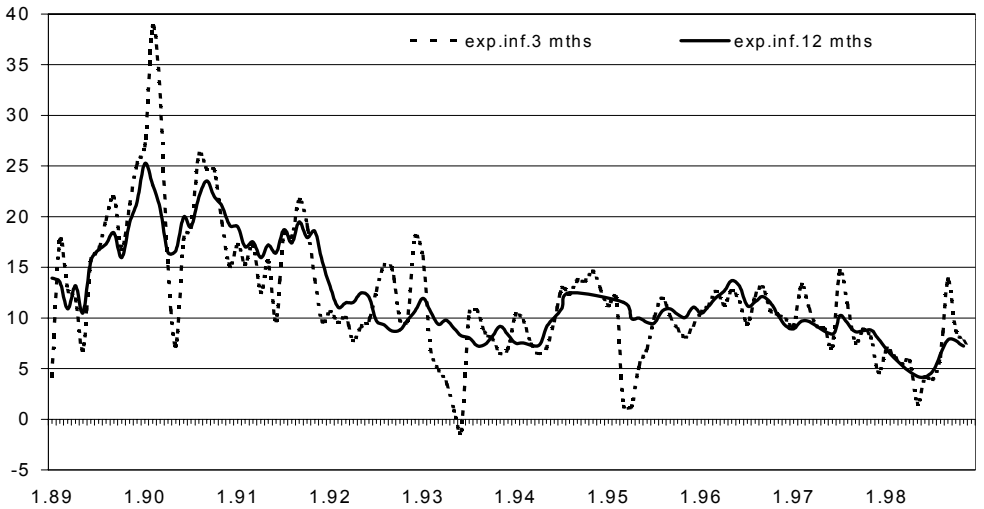
interest continued in 1994–98, reflecting the tight monetary policy pursued by the Bank of Israel in that period in order to attain the inflation target.

Figure 3. Expected Inflation, Treasury Bill Yields and Real Interest Rate (12 Months)



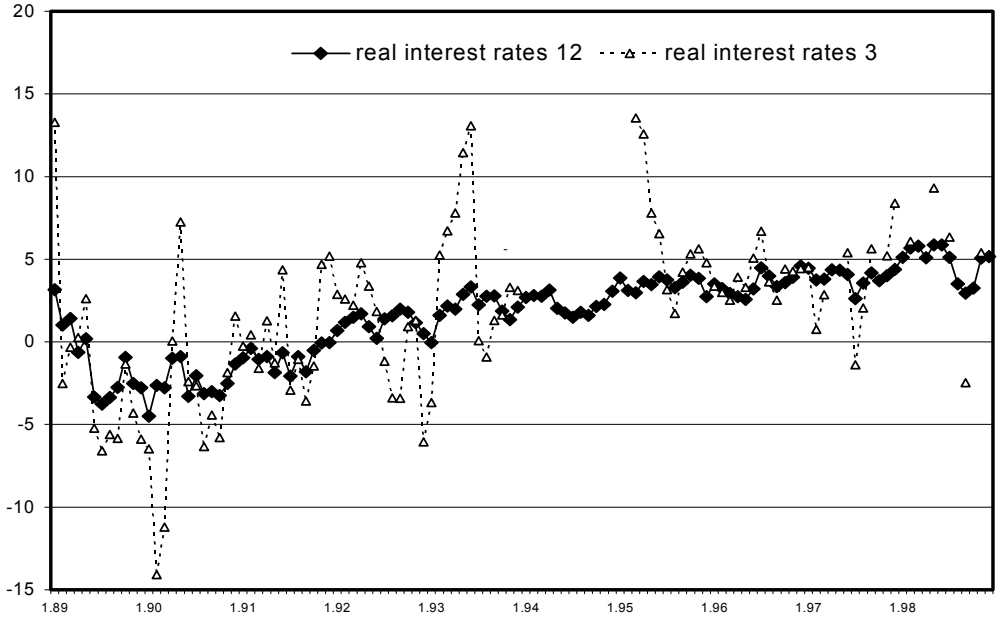
Source: Tel-Aviv Stock Exchange.

Figure 4. Expected Inflation Rates 3 and 12 Months (1989–98)



As stated, expectations can be estimated for different periods. As Figure 4 shows, yearly expectations fluctuate considerably less than those for three months, reflecting both the seasonal nature of price increases and the fact that this is taken into account in forming expectations. Fluctuations in real interest over three months do not appear significantly to affect the decisions of economic agents. In these seasonal periods real interest for three months fluctuated widely (Figure 5). Most contracts for these periods are not indexed, so that decisions are taken in nominal, not real, terms. The significance of this factor for policy purposes is that the rate of interest determined by the Bank of Israel need not be affected by the seasonality of the CPI.

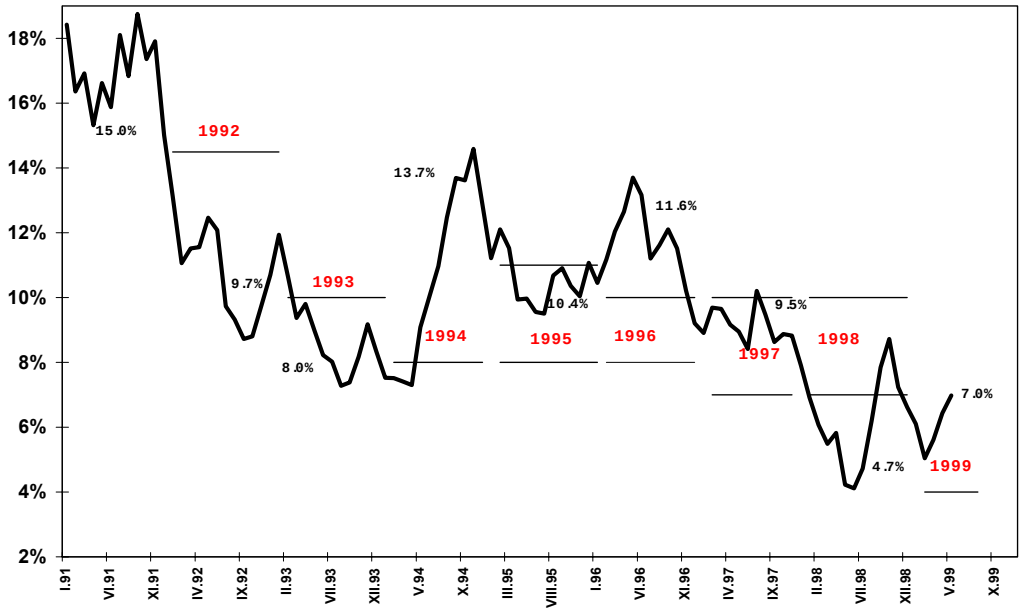
Figure 5. Real Interest Rates for 3 and 12 Months (1/1989–12/1998)



The inflation target policy

At the end of 1991, the Bank of Israel adopted a monetary policy based on announcing an inflation target for the next calendar year, together with the slope of the exchange-rate band, adjusted for the target. The object of announcing the inflation target was to provide stability and reduce uncertainty regarding inflation and the exchange rate, as well as to supply a framework enabling policymakers to reduce inflation gradually (Figure 6) (for a review and initial assessment of this policy, see Bufman, Leiderman and Sokoler, 1995).

Figure 6. Inflationary Expectations (12 months) and the Inflation Targets (1989–98)



Inflationary expectations may indicate the credibility accorded to the target inflation figure. The development of annual inflationary expectations at the time of the announcement of the target is shown below, and is compared with expectations for that calendar year. It is clear that other changes influencing the results may occur at the same time. The important point is that it is not the announcement itself which is likely to affect the public, but the extent of the policymakers' commitment to adopting the appropriate fiscal and monetary policies required to achieve the target.

On December 16, 1991, the crawling-band exchange rate policy was announced, and an inflation target of 14.5 percent was set for 1992. Figure 7a shows the data relating to the time of the announcement is for a week, and refers to four weeks before and after it (weeks are defined by the dates 16–23, 24–31, 1–7, and 8–15 of each measured month). The same figure illustrates that there was a significant fall in inflationary expectations, from 18–20 percent per year to about 16 percent. It should be noted that in the same month the rise in the CPI for November of only 0.1 percent was published. On November 8, 1992, the target inflation rate of 10 percent for 1993 was announced, and there was a marginal rise in expectations, which were around the target level. On July 24, 1993, an 8 percent target rate for 1994 was announced (Figure 7c). Considerable pressure to reduce interest rates was exerted on the Bank of Israel. Inflationary expectations declined from 11 to 10 percent, remaining 2 percent higher than the target rate. Alongside the announcement, interest at the discount window was reduced by about 2.5 percentage points. In September 1994 the target for 1995—between 8 and 11 percent—was announced. At that time annual inflationary expectations rose slightly, from an average of 15.3 percent to 15.8 percent after the announcement. Two points to note in this context are that, first, the target rate differed significantly from actual inflation; second, at the same time as the announcement, interest at the discount window was raised by 1.5 percentage points. Following the announcement of inflation targets for 1996 to 1998, there was a certain lowering of inflation

expectations; this may have been related to the certainty that the announcements themselves instill. In August 1998, a 4 percent target was announced for 1999 following a significant decline in the rate of inflation in the first half of the year. Along with this announcement, there was an apparently unexpected reduction of 1.5 percent in the Bank of Israel key interest rate, which led, among other considerations, to some increase in inflation expectations.

Figure 7. Inflationary Expectations Before and After the Inflation Target Announcements 1992 - 95 (Weekly Average)

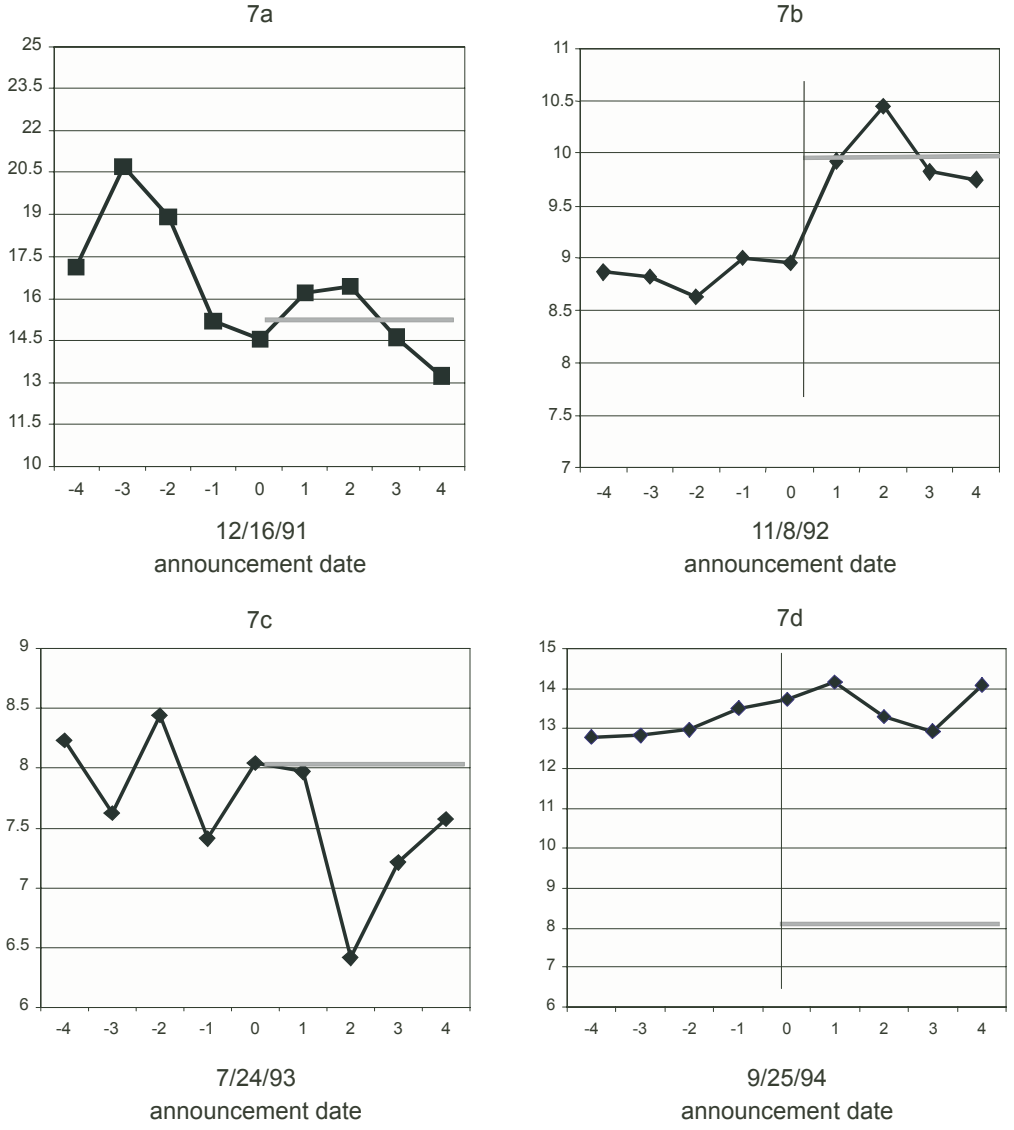
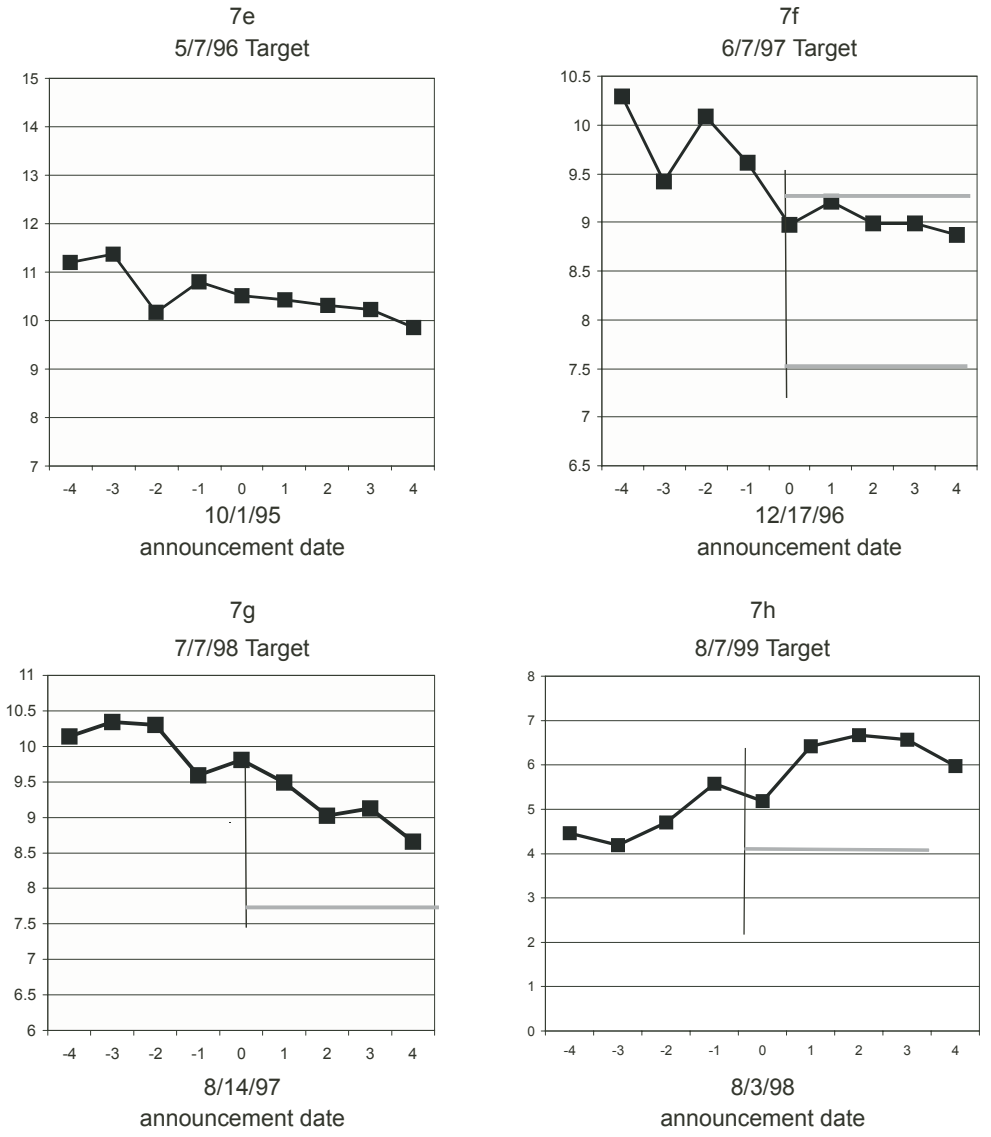
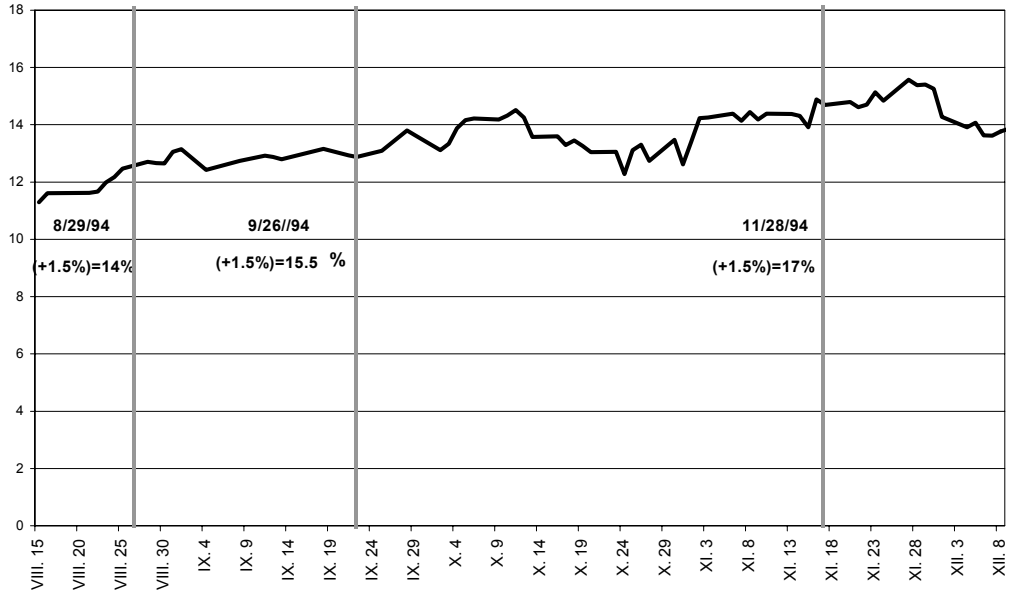


Figure 7 (cont'd). Inflationary Expectations Before and After the Inflation Target Announcements 1996 - 99 (Weekly Average)



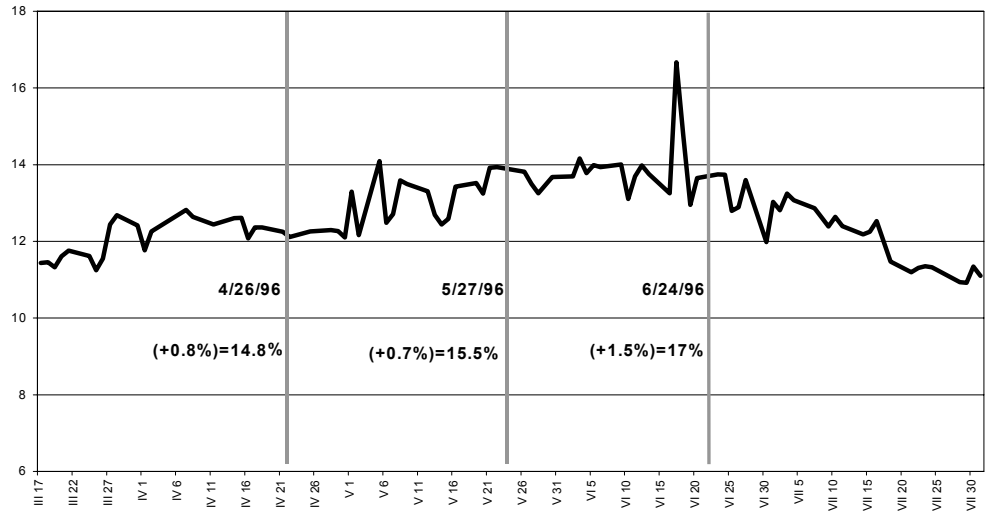
The response of the market to changes in the Bank of Israel interest rates, which were raised three times by about 1.5 percentage points each at the end of 1994, should be examined here. Figure 8.1 shows that the August rise was perceived mainly as an adjustment to bring it into line with inflationary expectations, and the Bank's notification merely confirmed the

Figure 8.1 The Impact of Monetary Policy on Inflationary Expectations 4Q 1994



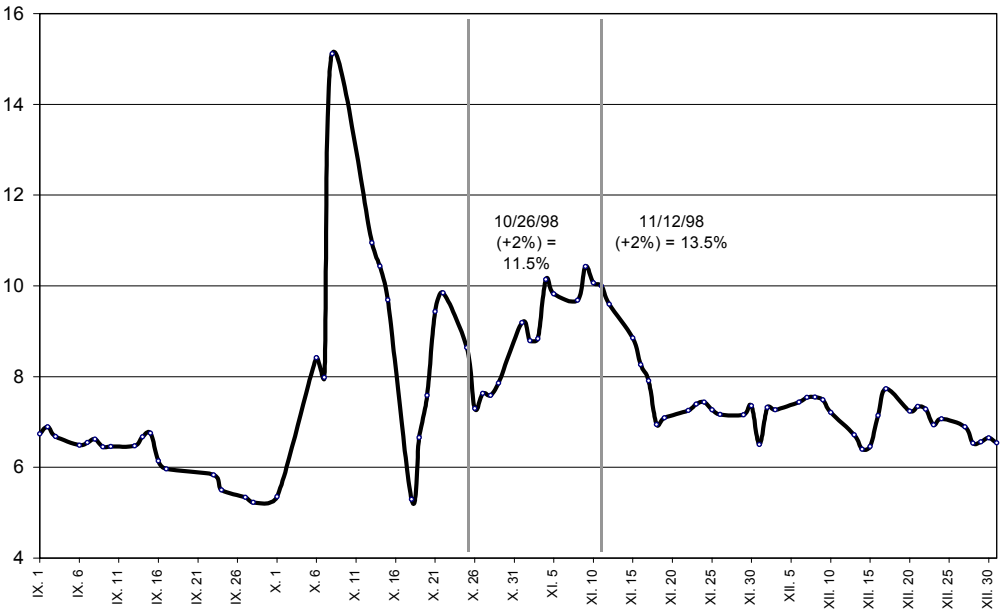
assessment that these had risen. The September increase in interest, however, (together with the announcement of the inflation target) was generally interpreted as signifying a rise in real interest, and after a further rise of 1.5 percentage points in the interest rate in November, inflationary expectations fell from 16.5 percent to about 15 percent. This indicates the

Figure 8.2 The Impact of Monetary Policy on Inflationary Expectations 2Q 1996



credibility earned by the Bank of Israel's determination to achieve the inflation target, following the steady increases in nominal interest. In the last quarter of 1998, following a rise in inflation expectations in the wake of the rise in the exchange rate, expectations fell again after the increase in the Bank of Israel interest rate, despite the rise in the CPI (Figure 8.3). The fall in expectations allowed both the public and policymakers to make the assessment that the acceleration in the price level at the end of 1998 had been essentially a nonrecurring occurrence (among other things due to the monetary policy response), thereby reducing the risk of a renewed more rapid inflationary spiral, with all the damage that it would cause.

Figure 8.3 The Impact of Monetary Policy on Inflationary Expectations 4Q 1998



Thus, the announcement of a target inflation rate was initially accorded a considerable degree of credibility and contributed to the reduction of inflationary expectations. As time passed, however, the announcement of a target did not appear to have a significant effect on expectations around the time of the announcement, so that changes in expectations seem to be connected with actual inflation. Nonetheless, the contractionary monetary policy at the end of 1994 and 1998 led to a significant reduction of inflationary expectations, evidence of the credibility accorded to that policy and the measures taken to achieve it.

Assessing the estimate

A first assessment of inflationary expectations may be obtained by comparing the actual and expected inflation using the average and standard deviation over different periods. As Table 1 shows, expected inflation is similar to actual inflation for all periods regarding both the average and the standard deviation. The difference between estimated and actual inflation is not more than 0.5 percent, and the standard deviation does not vary significantly either over different periods.

Table 1. Mean and Standard Deviation of Expected and Actual Inflation, by Period (January 1988–December 1998)

	Period (months)				
	1 1/	3	6	9	12
			(percent)		
Mean					
Actual inflation	1.1	3.0	5.8	8.7	11.7
Expected inflation	1.2	2.5	5.4	8.3	12.5
Standard deviation					
Actual inflation	0.72	1.51	2.52	3.46	4.26
Expected inflation	0.81	1.02	2.10	3.13	3.98
Correlation coefficient	0.54	0.29	0.35	0.55	0.59
Difference	0.12	-0.51	-0.35	-.043	0.73
Number of observations	114	115	112	109	106

Source: Central Bureau of Statistics, Israel.

1/ Data in this column relate to January 1988–June 1997.

The analysis of expectations may also be tested by examining the rationality of the estimates obtained. The rational expectations approach states that the public's expectations of inflation (EXPINF) are not systematically biased compared with actual inflation (INF). More specifically, if we run:

$$INF = a + b \ \ EXPINF + e$$

we would expect to obtain that a=0, b=1, and the residuals will be "white noise" (i.e. unbiased and uncorrelated).

As Table 2 shows, in the sampling period, although there is no serial correlation (D.W.=1.58), a significant coefficient is obtained, but less than 1 (0.52), while the constant in the regression is significant and different from zero. On the other hand, when the sample is extended to 1984–87, a significant coefficient very close to 1 is obtained, and the constant is not significant. Thus, by extending the period to incorporate the time of very high inflation, estimates confirm the rationality test of the expectations. This result is obtained because inflation did not fluctuate enough in the 1988–98 period, and this created a bias in the test, apparently based on the Error of Variables.

Table 2. Rationality Test of Expectations for One Month and Three Months 1/ 2/

Period	No. of Observations	A	B	D.W.	R
One month					
1/88–4/97	112	0.52	0.47	1.58	0.29
		(5.0)	(6.7)		
1/84–4/97	160	-0.10	1.09	1.89	0.92
		(-0.8)	43.3)		
Three months					
1/88–4/97	43	8.33	0.41	1.56	0.07
		(3.2)	(2.0)		
1/84–4/97	55	23.94	0.50	2.33	0.47
		(1.5)	(7.0)		

Source: Central Bureau of Statistics, Israel.

1/ The estimated regression is INF = bEXINF + e: where INF is inflation and EXINF is expected inflation for the appropriate period.

2/ Including observations for three months estimated in this chapter (1988–98), and expectations for 1984-86 estimated in the 1990 study. The values in parentheses are *t*–values.

Similar results were obtained from the regression of the same equations for a three-month period. Here, too, significant results in the expected direction and with a sufficiently high explanatory level were obtained only when the high-inflation period was included.

To summarize, inflationary expectations satisfy the rationality test, strengthening the validity of the findings and the quality of the series.

REFERENCES

Bank of England, Inflation Reports, recent years.

Bufman, G., L. Leiderman and M. Sokoler, 1995, "Israel's Experience with Explicit Inflation Targets: A First Assessment," in *Inflation Targets,* ed. by L. Leideran and Lars Svensson, (London: Center for Economic Policy Research).

Cukierman, A., 1973, "On the Formation of Inflationary Expectation in Israel," in *Issues in the Economy of Israel* (eds. N. Halevi and Y. Kop), pp. 225–246.

Deacon, M., and A. Derry, 1994, "Deriving Estimates of Inflation Expectation from the Prices of United Kingdom Government Bonds," (Series No. 23), Bank of England Working Paper.

De Kock, Gabriel, 1991, "Expected Inflation and Real Interest Rates Based on Index-Linked Band Prices: the U.K. Experience," *Quarterly Review* 16 (No. 3, Autumn), Federal Reserve Bank, New York, pp. 47–60.

Fama, E. F., 1975, "Short-term Interest Rates as Predictors of Inflation," The American Economic Review 65 (No. 3, June), pp. 269–282.

Fischer, Stanley, 1984, "Contracts, Credibility and Disinflation," NBER Working Paper, No. 1339, April (Cambridge, Massachusetts).

Fiszman, Gabriel, 1997, "The Implied Inflation-Risk Premium on CPI-Indexed Options," *Monetary Outlook* (Tel Aviv: Bank of Israel).

Mishkin, S. F., 1992, "Is the Fisher Effect for Real?" *Journal of Monetary Economics*, Vol. 30, pp. 195–215.

Sokoler, Meir, 1997, "Credibility Half-Won in an Ongoing Battle: An Analysis of Inflation Targets and Monetary Policy in Israel," Joint Working Paper prepared in cooperation with the members of the Monetary Department, Bank of Israel.

Yariv, D., 1990, "An Estimate of Inflationary Expectation in Israel under the Disinflation Programs of 1984–86," *Bank of Israel Economic Review*, Vol. 64, pp. 51–70.

———, 1993, "CPI Announcements and the Efficiency of the Israeli Securities Market," *Bank of Israel Economic Review*, Vol. 65, pp. 1–16.

Urich, Thomas, and Paul Wachtel, 1984, "The Effects of Inflation and Money Supply Announcements on Interest Rates," *Journal of Finance*, Vol. 39 (No. 4, September). pp.1177–88.

Chapter 6

INFLATION-FORECAST TARGETING AND THE ROLE OF MACROECONOMIC MODELS

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INTRODUCTION

Several central banks have turned to inflation-forecast targeting as a framework for guiding monetary policy, but the degree of transparency about how the forecast is constructed varies considerably across countries. Over the last several years, the Reserve Bank of New Zealand, which pioneered inflation targeting, has expended considerable effort to develop a consistent forecasting and policy system. To date, New Zealand is the only inflation-targeting country that releases a complete medium-term macroeconomic forecast as well as the modeling and policy assumptions that are used to construct it. This chapter argues that there may be significant potential benefits from using a consistent model-based projection process to inform policymakers even if considerable judgmental input is required to implement it. The chapter discusses the potential role of modern macroeconomic models in central banks as well as the pitfalls associated with using different classes of models to analyze the effectiveness of policy rules. A small macro model, calibrated for Czech economy, is used to illustrate the way such models can provide guidance for inflation targeting. The chapter also argues that while it is useful to adopt one model as a basic paradigm to organize the projection process, it is important to consider insights from a range of plausible models in order to quantify the potential uncertainties surrounding the forecast.

The remainder of the chapter is organized in the following way. Section II discusses some key strategic issues related to implementing an inflation-forecast-based targeting framework. The section argues that the main benefit of a transparent inflation targeting framework is that it will result in internally consistent policy analysis, improved policy credibility, and a more effective anchor for inflation expectations. This in turn should result in greater macroeconomic stability and higher levels of welfare. Section III discusses the monetary transmission mechanism and the role of monetary policy and then presents a paradigm for implementing an inflation-forecast-based targeting framework. Section IV discusses the implications of model uncertainty and provides a critique of recent research that has focused on analyzing the performance of policy rules in models where monetary policy errors only have second-order welfare implications. The basic argument of this section is that it may be dangerous to base monetary policy decisions solely on the insights obtained from one particular model. Instead, it argues that model uncertainty implies that several types of models should be used to assess the potential risks for monetary policy. That being said, Section V focuses on a specific small open economy model for the purposes of illustrating how such models can be used to support inflation targeting. Section VI provides some concluding remarks.

SOME KEY STRATEGIC ISSUES RELATED TO INFLATION TARGETING

Over the last decade a number of countries which have had difficult historical experiences with inflation control have turned to inflation targeting as a framework for governing monetary policy—see Bernanke et al. (1999) for a review of the experiences to date of the countries that have employed inflation targeting. While there are significant differences in the specific institutional arrangements that have been adopted in these countries, they usually embrace the following five basic principles.

Five basic principles

1. The primary role of monetary policy is to provide a nominal anchor for the economy; placing a weight on other objectives, such as unemployment, must not be inconsistent with this primary objective of providing an anchor for inflation and inflation expectations.

2. Given the possibility of a conflict between inflation targets and other objectives, central bankers must have reasonably clear goals and sufficient independence from the political process to achieve them.

3. Because of lags in the monetary transmission process, it is impossible to keep inflation exactly on target period-by-period; in practice, inflation targeting effectively boils down to inflation-forecast targeting where the monetary authorities set interest rates to eliminate deviations of their expected future inflation rates (inflation forecasts) from the target—see Svensson (1997a, 1997b).

4. There must be effective monitoring and accountability mechanisms to ensure that central bankers are behaving in a manner that is consistent with the announced underlying objectives and that monetary policy decisions are being based on the best available models and forecasts of the economy.

5. An effective inflation targeting framework should have beneficial first-order effects on welfare because such a framework will result in less uncertainty, higher levels of confidence in the monetary authorities' abilities to provide an anchor for inflation expectations, and a reduction in the incidence and severity of boom and bust cycles.

As mentioned above, while there seems to be general agreement on these basic principles, most countries that have adopted inflation targeting frameworks have significant differences in views about what the explicit objectives should be, what institutional arrangements are best to achieve them, and how transparent and accountable central bankers should be.

Instrument independence

A minimum necessary prerequisite is that the central bank must be assigned instrument independence. In principle, the government may also assign goal independence to the central bank, but what is important in practice is that the government provide a strong commitment that—unless there are extenuating circumstances—it will not override the central bank once the goals have been determined. Furthermore, in such circumstances where an override is judged to be necessary, it has to be made clear to the public and market participants that the central bank is being overridden. This is intended to provide a punishment mechanism in order to prevent overrides that may be motivated by short-term political gain and are not in society's long-term interests.

Transparency

Given the enormous difficulties and complexities associated with forecasting the economy and assessing the pervasive uncertainty inherent in any particular forecast, it is not surprising that many countries have been reluctant to implement a completely transparent inflation-forecast targeting framework. Even though some countries may implicitly be targeting an inflation forecast, their central banks may fear that releasing detailed information about the uncertainty in their forecasts and models not only might result in personal embarrassment, but also might undermine the public's confidence in their abilities to provide a stable anchor for inflation expectations. That being said, most of the countries that have announced inflation targeting have taken significant strides to ensure that the public understands the basic objectives and arguments behind their particular policy settings. This communication with the public has been done through regular inflation reports, minutes of various meetings, press conferences, public speeches, and conferences that are designed to illuminate the central bank's paradigm and to promote interest in improving it.

The primary motivation for these initiatives in the area of openness and transparency has not been the desire to achieve significant short-term credibility gains, but rather the view that there will be benefits over time if it becomes easier for the public and market participants to understand and assess the systematic component of monetary policy—see Longworth (1999).

The Reserve Bank of New Zealand (RBNZ), which pioneered inflation targeting, is clearly on the cutting edge in terms of openness, transparency and accountability. Not only does the RBNZ set precise targets and spend an enormous amount of time explaining its policies to the public, it is the only inflation-targeting country that releases a detailed medium-term forecast that includes information about its future policy assumptions as well as other key macroeconomic assumptions.

The RBNZ has also designed a model and projection system explicitly for implementing inflation-forecast-based targeting, and it makes its core policy projection model available to the public—see Black et al. (1997) for a description of the forecasting and policy analysis system employed at the Reserve Bank of New Zealand. The interest rate reaction function in the model is an inflation-forecast-based (IFB) rule where the slope of the term structure depends on the forecast of future inflation.

Uncertainty, openness, and learning from past errors

To develop and maintain credibility, central banks that adopt a strategy of inflation-forecast-based targeting should strive to learn lessons from past mistakes and then attempt to prevent these errors from occurring in the future. One of the problems with central banks in the past is that they have been very reluctant to admit policy errors in a timely manner—a stance that has significantly slowed down the learning process. For example, far too much ink has been spilled in academia and policymaking institutions debating issues that could have been easily resolved if monetary policy committees had been more open about the assumptions and projections on which their policy decisions were based.

One important benefit from transparency and openness is that the likelihood of large policy errors may be substantially reduced by involving a greater number of people outside central banks in the debate. As Buiter (1999) has emphasized, the process of fact finding and searching for truth is not served well by a highly secretive policymaking process. Moreover, failure to release detailed information behind policy setting results in an unproductive use of resources, both inside and outside central banks, in attempts to infer what policymakers might be thinking. For an inflation-forecast-targeting framework to be effective and credible, central bankers must be open and willing to change policies on the basis of past errors.

The New Zealand experience provides a great example of how an inflation-forecast-based system can be improved over time. In hindsight, it is clear that in its early stages, the policy process in New Zealand was excessively preoccupied with hitting near-term inflation objectives over a 6–12 month horizon at the expense of other objectives. However, with experience and firmer empirical evidence, it was recognized that such a policy could be destabilizing to activity and inflation in the medium term and the policy horizon was lengthened—see Svensson (1997b, 1998).

Several important lessons from the New Zealand experience with inflation targeting may be applicable to other countries. One lesson is that it can be counterproductive to overuse the direct exchange rate channel to hit a near-term inflation objective if it results in a loss in the public's confidence that the central bank is behaving in a manner that is consistent with the interests of society. Second, the policy process should not be focused exclusively on computing interest rate paths for hitting near-term targets without understanding the potential medium-term implications of these policy settings. Third, policies designed to win credibility too quickly by being too rigid may actually backfire when

the public and market participants recognize that there is a good chance that the system will be reformed in the future. In order to minimize the number of adjustments to key parameters in the framework, policymakers need to better understand the risks before committing to a particular inflation-based-forecasting strategy. Indeed, policies that destabilize the business cycle can have first-order welfare consequences and will and should be changed.

Flexible bands versus precise inflation-forecast targeting

In most cases it is generally recognized that the central bank has an important role to play in terms of stabilizing the business cycle, and that it should attempt to do this as long as achieving this objective does not conflict with its primary responsibility of providing an anchor for inflation and inflation expectations. However, the tradeoffs, or potential conflicts, pose a fundamental problem for the monetary authorities because uncertainty implies that it is impossible to commit in advance to how monetary policy should respond in the face of all shocks.

One strategy has been to retain flexibility by being somewhat vague about specific goals and by expressing inflation objectives as simply a desired range over the medium term. However, the main disadvantage of this approach is that it provides less information to the public about the future intentions of the monetary authorities in the face of shocks compared to a regime where the monetary authorities have a very precise target and attempt to achieve this target over a particular horizon. Indeed, proponents of precise and symmetric targets argue that these can be essential in order to anchor inflation expectations. For example, in reviewing the U.K. experience Haldane (2000) argues that the problem with the initial inflation target range of 1–4 percent between 1992 and 1995 was that it gave rise to positive "range bias" because it was interpreted as range of indifference. Haldane (2000) and Isard and Laxton (2000) report some data on long-term inflation expectations for the United Kingdom and show that the move to an independent central bank with a well-defined and symmetric target has resulted in a significant reduction in long-term inflation expectations and an improvement in policy credibility.

The adoption of a framework that has precise and symmetric targets also requires significantly greater transparency about how the monetary authorities will attempt to achieve their targets. In order to aid in the communication process some central banks have been releasing information about their own forecasts for inflation in order to provide some guidance to the public about the horizon over which they will attempt to achieve the target.[2] However, in some cases these forecasts are based on a constant interest rate assumption that is not perceived to be credible by bond market participants—see Isard and Laxton (2000) for a discussion of the problems with basing monetary policy decisions on an assumption of constant interest rates. As Flemming (1999) has argued, in order for the central bank's policy process to be forward-looking and internally consistent, it must be based on realistic assumptions about how monetary policy is likely to react to new information in the future. In other words, for a forward-looking monetary policy process to be internally consistent and transparent, the monetary authorities must provide an effective action plan, or strategy, that explains how exactly they plan to achieve these targets. In some central banks that have adopted an inflation targeting framework, this has resulted in the development of "working assumptions" about how the policy rate will respond to the central bank's

[2] The reason for providing a forecast is that it will not generally be optimal (or even feasible) to have a fixed horizon to set the forecast of inflation equal to the target. For most countries, what is important is that the monetary authorities' reactions be successful in steering inflation back towards the target over a reasonable horizon depending, inter alia, on the lags in the monetary transmission mechanism and the degree of serial correlation in the underlying shocks.

forecast; and in the case of New Zealand this information is made available to market participants.[3] These assumptions for monetary policy that are used inside central banks are sometimes referred to as working assumptions to emphasize that policymakers would never follow a rule blindly and that it is necessary to add judgment to the policy rule just as judgment is added to all of the other equations in the core projection model that is used to organize the projection process. For this chapter, we will assume that this is well understood and for this reason we will refer to the central bank's reaction function as a "policy rule" and consider the two types of forward-looking policy rules that have been suggested in the literature.

Targeting rules versus instrument rules

Svensson (1999) distinguishes between targeting rules and instrument rules. The latter amount to formulas or reaction functions that link the policy instrument to the observed (or forecast) outcomes for a set of macroeconomic variables. The former, which Svensson regards as more fruitful and realistic formalizations of real-world monetary policy, involve a commitment to minimize a given loss function or to fulfill some optimality condition for (forecasts of) the target variables, but allow the optimization to be done under discretion.[4]

There are several potential problems with targeting rules from a normative perspective. First, as demonstrated by Woodford (1999) and McCallum and Nelson (2000), targeting rules may be suboptimal because they are based on optimization under discretion. Second, as argued by Isard and Laxton (2000), because targeting rules are not time consistent, they are unlikely to be regarded as credible by forward-looking bond market participants, and consequently they may fail to provide valuable guidance to market participants about the systematic component of monetary policy. Third, as argued in Isard and Laxton (2000), the use of targeting rules can be counterproductive if it implies that the authorities limit themselves by basing policy either on relatively simple macroeconomic models for which they are able to derive first-order conditions for their policy instrument, or on a limited set of candidate paths for the policy instrument, such as paths that hold the policy instrument constant over the forecast horizon.[5]

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[3] Central bankers have been very reluctant to release the modeling and policy assumptions behind their forecasts, fearing that market participants may not completely understand the uncertainties in the forecast; at this point in time only the Reserve Bank of New Zealand publishes these assumptions. Section V of this paper shows that one of the advantages of developing an internally consistent modeling framework is that it is then possible to use that framework to develop confidence bands for the policy rate and a host of other macroeconomic variables.

[4] McCallum and Nelson (2000) dispute Svensson's claim that targeting rules provide a better characterization of the decision-making process in central banks that have adopted inflation targeting and argue that no central bank relies upon an explicit objective function.

[5] When Svensson introduced the concept of targeting rules he did so in a very simple model where only past changes in the policy rate affected aggregate demand and inflation, with no effects on aggregate demand and inflation from expectations of future movements in the policy rate. The resulting policy implications from these models should be interpreted with caution. First, even though the model was extremely simple, it may have given the impression that it would be optimal to choose a fixed horizon to set the forecast of inflation equal to the target. This generally will not be true in macroeconomic models with more realistic macroeconomic dynamics. Second, because of the extremely simple control lags in the model, it may have given the impression that it made sense to characterize an unchanged monetary policy assumption with an unchanged policy rate over the policy horizon. This will obviously not be true in models where expectations of future policy rates affect aggregate demand and inflation expectations and where attempting to follow a constant-interest-rate rule can produce very undesirable consequences—see Isard and Laxton (2000).

Much of the recent literature on instrument rules has addressed the stabilization properties of Taylor rules and inflation-forecast-based (IFB) rules. This research has suggested that IFB rules may be more robust to a larger variety of shocks than backward-looking Taylor type rules, because under unconstrained IFB rules, interest rates are free to jump to find a path for real monetary conditions that is consistent with both inflation control and stabilization objectives—see Isard, Laxton and Eliasson (1999). [6]

For an inflation-forecast-based rule to be credible, the rule must be reasonably robust and the central bank must be able to present a clear paradigm about how it thinks about the economy when setting interest rates. Central banks which are currently following an inflation-forecast-based regime, or may be considering doing so, will be well served by strengthening their analytical frameworks and projection paradigm along the lines that New Zealand has.

A Paradigm for Implementing Inflation-Forecast Targeting

This section discusses an appropriate paradigm for organizing and implementing an inflation-forecast targeting framework. We would emphasize at the outset that monetary policy necessarily involves a large element of discretion, but that formal models can be very useful in promoting the consistency of policy analysis and in helping the authorities communicate the rationale for policy actions. The views in this section reflect some personal experiences at the Bank of Canada as well as our observations about how inflation-forecast targeting is organized—or not organized—at other central banks. Box 1 provides some summary points about the key aspects of a basic paradigm. The remainder of this section and the other sections will attempt to elaborate on these points.

Box 1: Inflation-Forecast-Based Targeting Paradigm

1. Develop a clear view of the monetary transmission mechanism and the fundamental role of the monetary authorities.
2. Build a core projection model that embodies the consensus views of policymakers about how the economy responds to standard shocks. Keep the model simple and easy to understand but be wary of highly simplistic rule-of-thumb models in which the timing of monetary policy decisions are unimportant and where monetary policy errors only have second-order implications for welfare.
3. If there are differences in views about what the properties of the core projection model should be, develop a broader taxonomy of models to represent these alternative views and use this taxonomy to help measure the uncertainty in the core projection model. Good examples of where well-informed policymakers could disagree, for example, would be on lags in the monetary transmission mechanism, the role of expectations, and the relative incidence of supply versus demand shocks.
4. Acknowledge that the core projection model is designed to only handle a well-specified set of standard shocks. Keep the structure of the models simple so that it is easy to embody insights from

[6] Section V provides an example of how an IFB rule can be optimally calibrated for a small, simple, macro model of the Czech Republic. The model is "complete" in the important sense of having a well-specified role for the monetary authorities to provide an anchor for inflation expectations and to prevent large boom and bust cycles from occurring. The model is incomplete in the sense that it ignores many issues about real-world macroeconomic dynamics but, as Longworth (1999) has argued, such simple models may be a useful starting point to organize the "thinking process" inside central banks and the models can become more elaborate and sophisticated as more data and expertise become available.

non-model-based judgement, or other models that are designed to study the effects of non-standard shocks that appear too infrequently (or would excessively complicate the core projection model).

5. Encourage an active research agenda both within and outside the central bank to understand the implications of uncertainty. Don't forget that an important benefit of developing a transparent paradigm is that it provides a more productive direction for paradigm busters to come up with concrete alternatives that can compete with the core projection model.
6. Document errors from previous paradigms and models to ensure that these errors are not forgotten and repeated in the future.
7. Be prepared to adjust the paradigm and core projection model in response to new experiences and empirical evidence. This process is much easier if the initial paradigm explicitly acknowledges uncertainty.
8. Recognize the low power of statistical tests and don't let the paradigm fall hostage to poor methodology.

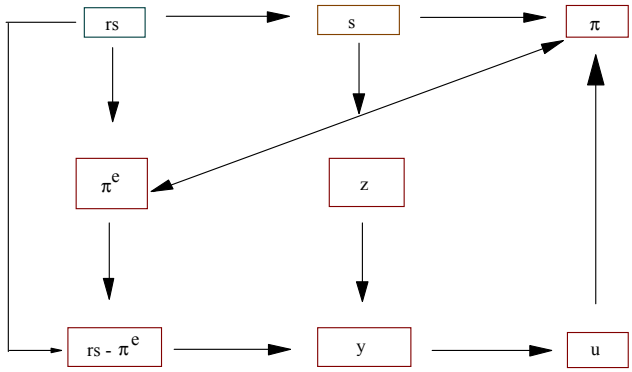
The monetary transmission mechanism and role of the monetary authorities

The first step is to develop a view of the monetary transmission mechanism and the role of the monetary authorities. These issues are considered in much more depth below and elsewhere, but a few summary points can be mentioned here.

A prerequisite for inflation-forecast-based targeting is that there must be a reasonably clear view about the monetary transmission mechanism as well as the major shocks that influence the economy and inflation.[7] The analytical frameworks that have been developed for addressing monetary policy issues for an open economy traditionally exhibit the monetary policy transmission mechanism depicted in Figure 1. The authorities control a short-term interest rate (rs) with the objective of influencing the rates of inflation (π) and unemployment (u). As shown by the arrows, changes in the policy instrument are transmitted to the policy target variables through several channels. Adjustments in the nominal interest rate can trigger movements in the nominal exchange rate (s), which are transmitted fairly directly to tradable goods prices and inflation and indirectly to unemployment through their effects on the real exchange rate (z) and the gap (y) between actual and potential domestic output. Changes in the nominal interest rate also affect the real interest rate ($rs - \pi^e$), both directly and through the response of inflation expectations (π^e); changes in the real interest rate in turn influence unemployment through their effects on aggregate demand and the domestic output gap; and changes in the output gap and unemployment rate influence the inflation rate through channels summarized by the Phillips curve. In addition, important feedback mechanisms are at work over time, with inflation expectations responding to the history of inflation and inflation influenced in turn by changes in inflation expectations.

Figure 1. The Monetary Policy Transmission Mechanism

[7] Most central banks in inflation-targeting countries have released information about how they view the monetary transmission mechanism—for examples, see Longworth (1999), Black et al. (1997), and Bank of England (1991a,b).



rs : Nominal short-term interest
s : Nominal exchange
z : Real exchange
y : Output

π : Inflation
π^e : Inflation
u : Unemployment

Figure 1 does not show any feedback mechanisms from the policy target variables to the policy instruments. The task of identifying and implementing a feedback mechanism that is conducive to macroeconomic stability is the responsibility of the monetary authorities. In particular, the role of monetary policy is to react to observed and anticipated changes in unemployment, inflation and other macroeconomic variables, taking account of the behavioral relationships among these variables.

In reality, the operation of monetary policy is greatly complicated by two types of uncertainties: imperfect information about the magnitudes of the various transmission effects shown in the diagram, and difficulties in identifying the effects on macroeconomic variables of various types of economic shocks. The operation of monetary policy is also complicated by the fact that policy credibility is imperfect and can vary with the effectiveness of the monetary authorities in achieving desirable outcomes for policy target variables. The endogenous behavior of policy credibility and its role in the monetary policy transmission mechanism has not yet been adequately incorporated into the models that have been used to analyze monetary policy issues.[8]

Countries that have adopted IFB targeting have generally embraced the principle that the fundamental role of the monetary authorities is to provide a nominal anchor for the economy. As mentioned above, one of the lessons derived from history is that it can be unproductive to ignore stabilization issues by placing too large a weight on manipulating near-term inflation forecasts. That being said, another important lesson from history is that it can be even more costly to place too high a

[8] See Isard and Laxton (1999) and Isard, Laxton and Eliasson (1998) for some first steps in this direction. Amano, Coletti and Macklem (1998) provide a recent analysis of monetary rules that explores the implications of changes in a credibility parameter, but without attempting to model the endogenous behavior of credibility.

weight on extremely uncertain measures of unemployment and output gaps—see Laxton and Tetlow (1992) and Orphanides (1998).[9]

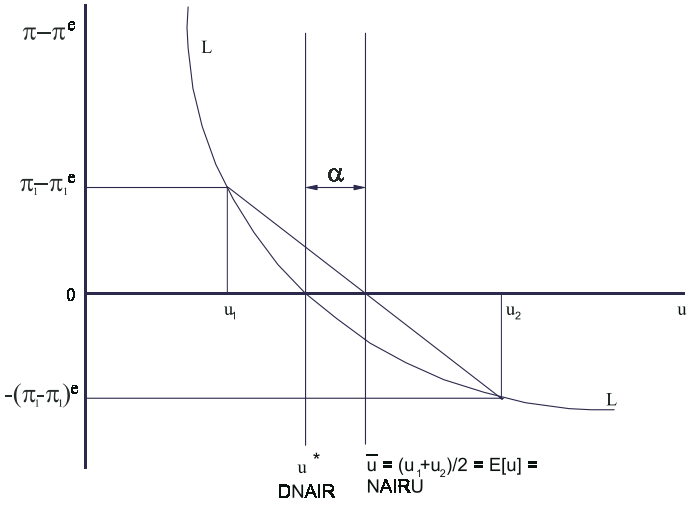
Most policymakers believe that experience suggests that large policy errors can result in first-order welfare consequences, but the simple linear macro models that have been used extensively in policymaking institutions imply that there are only second-order welfare consequences associated with monetary policy errors. One place where standard linear models should and can easily be modified is to re-introduce convexity into the short-run Phillips curve, which can be done within the confines of the long-run natural rate hypothesis. The introduction of such convexity gives rise to much more realistic and interesting policy implications insofar as it explicitly recognizes that myopic policy rules can have significant effects on both the means and the variances of inflation and unemployment.

Convexity in the short-run Phillips curve implies that the tradition of decomposing unemployment into structural and cyclical components requires modification, as does the traditional discussion of the non-accelerating inflation rate of unemployment—the so-called NAIRU. To illustrate, Figure 2 shows a convex (to the origin) short-run Phillips curve, plotted as a relationship between expectations-augmented inflation (vertical axis) and the unemployment rate (horizontal axis), with expectations-augmented inflation corresponding to the difference between actual and (ex ante) expected inflation. The unemployment rate at which expectations-augmented inflation is zero–labeled u^* in Figure 2 and referred to as the DNAIRU or *deterministic* NAIRU—corresponds to the structural rate of unemployment that would prevail in a deterministic world. It is critical to recognize that the DNAIRU is not a feasible stable-inflation equilibrium in a *stochastic* economy with convexity. The average rate of unemployment that would be associated with non-accelerating inflation (and expectations equilibrium) in a stochastic world—labeled $\bar{u}$ in the figure and referred to as the NAIRU—must lie above the DNAIRU. This is because convexity in the short-run Phillips curve means that inflation rises faster when unemployment is below the DNAIRU than it falls when unemployment is commensurately above the DNAIRU.[10] If u were maintained equal to u^* on average, the asymmetry in the response of inflation to symmetric aggregate demand shocks would make it impossible to maintain a constant average inflation rate.

[9]Examples of where linear models have been used to study the implications of uncertainty in the NAIRU or output gap can be found in Wieland (1997) and Smets (1999). Drew and Hunt (1999), Isard (1998) and Isard, Laxton and Eliasson (1998, 1999) employ nonlinear models and arrive at different conclusions regarding the potential risks of high degrees of interest rate smoothing that arise from uncertainty about the NAIRU and potential output.

[10]This type of convexity was an important feature of the original curve introduced by Phillips (1958) and discussed by Lipsey (1960) and several others. Macklem (1996) and Clark and Laxton (1997) provide a brief history of convexity in the Phillips curve and explain why it was overshadowed by other issues.

Figure 2. A Convex Short-Run Phillips Curve



The convex short-run expectations-augmented Phillips curve combined with standard models of inflation expectations implies that stabilization policies that are successful in avoiding boom and bust cycles will reduce the average unemployment rate and raise the average level of output. This can be seen in Figure 2, which has been drawn under the assumption that the unemployment rate is symmetrically distributed around the NAIRU over the range between u_1 and u_2. The important point is that success in reducing the variability of unemployment will also lower its mean value. One can see this immediately from Figure 2 by imagining a tighter control on the dispersion of unemployment. The line LL would move down and to the left and the gap between $\bar{u}$ and u^* would shrink. The key lesson is that stabilization can matter in the sense that policies that either induce or allow extreme variability in the business cycle will also cause a permanently higher NAIRU.

If the degree of convexity in the *short-run* expectations-augmented Phillips curve is independent of the long-term inflation objective, then it will still be true that the *long-run* Phillips curve is vertical and the average unemployment rate will be independent of the target inflation rate. However, if convexity in the short-run Phillips curve becomes greater at very low expected inflation rates, as suggested by Akerlof, Dickens and Perry (1996), then there may be a permanent tradeoff between inflation and unemployment at low inflation rates.

With convex models of the Phillips curve, the analysis of unemployment behavior, in addition to identifying the cyclical variation of actual unemployment around its average rate, needs to recognize that the average rate of unemployment exceeds the structural rate of unemployment by an amount that generally reflects both the nature and the magnitude of economic shocks and the effectiveness of stabilization policies. With convexity in the short-run Phillips curve, stabilization policies can have permanent effects on unemployment and output.[11] When combined with more elaborate models of inflation expectations and imperfect policy credibility, the convex Phillips curve paradigm will

[11]See Mankiw (1988) and DeLong and Summers (1988).

hopefully provide a much a richer macroeconomic framework for assessing the effectiveness of alternative monetary policy rules and stabilization policies—see Isard and Laxton and Eliasson (1998).

A core quarterly projection model

In order to formally implement an inflation-forecast-targeting framework, it is desirable to design and build a core projection model that embodies the consensus views of policymakers about how the economy responds to standard shocks. It is important that this model is easy to understand, but policymakers should be wary of overreliance on highly simplistic reduced-form rule-of-thumb models where there is no fundamental role for the monetary authorities. Relying upon such models may be acceptable when policy is always in the neighborhood of the optimum because, by definition, all policy errors are second order. However, the core projection model must to some extent embody the possibility that monetary policy reactions that do not respond forcefully enough or quickly enough to shocks can lead to shifts in inflation expectations and potentially to first-order welfare losses.

It must also be easy to incorporate judgment into the core projection model by drawing insights either from other types of models or from non-model-based monitoring and forecasting of individual sectors. Experience at some central banks suggests that non-model-based forecasting is more reliable for very near-term forecasting than pure model-based forecasting—see Kohn (1995) and Longworth (1999). Consequently, economists should be prepared to fine-tune the first few quarters of the projection horizon for those variables where more accurate projections can be obtained, and use the judgment and intuition of sectoral specialists to incorporate non-model-based information—see Black et al. (1997) and Longworth (1999)

.

There are a number of advantages to having a core projection model. First, it will get people inside and outside central banks speaking the same language, and further improvements can be made by those people that choose to be paradigm builders and paradigm busters. Without a clear core model to serve as a standard of comparison, it is very difficult to judge whether or not good and bad outcomes of the policy process over time are being driven by good and bad luck or by good and bad monetary policy.

Classification of small models that encompass the core model

If there are differences in views about what the properties of the core projection model should be, it would be useful to develop a broader taxonomy of models to represent these alternative views and use this arrangement to help measure the uncertainty in the core projection model. Good examples of where well-informed policymakers could disagree, for example, would be on lags in the monetary transmission mechanism, the role of expectations, and the relative incidence of supply versus demand shocks. There has been a tendency in central banks not to analyze sufficiently the enormous risks associated with a given projection and policy setting.

With the advent of inflation-forecast-based targeting, transparency and openness has created a much better environment for studying and presenting risks. Indeed, although some current-generation inflation reports are far too descriptive and not sufficiently analytical insofar as they stop short of spelling out an acceptable formal macro paradigm, some significant progress has been made in illustrating the uncertainties in the forecast.

A simple model focused to address a well-defined set of issues

Acknowledge that the core projection model is designed to only handle a well-specified set of standard shocks. This is critical, because taking on too many issues with a model runs the risk of it becoming too large and too complicated. If the model becomes a black box, experience has shown that it will soon lose the confidence of policymakers. Again, the structure of the model should be kept simple so that it is easy to embody insights from non-model-based judgment, or from other models that are designed to study the effects of non-standard shocks that appear infrequently (or would excessively complicate the core projection model). The model should not hide weaknesses, nor should it ever fall hostage to methodology that is based either on pure empirics or on theoretical elegance alone.

For a model to be used by policymakers, they must have confidence that it has something useful to say. Given the low power of statistical tests, it is important that the model's parameters and structure be based on an assessment of Type I and Type II policy errors—see Laxton, Rose and Tetlow (1993). Beware of pure empirics that place linear models on the pedestal and then use low-powered statistical tests to show that they cannot be rejected against models that have much more intuitive policy implications.

Laxton, Rose and Tambakis (1999) show that recent statistical rejections of convexity in the Phillips curve have been uninformative because researchers have employed measures of business cycle gaps that are inconsistent with implications of convexity. Their paper also shows that identifying convexity in the Phillips curve will become even more difficult if policymakers are successful in avoiding large boom and bust cycles. To the extent that convexity in the Phillips curve is used as a rationale for establishing stabilization policies and for the importance of forward-looking monetary policy rules, their findings present an interesting conundrum, because successful policymakers will further weaken the empirical evidence on which such policies are based.

There are a host of econometric difficulties associated with building models for monetary policy analysis. In the end, it may be more productive and informative to simply calibrate certain parameters based on a more considered view about system properties rather than single equation diagnostic tests.

The implications of uncertainty

Encourage research to understand the implications of uncertainty. An active research agenda, both within and outside the central bank, should be encouraged so as to understand the implications of uncertainty. The Reserve Bank of New Zealand, the Bank of Canada and the European Central Bank have organized conferences to study the implications of uncertainty, and most central banks that have adopted inflation targeting have been prepared to invest significant resources to publish papers that document the structure and properties of their core models—see for example Drew and Hunt (1998), Black, Macklem and Rose (1997) and Bank of England (1999a). An important benefit of developing a transparent paradigm is that it provides a more productive direction for paradigm busters to come up with concrete alternatives that can compete with the core projection model; such a benefit should not be forgotten.

Document and publish errors

Document and publish errors and don't forget them. It is important to document errors from previous paradigms and models to ensure that these errors are not forgotten and repeated in the future.

Adjust the paradigm

Be prepared to adjust the paradigm and core projection model. It is equally important to be prepared to adjust the paradigm and core projection model in response to new experiences and empirical evidence. This process is much easier if the initial paradigm explicitly acknowledges uncertainty.

The low power of statistical tests

Recognize the low power of statistical tests, and don't let the paradigm fall hostage to poor methodology. Enough said.

MODEL UNCERTAINTY AND RECENT RESEARCH ON MONETARY POLICY RULES

The past few years have brought a flurry of papers devoted to studying the properties of simple monetary policy rules in which the short-term nominal interest rate responds directly to measures of both inflation and output gaps. John Taylor of Stanford University has been one of the leading advocates of these types of monetary policy rules, which are now commonly referred to as Taylor rules. Taylor (1999a) has suggested that the poor performance of the U.S. economy during the late 1960s and 1970s could have been avoided if policymakers had relied upon the simple Taylor rule as a guideline for policy, provided that the rule was calibrated to respond to inflation and output about as aggressively as the interest rate was adjusted in the late 1980s and 1990s. Along similar lines, Levin, Wieland and Williams (1999) have recently shown that simple rules linking the change in the interest rate to the variables that enter conventional Taylor rules have desirable properties in four different macro models of the U.S. economy. However, as Christiano and Gust (1999) argue, one of the shortcomings of most evaluations of monetary policy rules—including the work of Taylor and Levin, Wieland and Williams—is that the effectiveness and robustness of these rules has only been analyzed in a very small class of IS-LM models. Unlike Levin, Wieland and Williams, Christiano and Gust conclude that these simple interest rate rules are not robust to model uncertainty. In fact, they argue that it would be very dangerous for policymakers to follow such rules in practice because it would risk a repeat of the great inflation of the 1970s.

Too simple—the conventional Taylor Rule?

Is the Taylor rule too simple to be taken seriously? Yes. The reason that the conventional Taylor rule is too simple, and would be dangerous to adhere closely to in practice, reflects the following considerations.

First, as a general point, the effectiveness of any rule for the nominal interest rate depends critically on its success in preventing significant and prolonged deviations of unemployment from the NAIRU, and in thereby preventing an acceleration of inflation. Adjustments in nominal interest rates influence unemployment largely through their effects on aggregate demand, which are transmitted primarily through the real interest rate.

Second, under the Taylor rule, the level of the short-term nominal interest rate depends on the *current* level of inflation, which serves as both an indicator of inflation expectations and a variable that, in conjunction with either the unemployment gap or the output gap, tells the monetary authorities in which direction, and by how much, they should adjust the real interest rate.

Third, inflation expectations in reality have a significant rational and forward-looking component. By contrast, the Taylor rule is myopic and backward-looking insofar as it embodies the current level of inflation as a measure of inflation expectations.

Fourth, monetary policymakers confront considerable uncertainty about the behavior of the economy. Because estimates of the output gap and the equilibrium level of the real interest rate are imprecise, and because economists tend to make serially correlated errors in estimating the output gap, even the best informed policymakers occasionally come to the realization that they had been misgauging the strength of the economy in the recent past, and that their policy errors have led to a state of significant excess demand or significant excess supply.[12] States of significant excess demand or supply can also result from the economy being hit by large and unanticipated shocks, and from serially-correlated errors in policymakers' attempts to distinguish between the transitory and permanent components of shocks.[13]

Fifth, when an economy is experiencing a state of significant excess demand, the nominal interest rate adjustments that would be dictated by a backward-looking Taylor rule may be insufficient to raise the level of the real interest rate that is perceived by forward-looking market participants, and might therefore allow excess demand to continue to strengthen, accompanied by a continuing upward spiral in market participants' inflation expectations. As elaborated by Isard, Laxton and Eliasson (1999) in evaluating the Taylor rule calibrations advocated by Taylor (1993, 1999a), in some plausible models it would take only a moderate level of excess demand to break loose the anchor for inflation expectations.

In our view, the conventional Taylor rule is too simple to be taken seriously because it would risk a repeat of the types of monetary policy errors that have been experienced in the past. As Kohn (1999) has emphasized, "certainly central banks would modify reaction functions if they sensed destabilizing behavior." Thus, for an economy that was experiencing significant excess demand, a myopic Taylor rule in a world of forward-looking agents would simply not be a credible guideline for monetary policy.

The role of monetary policy and lessons learned from historical policy errors

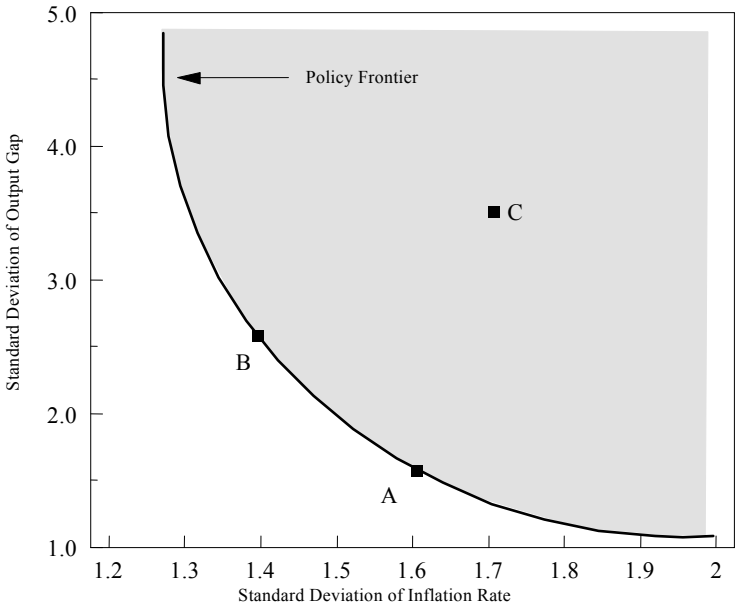
What is the role of monetary policy and what lessons have we learned from historical policy errors? What types of macroeconomic models should be admissible for evaluating the performances of monetary policy rules? In *linear* macro models that embody the long-run natural rate hypothesis, monetary policy does not affect the average level of output, but it does influence the variances of the output gap (i.e. the gap between actual output and potential output) and the inflation rate. Accordingly,

[12]For a discussion of the historical errors in estimating potential output and the NAIRU in Canada and the United States, see Laxton and Tetlow (1993) and Orphanides (1998, 1999).

[13]As elaborated below, in macro models that are globally linear, states of significant excess demand or supply do not pose risks of large and undesirable consequences (i.e. overheating or deflation). In such linear models, Taylor rules—which are linear functions of the current level of the inflation rate and the output gap (or unemployment gap)—typically embody all the information that is required to forecast inflation and stabilize the business cycle; hence, Taylor rules tend to work very well in linear models. For nonlinear models, by contrast, a rule that depends on current (or past) inflation and output gaps generally must be a nonlinear function of these variables to work well in maintaining macroeconomic stability (see Schaling, 1998, and Clark, Laxton and Rose, 2000), although linear functions of (model-consistent) inflation forecasts and output gaps can work well as policy rules in some nonlinear models (see Isard, Laxton and Eliasson, 1999).

the role of monetary policy is often described in terms of a simple chart like Figure 3, popularized by Taylor, which shows the minimum standard deviation of the output gap that is feasible for any standard deviation of the inflation rate.[14] In terms of Figure 3, the role of monetary policy can be characterized as the task of insuring that the economy reaches some point on (or acceptably close to) this policy frontier, where the optimal point on the frontier depends on society's preferences. This role is equivalent to, and is sometimes described more formally as, minimizing a quadratic loss function that is separably additive in the squared output gap and the squared deviation of inflation from target.[15]

Figure 3: Policy Frontier Derived From the Federal Reserve Board of Governors' Econometric Model of the U.S. Economy



Source: Reifschneider, David, Robert Tetlow and John Williams, 1999, "Aggregate Disturbances, Monetary Policy, and the Macroeconomy: The FRB/US Perspective," Federal Reserve Bulletin, January, pp. 1-19.

This view of the role of monetary policy, along with the underlying macro models that support such a characterization, fail to focus on the "possibility" that monetary policy in reality can have substantial and prolonged effects on the average levels of inflation and output gaps. Most central bankers and

[14]The policy frontier in Figure 3, which has been taken from Reifschneider, Tetlow and Williams (1999), was derived for the Federal Reserve Board's FRB/U.S. model of the U.S. economy.

[15]Within the four models considered by Levin, Wieland and Williams (1999) the optimal calibrations of simple interest rate rules for one model also tend to perform relatively well in the other models in the sense that they generate standard deviations (of inflation and the output gap) that are relatively close to the policy frontiers for the other models.

economic historians would assert that such effects are a clear reality, not simply a possibility. Linear macro models that do not reflect this possibility risk seducing policymakers into a repeat of the large monetary policy errors of the past and should not be admissible for evaluating the performances of monetary policy rules.[16]

Several types of nonlinearities seem relevant in efforts to develop admissible models for monetary policy evaluation. One potentially important element of nonlinearity is the Phillips curve—see, for example, Debelle and Laxton (1997), Laxton, Rose and Tambakis (1999), and Clark, Laxton and Rose (2000). A second potentially important element of nonlinearity is the endogenous nature of monetary policy credibility and the apparent asymmetry in the speeds with which the gap between expected inflation and actual inflation responds to the track record of the monetary authorities; see Isard and Laxton (1998) and Isard, Laxton and Eliasson (1998). Still another important source of nonlinearity, sometimes alluded to as a "liquidity trap," is the fact that monetary policy cannot push nominal interest rates below a floor of zero; see Laxton and Prasad (1997, 1999) and Sims (1999).

One of the key lessons from history, which reflects both *lags* in the transmission of monetary policy to output and inflation and *nonlinearities* in the output-inflation process, is that it is important for monetary policy to be forward-looking, and to try to take account of all available information that has a significant bearing on the future paths of inflation and output; see Mussa (1994) and Clark, Laxton and Rose (2000). Myopic policy responses to available information can have potentially large costs in terms of output and inflation.

A second key lesson from history is that uncertainty is important. Failing to account adequately for uncertainty about the level of potential output, or about the level of the NAIRU, can lead the monetary authorities to adjust interest rates too aggressively in response to estimated output or unemployment gaps, and would risk a repeat of the policy errors of the 1970s, when many central banks provided excessive monetary accommodation in response to inaccurate estimates of the NAIRU and potential output; see Laxton and Tetlow (1992) and Freedman (1996).

A third lesson is that, in evaluating monetary policy strategies, it is important to distinguish between ex ante policy mistakes and ex post policy mistakes. For example, while some may regard the Federal Reserve Board's "pre-emptive strikes" to raise U.S. interest rates in the Fall and Winter of 1994–95 as, in retrospect, unnecessary or excessive, it would not be appropriate to characterize those policy actions as ex ante mistakes, given the information that the Federal Reserve was acting upon at the time. Ex post, the case for those actions has been weakened by the combination of downward reductions in estimates of the NAIRU and the greater-than-expected slowdown in U.S. economic activity during the first half of 1995 (partly reflecting spillovers from the economic crisis in Mexico). But ex ante, the case for such pre-emptive strikes can be argued on the basis of a combination of NAIRU uncertainty, asymmetries in the unemployment-inflation process, and significant lags in the monetary transmission mechanism (Isard and Laxton, 1998).[17]

[16]For critiques of policy analysis based on models with linear Phillips curves, see Summers (1988), DeLong and Summers (1988), and Laxton, Rose and Tambakis (1999). While models that presume global linearity may be useful for short-term forecasting, models designed for policy analysis must allow for the possibility that poorly conceived policies can result in deficient outcomes.

[17]In Congressional testimony explaining the 1994–95 interest rate actions, Federal Reserve Chairman Greenspan (1995) professed that it could be potentially costly to delay an interest rate hike: "In modern economies output levels may not be so rigidly constrained in the short run as they used to be when large segments of output were governed by facilities such as the old hearth steel furnaces that had rated capacities that could not be exceeded for long without breakdown. Rather, the appropriate analogy is a flexible ceiling that can be stretched when pressed, but as the degree of pressure increases, the extent of flexibility diminishes." These arguments apply to guarding not only

The robustness issue

Has the robustness issue been explored adequately? No. As Christiano and Gust (1999) argue, the four models that Levin, Wieland and Williams (1999) have explored are all quite similar insofar as they all belong to the class of sticky-price IS-LM models. Moreover, as noted above, most evaluations of monetary policy rules have relied on linear macro models. We have shown that small extensions to the structures of the models studied by Levin, Wieland and Williams (1999) to account for nonlinearities in the unemployment inflation process and uncertainty in the NAIRU can give rise—under either the conventional Taylor rule or the rule advocated by Levin, Wieland and Williams—to large boom and bust cycles, or to extreme instabilities in inflation expectations; see Isard, Laxton and Eliasson (1998).

Problems with the optimal policy rules

What are the specific problems with the optimal policy rules derived from simple linear IS-LM Rational Expectations models? A considerable amount of time has been devoted to studying the effectiveness and robustness of simple interest rate rules in a class of simple linear IS-LM Rational Expectations models. As noted above, one important lesson from history is that it is important for monetary policy to be forward-looking in order to prevent large boom and bust cycles. The optimal reaction functions derived from these simple linear IS-LM Rational Expectations models are extremely myopic, and we agree with Christiano and Gust that blindly following such rules would risk a repeat of the types of monetary policy errors that have been experienced in the past.

The types of models that have been used by Levin, Wieland and Williams (1999) and several others have two basic problems that make them ill-equipped for studying alternative policy rules. First, the models presume that the monetary policy rule is always perceived to be fully credible by the public, even when the monetary authorities respond myopically to inflation developments or place a very large relative weight on real objectives. Second, in this class of models, myopic policy rules only have second-order welfare implications. In our view, any serious model of the economy advanced for studying alternative monetary policy rules must embody the notions that the timing of monetary policy is essential, and that myopic policy responses can, in practice, have significant first-order welfare implications for the economy.[18] We agree with Christiano and Gust (1999) that research should be directed away from fine-tuning optimal policy reaction functions in models where there is no real role for monetary policy to focus on a much broader set of models in order to develop strategies for attempting to avoid large policy errors that can result in first-order welfare losses.

In the spirit of Christiano and Gust (1999), we illustrate the problems with optimal policy rules derived from simple IS-LM Rational Expectations models, by reporting the Blanchard-Kahn (1980) saddle-point stability conditions for two classes of interest rate rules in the context of one of the linear forward-looking models that Levin, Wieland and Williams (1999) used to investigate the robustness properties of such rules.[19] We show that both classes of rules produce saddle-point stability over an enormous range of parameter values.

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against overheating but also against serious overcooling where economies are more sensitive to the risks of deflationary shocks; see Laxton and Prasad (1997).

[18]For example, in nonlinear models of the unemployment-inflation process, a failure to prevent large boom and bust cycles will result in a permanently higher level of unemployment; see Mankiw (1988).

[19]The specific model was developed by Fuhrer and Moore (1995a, 1995b). We chose this model because it was more easily accessible than the other models considered by Levin, Wieland and Williams (1999). We are indebted

Rule 1: Conventional Taylor Rule Generalized for Interest Rate Smoothing

Figure 4 reports the combinations of parameter settings that lead to unique, explosive, and indeterminate solution paths in the Fuhrer-Moore (1995b) model under a conventional Taylor rule that has been generalized to allow for interest rate smoothing.

This rule can be written as:

$$rs_t = \rho\, rs_{t-1} + (1-\rho)[w_\pi(\pi 4_t) + w_y(y_t)] \quad (1)$$

where rs_t is the nominal interest rate setting at time t; $\pi 4_t$ which is the average inflation rate over the previous four quarters; y_t represents the output gap in the Fuhrer-Moore model; and ρ, w_π, and w_y are parameters.[20] Note that the interest rate reaction function has been coded so that the parameters w_π and w_y represent asymptotic long-run responses of the interest rates to the year-over-year inflation rate and the output gap.[21]

A striking feature of Figure 4 is that for a very wide range of parameter values—and independently of the speed with which monetary policy reacts to inflation and output gaps (i.e. independently of ρ)—the model has a stable and unique solution. Indeed, the stability properties of the generalized Taylor rule in this linear rational expectations IS-LM model are extremely simple. The only condition necessary for stability and uniqueness is that the long-run response of the interest rate to year-over-year inflation must be greater than one. Provided this condition is met, even a Taylor rule that reacts much more aggressively to output than to inflation and allows inflation to drift persistently above the target will provide an anchor for inflation expectations in the Fuhrer-Moore model.

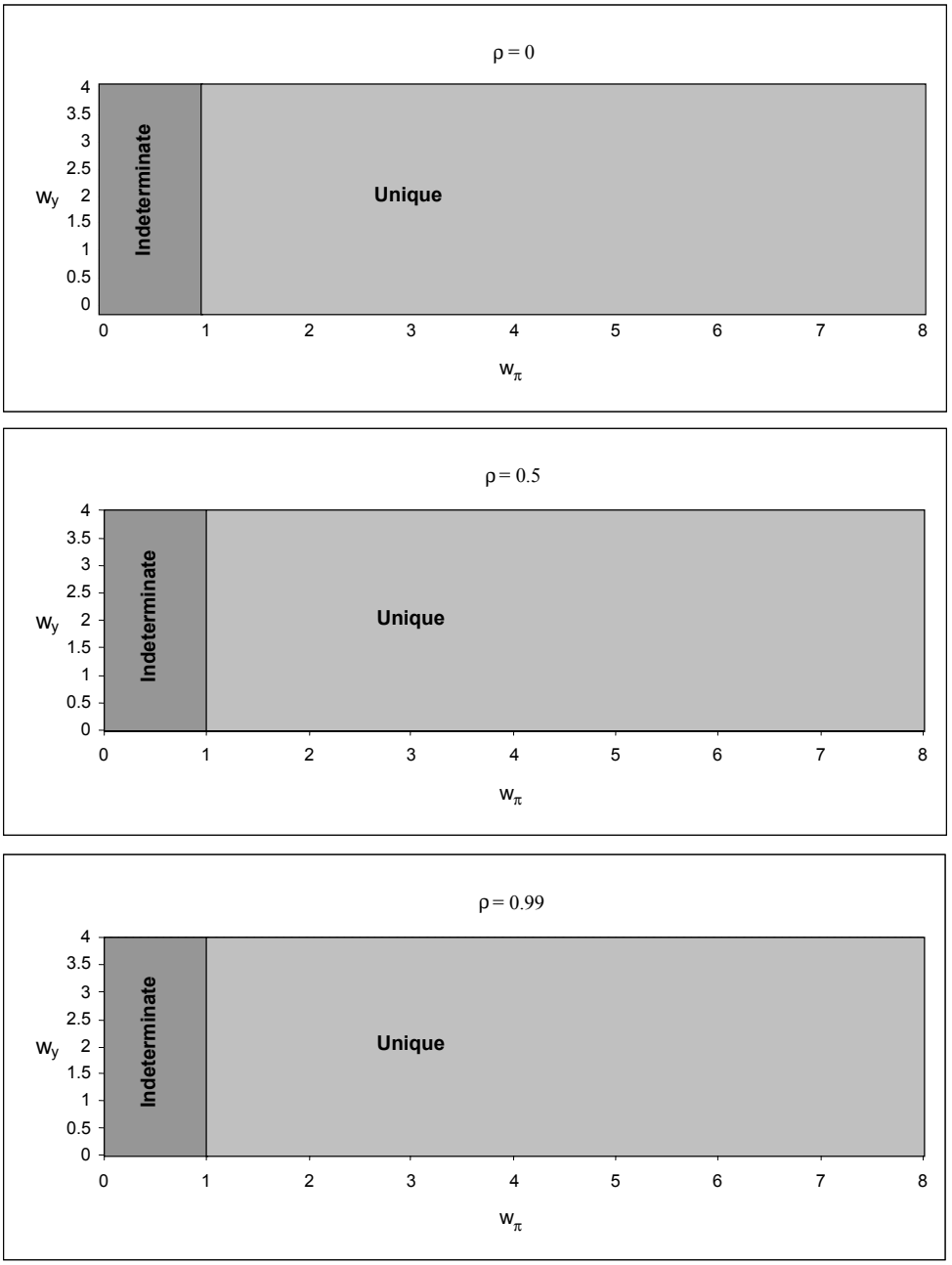
to Jeffrey Fuhrer for taking the time to help us replicate some of his earlier results. The results reported in this paper have been derived from the parameter estimates reported in Fuhrer and Moore (1995b).

[20]It is convenient here to follow Taylor (1993) in defining the rule in terms of the output gap rather than the unemployment gap. For notational convenience we have dropped the constant term in the equation by assuming that the equilibrium real interest rate and long-run inflation target are zero.

[21]For example, the long-run effect of a permanent unitary change in the output gap is equal to the short-run effect, $(1-\rho)w_y$, divided by $(1-\rho)$.

Figure 4: Regions of Uniqueness, Explosiveness and Indeterminacy
(Generalized Taylor Rule in Fuhrer and Moore (1995) Model)

Policy Reaction Function: $rs_t = \rho rs_{t-1} + (1-\rho)[w_\pi(\pi 4_t) + w_y(y_t)]$



What is it that explains the "excessive stability" generated by conventional Taylor rules in these sticky-price linear rational expectations models? What gives rise to stable macroeconomic behavior even when the monetary authorities respond in a very myopic way to inflation developments, or place an extremely high weight on real objectives relative to inflation objectives? Two assumptions appear to be critical here. The first is the assumption that the economy can be characterized by a Phillips curve that imposes global linearity.[22] The second is the premise—embodied in the simulation exercise—that no matter how myopic policy responses are in the short run, the private sector forms its expectations under the assumption that the monetary policy rule will be adhered to forever.

Isard, Laxton and Eliasson (1998) study the implications of uncertainty about the NAIRU in a nonlinear Phillips curve model and show that following a Taylor rule blindly not only would fail to prevent the policy errors of the 1970s, but also would almost certainly ensure that they would occur again. For the nonlinear model considered in their paper, even moderately myopic policy rules like the conventional Taylor rule can result in explosive behavior if the economy is subjected to a significant degree of overheating. This reflects a combination of factors. First, even moderate convexity in the Phillips curve implies that at some point the short-run unemployment-inflation tradeoff must worsen considerably when unemployment falls significantly below the NAIRU, and beyond this point a further marginal easing of monetary policy results mainly in inflation with only a very small incremental reduction in unemployment.

Second, to the extent that policymakers tend to make serially correlated errors in estimating unemployment and output gaps, the probability of experiencing a significant degree of overheating is heightened.[23] Third, when inflation expectations have a model-consistent component and rational agents possess information about the policy rule and the nonlinear nature of the expansionary effects of monetary policy, attempting to adhere to a conventional Taylor rule with a high weight on imprecise measures of unemployment gaps relative to a backward-looking measure of inflation could be conducive to wide swings or explosiveness in inflation expectations.

As is evident in Figure 4, one of the striking features of the stability conditions for the Fuhrer-Moore model is that they appear to be independent of the degree of interest rate smoothing. This points to a general problem with linear models of the inflation process, which imply that slow monetary policy responses to information about future inflation developments only have second-order welfare consequences. Isard, Laxton and Eliasson (1998) also show that these stability problems are exacerbated when interest rate smoothing is imposed on an already myopic policy rule.

[22]Under the global linearity assumption, the estimated slope of the Phillips curve (based on post-war U.S. data) suggests that unemployment or output gaps have small effects on the inflation process. These small effects imply that it can be very costly, in the context of these models, to reduce inflation once high inflation expectations have become entrenched. It also means that for given inflation expectations, the marginal effect on inflation of an increase in excess demand is small, even when the level of excess demand is high.

[23]One important shortcoming with the analysis provided by Taylor (1999a), and Levin, Wieland and Williams (1999) is that it reflects a strong inherent presumption that policymakers do not make large and persistent errors in estimating output gaps and unemployment gaps.

Rule 2: Levin, Wieland and Williams Interest-Rate-Change Rule

Figure 5 reports the regions of stability for the class of interest-rate-change rules suggested by Levin, Wieland and Williams (1999). In this case, the general form of the reaction function is:

$$rs_t = rs_{t-1} + (w_{\pi}(\pi n_t) + w_y(y_t)) \quad (2)$$

where πn_t is an n-quarter moving average of inflation measured over the previous n quarters. The top and middle panels of Figure 5 consider the two optimal rule parameterizations reported by Levin, Wieland and Williams (1999), where n is equal to 4 quarters and 12 quarters; the longer lag structure on inflation was found to be optimal in a linearized version of the FRB-US model, while the shorter lag structure was found to be optimal in the other linear models that they included in their study. In this case again, even where there is extreme interest rate smoothing and monetary policy responds to very backward-looking measures of inflation, the linear model is stable for an incredibly wide range of weights on inflation and output. The lower panel of Figure 5 considers an even more extreme case of myopic reaction functions, where the reaction function now depends on a six-year moving average of past inflation. Here there is some evidence of instability in the model; but unlike the type of results found by Christiano and Gust (1999), in this case explosiveness can arise from setting too low a weight on output.

In contrast to the impressive stabilization properties suggested by Figure 5, the interest rate change rule has extremely poor stabilizing properties in the nonlinear model developed studied by Isard, Laxton and Eliasson (1999), for two reasons. First, the rule is so myopic and backward-looking that it fails to provide an anchor for inflation expectations. Second, even if one recalibrates the model to reduce the effects of overheating very substantially, an optimal "parameterization" of the Levin, Wieland and Williams (1999) rule still gives rise to significant boom and bust cycles.

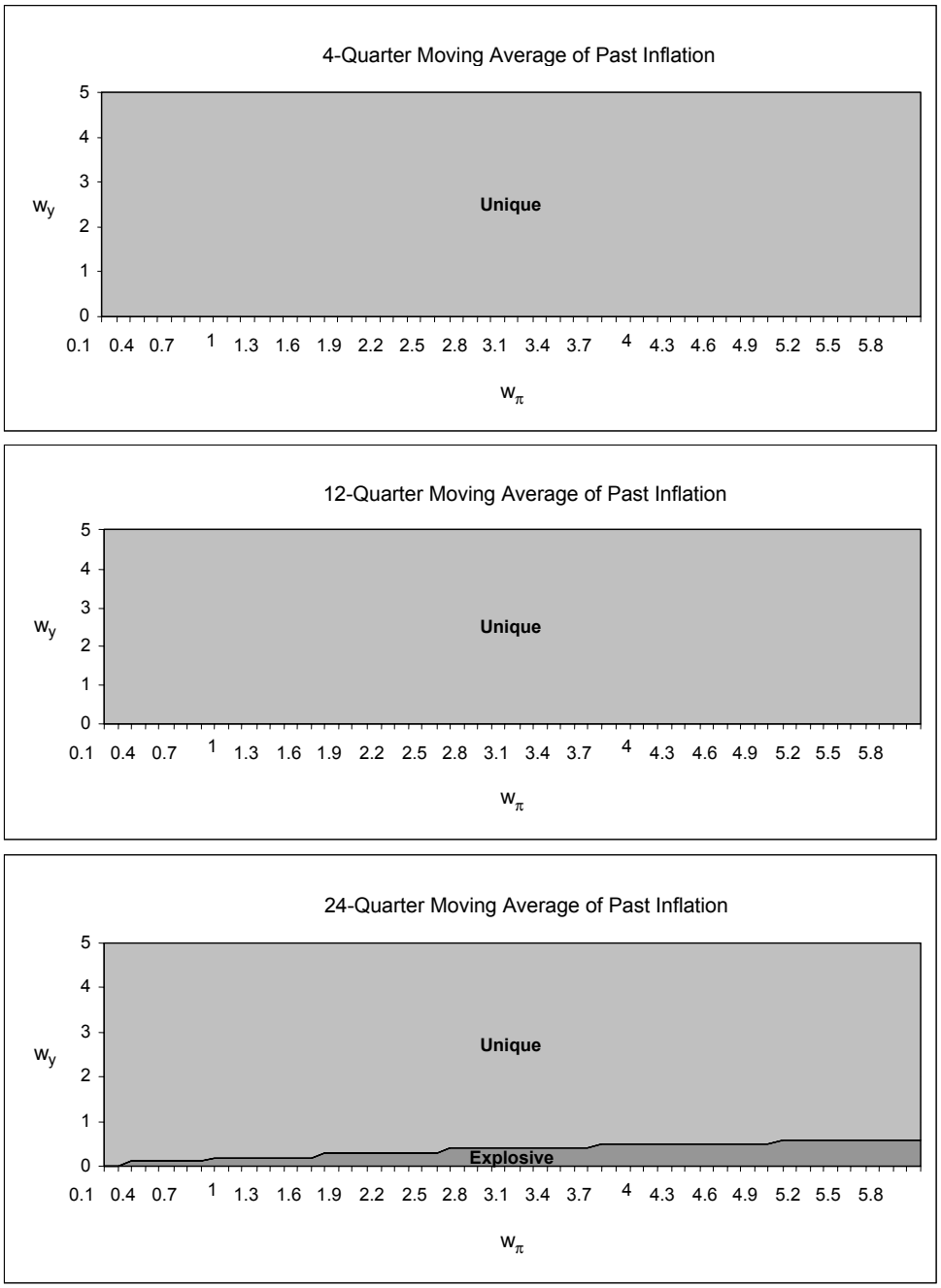
It does not seem to be widely recognized that interest-rate-change rules such as equation 2 are exactly equivalent to targeting a trend change in the price level when $w_y = 0$, and result in approximate price level targeting for small values of w_y. To see this, consider a simple case in which the interest rate change depends solely on the quarterly change in the logarithm of the price level (P) expressed at an annual rate:

$$rs_t = rs_{t-1} + w_{\pi}\pi_t \quad (3)$$

where $\pi_t = 4(P_t - P_{t-1})$. As initial conditions, assume that inflation is on target and the real interest rate is at its equilibrium value (i.e. in period 0, $rs_0 = rs^*$ and $\pi_0 = \pi^* = \pi^e$,where * denotes equilibrium).

Figure 5: Regions of Uniqueness, Explosiveness and Indeterminacy
(LWW Rule in the Fuhrer and Moore Model)

Policy Reaction Function: $rs_t = rs_{t-1} + w_\pi(\pi\, 4_t) + w_y(y_t)$



Now assume that a demand or supply shock raises the inflation rate in period 1 to some arbitrary value π_1 . It is interesting, and perhaps even surprising, that monetary policy governed by equation 3 would attempt to move the price level back to the original baseline path. This will be the case, for example, if long-run neutrality holds (as Levin, Wieland and Williams claim for each of the models they consider), because long-run neutrality implies that the real interest rate must return back to its initial value. But if the real interest rate returns back to control, the nominal interest rate must also eventually return back to control in some period T since, by assumption, the rule is successful in moving inflation back to its initial level of π^*.

If we now sum equation 3 between periods 1 and T, we obtain:

$$rs_T - rs_0 = w_\pi \sum_{i=1}^{T} \pi_i \tag{4}$$

So $rs_T - rs_0 = 0$ implies

$$\sum_{i=1}^{T} \pi_i = 0 \tag{5}$$

Thus, under the assumption that long-run neutrality holds, a policy rule in the form of equation 3 essentially amounts to a price-level targeting rule, since any shock that generates positive inflation must be offset at some point by negative inflation rates. This result obviously carries over to cases in which the contemporaneous inflation rate in equation 3 is replaced by some finite moving average lag structure on past inflation; and even when the rule is extended to include a term in the output gap, as in the general form of interest rate change rules described by equation 2, it continues to bear a close resemblance to price-level targeting. Accordingly, it should not be surprising that such myopic interest rate change rules can generate extremely poor business cycle properties in models with strong inflation persistence and convexity in the Phillips curve.

No policy rules apply

What types of rules, if any, should policymakers rely upon? They should not rely mechanically on any monetary policy rule. Fully state-contingent policy rules are not relevant possibilities in a world of incomplete information about the structure of the economy and the nature of shocks, and there is no clearly superior choice between simple (or partially state-contingent) rules and discretion; see Flood and Isard (1989).

We believe that the effectiveness and credibility of monetary policy can be greatly enhanced if policymakers are transparent about their policy objectives, their paradigm (or model) of macroeconomic behavior, their forecasts, and their assessments of the risks. As discussed earlier, it is also critically important for policymakers to be forward-looking, and to adjust their nominal interest rate instrument based on forward-looking assessments of inflation expectations and real interest rates.

Some research has suggested that simple linear inflation-forecast-based rules can come close to optimizing traditional forms of explicit policy objective functions in the context of plausible nonlinear

macro models; see Isard and Laxton (1999) and Isard, Laxton and Eliasson (1999). Additional research into the effectiveness and robustness of inflation-forecast-based rules may be worthwhile and useful for highlighting risks and avoiding the types of errors that have been made in the past. But with the continuing evolution of the world economy and the periodic occurrence of new types of economic shocks, there will inevitably be times when our best macroeconomic models are recognized to be seriously deficient and when continued adherence to policy rules associated with those models would have strongly adverse welfare consequences. Thus, while simple inflation-forecast-based policy rules may provide useful guidelines for policymakers in attempting to achieve their policy objectives, discretion is also important.

A Small Model of the Czech Economy

This section uses a small open economy model of the Czech economy to illustrate how small macro models can be used to support inflation targeting. We first specify a small macro model of the economy and show how a macro model, once specified, can be used to develop a forward-looking monetary policy reaction function. Then, given this reaction function, we illustrate some of the properties of the model and show how it can be used to derive confidence intervals around the forecasts for inflation and the short-term interest rate.

Table 1 presents the equations of the model and Table 2 defines notation, and time periods correspond to calendar quarters. Most of the equations in Table 1 reflect behavioral assumptions; the others amount to definitions or arbitrage conditions. While the parameters of the model have been calibrated to be consistent with some empirical work done at the Czech National Bank (CNB), we emphasize that this version of the model—which is intended for illustrative purposes—is preliminary and does not represent the official views of policymakers at the CNB. Nevertheless, it is hoped that the development of simple models, such as the one studied here, will provide a useful start in moving toward a complete forecasting and policy analysis system which explicitly recognizes the important roles of structure, judgment and uncertainty.

The Phillips curve

Equation (1) is a nonlinear Phillips curve that describes the behavior of the inflation rate, where inflation in period t is measured as the change in the log of the price level over the year from period t-4 through period t. The specification is based on a convex functional form proposed by Chadha, Masson and Meredith (1992) and studied by Laxton, Meredith and Rose (1995). The model posits that the short-run tradeoff between output and inflation is roughly linear when output is in the neighborhood of potential, but that the tradeoff starts to worsen considerably as the output gap rises above 2 percent.[24] Indeed, in the limit as the output gap approaches 6 percent, the economy is assumed to run into a short-run capacity constraint and the short-run Phillips curve becomes vertical. This estimate of the degree of potential short-run capacity in the model is reflected in the parameter estimate of .06 in equation (1) and has been calibrated to be consistent with estimates of capacity limits derived from pooled estimation from the group of major industrial countries—see Laxton, Meredith and Rose (1995).[25] The effect of

[24] The output gap in the model is defined to be the log of GDP minus the log of potential GDP.

[25] There is obviously considerable uncertainty about this estimate of the short-run capacity constraint because a fundamental role of the monetary authority is to be forward-looking and to prevent the economy from getting close to it. Indeed, Laxton Rose and Tambakis (1999) show that this presents an interesting conundrum for policymakers because policies which are successful at stabilizing the business cycle and avoiding large boom and bust cycles will actually destroy the empirical evidence on which these good policies are based.

output gaps in the region where the Phillips curve is roughly linear has been calibrated to be consistent with estimates provided by economists at the CNB.[26] The Phillips curve specification allows for a significant influence of the contemporaneous change in import prices, reflecting a very large share of imported goods in the basket of the price index that the CNB targets. Note that the coefficients of the first two right-hand-side terms sum to unity, consistent with the long-run natural rate hypothesis.

Inflation expectations and other sources of inflation persistence

Equation (2) is a fairly standard forward- and backward-looking representation of the private sector's inflation expectations. In line with other work on empirical Phillips curves, it features a small weight on the forward-looking, model-consistent component. The large weight on the backward-looking component is consistent with the view that wages and prices are sticky, reflecting in part the influence of contractual arrangements, but in addition the presence of a large proportion of the population that is uninformed. This estimated weight is roughly consistent with reduced-form evidence on Phillips curves for other countries, which also suggests a very small weight on the forward-looking or model-consistent component.[27]

The output gap and real monetary conditions

Equation (3) relates the output gap to its own lagged value and a lagged measure of real monetary conditions. The measure of real monetary conditions is assumed to depend on the real exchange rate and an average real interest rate term that places a weight of 0.75 on the 1-year real interest rate and a weight of 0.25 on a 3-year real interest rate—see Equation (4). These elasticities are based on estimates provided by economists at the CNB and suggest that the effects of a 100 basis point increase in the average real interest rate on the output gap is equivalent to a 1.7 percent appreciation in the real effective exchange rate.

Real interest rate definitions

Equations (5) and (6) define the one-year (4-quarter) and three-year (12-quarter) real interest rates. Equation (7) defines abbreviated notation and equation; and equation (8) defines an average three-year-ahead measure of inflation expectations in a manner consistent with the behavior of one-year ahead of inflation expectations, as described in equation (2). The first term on the right-hand-side of equation (8) is the model-consistent component of the annualized inflation rate expected over the next 12 quarters, which receives a weight of 0.10, while the backward-looking component receives a weight of 0.9.

Exchange rate and interest rate determination

Equation (9) defines the real exchange rate; an increase represents a real appreciation of the domestic currency. Equation (10), which includes an error term, can be regarded as a generalized form of the interest rate-parity arbitrage condition. Equation (11) assumes that the future spot rate expected by the private sector is a weighted average of the forward-looking model-consistent expectation and a component that is essentially backward-looking. The latter component is simply the lagged spot rate adjusted for the expected inflation differential.[28] This specification provides a way of reconciling the

[26] Despite the problems inherent in attempting to estimate nonlinear Phillips curves with a limited number of observations it might still be useful to attempt such a study for the countries in transition.

[27] For example, see J. Fuhrer (1997).

[28] Adjustment for the expected inflation differential is necessary for ensuring that the behavior of the real exchange rate is independent of the target rate of inflation.

notion that market participants are rational and forward looking with econometric evidence that exchange rates cannot be explained very well by macroeconomic fundamentals alone. It is also motivated by survey evidence that participants in foreign exchange markets rely heavily on "technical analysis," which essentially links their exchange rate forecasts (expectations) to the level of exchange rates in the recent past.[29] Equation (12) and equation (13) represent the expectations theory of the term-structure, which relates the yield on four-period and twelve-period maturities to the cumulative yield on a sequence of one-period contracts. However, as is the case with the foreign exchange market it is assumed that the weight on the model-consistent solution is 0.40 suggesting that a large proportion of bond market participants are myopic and base their expectations of future short-term interest rates on a simple extrapolation of the currently observed rate. Note, however, that a key aspect of the model is that expectations are assumed to adjust considerably faster in the bond market and foreign exchange market (weights of 0.4 on the model-consistent solutions) than they do in the goods market and the labor market (weights of 0.1 on the model-consistent solutions in the inflation expectation equations).

Other definitions

Equation (14) simply defines the inflation rate as the change in the price level over four quarters, and equation (15) is an analogous definition of the rate of inflation of import prices (i.e. of foreign prices converted into domestic currency units).

Closing the model with a monetary policy reaction function

The model can only be closed by specifying a policy reaction function for the monetary authorities. While the fundamental role of the monetary authorities in the model is to provide an anchor for inflation expectations, the nonlinear structure of the Phillips curve also suggests that there can be first-order benefits from stabilizing the business cycle. As shown by Clark, Laxton and Rose (2000) the combination of nonlinearity in the Phillips curve and lags in the monetary transmission mechanism suggests that there can be important benefits from following a forward-looking monetary policy reaction function and for this reason we focus our attention on inflation-forecast-based rules.[30]

The optimal calibration of an inflation-forecast-based (IFB) rule

The specific forms of the IFB rules are presented in Table 3. In these rules the short-term rate, rs, is assumed to be controlled directly by the monetary authorities and is adjusted in response to their one-year-ahead forecast of inflation ($\pi 4_{t+4}$), the contemporaneous value of the output gap (y) and an equilibrium measure of the short-term real interest rate (rr*).[31] The two reaction functions also include a lagged short-term interest rate term to allow for interest rate smoothing. In the first reaction function the weight on the lagged interest rate term in principle can vary between zero and some value below one, while in the second reaction function the weight on the lagged interest rate term is imposed to be exactly one. Note, that in this last case the measure of the equilibrium real interest rate (rr*) drops out of the equation and the reaction function becomes an interest-rate-change rule where the change in interest

[29] See Isard (1995).

[30] Clarida, Gali and Gertler (1997) provide some econometric evidence that suggests that monetary policy in several countries since 1979 seems to be guided more by forecasts of future inflation as opposed to contemporaneous or lagged inflation.

[31] Once the model has been developed further it would be interesting to search for the optimal horizon of the inflation forecast in the IFB rule.

rates responds only to deviations of forecast inflation from the target inflation rate and to the contemporaneous output gap. The optimal calibration of the IFB rule is determined by specifying a loss function and studying the properties of the model presented in Table 1 and 2 under different assumptions for the parameters in the IFB rules.

Stochastic simulation methodology

The simulations extend over a horizon of 100 periods (calendar quarters). In each period the economy experiences three types of exogenous shocks: a shock to the output gap, a supply shock to the inflation rate, and a shock to the exchange rate. These exogenous shocks are drawn randomly from independent normal distributions with zero means and standard deviations of 0.8, 0.4 and 1.9 percentage points respectively.

The initial state of the economy is characterized by a steady state where all variables are zero. Following the realizations of the shocks in the first period, the authorities use their prespecified policy rule—along with the assumption that the realizations of random shocks in future periods will coincide with their expected values of zero—to determine the interest rate setting for that period and to generate forecasts, over a horizon of 50 periods, of the future time-paths of all of the endogenous macroeconomic variables in the model, including interest rates.[32] The shocks for the second period are then realized, after which the authorities update their forecasts and adjust their policy settings. And so forth until the end of period 100.

The 100-period simulation is repeated 10 times, each time drawing a different sequence of the random shocks, but saving the shocks and subjecting each different form and calibration of policy rule to the same sequences of shocks. For each specified policy rule, the process of generating 10 simulations over 100 quarters results in 1000 observations on the outcomes for inflation, output and the policy interest rate.

The policy loss function and optimal calibration of the IFB Rule

The literature on optimal policy rules has traditionally relied on quadratic loss functions that are separably additive in the deviation of inflation from target, the output gap, and sometimes also the change in the nominal interest rate; see, for example, Rudebusch and Svensson (1999) and Wieland (1998). To remain consistent with this literature, we adopt an objective function in which the period-t loss has the following general form

$$L_t = (\pi 4_t - \pi^{TAR})^2 + \theta[y_t]^2 + \upsilon(rs_t - rs_{t-1})^2 \qquad (6)$$

where $\pi 4$ is year-on-year RPIX inflation, y is the output gap, rs is the one-quarter interest rate, and $[\theta, \upsilon]$ are the relative weights on output gap variability and interest rate volatility. These relative weights have been set at 1 and 0.5 to be consistent with other studies on monetary policy rules. The optimal parameters for the reaction functions reported in Table 3 have been derived numerically by searching over a grid of policy-rule parameter values (in increments of .05) for the calibration that minimizes the value of the loss function averaged over the 1000 observations generated by the

[32] The only exogenous variables in the model are the foreign price level and the foreign interest rate. These variables are held constant in the simulation experiments.

stochastic simulations. The best rule is an interest rate change rule (8 = 1.0) where the policy rate is adjusted fairly aggressively (with a weight of 6.95) in response to deviations of forecast inflation from target, but there is also a significant weight on the output gap (0.70). As can be seen in Table 3, this policy rule is quite successful at producing low variability in inflation and the output gap. It is important to emphasize, however, that the analysis presented here ignores uncertainty about the level of potential output.

Some illustrative deterministic simulations

Figure 6 reports the responses of the short-term interest rate and year-on-year net inflation for the three shocks that were used to optimally calibrate the IFB rule in Table 3. The top panel reports the responses for a supply shock or a 0.004 shock to the Phillips curve residual. The middle panel reports the results for a 0.019 shock to the residual in the exchange rate equation, and the bottom panel reports the results for a 0.008 shock to the residual in the output gap equation. The responses in the figures have been multiplied by 100 to provide approximate deviations from control in percentage points. The figures also have vertical lines drawn at the 4^{th} and 8^{th} quarters to make it easier to see when inflation and the short-term interest rate can be expected to return approximately to their control values. We emphasize that these shocks are purely transitory and that the short-term interest rate would have to be adjusted more aggressively in the presence of highly persistent shocks.

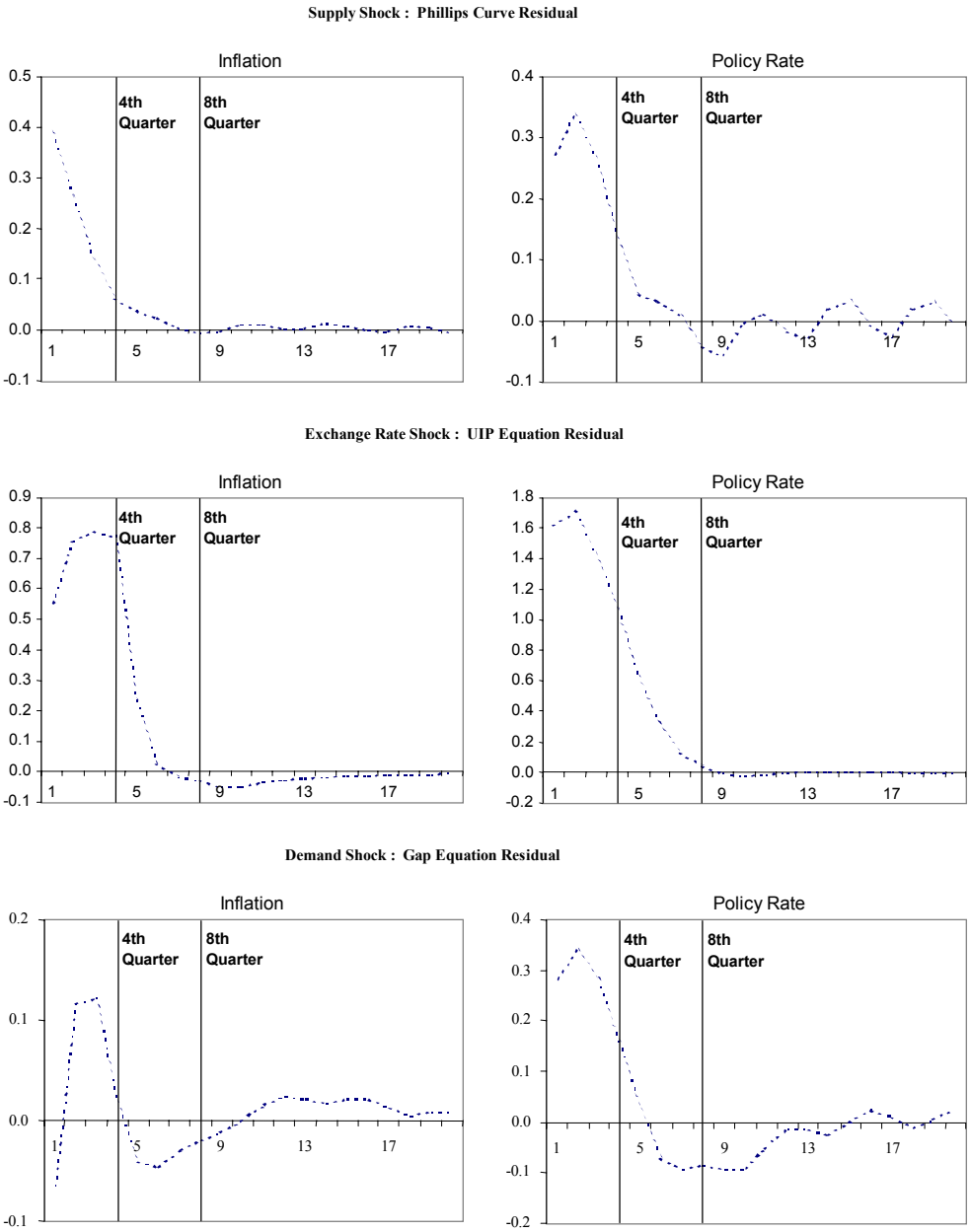
Supply shock (increase in Phillips curve residual of 0.004)

Inflation rises by 0.4 percentage points on impact and then gradually returns back to the target within 7–8 quarters. For this shock it is necessary to raise the short-term interest rate by around 0.3 percentage points in the short run and this results in an appreciation in the real exchange rate. This combined with the increase in market interest rates produces a sufficient tightening in real monetary conditions to return inflation close to control within 4 quarters.

Exchange rate equation shock (increase in UIP equation residual of 0.019)

The direct effect of this shock would result in a 1.9 percent depreciation in the value of the exchange rate. Because of the important role of the exchange rate in both the Phillips curve equation and the output gap equation, this shock requires a much larger increase in the short-term interest rate. Indeed, in the short run, the short-term interest rate rises by about 160 basis points. Note that the effects of this shock have much more persistent effects on the year-to-year net inflation rate and in fact grow over the first year of the simulation horizon reflecting the lags in the Phillips curve. Note, however, that after the first year inflation falls sharply and is very close to the target by the 6^{th} quarter of the simulation horizon.

Figure 6: Response of Policy Rate and Inflation to Three Types of Shocks



Demand shock (increase in output gap residual of 0.008)

The direct effect of this shock would be to raise aggregate demand by 0.8 percent above potential output. This size of a demand shock also requires an increase in the short-term interest rate of 30 basis points and the resulting tightening in real monetary conditions is sufficient to ensure that inflation never departs significantly from the target. Note that inflation actually declines in the very short run. This reflects a significant appreciation in the exchange rate which dominates the dynamics of the model in the very short run. However, over time the effect of the positive output gap dominates the more direct exchange rate channel and inflation peaks at 0.1 percentage points above control in the 2nd and 3rd quarters. This example illustrates that demand shocks in the model have very small effects on inflation provided that the monetary authority is committed to anticipating and reacting promptly to excess demand pressures. However, because of the convex structure of the Phillips curve there can be large costs from delaying interest rate reactions and allowing large boom and bust cycles to occur.

Deriving model-based confidence intervals for the forecast

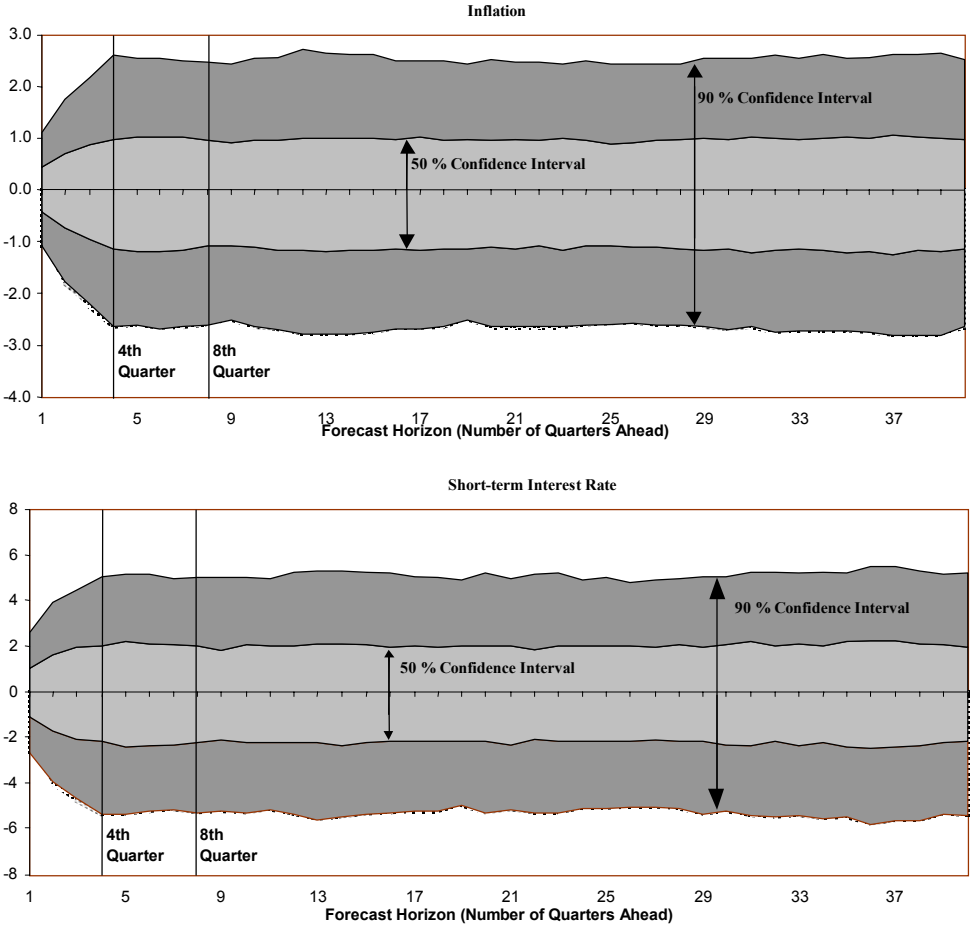
As mentioned above, an important principle of inflation targeting is transparency, and most central banks that have adopted inflation targeting frameworks have taken steps to try to communicate the arguments behind their policy settings and the speed at which they plan to bring inflation back to target. However, while in some cases central bankers have been willing to provide information about their forecast of future inflation, most central bankers are very reluctant to release a future path for the policy rate, fearing that market participants may not fully realize the uncertainties in their forecasts. One obvious solution to this potential communication problem is not only to provide a point forecast for inflation and the policy rate but also to provide confidence intervals around these point forecasts.

Figure 7 provides estimates of confidence intervals that were derived from the stochastic simulations discussed earlier. Note that in the experiments considered here, the monetary authority not only is successful in providing an anchor for inflation expectations and delivering low variability in inflation, but also acts in a way that tends to bound uncertainty in the long-term outlook for inflation and interest rates. The reason that there is bounded uncertainty in the forecast at long horizons is that the long-term inflation outlook takes account of the central bank's likely reactions to future shocks.

How does this approach compare with the Bank of England's approach to creating the fan charts? In the regular monthly *Inflation Reports* released by the Bank of England, the Monetary Policy Committee (MPC) provides its best guess for inflation over a two-year horizon based on a constant interest rate assumption. In order to highlight uncertainty in the inflation forecast, the MPC also provides a fan chart showing estimates of confidence intervals around its most likely forecast for inflation. The MPC's fan chart is created by assuming a univariate statistical distribution and the confidence intervals are computed by making assumptions about the moments of this distribution.[33] There are a few differences between the MPC's approach and the more model-based approach considered here.

[33] For a discussion about how the fan carts are created see Britton, Fisher and Whitley (1998).

Figure 7: Confidence Intervals for Inflation and the Short-term Interest Rate



Comparison to Bank of England's approach

The estimates derived and presented in Figure 7 are based on a quantitative model of the monetary transmission mechanism including information about how the monetary authorities are likely to respond to revisions in their own inflation forecast. Indeed, one of the potential benefits of basing the inflation forecast on a core quantitative macro model is that it is easier to provide forecasts for more variables over longer horizons and to derive estimates of confidence intervals based on both the structure of the model and assumptions about the distributions of the model's error terms. The confidence intervals provided in Figure 7 are for forecasts as long as 10 years ahead and look more like sausages inside buns than the two-year-ahead fan charts that are presented by the MPC.

This sausage-inside-a-bun shape to the confidence intervals reflects a few critical assumptions. First, it reflects the fact that the monetary policy rule is successful in delivering low inflation variability and providing an anchor for inflation expectations. Thus, even though the monetary authority doesn't know the future values of the shocks, as long as it responds to the these shocks appropriately each period and

aims its forecast of inflation back to the target based on the IFB rule, it may be successful in bounding uncertainty in its own inflation forecast. By contrast, policy rules that allow significantly greater persistence in the inflation process will be associated with confidence intervals that look more like fan charts over the first few years of the forecast horizon rather than the sausage-in-the-bun shapes associated with more aggressive IFB rules that are more successful in bounding inflation forecast uncertainty.

Another difference is that the MPC's methodology for creating the fan chart allows them to enter an assumption to introduce skewness into the distribution. This is sometimes used by the MPC to communicate a change in their assessment of the balance of the risks and in the fan chart shows up in a distribution that is fatter on one side than on the other side. The approach suggested here could obviously be extended to allow for abnormal distributions on the disturbance terms. However, one advantage of a macro-model based approach is that it provides an explicit mechanism where skewness in the forecast distribution can result from perceived nonlinearities in the structure of the economy rather than just assumptions about distributions. This will be the case for example in the current model when the initial level of the output gap is quite high and there is a significant risk of overheating.

Concluding Remarks

This chapter has argued that a forward-looking inflation-forecast-targeting strategy provides a useful framework for monetary policy. It has also argued that macroeconomic models have an important role to play in helping policymakers to coherently analyze the appropriate settings of their policy instruments and to communicate the rationale for policy decisions.

In practice, inflation-forecast targeting does not imply mechanical adherence to any specific rule for setting the policy interest rate. Successful inflation-forecast targeting requires good analysis, the sensible exercise of discretion, and considerable communication and transparency to explain the rationale for policy decisions and maintain the credibility of the monetary policy framework.

Models can be very useful in promoting the consistency of policy analysis and in helping the authorities communicate the rationale for their policy actions. The core projection model should be relatively simple and easy to understand, but should not be a model in which the timing of monetary policy decisions is unimportant and monetary policy errors have only second-order implications for welfare. The core projection model should be used primarily as an organizational device and its success will depend ultimately on how well it serves policymakers to incorporate all relevant information in the projection process.

Table 1: A Small Model of the Czech Economy

(1) $$\pi 4_t = 0.25\pi 4_t^m + 0.75E_t^P\pi 4_{t+4} + 0.30\left[(0.06)^2/(0.06-y_{t-1})-0.06\right] + \varepsilon_t^{\pi}$$

(2) $$E_t^P\pi 4_{t+4} = 0.10\,E_t^{mc}\pi 4_{t+4} + (1.0-0.10)\pi 4_{t-1}$$

(3) $$y_t = 0.80\,y_{t-1} - rmci_{t-1} + \boldsymbol{\varepsilon}_t^{y}$$

(4) $$rmci_t = 0.30(0.25\,rr4_{t-1} + 0.75\,rr12_{t-1}) + 0.20\,z_{t-1} + \boldsymbol{\varepsilon}_t^{y}$$

(5) $$rr4_t = rs4_t - \boldsymbol{\pi} 4_t^e$$

(6) $$rr12_t = rs12_t - \boldsymbol{\pi} 12_t^e$$

(7) $$\pi 4_t^e = E_t^p\,\pi 4_{t+4}$$

(8) $$\pi 12_t^e = E_t^p\pi 4_{t+12} = 0.10(E_t^{mc}\pi 4_{t+4} + E_t^{mc}\pi 4_{t+8} + E_t^{mc}\pi 4_{t+12})/3 + (1-0.10)\pi 4_{t-1}$$

(9) $$z_t = s_t + p_t - p_t^f$$

(10) $$s_t = E_t^P s_{t+1} + (rs_t - rs_t^f)/4 + \boldsymbol{\varepsilon}_t^{s}$$

(11) $$E_t^P s_{t+1} = 0.40\,E_t^{mc}s_{t+1} + (1-0.40)\left[s_{t-1} - (E_t^P\pi_{t+1} - E_t^P\pi_{t+1}^f)/2\right]$$

(12) $$rs4_t = 0.40\sum_{i=0}^{3} rs_{t+i}/4 + (1-0.40)\,rs_t$$

(13) $$rs12_t = 0.40\sum_{i=0}^{11} rs_{t+i}/12 + (1-0.40)\,rs_t$$

(14) $$\boldsymbol{\pi} 4_t = p_t - p_{t-4}$$

(15) $$\boldsymbol{\pi} 4_t^m = (p_t^f - p_{t-4}^f) - (s_t - s_{t-4})$$

Table 2. Notation; Time Periods Correspond to Calendar Quarters

$\pi 4_t$	:	Change from *t-4* to *t* in the log of the net price deflator (Emil ?)
$\pi 4_t^m$	:	Change from *t-4* to *t* in the log of the import price deflator.
$E_t^P \pi 4_{t+4}$	:	Private sector's expectations in quarter *t* of inflation over next four quarters.
$E_t^{mc} \pi 4_{t+\tau}$	:	Model-consistent expectations in quarter *t* of inflation over four quarters ending in $t+\tau$.
$\pi 12_t^e$	:	Expectations in quarter *t* of inflation over next twelve quarters.
$\pi 4_t^e$	:	Expectations in quarter *t* of inflation over the next four quarters.
y	:	Output gap.
ε^{π}	:	Shock in inflation equation.
ε^{y}	:	Shock in output gap equation.
ε^{s}	:	Shock in exchange rate equation.
z	:	Log of the real exchange rate
s	:	Log of the nominal exchange rate.
p	:	Log of RPIX deflator.
pf	:	Log of foreign price level.
rs	:	Short-term (one quarter) nominal interest rate.
rsf	:	Foreign short-term nominal interest rate.
$E_t^p \pi_{t+1}$	:	Private sector's expectations in quarter *t* of inflation one quarter ahead.
$E_t^p \pi_{t+1}^f$	:	Private sector's expectations in quarter *t* of foreign inflation one quarter ahead.
$E_t^{mc} S_{t+1}$	:	Model-consistent expectation at *t* of exchange rate at *t + 1*.
$E_t^p S_{t+1}$	:	Private sector's expectations in quarter *t* of exchange rate at *t + 1*.
rs12	:	Nominal interest rate on a twelve-quarter bond.
rr12	:	Real interest rate on twelve-quarter bonds.

Table 3. Optimal Calibrations of an Inflation-Forecast-Based Rule

Inflation-Forecast-Based Rule:

$$rs_t = \lambda\, rs_{t-1} + (1-\lambda)\left[rr_t^* + \pi 4_{t+4} + \alpha(\pi 4_{t+4} - \pi^*) + \beta\, y_t\right] \text{ for } 0 \le \lambda < 1$$

$$rs_t = \lambda\, rs_{t-1} + \alpha(\pi 4_{t+4} - \pi^*) + \beta\, y_t \text{ for } \lambda = 1$$

Notation

rs	=	policy interest rate
rr*	=	measure of equilibrium real interest rate
π	=	inflation target
$\pi 4$	=	rate of inflation over previous four quarters
y	=	output gap

Optimized Weights

Weights			Variability Measures (Standard Deviations)		
8	∀	∃	Inflation	Output Gap	Policy Rate
1.00	6.95	0.70	1.56	1.23	3.04

Table 3a. Optimal Calibrations of an Inflation-Forecast-Based Rule

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Inflation-Forecast-Based Rule:

$$rs_t = \lambda\, rs_{t-1} + (1-\lambda)\left[rr_t^* + \pi\, 4_{t+i} + \alpha\,(\pi\, 4_{t+i} - \pi^*) + \beta\, y_t\right] \text{ for } 0 \le \lambda < 1$$

$$rs_t = \lambda\, rs_{t-1} + \alpha\,(\pi\, 4_{t+i} - \pi^*) + \beta\, y_t \text{ for } \lambda = 1$$

Notation

rs	=	policy interest rate
rr*	=	measure of equilibrium real interest rate
π	=	inflation target
$\pi 4$	=	rate of inflation over previous four quarters
y	=	output gap
i	=	horizon for inflation forecast

Optimized Weights

Horizon	Weights			Variability Measures (Standard Deviations)			Value of Loss Functions
i	8	∀	∃	Inflation	Output Gap	Policy Rate	
0							
1							
2							
3							
4	1.00	6.95	0.75	1.56	1.23	3.04	
5							
6							
7							
8							

REFERENCES

Akerlof, George, William Dickens, and George Perry, 1996, "The Macroeconomics of Low Inflation," *Brookings Papers on Economic Activity: I,* Brookings Institution, pp. 1–76.

Amano, Robert, Don Coletti, and Tiff Macklem, 1998, "Monetary Rules When Economic Behavior Changes," paper prepared for the Federal Reserve Bank of San Francisco/Center for Economic Policy Research Conference on *Central Bank Inflation Targeting* (March 6–7).

Bank of England, 1999a, "Economic Models at the Bank of England," (April).

———, 1999b, "The Transmission Mechanism of Monetary Policy," *Quarterly Bulletin*, (May), pp. 161–76.

Bernanke, B., T. Laubach, F. Mishkin, and A. Posen, 1999, Inflation Targeting: Lessons from the International Experience, (Princeton, N.J.: Princeton University Press).

Black, R., V. Cassino, A. Drew, E. Hansen, B. Hunt, D. Rose, and A. Scott, 1997, "The Forecasting and Policy System: The Core Model," Reserve Bank of New Zealand *Research Paper* No. 43, Wellington.

Black, R., T. Macklem, and D. Rose, 1997, "On Policy Rules For Price Stability," in *Price Stability, Inflation Targets and Monetary Policy,* Bank of Canada, Conference Volume.

Black, R., D. Laxton, D. Rose, and R. Tetlow, 1994, "The Steady-State Model: SSQPM," The Bank of Canada's New Quarterly Projection Model, Part 1, Technical Report Number No. 72 (Ottawa: Bank of Canada).

Blanchard, Olivier J., and Charles M. Kahn, 1980, "The Solution of Linear Difference Models Under Rational Expectations," *Econometrica*, Vol. 48, pp. 1305–11.

Britton, Erik, Paul Fisher, and John Whitley, 1998, "The *Inflation Report* Projections: Understanding the Fan Chart," *Quarterly Bulletin*, (February), pp. 30–37.

Buiter, W., 1999, "Alice in Euroland," forthcoming in the *Journal of Common Market Studies*.

Chadha, B., P. Masson, and G. Meredith, 1992, "Models of Inflation and the Costs of Disinflation," *Staff Papers*, International Monetary Fund, Vol. 39, pp. 395–431, (Washington: International Monetary Fund).

Christiano, Lawrence J., and Christopher J. Gust, 1999, "Taylor Rules in a Simple Limited Participation Model," DNB Staff Reports No. 33.

Clark, Peter, and Douglas Laxton, 1997, "Phillips Curves, Phillips Lines and the Unemployment Costs of Overheating," IMF Working Paper 97/17 (Washington: International Monetary Fund).

———, and David Rose, 2000, "An Evaluation of Alternative Monetary Policy Rules in a Model with Capacity Constraints," forthcoming in the *Journal of Money Credit and Banking*.

Clarida, R., J. Gali, and M. Gertler, 1997, "Monetary Policy Rules in Practice: Some International Evidence," NBER Working Paper No. W6254.

Debelle, G., and D. Laxton, 1997, "Is the Phillips Curve Really a Curve? Some Evidence for Canada, the United Kingdom, and the United States," *IMF Staff Papers*, Vol. 44, No. 2 (June) (Washington: International Monetary Fund).

DeLong, J. B., and L. H. Summers, 1988, "How Does Macroeconomic Policy Affect Output?" *Brookings Papers on Economic Activity*, Vol. 2, pp. 433–80.

Drew, A., and B. Hunt, 1998, "The Forecasting and Policy System: Stochastic Simulations of The Core Model," Reserve Bank of New Zealand *Discussion Paper* G98/6, Wellington, New Zealand.

———, 1999, "The Effects of Potential Output Uncertainty on the Performance of Simple Policy Rules," in *Monetary Policy Under Uncertainty*, Reserve Bank of New Zealand, Conference Volume.

Flemming, John 1999, "Monetary Policy: Questions of Adequacy, Design and Presentation," *Oxford Economic Outlook,* (October).

Flood, Robert, and Peter Isard, 1989, "Monetary Policy Strategies," *Staff Papers*, International Monetary Fund, Vol. 36, pp. 612–32, (Washington: International Monetary Fund).

Freedman, C., 1996, "What Operating Procedures Should be Adopted to Maintain Price Stability? Practical Issues," prepared for the Federal Reserve Bank of Kansas City Symposium (August).

Fuhrer, Jeffrey C., 1997, "The (Un)Importance of Forward-Looking Behavior in Price Specifications," *Journal of Money Credit and Banking*, Vol. 29, No. 3 (August), pp. 338–50.

———, and George R. Moore, 1995a, "Inflation Persistence," *The Quarterly Journal of Economics*, Vol. 109, pp. 127–59.

———, 1995b, "Monetary Policy Trade-offs and the Correlation Between Nominal Interest Rates and Real Output," *American Economic Review*, Vol. 85, pp. 219–39.

Greenspan, Alan, "Statement to the U.S. Senate Committee on Banking, Housing, and Urban Affairs," February 22, 1995, printed in the *Federal Reserve Bulletin*, Vol. 81, pp. 342–48 (April 1995).

Haldane, Andrew 2000, "Inflation Targeting: The UK in Retrospect," in Inflation Targeting in Practice: Strategic and Operational Issues and Applications to Emerging Market Economies, ed. by Blejer et al., forthcoming.

Isard, Peter, 1995, "Exchange Rate Economics," (Cambridge University Press).

———, and Douglas Laxton, 2000, "Issues Related to Inflation Targeting and the Bank of England's Framework," forthcoming IMF Working Paper (Washington: International Monetary Fund).

———, 1999, "Monetary Policy with NAIRU Uncertainty and Endogenous Credibility: Perspectives on Policy Rules and the Gains from Experimentation and Transparency," in *Monetary Policy Under Uncertainty*, Reserve Bank of New Zealand Conference Volume.

———, and Ann-Charlotte Eliasson, 1998, "Inflation Targeting with NAIRU Uncertainty and Endogenous Policy Credibility," prepared for a conference on Computational Economics at the

University of Cambridge, England, (June 29–July 1), forthcoming in *Journal of Economic Dynamics and Control.*

———, 1999, "Simple Monetary Policy Rules under Model Uncertainty," in *International Finance and Financial Crises: Essays in Honor of Robert P. Flood, Jr*. ed. by P. Isard, A. Razin, and A. Rose (Boston: Kluwer and Washington: International Monetary Fund).

Kohn, Donald, 1999, "A Comment on Haldane and Batini," forthcoming in Taylor (1999).

———, 1995, Comment, NBER Macroeconomic Annual 10 (NBER: Cambridge, MA) pp. 227–33.

Laxton, D., G. Meredith, and D. Rose, 1995, "Asymmetric Effects of Economic Activity on Inflation: Evidence and Policy Implications," *Staff Papers*, International Monetary Fund, Vol. 42, pp. 344–74, (Washington: International Monetary Fund).

Laxton, Douglas, David Rose, and Demosthenes Tambakis, 1999, "The U.S. Phillips Curve: The Case for Asymmetry," *Journal of Economic Dynamics and Control*, Vol. 23*,* pp. 1459–85.

Laxton, Douglas, David Rose, and R. Tetlow, 1993, "Monetary Policy, Uncertainty and the Presumption of Linearity. Technical Report No. 63 (Ottawa: Bank of Canada).

Laxton, Douglas, and Robert Tetlow, 1992, "A Simple Multivariate Filter for the Measurement of Potential Output," Bank of Canada Technical Report No. 59 (Ottawa: Bank of Canada, June).

Laxton, Douglas and Eswar Prasad, "Possible Effects of European Monetary Union on Switzerland: a Case Study of Policy Dilemmas Caused by Low Inflation and the Nominal Interest Rate Floor," IMF Working Paper 97–23, March 1997 and forthcoming in the *Journal of Policy Modeling* (Washington: International Monetary Fund).

———, 1999, "International Spillovers of Macroeconomic Shocks: A Quantitative Exploration," paper prepared for a seminar at the London Business School, June 18, 1999, (London).

Levin, Andrew, Volker Wieland, and John Williams, 1999, "Robustness of Simple Monetary Policy Rules Under Model Uncertainty," in *Monetary Policy Rules*, ed. by John Taylor (Chicago: University of Chicago Press), pp. 263–98.

Lipsey, R. G., 1960, "The Relation Between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom 1862-1957: A Further Analysis," *Economica,* new series, Vol. 27 (February) pp. 1–31.

Longworth, David, 1999, "The Canadian Monetary Transmission Mechanism and Inflation Projections," paper prepared for an IMF-Central Bank of Brazil seminar on Analytical and Operational Issues Related to the Implementation of Inflation Targeting, Rio de Janeiro, (May).

Macklem, Tiff, 1996, "Asymmetry in the Monetary Transmission Mechanism: What Can We Learn From VARS?," unpublished (Ottawa: Bank of Canada).

Mankiw, N. Gregory, 1988, "A Comment on How Does Macroeconomic Policy Affect Output?" *Brookings Papers on Economic Activity*,Vol. 2*,* pp. 481–85.

Mussa, Michael, 1994, "U.S. Monetary Policy in the 1980s," *American Economic Policy in the 1980s*, ed. by Martin Feldstein (Chicago: University of Chicago Press).

Orphanides, Athanasios, 1998, "Monetary Policy Evaluation with Noisy Information," Working Paper, Board of Governors of the Federal Reserve System, Division of Research and Statistics, Finance and Economics Discussion Series, No. 1998–2050, pp. 1–35.

———, 1999, "The Quest for Prosperity Without Inflation," Sveriges Riksbank Working Paper Series (Sweden), No. 93, (May) pp. 1–68.

———, R. Porter, D. Reifschneider, R. Tetlow and F. Finan, 2000, "Errors in the Measurement of the Output Gap and the Design of Monetary Policy," forthcoming in *Journal of Economics and Business*.

Phillips, A. W., 1958, "The Relationship between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1861–1957," *Economica* 25, pp. 283–300.

Reifschneider, David, Robert Tetlow, and John Williams, 1999, "Aggregate Disturbances, Monetary Policy, and the Macroeconomy: The FRB/US Perspective," *Federal Reserve Bulletin* (January), pp. 1–9.

Rudebusch, G., and L. Svensson, 1999, "Policy Rules for Inflation Targeting," in *Monetary Policy Rules* ed. by John Taylor (Chicago: University of Chicago Press).

Schaling, Eric, 1998, "The Nonlinear Phillips Curve and Inflation Forecast Targeting—Symmetric versus Asymmetric Monetary Policy Rules," Bank of England Working Paper No. 98 (July) pp. 1–43.

Sims, Christopher, 1999, "The Precarious Fiscal Foundations of EMU," forthcoming in DNB Staff Reports, De Nederlandeshe Bank NV.

Smets, Frank, 1999, "Output Gap Uncertainty: Does it Matter for the Taylor Rule?" in *Monetary Policy under Uncertainty*, Reserve Bank of New Zealand Conference Volume.

Summers, Lawrence H., 1988, "Should Keynesian Economics Dispense with the Phillips Curve?" in *Unemployment, Hysteresis and the Natural Rate Hypothesis*, ed. by Rod Cross, pp. 11–25 (Oxford: Basil Blackwell).

Svensson, L. E. O., 1997a, "Inflation Forecast Targeting: Implementing and Monitoring Inflation Targets," *European Economic Review,* Vol. 41, pp. 1111–146.

———, 1997b, "Inflation Targeting in an Open Economy: Strict or Flexible Inflation Targeting?," text of a public lecture held at Victoria University of Wellington and the Reserve Bank of New Zealand, (October–November).

———, 1998, "Open-Economy Inflation Targeting," Reserve Bank of New Zealand *Discussion Paper*, Wellington.

———, 1999, "Inflation Targeting as a Monetary Policy Rule," *Journal of Monetary Economics*, Vol. 43, pp. 607–54.

Taylor, John B, 1993, "Discretion Versus Policy Rules in Practice," Carnegie- Rochester Conference Series on Public Policy, Vol. 39, pp. 195–214 (December).

———, 1999a, "A Historical Analysis of Monetary Policy Rules," NBER Working Paper No. 6768 (October), in Taylor, 1999b.

———, 1999b, *Monetary Policy Rules*, (Chicago: University of Chicago Press).

Tetlow, Robert J., Peter von zur Muehlen, and Frederico S. Finan, 1999a, "Learning and the Complexity of Monetary Policy Rules," in *Monetary Policy Under Uncertainty,* ed. by Benjamin Hunt and Adrian Orr, pp. 113–153. (Wellington: Reserve Bank of New Zealand).

———, 1999b "Simplicity versus Optimality: the Choice of Policy Rules When Agents Must Learn," FEDS Series Paper No. 1999–10 (forthcoming in *Journal of Economic Dynamics and Control*).

———, 1999c "Robust Monetary Policy with Misspecified Models: Does Model Uncertainty Always Call For Attenuated Policy?" (unpublished manuscript, in submission to *Journal of Economic Dynamics and Control)*.

———, 1999, "Simplicity versus Optimality: the Choice of Monetary Policy Rules When Agents Must Learn," forthcoming in the *Journal of Economic Dynamics and Control*.

Wieland, Volker, 1997, "Monetary Policy and Uncertainty about the Natural Unemployment Rate," mimeo, Board of Governors of the Federal Reserve System, Washington.

Chapter 7

INFLATION TARGETING IN THE CZECH REPUBLIC

The Czech National Bank[1]

[1] This chapter represents an official explanation of the Czech National Bank's adoption and use of the inflation targeting framework.

At the start of 1998, the Czech National Bank switched to direct inflation targeting. This new monetary policy regime replaced the previous scheme based on an exchange rate peg and money targeting. In contrast with these intermediate targets, inflation targeting implies a direct focus on price stability.

The objective of this paper is to evaluate inflation targeting as a monetary policy strategy in the Czech Republic. Part 2 defines the monetary policy objective and describes the negative effects of high inflation. There follows a description of the most important monetary policy regimes, giving their main advantages and shortcomings and indicating which environment is most suitable for each particular regime. The next part provides a survey of monetary policy regimes in the Czech Republic prior to the introduction of inflation targeting. It also explains the causes of the foreign exchange turbulence in May 1997. It goes on to give the main reasons behind the decision to adopt the inflation targeting scheme and gives the prerequisites for effective implementation of this scheme. This is followed by an explanation and survey of the CNB's inflation targets and a description of inflation and monetary policy developments in 1998 and 1999. The last part summarizes the main results of the analysis and the advantages of the inflation targeting regime.

THE AIM OF MONETARY POLICY AND THE CENTRAL BANK'S OBJECTIVE

The aim of monetary policy and the central bank's objective are laid down in the provisions of Article 98 of the Constitution of the Czech Republic and of Article 2 of Act No. 6/1993 Coll., on the Czech National Bank. These charge the Bank with ensuring the stability of the Czech currency. Monetary stability has an internal dimension (price stability) and an external dimension (exchange rate stability). Achieving and maintaining monetary stability is the central bank's ongoing contribution to the creation of a pro-growth environment.

In recent years, the internal dimension of monetary stability—price stability—has become the primary objective of central banks. The task of ensuring price stability in the economy, that is, of helping to create a stable environment for entrepreneurial activities is, on the one hand, an expression of the increasing responsibility of central banks for sustainable economic growth. Central bank independence is, on the other hand, a prerequisite for the implementation of monetary policy leading to price stability.

The push towards price stability ensues from knowledge of the unfavorable effects of inflation. High and volatile inflation has a negative impact on economic growth. This is confirmed by long-term empirical experience from developments in the world economy. High inflation decreases the value of incomes and savings and leads to higher interest rates. It often also implies higher volatility of inflation, which substantially increases its costs. This is because higher inflation increases the uncertainty about future relative prices and about the price level. Domestic and foreign financial markets thus require a higher risk premium as compensation for the increased uncertainty. When inflation is high, there occurs a fixing of inflation and depreciation expectations in the decision-making of economic agents. Because of the greater inflation volatility, investors focus more on short-term financial investments (speculative activities) and on hedging against inflation, and less on longer-term investment projects in the real economy. Inflation also gives rise to other economic distortions which in the longer time horizon reduce the long-term growth potential of the economy by redistributing income from creditors to debtors, creating tax distortions and representing a hidden burden on savers, who are unable to safeguard the purchasing power of their incomes and savings. Another disadvantage of high inflation is high interest rates, which tend to attract short-term risk capital.

The disinflation process leading to price stability is often accompanied by short-term costs in the form of slower economic growth and increased unemployment. Such short-term costs are, however, more than offset by the long-term, favorable growth effects of price stability. Empirical studies show unambiguously that countries with low inflation achieve higher economic growth rates in the long term than those with higher inflation.

In addition to the generally valid conclusions about the negative influence of inflation on economic growth, another reason for the CNB's efforts to achieve monetary and price stability is the low inflation rate in EU countries, toward which the Czech Republic will have to converge in the long term if it wants to become part of European structures. EU accession in itself is not tied to any quantitative criteria for price and monetary stability. Nevertheless, it is desirable to create conditions for keeping the inflation and interest rate differentials as low as possible in the pre-accession period, so that the accession costs are also as low as possible. It is possible that there will not be a significant gap between the Czech Republic's accession to the EU and its entry into the EMU. The Czech Republic's readiness to participate in a single currency will thus depend on the fulfillment of a set of macroeconomic criteria, including price and monetary factors.

THE MAIN TYPES OF MONETARY POLICY REGIME

As stated above, the main long-term objective of central banks' monetary policy in democratic countries with market economies is price stability. Individual monetary policy regimes serve as a means of achieving this objective. The difference consists in whether the monetary policy aims directly at its final target of price stability, as in the case of inflation targeting, or at an intermediate target—for example, the exchange rate or money supply—where a relatively stable, or at least fairly predictable, link between the intermediate and the final target is assumed.

This chapter deals with the four most frequently used regimes, giving their main features and the empirical experience with their application and describing the environment which is most appropriate for each. The basic feature of all the monetary regimes below is the existence of a nominal anchor (namely the exchange rate, a money target or an inflation target)—that is, a nominal macroeconomic variable anchoring price developments.

Exchange rate targeting

Under exchange rate targeting the central bank tries to ensure nominal exchange rate stability via interest rate changes and direct foreign exchange interventions, thereby "importing" low inflation from the anchor country. Maintaining the exchange rate is an obligation the fulfillment of which requires certain preconditions. These include above all an appropriate macroeconomic policy mix ensuring a low inflation differential vis-à-vis the "anchor" currency, a sufficient level of international reserves, and the maintaining of the country's competitiveness and overall credibility, including its institutional and legislative framework and political stability.

In the basic variant of exchange rate targeting, we speak of an exchange rate "peg." This involves fixing the nominal rate to the currency of either one or several countries. As a rule, such an "anchor country" is a larger state with low inflation and a substantial share in mutual trade (e.g. the eurozone or the United States). This regime, however, has other variants. A band can be set for the nominal exchange rate. Within this band, the rate can float freely and the central bank intervenes only if there is a danger of the margins of the band being exceeded. In the case of an exchange rate band, speculative capital flows are reduced because of the increased exchange rate uncertainty, and this increases the autonomy of monetary policy. A "crawling peg" is a modification of exchange

rate targeting. Here, the targeted nominal rate level is shifted (usually it is devalued in a controlled fashion), but generally by less than the inflation differential in the relevant period. This modification of the fixed exchange rate regime prevents the real rate from an excessive strengthening which would lead to erosion of the price competitiveness of domestic products. An extreme variant of exchange rate targeting is the so-called "currency board." Here, the domestic currency is issued only against growth in foreign exchange reserves and in a fixed ratio. The benefits of this form of rate targeting include its greater credibility and consequently greater resistance to speculative attack. This regime is frequently applied in crisis situations in order to stabilize the exchange rate, inflation and foreign exchange reserves.

The fundamental advantage of exchange rate targeting is the "import" of inflation from the anchor country, which as a rule is lower than in the domestic economy. Another advantage is that the nominal anchor is understandable to the public. A fixed exchange rate regime can also contribute to economic and political integration, as, for example, in the case of the ERM which was in place in the EMU states prior to the introduction of the euro.

One of the main disadvantages of exchange rate targeting is that it weakens the autonomy of monetary policy, as domestic interest rates must in conditions of liberalized capital flows be set "in harmony" with the rates of the anchor country while at the same time taking credit risk into account. In the case of domestic demand or supply shocks, the possibility of reacting via domestic rates is limited. Conversely, shocks occurring in the anchor country are transferred into the real economy through the imported monetary policy. The fact that domestic interest rates are tied to foreign rates leads to the loss of the signal on market forming of interest rates as the price of money. The disadvantage of exchange rate fixing (with the exception, to a certain extent, of the currency board) is the risk of speculative attacks on the domestic currency. This risk increases when long-term maintaining of an overvalued fixed exchange rate leads to erosion of the price competitiveness of domestic producers, thus feeding through into worsening external imbalance. The increased probability of exchange rate instability results in the raising of interest rates, with unfavorable effects on the domestic economy.

Exchange rate targeting is suitable for small open economies where the exchange rate is a significant determinant of domestic price developments. The exchange rate is relatively good as a nominal anchor in the case of capital flow regulation. The reduction in capital flows decreases the risk of exchange rate speculation and allows some other schemes of autonomous monetary policy regulation to be applied concurrently. On the other hand, it postpones the identification of economic problems within the country in question. Under conditions of liberalized capital flows, the main prerequisite for maintaining the exchange rate parity set in advance is an appropriate policy mix leading to balanced economic development. With the increasing liberalization of capital flows and globalizaton of financial markets, the world has been moving away from exchange rate targeting in recent years. The only exception is the shift to the currency board scheme in some unstable and emerging economies lacking credibility in the area of monetary and overall macroeconomic development.

Money targeting

Money targeting is based on the theoretical finding that, in the long term, price growth is affected by money supply growth. Within this regime, monetary policy is focused on ensuring an appropriate growth rate of the chosen monetary aggregate. According to the quantity equation of exchange, this variable is proportional to nominal output growth. The diversity of this regime shows

up in the choice of monetary aggregate, the type of corridor for the target and in the manner of management of the chosen aggregate.

The advantage of this regime consists particularly in the possibility of pursuing an independent monetary policy and of reacting accordingly to specific problems arising in the domestic economy.[2]

On the other hand, money targeting has some limitations. One problem lies in the choice of an appropriate monetary aggregate itself. The aggregate should be relevant in terms of economic theory and at the same time have an econometrically justified stable link with prices or nominal output. In an environment of financial innovation and market computerization and globalization, this relationship is ever more volatile and therefore ever more difficult to predict. Another problem is that the central bank may not be able to manage the selected monetary aggregate with sufficient precision. A further disadvantage is that the money target is not fully understandable to the public. Moreover, both empirical analyses and theoretical findings show that excessively high monetary aggregate growth rates pass through into inflation with a long time lag. To influence future inflation, the central bank must therefore act well in advance.

The experience with money targeting differs in individual countries. The results were not satisfactory in the United States, Canada and the United Kingdom, where consistent management of the monetary base resulted in excessive volatility of short-term interest rates. In Germany and Switzerland, this regime was applied with relative success. The specific formulation of targets in individual countries depends on local conditions. In most cases, the money growth target is not a point one, but is defined as an interval for the year-end or as a corridor for the aggregate during the year. Money targets are increasingly being set not only for the following year, but also for several years ahead.

Monetary policy management through money targeting is particularly appropriate in an environment with a stable, reliable and predictable link between the targeted monetary aggregate and inflation. Financial innovation and the liberalization of capital flows, however, are substantially decreasing the stability of this link, resulting in an erosion of the scheme's benefits. A prerequisite of effective monetary aggregate management is the existence of a functioning credit channel in which credit creation reacts to interest rate changes.

Regime with an implicit nominal anchor

A regime with an implicit nominal anchor involves targeting a certain nominal variable not announced explicitly, but adopted only internally within the central bank without any specific parameter or criterion being declared. This regime gives the central bank substantial room and autonomy. The problem here is lower transparency, as it is not entirely clear how to assess the central bank's monetary policy and predict its behavior.

[2]The European Central Bank (ECB) uses money targeting as one of the cornerstones of its monetary policy too. This stems from the German Bundesbank's long-term success in combining non-inflationary development with economic growth. The ECB, however, has simultaneously set an inflation target in the form of a harmonized consumer price index of no higher than 2 percent. Similarly, the Bundesbank did not concentrate in the past exclusively on monetary aggregate growth, but used a multi-criteria approach with an emphasis on expected future inflation.

A prerequisite for successful functioning of this regime is high credibility of the central bank built on a relatively long history of monetary and price stability in the country. The practice of the U.S. Federal Reserve System, where this scheme is applied, has shown a shift from money targeting via a certain implicit anchor to a form comprising some elements of inflation targeting.

Inflation targeting

During the 1990s, more and more central banks introduced the historically youngest monetary policy regime—inflation targeting. One of the main features of this regime is the public and explicit announcement of an inflation target or succession of targets. In most cases, the targets are set for a certain period, but they may also be defined as intervals in the form of running (falling or horizontal) bands. Also publicly declared is the determination to achieve long-term price stability. This involves active and direct shaping of inflation expectations.

In its decision-making scheme, inflation targeting involves the use of much more information than do the exchange rate or monetary aggregate regimes. In addition to the main inflation factors, analysis is conducted of labor market variables, import prices, producer prices, the output gap, nominal and real interest rates, the nominal and real exchange rate, public budgets, etc. This regime assumes a good ability to predict future trends for the above macroeconomic variables and their implications for inflation.

The targeted price index is chosen as sufficiently wide and representative to provide a good approximation of overall inflation. However, those items whose prices are subject to exogenous factors beyond the reach of monetary policy instruments are excluded.

The merit of inflation targeting consists in the possibility of autonomous conduct of monetary policy, even in a world of continuing globablizaton, financial innovation and liberalized capital flows. Its multi-criteria nature allows the maximum amount of information to be incorporated into the decision-making process. Another advantage of inflation targeting is monetary policy transparency, which makes policy more understandable to the public and allows for better prediction of the central bank's intentions. This is reflected favorably in an improvement in credibility—an important prerequisite for effective functioning of a scheme that uses influencing of inflation expectations. Another benefit of inflation targeting is its medium-term focus, consistent with the relatively long lag between monetary policy measures and their effects on inflation.

The disadvantage of this monetary policy scheme is that the central bank is not as a rule able to influence all the items included in the consumer price index, which is the primary anchor of inflation expectations. The success of the inflation forecast also depends on exogenous inflation factors and, in the Czech Republic, on changes in regulated prices and indirect taxes. The risk of inflation deviating from the prediction requires better central bank communication with the public.

Monetary policy regimes in the 1990s

Monetary policy regimes saw two significant trends in the 1990s. The first was a clear inclination towards introducing explicit monetary policy targets (an inflation target, a money growth target, an exchange rate target or a combination thereof). The second was a rapidly growing number of countries in which monetary policy is based on inflation targeting or where inflation targets are at least declared together with other monetary policy objectives. The above trends are apparent in

advanced as well as emerging and transition economies. One of the most recent Bank of England studies,[3] comprising 91 central banks from all types of economies and covering the 1990s, provides the following information. The number of countries which introduced some form of exchange rate targeting increased from 30 to 47 in the 1990s. The number of countries with money targets during the period increased from 18 to 39, whereas the number of countries with inflation targets grew almost seven-fold, from 8 to 54. Of those 54, 13 had inflation as their sole target. For comparison, at the start of 1990, only 8 countries had inflation targets and only one (New Zealand) claimed inflation to be its key target.

On the other hand, 17 countries abandoned or changed their explicit monetary policy targets during the 1990s. In ten cases, some form of exchange rate targeting was abandoned (e.g. the United Kingdom, Finland, Croatia, the Czech Republic, Sweden). In most economies, this was a reaction to exchange rate crises. Seven economies dropped money targeting (e.g. the United Kingdom, Spain, Poland, the Czech Republic). The most frequent reason was the breakdown of the relationship between money supply growth and inflation due to financial innovation and financial deregulation. No country abandoned inflation targeting during the 1990s.

Monetary Policy Regimes in the Czech Republic Prior to Inflation Targeting

The monetary policy regimes applied since the establishment of the Czech Republic can be divided into three stages. In the first period, from the start of the transformation up to the foreign exchange turbulence at the end of May 1997, a strategy was used which combined an exchange rate peg (partially relaxed at the end of February 1997) with a monetary policy based on money targeting. During the short period following the exchange rate turbulence until the end of 1997, when the exchange rate peg was replaced by managed floating, money supply was the only target. In the third period, since the beginning of 1998, monetary policy has been conducted within an inflation targeting scheme.

Exchange rate and money targeting under the conditions of economic transformation and liberalization of capital flows

The application of a monetary policy scheme combining exchange rate targeting with money targeting was probably the only possible solution at the very start of the transformation. It should be emphasized that at the time of the fundamental reforms (extensive and rapid price and foreign trade liberalization) this solution was very effective. The fixed exchange rate served as an effective stabilizing nominal anchor of the economy. This anchor at the same time helped improve the credibility of the central bank and its monetary policy. Money targeting made it possible to react directly to specific economic developments. Inflation, the reduction of which was the primary monetary policy task, fell from about 20 percent during 1993 to 10 percent in the first quarter of 1994 in year-to-year terms.

The following period saw increasing imbalances in the economy. The key problem was the insufficient response of domestic output to the pick-up in demand. The low flexibility on the supply side was due to incomplete restructuring in the corporate sector, incomplete privatization of major

[3] See G. Stern, "The Use of Explicit Targets for Monetary Policy: Practical Experiences of 91 Economies in the 1990s," *Quarterly Bulletin*, Vol. 39, No. 1 (August 1999) (London: Bank of England).

sectors of the economy, and the existence of microeconomic, institutional and legislative barriers to economic activity.

The upturn in demand in this period was attributable to an accumulation of several factors, in particular rapid wage growth substantially outpacing labor productivity growth in 1994–96. The wealth effect ensuing from voucher privatization also played a role in stimulating domestic demand through household consumption. Major investment projects in the state sector led to an acceleration of fixed capital formation and a high rate of investment.

In this situation, moreover, the inflow of capital from abroad strengthened, creating an additional demand stimulus. The capital inflow was favorably affected by the gradual liberalization of capital flows, the existence of an interest rate differential in conditions of a fixed exchange rate, and by the results of the economic transformation, which at that time were positively evaluated by both international organizations and investors. However, the ability of the economy to absorb additional funds was limited and money supply growth (accelerated by the capital inflow) outpaced that of nominal output, signaling longer-term inflationary pressures.

The pick-up in economic growth in the first half of both 1994 and 1995, driven by the accelerating demand, was thus built on shaky foundations. In 1994–96, the gap between supply and demand in the economy gradually fed through into increased external imbalance. The problems on the supply side showed up in a gradual decline in economic growth as early as in the second half of 1995 —that is, long before the adoption of the macroeconomic stabilization measures specified below.

This trend was not sustainable in the long term and required a tightening of macroeconomic policies to restore the balance between domestic demand and output. However, within the then mix of economic policies, monetary policy had to substitute to a large extent for the insufficiently rigid fiscal and income policies. Amid accelerating capital inflow, increasing demand pressures and an overheating of the economy, public finances should have been oriented towards fiscal surpluses. The wage area required a trend corresponding with that of labor productivity. In reality, however, the fiscal and wage developments were very expansive. The overall public budgets deficit moved between 1 percent to 2 percent of GDP in 1994–96, and the so-called "hidden" deficits also rose. The structural component of the public finance deficit gradually increased to more than 2.5 percent of GDP in 1996, indicating a rising fiscal expansion. Real unit wage costs in 1994, 1995 and 1996 rose by 3.6 percent, 1.2 percent and 3.9 percent respectively—another indication of the unbalanced inflationary influence of wages.

In an effort to help restore macroeconomic stability, the CNB adopted several monetary policy measures during 1996. The widening of the fluctuation band of the koruna from ±0.5 percent to ±7.5 percent was of fundamental significance. This measure was adopted to prevent the inflow of short-term speculative capital. It was this type of capital which had considerably accelerated money supply growth and had fostered the excessive domestic demand expansion. The aim was to increase the exchange rate risk, thereby reducing at least partially the profits of foreign investors arising from the high interest rate differential.

The relaxing of the exchange rate created space for a more autonomous monetary policy allowing more effective interventions in the area of domestic money creation. In this context, the CNB in mid-1996 adjusted its monetary policy interest rate and reserve requirements. Bank lending, despite these measures, remained relatively dynamic up to 1997, showing year-to-year increases of about CZK 100 billion annually in that period. The monetary policy measures thus did not generate

any substantial restriction of domestic lending. Despite a slightly higher interest rate differential, the pace of capital inflow slowed, resulting in a corresponding slowdown in money supply growth.

The widening of the fluctuation band for the koruna's exchange rate alone, however, could not solve the problem of growing macroeconomic imbalances. It was only a partial contribution to subduing one of the factors of this unbalanced trend.

The currency shock, loss of the nominal anchor, rising inflation and worsening inflation expectations

At the beginning of 1997, the macroeconomic imbalances continued widening. Real wage growth was still excessive and was out of line with labor productivity growth. The state budget posted an unexpected deficit in the first months of the year. As a result, demand accelerated amid ongoing rigidity on the supply side, causing a widening of the external imbalance. The current account deficit reached values of above 8 percent of GDP at the beginning of 1997, well above the generally acknowledged critical level (5 percent). In this situation, the conviction gradually strengthened among investors that the macroeconomic trend was unsustainable, and depreciation expectations mounted. Elements of instability in the domestic political situation and the "currency contagion" from foreign exchange crises in Southeast Asia also played a role in the exchange rate turbulence.

The above factors resulted in May 1997 in strong pressures on the koruna. Using foreign exchange interventions and interest rate adjustments, the CNB succeeded in handling the attack against the koruna so that its consequence was, compared with the currency shocks in some other countries, only a modest depreciation of the exchange rate. As a result of the exchange rate turbulence, the fixed exchange rate was replaced by managed floating. Money supply growth decelerated during 1997 back to within the set bandwidth. At the same time, interest rates returned relatively quickly to lower levels.

Factors other than demand started to predominate among inflationary pressures. The demand factors had been considerably subdued by the adoption of the restrictive fiscal and wage measures of the two "government packages" in April and May 1997, as well as by the 1996 monetary measures. The more marked increase in price indices was attributable to relatively extensive changes in regulated prices in mid-1997 and again at the start of 1998, which were moreover accompanied by indirect tax adjustments. The depreciated koruna (down by about 10 percent against the former currency basket) also played a role. The year-to-year CPI, which was just above 6 percent in May, reached 10 percent at the end of 1997 and more than 13 percent in the first quarter of 1998. In this situation, inflation expectations accelerated.

The Inflation Targeting Regime—Arguments and Reasons for Its Introduction in the Czech Economy

The choice of inflation targeting at the end of 1997 was a way out from the situation in which the economic and monetary policy had lost, following the exchange rate turbulence, its nominal anchor in the form of the exchange rate. At the same time, it was obvious that any return to the pegged exchange rate regime was quite unrealistic and that even the other alternative—money targeting—could not, in the given conditions, provide a sufficiently functional criterion for monetary policy orientation.

In this respect, the Czech economy followed the experience of numerous countries that were also forced to abandon a fixed exchange rate prior to introducing inflation targeting. Forced exit from the EMS exchange rate regime directly preceded the introduction of inflation targeting in the United Kingdom in October 1992. Similarly, the breakdown of a fixed exchange rate regime was the principal reason behind the choice of inflation targeting in Sweden and Finland at the start of 1993. Inflation targeting was meant to provide a new cornerstone for monetary policy and substitute for the loss of the nominal anchor in the form of the fixed exchange rate.

The second key argument for introducing inflation targeting was the inertia of the relatively high level of inflation in previous years. The Czech economy was one of the first Central and Eastern European countries to achieve single digit inflation. Nonetheless, from 1994, when the CPI reached the 10 percent level, no further reduction in price indices could be achieved. Conversely, from the second half of 1997 H2, the inflationary pressures picked up significantly and price indices rose. The CPI reached 13.4 percent in March 1998 and the inflation expectations for the end of 1998 on the part of, among others, trade union representatives and most analysts were even higher, at up to 15–16 percent. The shift to inflation targeting was therefore also associated with an intention to overcome the inertia of the relatively high inflation and to employ more effective stimuli for renewing the disinflation process. The shaping of inflation expectations was of key significance in this context. In the specific conditions of the Czech economy at the end of 1997 and the start of 1998, it was essential to convince market participants that no further acceleration of inflation would occur. An inflation targeting regime based on effective influencing of inflation expectations was therefore an appropriate strategy and a promising solution.

The experience of the world economy was an important argument as well. Although inflation targeting as a formalized monetary policy strategy for achieving price stability is in essence a product of the early 1990s, it has been spreading quite rapidly. The pioneer countries were advanced market economies such as New Zealand, Canada, the United Kingdom, Sweden, Finland, Australia and Spain. However, these have been followed by economies from less developed parts of the world. During the expansion of inflation targeting, it has been significant that the countries applying this regime which were not part of the "club" of low-inflation countries have registered a substantial shift to low inflation levels during the 1990s. After the exchange rate turbulence, the Czech economy's task was to break the inertia of 10 percent inflation and gradually achieve the characteristics of a low-inflation economy. The option of inflation targeting was therefore considered a justified choice for the Czech economy.

THE PREREQUISITES FOR EFFECTIVE IMPLEMENTATION OF INFLATION TARGETING

Although inflation targeting has spread rapidly across the world economy, certain prerequisites need to be met for its effective implementation. The official introduction of inflation targeting on 1 January 1999 was preceded by a detailed assessment of these prerequisites in the Czech economy in the second half of the 1990s.

The general prerequisite is for the priority of price and monetary stability to be shared by the main market participants and by individual tiers of society. In this direction, it was possible to continue the traditions of the interwar and postwar periods. After the First World War, the former Czechoslovakia was the only country in the region to avoid hyperinflation. Moreover, before the transformation started in the 1990s, the degree of money overhang and suppressed inflationary potential was very low compared with neighboring countries.

The central issue in considering the justification of introducing inflation targeting was, however, to what extent the existing macroeconomic and institutional framework was consistent with the principles of inflation targeting. In this context, the positive prerequisites in particular included:

- the legally stipulated and actually implemented independence of the central bank in pursuing monetary policy,

- the observance of fiscal discipline. (Foreign experience has shown that inflation targeting is unsustainable without discipline in public finances), and

- the existence of sufficiently developed financial markets and their infrastructure so that effective transmission of monetary policy measures can be ensured.

These prerequisites were the key precondition for the existence of an inflation targeting regime. They were important not only for its introduction but are also a condition for its effective implementation.

In addition to the above characteristics of the macroeconomic and institutional framework, the successful implementation of inflation targeting is conditioned by a whole range of other dimensions, including factors of a technical nature. These include in particular the requirement that no other nominal variable be targeted along with inflation or price indices. This applies in particular to the exchange rate. This requirement was met in the Czech economy with the shift from the fixed exchange rate to managed floating at the end of May 1997.

Limiting Factors in Monetary Policy Implementation in the Czech Economy

As follows from the above conclusions, the Czech economy fulfilled the basic prerequisites for inflation targeting. The introduction of this regime at the end of 1997 was, nevertheless, confronted with some specific circumstances and limitations:

- In contrast with maintaining an already achieved low level of inflation, which was the standard problem in most advanced countries, the Czech case involved disinflation from two-digit price indices to a low-inflation level; moreover, inflation was accelerating at that time,

- The Czech economy was still in transition, with all the attributes of incomplete restructuring and ongoing institutional changes. The main limitation with respect to inflation targeting was the unfinished process of regulated price adjustment; moreover, there existed no scenario or time schedule for this process,

- The high degree of openness of the Czech economy in the real and financial sectors predetermined that exchange rate changes and external shocks would have a major impact on the domestic price level. With the benefit of hindsight, it should be stated that these effects on domestic price indices were exacerbated by the substantial fluctuations in the world economy, in commodity prices and on financial markets, due among other things to the Asian and Russian crises, which were typical of that particular stage.

From time to time, the above problems are presented as arguments casting doubt on the wisdom of introducing inflation targeting as well as on its further application in the Czech economy. This is,

however, a fundamental misunderstanding. These specific circumstances, inherent in a small open economy and moreover in an economy in transition, undoubtedly represent limiting or complicating factors for the effectiveness of monetary policy. Nonetheless, these factors are, by definition, limitations for monetary policy in any regime, (i.e. not only under inflation targeting).

THE AIMS OF MONETARY POLICY: SPECIFICATION AND IMPLEMENTATION

As stated in Section 2, the central bank's long-term and fundamental objective is to achieve and maintain monetary and price stability. The CNB's monetary policy has always been founded on the principle that balanced and sustainable economic growth must be based on macroeconomic stability. Achieving and maintaining monetary and price stability is the central bank's essential contribution to the creation of a pro-growth environment.

The shift to an inflation targeting strategy did not mean a change in this core monetary policy orientation. The change occurred only in the regime under which it is implemented. Compared with previous regimes, inflation targeting aims at price stability directly, not indirectly via a certain indicator such as the money supply or the exchange rate. At the same time, inflation targeting allows the whole range of relevant variables of both the real and fiscal sectors to be integrated into the decision-making process and into the setting of monetary policy instruments. Thanks to this, the effectiveness of monetary policy instruments in the pursuit of the primary objective—price stability— is strengthened.

For the current stage of the Czech economy, this means achieving the standard of a low-inflation environment consistent with the criteria of the country's integration into the EMU. The long-term monetary strategy approved by the CNB Board on 8 March 1999 and submitted to the Czech Government and the public was also formulated to this end.

The long-term inflation target for year-to-year net inflation is specified in the above document at 2 percent ± 1 percentage point; this target should be hit in 2005 or thereabouts. When setting individual steps along this trajectory, the CNB is guided by the principle that the setting and implementing of targets for individual time horizons must not:

- generate an acceleration in inflation (allowing for exogenous and temporary influences),
- be directed below the price stability level, defined as 2 percent ± 1 percentage point.

A comparison of the proposed long-term target for 2005 (2 percent ± 1 percentage point) and the current target for the year 2000 (4.5 percent ± 1 percentage point) shows that the long-term target establishes only a very slow trajectory toward price and monetary stability. A linear trajectory would mean net inflation falling by about 0.5 percentage points a year.

The proposed mid-value for the long-term inflation target, and consequently the definition of price stability for the Czech economy, establishes gradual convergence to the inflation level in the eurozone. However, it is slightly higher than the target declared by the European Central Bank, according to which growth in the harmonized consumer price index should not exceed 2 percent. This primarily reflects the fact that the probable extent of the distortion of price indices due to changes in the quality and range of goods and services, as well as to the more intense adjustment of relative prices in the still transforming Czech economy, will continue to be larger than in eurozone countries.

The principles of the long-term monetary strategy were incorporated into the document of the Czech Government, "Economic Strategy of the Accession to the European Union," which is the fundamental document for economic policy orientation in the run-up to EU accession. These principles then also became part of a joint document of the Czech Government and the European Commission "Joint Assessment of the Economic Policy Priorities of the Czech Republic." On this basis, it can be stated that the long-term monetary strategy objectives have been accepted and supported not only by the Czech Government, but also by the highest EU authorities as an appropriate monetary policy strategy in the run-up to EU accession and subsequent entry into the EMU.

Achieving a consensus between the Government and the CNB on the price and monetary stability target was one of the major objectives of the long-term monetary strategy. The CNB's strategy assumes that price and monetary stability is for the small and very open Czech economy a basic precondition for sustainable growth and that sharing the monetary policy strategy with the Government increases its credibility, positively influences inflation expectations and reduces the costs of the disinflation process.

Together with the long-term anchoring of the disinflation trajectory, progress targets have also been identified for specific time horizons. In particular these include a target for the end of 2000, which was adopted when inflation targeting was introduced at the end of 1997 and which currently represents a fundamental CNB commitment towards the public. The three-year horizon of this target takes into account the time lags in transmission of monetary policy measures and is consistent with standard procedures in countries with inflation targeting.

In addition to the above medium-term target, orientation values were also specified for price indices in an annual horizon—that is, for the end of 1998 and 1999—as target indicators for the progress of the disinflation process. These were justified mainly by the initial conditions of the switch to inflation targeting combined with the institutional characteristics of the Czech economy. As mentioned above, the end of 1997 and the start of 1998 were characterized by accelerating inflationary pressures resulting in an unfavorable increase in inflation expectations accompanied by the risk of an inflation-depreciation spiral: prices-wages-exchange rate-prices. The identification of a target variable for the disinflation process in the not-too-distant horizon was therefore justified, particularly in a situation where wage bargaining in the Czech Republic is still limited to a one-year period.

Inflation targets are defined using the concept of "net inflation." This is a compromise between the intention to use as wide a price index as possible, but at the same time to target only the items of "standard" price developments, not the consequences of administrative and tax changes which are completely beyond the reach of monetary policy. The net inflation index is derived from the overall CPI adjusted for regulated prices, prices affected by administrative interventions and for indirect tax changes. The CPI at present consists of 754 items, with regulated prices comprising 91 items and net inflation 663 items. The ratio of the two price groups, taking into account their current weights in the consumer basket, is about 82.2:17.8, that is, with a significant preponderance of net inflation items. The net inflation indices are processed and published by the Czech Statistical Office, an independent institution—a desirable attribute for the credibility and reliability of indices.

The exclusion of some items or influences from overall price movement when setting an inflation target is also quite common in other countries, including the advanced nations. Along with changes in indirect taxes, these items usually include changes in prices of imported commodities, food and agricultural products. These are items which are subject to substantial deviations and

fluctuations and which at the same time show low sensitivity to central bank monetary policy instruments. In contrast to some other countries, the net inflation index targeted by the CNB is not adjusted for these volatile items, even though they complicate the preparation of inflation forecasts. For example, food prices account for about one-third of the CPI. If they were to be excluded, the breadth and reach of the targeted index would narrow significantly.

The setting and implementing of inflation targets by means of monetary policy measures must take into account a number of complicating factors. The aforementioned monetary policy targets and measures aim at the nearer or more distant future, and this is always connected with a high degree of risk and uncertainty. Forecasts, by definition, are of a probability nature only. Knowledge of the monetary policy transmission mechanism is always imperfect; moreover, this mechanism is subject to changes, as are the time lags of its individual channels.

The institutional framework of inflation targeting in the Czech economy responds to these uncertainties at two levels, similarly as in numerous other countries, by:

- identifying inflation targets in the form of an interval that should make it possible to adapt to the normal degree of fluctuation of variables in both the real and fiscal sectors; and

- defining a set of "exceptions," including unforeseeable sudden changes, fluctuations and shocks whose occurrence lies completely or largely outside the reach of monetary policy measures and which at the same time significantly affect price indices. The establishment of such exceptions authorizes monetary policy not to react immediately to such shocks, as such a response would be costly in terms of the real economy and its performance as well as counterproductive for the disinflation process itself.

The exogenous and unforeseeable factors that fulfil the exceptions criterion are defined as follows:

- substantial deviations of global prices of raw materials, energy sources and other commodities from the prediction;

- major deviations of the koruna's exchange rate from the prediction that are not connected with domestic economic fundamentals and domestic monetary policy;

- marked changes in the conditions for agricultural production having an impact on agricultural producer prices; and

- natural disasters or similar extraordinary events having cost and demand impacts on prices.

Although with the benefit of hindsight the net inflation concept seems fully justified for the initial phase of regulated price adjustment, it unquestionably has its limitations. These primarily include a differing trend for the CPI and the net inflation index and the consequences of this for the effectiveness of monetary policy, shaping of inflation expectations and communication with the public. For this reason, it is desirable to switch in the future to targeting a wider CPI. In this context, it comes as positive news that the Government has presented a scenario for further regulated price adjustment, committing itself to complete this process by the end of 2002. Assuming that this convergence of the CPI and the net inflation index occurs, it will be possible to switch smoothly to CPI targeting.

PRICE INDICES IN 1998 AND 1999 AND THE MONETARY POLICY RESPONSE

The monetary and price developments during 1998 and 1999 can be divided into three periods:

- The first half of 1998 was characterized by a relatively high price index level, with the CPI reaching two-digit values. The level of key interest rates was consistent with this, with the 2-week repo (repurchase agreement) rate reaching 15 percent in March 1998. From the second quarter, the rise in both the net inflation index and the CPI slowed and the unfavorable inflation expectations were gradually corrected.

- In the second period, from mid-1998 to mid-1999, the Czech economy saw a marked disinflationary process. The year-to-year CPI dropped from 10.4 percent in July 1998 to 1.1 percent in July 1999. Following a drop in the levels of conditional inflation forecasts consistent with the unwinding of inflationary pressures, the 2-week repo rate was gradually lowered from 15 percent in July 1998 to 6.5 percent in June 1999. This reduction was accompanied by cuts in the discount and Lombard rates and by a narrowing of the spread between them. In July 1998, a gradual process of reducing the minimum reserve requirements on primary deposits was started. Between July 1998 and October 1999, the requirements were cut in three steps from 9.5 percent to 2 percent, which is now consistent with the level in EMU countries.

- Since mid-1999, the year-to-year changes in the CPI and net inflation index have stabilized at a relatively low level. This stabilization has been achieved despite a certain increase in inflationary pressures, mainly in the form of imported inflation connected with the sizable upward correction in oil prices. The CPI showed year-to-year growth of 1.9 percent in November 1999 and the year-to-year net inflation index rose by 0.6 percent in the same period. Monetary policy again reacted with an interest rate lowering, although with less intensity than in the previous period. The 2-week repo rate fell from 6.5 percent in July 1999 to 5.25 percent in November 1999.

In general, it can be stated that price indices in this period have been falling faster than assumed by the targets for the end of 1998 and 1999. This is the result of a unique combination of concurrent external and internal factors.

The external environment in the last two years has been characterized by extraordinarily strong fluctuations associated with the financial crises in Southeast Asia and Russia. Commodity and food prices, as well as relative exchange rates, have undergone abrupt changes from their previous values. The major fall in prices of numerous imported commodities, notably oil, and the absolutely unique decline in food prices alone have contributed to a 2–3 percent reduction in price indices according to calculations.

Internal factors, such as the domestic demand contraction, the longer-than-expected period of economic decline and the koruna's appreciation tendency, have been acting in parallel.

Given the above character of the factors contributing to the higher-than-targeted drop in price indices, it would be irrational for monetary policy to try to directly correct their influence and return price indices to the targeted values of the short-term annual horizon. The side effects of the volatility generated in the real economy and in the size of its output would be an excessive cost. Recognizing these facts, it is necessary to interpret and evaluate the hitting of short-term inflation targets in an appropriate manner and with adequate flexibility and to avoid the schematic conclusions of the "planner's" assessment of percent and tenths of percent. The reasonableness of

this approach is moreover underlined by the choice of the target variable as the end point of the relevant time horizon, e.g. December 1998 or December 1999. It would be not only costly but also counterproductive to try to return the actual price trend as fast as possible to the targeted value prior to the end of the year in the case of the occurrence of an unforeseen shock.

Although price indices stabilized at a low level in the second half of 1999, it cannot justifiably be said that the characteristics of a low-inflation economy have been attained, nor can it be assumed that these characteristics will be sustainable in the future. Numerous factors which in the past contributed to the fall in price indices are now acting, or must be expected to act, in the opposite direction, i.e. towards an upward correction. These include rising oil prices and changes in the external environment as a whole, the ongoing recovery in the domestic economy and the renewal of the process of regulated price adjustment.

ADVANTAGES OF THE INFLATION TARGETING REGIME IN THE CZECH ECONOMY

Inflation targeting has meant a departure from the application of explicit intermediate targets. This departure is due to substantial changes in the world economy, particularly financial market globalizaton and massive capital flows, which greatly reduce the effectiveness and relevance of intermediate targets. The advantage of inflation targeting is that the unilateral character of one or another intermediate target is replaced by the integration and synthesis of a whole range of indicators from the fiscal and real sectors of the economy. In fact, inflation targeting thus develops and arranges into a consistent system the previous spontaneous tendencies of monetary policies in individual countries toward a comprehensive evaluation of a greater number of indicators and data. This was indeed the case for the Bundesbank, notwithstanding its "nominal" adherence to money targeting. In reality, even the Bundesbank tolerated fairly large deviations from its money supply target range. In this sense, the Bundesbank was rather an example of long-term, albeit implicit, implementation of inflation targeting. The explicit inflation target is also the cornerstone of the monetary strategy and policy of the European Central Bank.

Inflation targeting has introduced a certain order, rules and discipline into the decision-making of the central bank. This has led to better predictability of its reactions to economic developments. Thanks to this, the "news" consists increasingly of the announcement of the relevant statistical data—according to which financial markets and analysts anticipate these decisions—and not just of the decisions of the monetary institution itself.

Another feature of the shift to inflation targeting is the increased transparency of monetary policy and better central bank communication with the public. The CNB has made good progress in this direction. Since the start of 1998, the public has been acquainted with monetary developments and with the concrete implementation of monetary policy through quarterly inflation reports. The minutes of CNB Board meetings on monetary issues are published within 12 days. Other forms of the CNB's improved communication with the public include regular meetings of CNB representatives with journalists, domestic and foreign analysts and trade union representatives. The information published on the CNB's website has also been expanded considerably. The IMF report on the transparency of monetary and financial policy in the Czech Republic states that the shift to inflation targeting in the Czech Republic was transparent and that "the presentation and disclosure of information underlying the inflation outlook and related monetary policy decisions is close to the standards of industrial countries."

Another considerable benefit of the shift to the inflation targeting strategy is the announcement of a quantitatively defined target by which the central bank makes known its commitment toward the public. Such a public commitment creates conditions for much more intensive influencing of the inflation expectations of market participants. Given the key significance of inflation expectations for the disinflation process and for its costs, inflation targeting is an appropriate strategy for countries, including the Czech Republic, striving to achieve disinflation.

The monetary and economic developments in 1999 show that adhering to money targeting could have been very controversial. In the recent period, there has been a pick-up in money supply growth which has not corresponded to nominal GDP growth. If money supply had been taken as the deciding criterion, this would have implied a requirement for a tightening of monetary policy. Such action would not have been justified in a situation where only the first signs of a modest recovery were being felt.

The conditional inflation forecast for the end of 2000, that is, the upper band of the inflation target, is currently heading toward the lower limit of the target range, with its mid-value slightly below the inflation target. This testifies to the success of the disinflation process to date, despite the highly unstable external environment. The increasing credibility of the CNB together with the much greater transparency of monetary policy within the inflation targeting regime has made a major contribution to a positive change in inflation expectations. Recently, the inflation expectations of the CNB, the Government, trade unions and analysts have converged considerably. This contrasts sharply with the situation in 1997 and 1998. The period of low inflation has at the same time generated a downward shift in the “inbuilt level” of expectations. This is of key importance for minimizing the total costs of the progress toward a low-inflation economy.

Chapter 8

STRATEGIC CHOICES FOR INFLATION TARGETING IN THE CZECH REPUBLIC

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The ideas and arguments in this chapter were influenced by numerous contacts with policymakers and economists at the CNB and the IMF over a decade. I would like to thank all of them, especially Tibor Hlédik and Warren Coats whose comments materially improved an earlier draft. I should also like to express my appreciation to both institutions for their openness to alternative approaches—outside advisers such as myself were given wide scope in our analyses of the issues. It follows that the views expressed are mine, and not necessarily shared by the IMF or, for that matter, the Bank of Canada.

INTRODUCTION

This chapter is about choices for the conduct of monetary policy in the Czech Republic that to a large extent have already been made. Section 2 traces the evolution of events and thought that led to the adoption of inflation targets by the Czech National Bank (CNB) early in 1998. Section 3 outlines the operating principles elaborated a year later, and argues that these conform to the main lessons spelled out in the recent literature on inflation targeting. Section 4 advocates the development and use of models specifically adapted to an inflation targeting framework, and discusses aspects of such modeling that are of particular relevance to the Czech Republic. Transparency and communications are crucial aspects of such an approach, and Section 5 describes the remarkable progress of the CNB in this regard. Other strands are of the argument are summarized in the concluding section.

SEARCHING FOR A NOMINAL ANCHOR

Fixed exchange rate phase

Since 1990, the Czech government has had in mind eventual accession to the European Union.[2] This would imply adopting its monetary institutions, and replacing the koruna with the euro at some future date. In the meantime, the CNB has sought the most effective means to that end. Until 1998 the CNB used an approach to monetary policy based on three guidelines:

- a fixed exchange rate against a currency basket initially composed of five currencies but later of just two, the U.S. dollar and the German mark; and

- a money supply target, expressed as a range for the growth of M2;[3]

- a disinflation target, usually an inflation rate for the year ahead, which is somewhat lower than the realized rate the year before.

This approach, underpinned by the CNB's strong reputation at home and abroad for competence and discipline, was relatively successful for some years.[4] Until 1996 the potential for conflict between these guidelines was minimal because the overriding factor, both officially and in practice, was the fixed exchange rate. Moreover, in the early 1990s cross-border mobility of capital was fairly low because of exchange controls and the uncertainties perceived by foreign investors in the unfamiliar new regime. This allowed a degree of freedom to pursue domestic objectives that would diminish over time.

[2] Prior to its division in January 1993, the sovereign entity was the Czech and Slovak Republic.

[3] In practice, the growth of the M2 aggregate has tracked the trend in inflation reasonably well. However, this leg of the tripod has never been the pivot that the exchange rate was until 1996, and that the inflation target is now.

[4] The international recognition given to Governor Tosovsky is ample evidence of this reputation. His stature within the Czech Republic is such that he was called upon to serve as interim Prime Minister (1997–98).

TABLE 1. Year-end exchange rate: Koruna/US dollar

1989	1990	1991	1992	1993	1994
14.3	28.0	27.8	28.9	30.0	28.0
1995	1996	1997	1998	1999	
26.6	27.3	34.6	29.7	35.6	

a. "Principal Rate," IMF International Financial Statistics

The authorities pointed to the stability of the exchange rate, from 1990 through 1995 (Table 1), as evidence of successful monetary policy. Although they accepted the argument that the accumulation of foreign exchange reserves was creating an inflationary increase in the money supply, the alternative option of allowing the nominal exchange value of the koruna to rise was explicitly ruled out. Thus, inflation remained at almost 10 percent, much higher than in the European Union, and it was thought preferable to keep the nominal external value of the koruna stable, and to let the real value rise by means of the higher domestic rate of inflation.

However, by the end of 1995, the CNB was becoming increasingly concerned. The capital inflow remained very strong, and M2 was expanding well in excess of the 13–16 percent guideline, as the CNB was not able to fully sterilize the monetary impact of its purchases of foreign exchange. Ample supplies of liquidity combined with lax lending standards of the banks led to a credit bubble. By the middle of the decade, there were many signs of overheating in the economy, such as a rapidly deteriorating trade balance.

TABLE 2. Data for the Czech Republic: December/December percentage changes

	Inflation				3-month interest rate	Real GDP
	CPI	Regulated prices	Net	M2	December level	Q4/Q4
1993				19.8	8.0	
1994				19.9	12.6	6.1
1995	7.9	10.2	7.3	19.8	11.0	4.9
1996	8.6	13.8	6.6	9.2	12.6	3.2
1997	10.0	22.7	6.8	10.1	17.5	2.2
1998	6.8	20.4	1.7	5.2	10.3	-4.2
1999	2.5	4.0	1.5	9.3 (Nov.)	5.6	0.8 (Q3/Q4)

Sources: CNB Inflation Report and IMF International Financial Statistics; updates from "Monetary Indicators" page on the CNB website

A major wave of price increases was looming: the level of regulated prices, which make up over 20 percent of the Consumer Price Index (CPI) basket, would increase 70 percent over the next three years (Table 2). Preventing an induced spiral of secondary increases, subsequent to the price liberalization, would require shutting off this monetary stimulus. The CNB responded, in early 1996, by widening the fluctuation zone around the official parity rate for the price of foreign exchange from ±0.5 to ±7.5 percent. This allowed a modest appreciation (3 percent against the dollar) to occur. More importantly, the widened band introduced an element of exchange risk, which

was sufficient to shut off much of the capital inflow. This allowed the CNB to raise short-term interest rates steadily through 1996, and to reduce money growth. By the end of the year, the rate of increase of M2 was reduced to about 10 percent.

Although the revision to the exchange rate band was not announced as a shift in regime, it almost amounted to one because the official range of fluctuation was now so wide. A 15 percent range does not act as a tight constraint on the conduct of monetary policy. In any event, the wide-band, fixed-rate experiment was short-lived, since shortly after the onset of a speculative attack in May 1997, which monetary policy initially resisted with a sharp rise in interest rates, the CNB moved formally to a floating rate. In retrospect, several common drawbacks of a fixed exchange rate system had been present throughout its tenure:

- **Difficulty finding a sustainable exchange rate.** Searching for a sustainable value, after many years of inconvertibility, the authorities devalued the koruna three times in 1990, halving its official U.S. dollar value. But by 1993, upward pressures on the currency had emerged, and these were to strengthen over the next few years.

- **Credibility problems.** Early in the decade, it was by no means clear to exchange markets that the new central bank could or would, under pressure, hold to the official parity rate of exchange. An initial problem was the weakness of the balance of payments, which was not helped by a web of capital controls. Later on, as the exchange rate stabilized, there was an evident inconsistency between the wide interest spreads against the United States and Germany and expectations of continued exchange rate stability.

- **Moral hazard.** The official commitment to a fixed exchange rate, and its realization for some years, made investors less cautious about cross-border capital transactions. During the middle years of the decade, Czech corporations borrowed heavily abroad. For the most part this inflow would have been justified by the needs and high returns of a restructuring economy, by low existing levels of foreign indebtedness, and by prudent macroeconomic policies. But implicit government guarantees and the explicit commitment to a fixed exchange rate contributed to an environment in which risks were underestimated. In consequence, the level of foreign borrowing quickly rose to an imprudent level.

- **Conflict with domestic price stability.** From 1993 through 1995, the commitment to the exchange parity required a rapid rate of domestic monetary expansion. Higher interest rates were necessary to reduce inflationary pressures, but these would have further increased the upward pressure on the koruna, and hence would have been at variance with maintaining the parity rate.

The floating of the koruna eased some of these inconsistencies. Although it had no specific nominal objective to replace the fixed exchange rate, the central bank was able to focus on reducing excess demand. Monetary conditions were tight throughout 1997, with real short-term interest rates exceeding 5 percent in the second half of the year. This brought the credit bubble to a close and exposed massive bad loans in the banking system—a situation which would result in serious capital impairment, official assistance, and closures. The CNB had to divert key resources from monetary policy to crisis management, and also had to fend off criticisms of its supervisory practices. Abroad, the emerging crisis in southeast Asia had contagion effects on economies in transition generally, including the Czech Republic, and resulted in further downward pressure on the koruna. In short, as

1997 drew to a close, expectations of inflation were coming adrift, the exchange rate anchor was gone, and the reputation of the CNB had been damaged.

CNB INFLATION TARGETING

Explicit inflation targets may have been an obvious option to replace the fixed exchange rate as the anchor for monetary policy. But there were widespread doubts about their practicability as a nominal anchor in the Czech Republic. In the late 1990s, the Czech economy, in the aftermath of decades of decay under state repression, was still suffering from structural flaws and distortions. Particularly awkward for the notion of inflation targeting was that price controls on products such as utilities and housing were scheduled to be lifted over the next few years. Deregulation would cause large, discrete increases in the cost of living at uncertain future dates. Another difficulty was lack of knowledge about the effectiveness of monetary policy in the new, incomplete market environment, and about the transmission mechanisms. For these reasons, many economists were skeptical that the CNB could realistically commit to any quantitative targets for inflation reduction and control, and there was no groundswell of opinion favoring them.

Thus, the CNB declaration early in 1998 of an inflation targeting approach was not widely anticipated. The central bank itself took the lead in assuming responsibility for a clearly defined and published objective. In April 1999 a CNB inflation-targeting strategy document laid out the main parameters of the approach to be followed towards this objective. The main principles enshrined in the April 1999 strategy document were as follows.

Numerical targets for net inflation

- A schedule of declining targets was set for net inflation (i.e. the rate of increase of the CPI, excluding regulated prices).

- By 2005, net inflation was to be 2 percent ±1 percent—this range thus became the CNB's operational definition of price stability.

- The inflation-reduction path was embodied in a target for 2000 of 4.5 ±1 percent and thereafter declines of 0.5 percent per annum.

- Special factors that might disturb this path would be take into account through modified annual targets, if necessary. Each year, targets for the next full year ahead would be set in April (e.g. in April 2000 for calendar year 2001). The annual targets will be constrained, in that they must not imply an acceleration of target inflation from one year to the next, or an annual target below the price stability range of 2 percent ±1 percent.

Explicit exceptions for price level shocks

In a given year, it was recognized that certain unforeseen events might knock the price level off the planned trajectory. There were two sources of particular concern:

- sharp changes in commodity prices and the exchange rate, or other extraordinary events; and

- changes in relative prices as the economy adapts to European Union norms. While such shocks may affect the price level, and hence the inflation rate in a given year, this would be a one-off effect.

Cooperative government-central bank approach

The April 1999 document invites the government to endorse the main outlines of the CNB inflation targeting strategy, arguing that it will work better if its main parameters embody a consensus among the Czech authorities. At a minimum, the CNB called for budget forecasts embodying inflation assumptions in line with its announced targets.

At the same time, the CNB underlined that it has the mandate and the powers to control inflation independently. Adhesion to this objective by the government would not be necessary to its feasibility, since the central bank possesses both the mandate and sufficient powers to achieve the announced target independently. Instead, the advantage of government backing would be that the strategy would have stronger credibility. The CNB argued that expectations of inflation might fall into line with the policy targets more quickly, which would reduce the short-run losses of output that occur during a period of disinflation. Also, interest rate risk premiums, which impose a deadweight burden on a debtor country, might be somewhat lower. However, at the time of this writing, the government had not yet explicitly endorsed the CNB proposal.

ASSESSMENT OF THE CNB STRATEGY

The components of the CNB's strategy can be assessed one by one, and as a whole, against lessons drawn in the literature on inflation targeting.

Choice of index—net inflation

Inflation-targeting central banks have focused on the CPI, which gauges the cost of living for a representative consumer, or on a measure of "core inflation," which excludes certain volatile components, such as food and energy prices, or mortgage interest or indirect taxes. Whatever the exact choice, the CPI family has overwhelming advantages over other price level measures (e.g. the GDP deflator, which covers a broader range of output) because it is of direct interest to the population, and because it is rarely revised.

In the Czech Republic, the integrity of the data is unchallenged. At the suggestion of the CNB, the Czech Statistical Office (CSO), an independent government agency, began calculating and publishing an official measure of net inflation, in addition to the CPI and other indexes for which it is responsible. To make the changes in the CPI and net inflation more transparent to the public, the CNB releases a detailed breakdown by component, based on CSO data.

However, the Czechs have to deal with a problem not faced by the more advanced inflation-targeting countries—major price deregulation—a factor that has still has some way to go and is likely to cause significant jumps in the CPI at irregular intervals over the next few years. The CNB's choice of net inflation, as opposed to the CPI, as the target has one great convenience in this regard: the government does not have to worry about possible monetary policy reactions to price liberalization (e.g. that a faster liberalization of rents, or utility prices, might lead to higher interest rates). The target for net inflation would allow the government to focus just on the allocative and efficiency aspects of price deregulation. Under its proposal, the CNB would accommodate the first-

round impact, but it would not allow a second round, as might occur if people thought they could protect their real incomes by passing on price increases or by raising wage demands.

To the extent that it is understood by the public, the concept has some related advantages. It improves accountability, since it excludes some price level changes originating outside the purview of monetary policy. And, it tends to reinforce the idea that inflation targeting is based on long-term objectives, since it is less sensitive to short-run price level shifts than the overall CPI.

A disadvantage is that net inflation might not reflect the change in the cost of living very closely. An index that leaves out large items, such as housing rents and electricity costs, might be regarded skeptically. If people are going to accept the central bank's policy, they must be persuaded that ultimately the overall cost of living will be stabilized. The CNB has had the challenge of showing convincingly that, at the end of the deregulation process, there would no longer be a systematic difference between overall inflation and core inflation. One means to this end might be to announce that the CPI (unadjusted) would become the operative inflation target by, say, 2005, a date at which the price deregulation process should be virtually complete.

The target level of inflation—long-run and short-run

Long-run target

As Bernanke et al. (1999) emphasize, the rationale for inflation targeting is essentially a long-term one. The output and employment costs of inflation reduction, although not long-lasting, are readily apparent, whereas the benefits to economic efficiency of maintaining price stability, which may be small and barely noticeable in any given period, are permanent. In setting low inflation as the primary long-run goal, the central bank is not denying that it can affect output in the short run, or being negligent of the more important real economic objectives of society. It is merely recognizing that in the long run the options open to monetary policy boil down to a higher or lower rate of inflation, and that the chances for good economic performance are better at low inflation or price stability.

While accepting this point in principle, economists have been debating for a long time what particular low rate of inflation would be optimal. For example, some believe there is a substantial positive bias in the measurement of consumer price inflation, or that there is a large degree of downward wage rigidity, or that it is important to allow real interest rates to become negative at troughs in the business cycle.[5] This leads them to recommend a relatively high target rate—typically 3 percent. Those who think the measurement bias is small and wages flexible would go for a lower rate, but there is a broad consensus that a zero target would raise too high a risk of falling into a deflationary spiral. Thus in practice the range of recommendations taken seriously in advanced economies, i.e. 1-3 percent, is not very wide.[6]

[5] For example, see Akerloff et al. (1996), Fortin (1996), and Summers (1991).

[6] At low rates of inflation, a more important question than the precise long-run target rate concerns whether the goal should be shifted from the rate of change to the level of prices. A target for the annual inflation rate implies that the variance of the price level increases without bound with futurity, whereas a target path for the price level would result in a constant variance. A credible price level target would also reduce the risk of falling into a deflationary trap. See Duguay (1994) and Svensson (1997) for arguments on the merits of this alternative. Also refer to Chapter III of this volume, "Controlling Inflation after Bretton Woods: An Analysis Based on Policy Objective by William T. Gavin, for an empirical investigation supporting the use of a price-level target.

However, uncertainties about the underlying issues are more acute for an economy in transition than for an advanced economy. The more rapid pace of change and the less experienced statistical bureaus increase the likelihood of bias. At the same time, less is known about key parameters in the optimizing problem, such as the rate of growth of productivity and the degree of wage flexibility. Precisely for these reasons, many economists in the Czech Republic have contested the desirability of inflation targets.

The CNB has also had to address a spurious argument for inflation which is based on the current low international purchasing-power value of the currency and the expected rate of growth of productivity. It is argued that the current real value of the koruna is below its long-run equilibrium value. As Czech productivity catches up to the rest of Europe, real wages will increase relatively quickly, and so will the price of non-tradeable goods. Therefore, if the exchange rate is stable, the price level can be expected to rise more rapidly at home than abroad and that the target rate of inflation should be higher than the 2 percent espoused by the European Central Bank (ECB). An obvious logical flaw in the argument is the proviso about a stable exchange rate: the koruna floats, and must float in an inflation targeting regime. Any required change in the real equilibrium value of the currency over time could easily be accomplished by a trend in the nominal value: the modest annual changes that would be required (say 1 percent) would be quite small compared to the normal variance of a flexible exchange rate (e.g., over the period 1993–1998, the mean monthly change in the trade-weighted exchange value of the German mark, one of the world's most stable currencies, was almost 1 percent).

There is also a less obvious flaw in the economic reasoning. One could just as well argue that a high rate of growth of productivity lowers the optimal rate of inflation. With rapid productivity growth both downward stickiness of nominal wage rates and the zero floor to nominal interest rates are less likely to pose problems. Consider first the argument of Akerloff et al. (1966), that a very low inflation rate might impede employment by reducing the adjustment of real wages in declining sectors. The idea is that if nominal wages are rigid downwards, inflation might be an effective way to reduce real wages. But if the overall equilibrium real wage is rising rapidly, as it would be with higher productivity growth, there is less need for real wage reductions. Therefore, given nominal wage stickiness, with high productivity growth there is less need for inflation. For example, whereas for an assumed rate of productivity growth of 1 percent, Akerloff et al. recommend an inflation rate of 3 percent, for productivity growth of 2 percent their argument would support an inflation target of 2 percent.

Next, consider the nominal interest floor argument put forward by Summers (1991). This argument suggests that in recessions a negative real interest rate might be appropriate, but impossible to achieve if nominal interest rates were already close to zero because of a long-run environment of very low inflation. However, a faster underlying rate of growth would imply a higher real return to capital, and less need for negative real interest rates to stimulate output during recessions.

In summary, there is nothing to suggest that the CNB's 2 percent long-run objective is inappropriate. It is squarely in the mainstream of the targets adopted by inflation targeters. More importantly, given the deep political desire in the Czech Republic for European integration, it would be roughly consistent with the ECB's objective of holding inflation at less than 2 percent. Although EU membership does not formally require low inflation, a rate much above the ECB target might pose questions about economic readiness for entry.

Short-run targets and outcomes

A transparent, accountable policy process requires not just the definition of an objective, but also some public indication of the strategy that the policymaker intends to follow in the pursuit of this objective—for example, to deal with unexpected contingencies. The CNB's strategy for keeping inflation in line with the announced path involves setting transitional targets annually. These annual targets would be consistent with the longer-run objectives, and at the same time take account of any surprises that actual data may reveal. Thus, short-run (but not longer-run) targets may be revised, subject to two constraints: first, the annual inflation target must decline at least as rapidly as originally announced to the ultimate 2 percent rate; and second, the target for the next year ahead would never fall below this level. This procedure would be loosely in line with the suggestion of Svensson (1997) that the central bank should target its own, published forecast of inflation. Moreover, since there would not be an attempt to follow closely a frequently revised target, the proposal avoids the theoretical risk of dynamic instability pointed out by Bernanke and Woodford (1997).[7]

As a practical matter, the CNB proposal does describe a transparent process for bringing inflation back into the target range should a deviation occur. It would oblige the central bank to present a precise view of the sources and degree of permanence of any shocks that may affect the current inflation rate, and an indication of how long it would take to get back on track, taking into account the lag effect of monetary policy. Moreover, since the published annual target provides an ex ante yardstick for monitoring the performance of monetary policy, it sets a standard by which to judge the accountability of the central bank.

It is as yet too soon to judge how well the framework may be working. Meanwhile, one should not make too much of the fact that inflation in 1999 fell significantly short of the one-year target announced in November 1998, or that net inflation was actually negative for much of the year. Special factors included a temporary fall in oil prices and prolonged tightness of bank credit following the banking crisis. In addition, economic restructuring, which had been postponed because of easy credit, led to layoffs and uncertainty about future job prospects. These factors had an unexpectedly strong disinflationary impact.

Qualitatively, the CNB's policy stance erred in the right direction, given the uncertainties of the situation and the ultimate objectives of monetary policy. The main priority at the start was not to try to exactly hit the interim target for 1999, but to lay the groundwork for a permanent reduction in inflation. Thus, the April 1999 strategy statement stresses that the objectives are for the longer term, more specifically for a horizon ending in 2005. The CNB also pointed out, in line with this horizon, its intention to focus on 2000 for the first serious test of the regime of inflation targeting. Moreover, any effective disinflation program requires actions that push down expectations of inflation. If nothing else, this meant ensuring that the inflation rate did not exceed even the interim target for 1999, since a failure of this kind would undermine trust in the program at the outset. In contrast, the outcome has had the considerable advantage of sending to the public a strong message as to the resolve of the monetary authorities. Surveys of financial market analysts conducted by the CNB (October 1999, Inflation Report) confirm that inflation expectations did decline in 1999, to the same range as the announced target range.

[7] Svensson's model (Svensson, 1997) has adaptive expectations, whereas Bernanke and Woodford (1997) use rational expectations.

Viewed in a broad perspective, the record of the CNB in 1999 is easily defendable. International experience adds additional evidence in this regard: several cases of disinflation of recent memory appear to owe a lot of their success to an initial rigorous phase in which a surprisingly sharp drop in inflation made people notice that monetary policy really had changed for the better (e.g. the United States in the early 1980s, or Canada in the early 1980s and again in the early 1990s).

Width and boundaries of the range

A range is usually given for inflation targets, rather than a single point, mainly to emphasize the considerable imprecision in the central bank's ability to control short-run movements in the price level for the short run. Ranges give a quantitative notion of the uncertainty involved, akin to a confidence interval in statistics. In addition, a range may underscore the authorities' intention to be symmetric in their responses: deviations will be resisted as strongly whether they are positive or negative. In this respect, inflation targeting regimes differ from the framework adopted by the ECB, and formerly used by the German Bundesbank, which has a ceiling on tolerated inflation, but no explicit floor. Economic justification for emphasizing symmetry is that the costs of deflation deserve as much emphasis as those of inflation, and that it is important for the public to be confident that the central bank will act vigorously to prevent a slide into a deflationary trap.[8]

In choosing the width of the range, two considerations compete: a) demonstrating that the central bank intends to be rigorous in its conduct of policy, which argues for a narrow range; versus b) the idea of realism about the actual variance of inflation and potential shocks to the price level, which might argue for a wide range. For example, vector autoregression studies suggested a confidence interval width of 6 percent or more (e.g. for Canada, Crawford and Kasumovich,1996; for the U.K., Haldane and Salmon, 1995; and for Australia, Stevens and Debelle, 1995). Most of the relevant central banks seem to have put more weight on the credibility benefits of a narrow range. Thus the $\pm$1 percent range frequently chosen could be viewed as an expression of intent to be more rigorous than in the past. And, so far, inflation has generally been inside the announced ranges. Against this background, the range adopted by the Czechs for net inflation looks feasible and appropriate.

At least as important as the width of the range are the presumed consequences of material breaches of the range. There are two considerations here:

- Accountability requires at least some explanation from the central bank of material deviations from target. Inflation-targeting countries all have mechanisms to ensure that this takes place. The Czechs would use the informal approach, similar, for example, to Canada's, rather than the more formal approach adopted by New Zealand, in which the target range is part of the performance contract of the Reserve Bank's Governor.

- Instrument instability can occur if the central bank tries to stick narrowly to a given target in the short run. Because of the lags in the transmission mechanism, large movements in interest rates would be required to stabilize inflation year by year in response to normal shocks. Moreover, each such movement would have strong effects in later years, when they would have to be offset by

[8] The recent experience of Japan illustrates the severe dislocations that can occur in deflation, the difficulties of getting out of the spiral once it starts, and the importance of credible preventive measures.

changes in the opposite direction. The risk of falling into an unstable pattern of policy responses is higher if great importance is attached to the limits of the band. The proposed approach to short-run disturbances makes it clear that Czech target does not have hard edges.

RESEARCH AND MODELS FOR INFLATION TARGETING IN THE PERIOD AHEAD

Inflation targeting has implications for the work of economists in a central bank. It gives a clear sense of direction to the research agenda, affecting the types of models that are appropriate and the nature of policy advice. A primary job of the economics becomes the derivation of paths for short-term interest rates (or, more generally, monetary conditions) that would result in the achievement of the given inflation targets. Conventional modeling to this end is based on four elements: a monetary policy rule, an aggregate demand function, a Phillips curve, and an international asset-market equilibrium condition.

It is particularly important to have models in which the implications of different simple policy rules can be investigated. Models that are calibrated to provide theoretically plausible simulation results, rather than estimated on the basis of a good fit to historical data, have become standard tools for this purpose over the past decade.[9] Such models may embody adaptive expectations, which are easy to implement, or, if the computer technology is available (it increasingly is), with model-consistent (i.e. rational) expectations. Similarly, inflation-targeting rules may be based simply on the observed rate of inflation and perhaps the output gap too (as per the well-known Taylor rule), or be derived from the forward-looking properties of the model. Both processes are worth exploring if this is technically feasible.

Issues in modeling

Policy rules

In previous generations of macroeconomic models, monetary policy was an ad hoc business, usually represented by an assumption about the policy instrument, the short-term interest rate. Policy reaction functions, if used, would be just a streamlined way to obtain a path for the interest rate. In contrast, the policy rule is an intrinsic element of an inflation-targeting model, since it implements the nominal anchor for the system. It is no accident that the widespread adoption of inflation targeting has been followed by extensive research on monetary policy rules.[10]

A simple generic policy rule can be written as:

$$i_t = r_t + \gamma(E_t\pi_{t+j} - \pi^T) \qquad (1)$$

[9] The Bank of Canada was a leader in this practice, with its QPM model.

[10] See, for example, the 1998 NBER conference (Taylor, 1998).

where i_t is the short-term interest rate, r_t is the real equilibrium interest rate, $E_t\pi_{t+j}$ is a forecast of inflation j periods ahead, and j is a horizon long enough for the interest rate to have a substantial impact on inflation. The elements of this rule include:

- **Inflation target.** As discussed in Section 2, this provides the nominal anchor to the system.[11] Rules of the equation 1 type would eliminate any deviation between expected and target inflation at some future horizon beyond j.

- **Inflation forecast.** The expectation $E_t\pi_{t+j}$ is conditional on the available information, which would exclude the current interest rate, for which a solution is sought. The simplest forecast would be represented by the most recently observed rate, π_{t-1}.

- **Systematic interest rate reaction to expected deviations from target.** The parameter γ affects the speed with which deviations from target are eliminated hence implicitly defines the targeting horizon—a high value would imply a short horizon. However, γ also has implications for the volatility of the interest rate—for example, an overly high value (overly short horizon) will result in instrument instability.

- **Real equilibrium interest rate.** This is the rate at which monetary policy has a neutral effect on the inflation rate.[12] In a small open economy the real equilibrium interest rate is given by the foreign real rate plus a risk premium, and in the long run by movements in the exchange rate, rather than by the interest rate that equilibrates the market for domestic output.

Most of the rules under serious consideration can be viewed as variants of equation 1. For example, consider the Taylor rule

$$\boldsymbol{i_t = r_t = 1.5(\pi_{t-1} - \pi^T) + 0.5\, gap_{t-1}} \qquad \textbf{(2)}$$

This implicitly relies on a forecast of future inflation based on the most recently observed rate and the output gap (actual-potential). Taylor set the value for the reaction coefficient, γ, at 1.5, such that every percentage point increase in inflation away from the target would lead to a 50 basis point rise in the real interest rate. This rule performs surprisingly well across a range of models, in terms

[11] **A pure inflation target**, however, provides an anchor only for the rate of change of nominal values. The equilibrium level of prices is path-dependent, and would be a function of the shocks to the system.

[12] Blinder (1999) discusses the concept in some detail.

of keeping down the variance of both inflation around target and output around potential.[13] Given this apparent robustness, and the high degree of model uncertainty in the Czech Republic, simple rules of the Taylor variety should be investigated intensively.

The transmission mechanism

One of the reservations about the prospects for inflation targeting in the Czech Republic was the lack of knowledge about monetary policy transmission. This went beyond uncertainties about the likely values of parameters. There was a widespread belief that the market mechanisms that operate in more advanced economies would not be effective in the Czech Republic.

This skepticism was not justified. First, a high proportion of Czech economic activity is sensitive to market conditions: the CSO measure of the share of the non-state sector in GDP for 1998 was 77.3 percent, considerably higher than in a number of west European economies. And the CSO might well understate the share, since the official coverage of rapidly growing sectors such as construction and services tends to be less complete. Second, if it is nevertheless the case that the effect of interest rate changes is smaller than in other countries, the implication is not that policy is ineffective but that policy must allow larger changes in interest rates to achieve a given impact on spending and inflation. Third, given the less-developed capital markets, the credit channel would be a very effective mechanism. Many firms have access only to bank financing, and the banks in turn have been constrained for some years by the weakness of their balance sheets. Fourth, to the extent that the internal channels are less strong, the importance of the exchange rate channel would be greater. Finally, there is much uncertainty about this mechanism in all countries—take, e.g., the case of New Zealand, which introduced inflation targets as part of an economy-wide transformation.

Thus, Czech macroeconomists are confronted with much the same set of problems as their counterparts abroad. There may be more work to do in narrowing down the plausible ranges of parameter values, and less data to work with, but there is no reason to think that conventional models are not applicable.

Potential output and the output gap

Measures of potential output and the output gap are necessary for the identification of the Phillips curve, and for the assessment of the effect that monetary policy may be having on the actual inflation rate. Various approaches have been used internationally, but these rely on the availability of long runs of data, and so are not readily adapted to the Czech Republic.[14] Mainly for this reason, there is little work to draw on. To stimulate research, the CNB could usefully take a lead, and it should publish its findings.

Until more data are available, such research will consist mainly of theoretical conjectures. Czech economists should be particularly interested in those that involve a varying potential growth rate over time. A lasting result from the theory and testing of the "real business cycle" models of the

[13] Taylor (1993) also found that he could track the actual behaviour of the Federal Reserve quite well with this equation.

[14] Dupasquier et al. (1999) provide a survey.

1980s is that a substantial part of the business cycle is due to supply factors.[15] (In contrast, earlier Keynesian and monetarist literature had tended to attribute fluctuations in activity around a trend line entirely to demand.) Given the magnitude of the structural changes to the Czech economy, it would be implausible that potential output were simply a uniform rising trend. This has immediate relevance to the current policy debate, as critics of the CNB tend to blame all the recent decline in output on tight macro policies, and thereby exaggerate the extent of usable excess capacity in the Czech economy.

Time horizons and forecasts

Medium-term conditional projections

Traditionally, central bank economists have devoted a lot of effort to forecasting short-run movements in the price level, in line with a typical forecast horizon of one or two years. This has tended to put a premium on the knowledge of sectoral specialists about actual price developments, because for at least a year ahead changes in current monetary conditions have little effect on the inflation rate. That is, an inflation forecast with a forecast horizon of less than a year is basically *not conditional* on monetary policy assumptions. But by the start of the second year, the pervasive effects of monetary conditions start to be felt, and by the end of the second year they should dominate the inflation outlook. By the same token, sectoral specialists have little specific information about prices a year or more from now.

In an inflation targeting environment, to capture the relevant dynamics of monetary policy it is helpful to do regular projections for the main aggregates and price indexes with a horizon of 4–5 years, or even longer. Over such horizons, one wants to see a picture that is conditional on achievement of numerical inflation targets. A logical procedure is to take the target beyond some date as given, toward which the forecast inflation rate will converge. The values of the policy instrument that will make this happen are obtained from the policy rule. Exogenous shocks may cause the actual inflation rate to diverge from the target rate in the short run, but the central bank would have a strategy to ensure that within a certain period such deviations are eliminated. A popular assumption for this period, based on the generally accepted view of the lagged effects of monetary policy, is a period of 4 to 8 quarters.[16]

Effects of exchange rate exchanges

A medium-term horizon is particularly relevant for adequate analysis of policy reactions to exchange rate changes. Under an inflation targeting regime, monetary policy should respond to changes in the exchange rate to the extent that they affect the rate of inflation. The value of the currency operates through two channels. The first is through the direct one-off impact of import prices on the CPI (which the CNB strategy would accommodate). The second is through the pressure of demand, as the real value of the exchange rate affects the level of domestic and foreign spending (the expenditure-switching effect). This could lead to a sustained spiral of inflation and

[15] See, for example, King et al. (1991).

[16] The Bank of Canada projection exercise assumes that deviations from target are eliminated in 6–7 quarters (Duguay and Poloz, 1994).

further depreciation, "second-round" effects which monetary policy clearly would not accommodate. For example, following a depreciation, there would have to be some interest rate increase to prevent an escalation of inflationary pressure—precisely how much would depend on the interest- and exchange-rate elasticities of demand for Czech output (for this purpose, the Bank of Canada and some other central banks use a "monetary conditions index," a rough quantitative guide).[17]

Economists in the Czech Republic have been prone to put undue emphasis on the direct effect of the exchange rate on the price level, a plausible estimate of which can be based arithmetically on the share of imports in consumption (e.g. if imported goods and services make up 30 percent of the consumption basket, then a depreciation of 10 percent in the koruna might imply an increase in the cost of living of 0.3(10) = 3.0 percent.) This kind of calculation has two limitations. First, the ability to pass on changes in costs of imports varies considerably with domestic market conditions, and can be quite low when there is excess capacity. Second, the more durable influence of the exchange rate on inflation is indirect, through the effect on aggregate demand (expenditure switching between foreign and home output) and, in turn, on the output gap. For this reason alone, macroeconomic models are generally more helpful than simple numerical calculations for deriving the potential implications of exchange rate changes for the price level.

TRANSPARENCY AND COMMUNICATIONS

The international survey by Bernanke et al. (1999) finds in every case examined that the announcement of inflation targets did not achieve rapid credibility. Generally, inflation expectations, as captured, say, in bond yields, or in survey data, have fallen only after the actual rate of inflation has declined. Thus, the crucial factor in establishing confidence in price stability in the Czech Republic is doubtless going to be the extent to which the announced objectives are achieved over a number of years. The central bank can nevertheless help the progress of public understanding by being transparent in its conduct of policy, and by communicating effectively.

Transparency

Announcing explicit inflation targets is itself a striking way to be transparent about the objectives of monetary policy. Moreover, the process that the CNB has followed in formulating its inflation targeting strategy has been unusually open. Its 1999 strategy document set out a clear framework, and invited feedback, before the parameters of the approach were finalized. As for openness in the actual conduct of policy, the CNB has moved ahead in various ways:

- The quarterly Inflation Report is released almost immediately after its approval by the Executive Board responsible for monetary policy. (The CNB website provides a prompt release of the report, which is generally a well-designed and useful source of information.)

- Statements by senior management in public presentations and debate are very frank.

- Minutes of Board meetings are released within a few days of the meetings. These are quite revealing with respect to the discussions that take place, e.g. indicating if there were differences of view (although not identifying individuals).

[17] For more details on such indexes see Freedman (1995).

- To implement policy, the CNB announces its operating target for the two-week repo (repurchase agreement) rate. Decisions to change the rate are followed immediately by a press release.

In the Inflation Report, the CNB does not indicate a specific view as to how the repo rate might move in the period ahead. Instead, it tends to emphasize uncertainties in the economic situation. It may be wise for the central bank to let the audience draw its own inferences on the likely future path of interest rates. Monetary policy has to be free to vary short-term interest rates as required by the evolving economic situation and the given inflation targets. Its credibility should be based solely on its adherence to objectives. By contrast, a prediction of interest rate movements by the central bank—even though it may be a conditional projection—might draw attention instead to an instrument of policy. The difference between a conditional projection and a commitment might not be understood by the press and the public. And if interest rates do not move in the direction indicated by the central bank, its credibility is not enhanced.

Communications

Consistent with increased transparency, the CNB has improved public communication of its policies. The very title of the main policy release, the quarterly Inflation Report, immediately highlights the main concern of the central bank. Previous to 1998, it was not always clear what priorities the CNB was expressing. For example, its annual and mid-year reports would usually put the balance of payments at the top of the agenda, as if there was something constructive that monetary policy should do about the current account, beyond maintaining a stable price level.

The Inflation Report gives details on several measures of inflation, on specific sectoral price changes, and on other relevant economic developments. This shows that the central bank does an enormous amount of serious analysis of the relevant aspects of price setting and other economic behavior. Moreover, in successive issues of the Inflation Report, one can see a movement toward a clearer, more succinct statement of the CNB's view on key macroeconomic questions. These include the question of: just what are the overall demand and supply trends in the economy; and whether there is an output gap that is affecting the underlying inflation rate. Other positions that are clarified in the Inflation Report include: (1) the state of expectations (the CNB has launched its own monthly survey of financial market participants); (2) whether special factors are temporarily affecting the inflation rate; (3) the net contribution of monetary conditions to actual inflation; (4) the growth rates of money and credit and whether they are broadly consistent with the inflation targets; (5) current monetary conditions and how they affect the inflation rate one way or the other, or do they have no effect?

Moreover, the CNB uses the Inflation Report, as well as other channels of communication, to insist on the few obvious facts that everybody should know about monetary policy: that it can in the end only deliver a higher or a lower rate of inflation; that the economy is more likely to prosper with a low rate of inflation; and that monetary policy will be aimed unconditionally at the latter objective.

CONCLUSIONS

Although the abandonment of the fixed exchange rate in 1997 created a need for some other long-run nominal anchor for monetary policy in the Czech Republic, explicit inflation targets were not immediately regarded as the obvious choice. The main obstacle to their adoption was a high degree of skepticism about their feasibility or desirability. Many economists thought that the Czech economy had not yet developed the market mechanisms that would allow monetary policy to be effective enough to achieve explicit quantitative targets for inflation. There was a widespread attachment to the view that monetary policy should be governed by multiple objectives, which would include employment and output and the balance of international payments, as well as the price level. Moreover, the general public had become accustomed since 1990 to an inflation rate seemingly stuck at about 10 percent.

The CNB confronted this situation with two major policy announcements. The first, released early in 1998, set out interim numerical targets for inflation reduction, while the second, published in April 1999, outlined a coherent strategy designed to achieve 2 ± 1 percent inflation by 2005. The latter document takes full account of the main lessons drawn in academic studies of the inflation targeting approach to monetary policy.

These studies not surprisingly found that credibility requires more than announcing targets. Crucial in convincing the public that inflation targets are to be believed is that the realized inflation rate stays within the target range for a period of years. To start with, the CNB made sure that monetary conditions were tight enough to ensure a rapid disinflation—indeed, its policy settings in 1998–1999 erred on the tight side. Since building the credibility of price stability is the essence of the task in the early days of an inflation reduction program, this was a reasonable way to start. Internationally, an initial sharp disinflation has often marked the start of a successful drive towards price stability. Such an experience grabs attention, and forces people to recognize that low inflation is more than a pious hope.

Inflation targeting has often been viewed as part of a more general movement to make monetary policy more transparent and accountable, and this has also been the case in the Czech Republic. The CNB has followed up with an enhanced program of communications, notably a quarterly Inflation Report, which discloses the strategic economic thinking of the central bank.

All in all, Czech inflation targeting is off to a promising start. For the period ahead, one of the contributions that economists can make is to develop models that embody monetary rules for achieving inflation targets over a medium-term horizon. High on the research agenda would be resolving some of the quantitative uncertainty about the monetary policy transmission mechanism, especially with respect to (a) the potential level of output, and (b) the effect on aggregate demand of interest rates and the exchange rate.

REFERENCES

Akerlof, G., W. Dickens, and G. Perry, 1996, "The Macroeconomics of Low Inflation," Brookings Papers on Economic Activity, (Washington: Brookings Institution).

Bernanke, B. S., T. Laubach, F. S. Mishkin, and A. Posen, 1999, *Inflation Targeting: Lessons from the International Experience,* (Princeton: Princeton University Press).

Bernanke, B. S., and M. Woodford, 1997, "Inflation Forecasts and Monetary Policy," *Journal of Money Credit and Banking,* Vol. 29 (4), pp. 653–84.

Blinder, A. S., 1998, *Central Banking in Theory and Practice*, (Cambridge, Mass.: MIT Press).

Crawford, A., and M. Kasumovich, 1996, "Does Inflation Uncertainty Vary with the Level of Inflation?" Bank of Canada Working Paper No. 96-9.

Czech National Bank, 1999, "CNB Monetary Strategy," (April), (Prague).

Dupasquier, C., A. Guay, and P. St-Amant, 1999, "A Survey of Alternative Methodologies for Estimating Potential Output and the Output Gap," Journal of Macroeconomics, Vol. 21, No. 3, (Summer), pp. 577–95.

Duguay, P., 1994, "Some Thoughts on Price Stability versus Zero Inflation," Bank of Canada working paper.

——— and S. Poloz, 1994, "The Role of Economic Projections in Canadian Monetary Policy Formulation," Canadian Public Policy - Analyse de Politiques (June).

Freedman, C., 1995, "The Role of Monetary Conditions and the Monetary Conditions Index in the Conduct of Policy," *Bank of Canada Review* (Autumn).

Fortin, P., 1996, "The Great Canadian slump," Canadian Journal of Economics 29 (4): 761–787

Haldane, A. G., and C. K. Salmon, 1995, "Three Issues on Inflation Targets," in *Targeting Inflation*, ed. by A. G. Haldane, (London: Bank of England).

King, R. G., C. I. Plosser, J. H. Stock, and M. W. Watson, 1991, "Stochastic Trends and Economic Fluctuations," *American Economic Review*, (September).

Liederman, L., and L. E. O. Svensson, 1995, "Inflation Targets," CEPR.

Stevens, G., and G. Debelle, 1995, "Monetary Policy Goals for Inflation in Australia." in *Targeting Inflation,* ed. by A. G. Haldane, (London: Bank of England).

Summers, L., 1991, "How Should Long-Term Monetary Policy be Determined?" *Journal of Money Credit and Banking* Vol. 23 (3), pp. 625–631.

Svensson, L. E. O., 1996, "Price Level Targeting versus Inflation Targeting: A Free Lunch?" NBER Working Paper No. 5719.

———,1997, “Inflation Forecast Targeting: Implementing and Monitoring Inflation Targets,” *European Economic Review*, Vol. 41 (6).

Taylor, J. B., 1993, “Discretion versus Policy Rules in Practice,” Carnegie-Rochester Conference Series on Public Policy, (December), pp. 195–214.

———, ed., 1998, “Monetary Policy Rules,” NBER conference proceedings.

Chapter 9

DISINFLATING WITH INFLATION TARGETING:

LESSONS FROM THE CZECH EXPERIENCE

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A SEARCH FOR A BETTER STRATEGY TO DISINFLATE

Inflation targeting is the monetary strategy of the 1990s. According to recent surveys, more than 50 percent of the central banks use explicit inflation targets when formulating their monetary policy.[2] Literature on inflation targeting in principle is based on the experience of developed economies, while monetary strategies of emerging economies are as a rule linked to monetary or exchange-rate targets.

This chapter argues that inflation targeting is a strategy that can be adopted by central banks in countries in transition even though their monetary strategies have different aims than in developed economies. A typical goal of an economy in transition is to disinflate instead of stabilizing low inflation. Under certain conditions, inflation targeting may be a better monetary strategy than using intermediate targets, since it offers two important benefits: increased control over expectations and short-term flexibility. They are both attractive for an economy in transition,[3] since the transitional process has several features that require an anchor for expectations in the medium term as well as flexibility for policymakers in the short term.

Specifically, in the Czech case, inflation was persistent for several years, and even in the later stages of transition the economy had a tendency to experience periods of inflation.[4] Several other points should also be made. Second, the relationship between the operational target (interest rates), money and inflation was not reliably predictable,[5] since "transitional" innovations and increasing financial openness destabilized the relationship. Third, capital inflows and outflows started dominating exchange rate developments owing to increasing financial openness. Hence, defending the peg became more costly.[6] Fourth, prior to the introduction of inflation targeting, the corrections of administered prices remained unfinished, and there was a great deal of uncertainty about the scale and speed of future corrections. It was important for monetary strategy policy to accommodate

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[2] Fry et al. (1999) demonstrate that at the start of 1990 only four countries in their sample of 77 had explicit inflation targets. In 1998, 57 percent of the central banks in the sample had inflation targets.

[3] Analogously to transitional factors, the great openness of the Czech economy had also made the property of short-run flexibility attractive in the Czech case.

[4] CPI inflation had the following record (annual average rates): 11 percent (1992), 21 percent (1993), 10 percent (1994), 9 percent (1995), 9 percent (1996), 8 percent (1997) and 11 percent (1998). In the second half of 1997, a new inflation episode had begun to develop. Various inflation forecasts signaled accelerating inflation expectations well above one-digit levels for the first time since 1994. In particular, the wage negotiations continued to be based on a double-digit assumption. The wage negotiations for 1998 were based on an inflation forecast of 14 percent (See Pohledy, 1997). For comparison, growth in the average nominal wage was 25 percent in 1993, 19 percent in 1994, 19 percent in 1995, 18 percent in 1996, and 11 percent in 1997. Wages grew 9 percent in 1998.

[5] In addition to constraints observed elsewhere, transition made the analysis of monetary transmission more complicated. The institutional features of financial markets went through profound changes within a relatively short time span. Moreover, new financial assets, new types of transactions, and new market players emerged during the transition. See Allen and Šmídková (1998) for an analysis of the impact of voucher privatization on portfolio decisions.

[6] The problem of capital inflows occurred on a large scale in the case of the Czech Republic. The ratio of the financial account to GDP was 8.4 percent in 1994, 16.2 percent in 1995, and 7.6 percent in 1996.

the primary impact of transition shocks on prices while smoothing their secondary effects, since tax reform and price corrections[7] had a large impact on CPI inflation.[8]

It should be said that, similar to the experience of many countries, a search for better monetary strategy started after other strategies failed to secure the disinflation process.[9] Since 1990, the stability of the Czech koruna has been the ultimate target of Czech monetary policy.[10] Prior to 1997, the Czech National Bank (CNB) consecutively applied three monetary strategies in order to ensure disinflation under constraints given by a transitional process.[11] These strategies worked with intermediate targets (See Figure 1). At first, the koruna was pegged to a basket of currencies, and the money supply was used as a complementary intermediate target until 1995. Second, in February 1996, the relative importance of the two intermediate targets was altered as a response to large capital inflows, financial innovations and liberalization. The koruna remained pegged to a basket, but the fluctuation band was widened from $\pm$0.5 to $\pm$7.5 percent, and interventions on the foreign exchange market became rare. Consequently, the target for money supply growth gained in significance. Third, in May 1997, after the exchange rate crisis, the CNB let the koruna float.[12]

When the crisis was overcome and interest rates fell to levels comparable to the pre-crisis ones, an intensive policy debate took place on which monetary policy strategy should be adopted. The previous experience showed that strategies based on an intermediate target were not efficient, since they did not guarantee disinflation or anchor inflation expectations. Moreover, money targeting itself could not provide a basis for the medium-term disinflation strategy owing to the instability in monetary transmission. Defending the peg became inconsistent with the strategy of disinflation owing to the costly volatility of other variables in periods of capital flows. Also, the peg had lost its credibility during the May 1997 crisis.

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[7] Apart from the initial liberalization of the majority of prices, a segment of administered prices, such as energy prices or rents, are gradually corrected by government decision during a transition.

[8] This follows from comparison of CPI inflation with changes in regulated prices, which were as follows: 9 percent in 1994, 9.7 percent in 1995, 11.2 percent in 1996, 19.7 percent in 1997 and 20.7 percent in 1998.

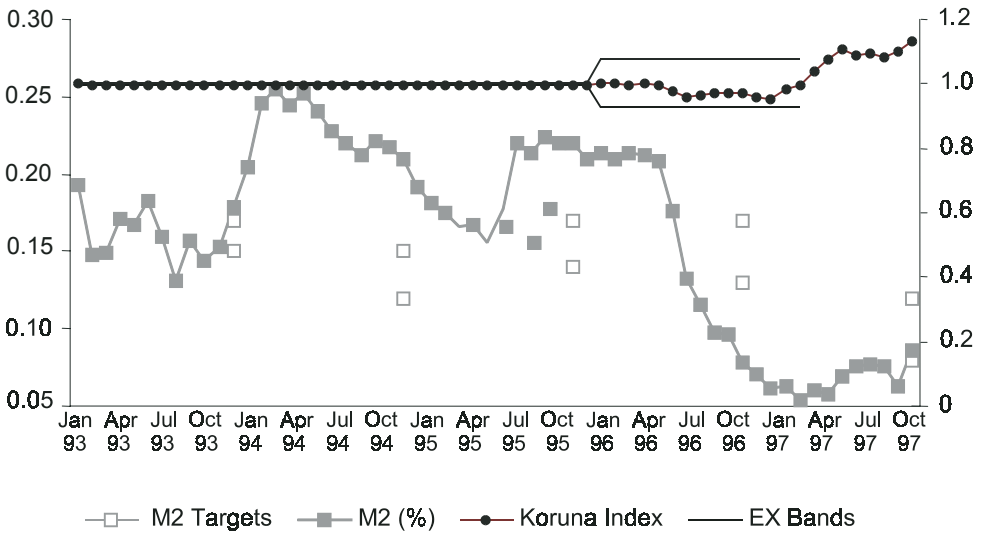
[9] Fry et al. (1999) show that a typical reason for implementing inflation targets in the 1990s was either collapse of the exchange rate regime or financial innovations that changed monetary transmission.

[10] The Czech National Bank was established on January 1, 1993 after the dissolution of Czechoslovakia, and became a successor to the State Bank of Czechoslovakia (See Constitutional Act No.542/1992 Coll., on the Dissolution of the Czech and Slovak Federal Republic, adopted January 1, 1993). Act No. 130/1989 Coll., on The State Bank of Czechoslovakia, adopted on November 15, 1989, created the preconditions for the emergence of the two-tier banking system.

[11] See Hrnčíř, Šmídková (1999) for a more detailed discussion of the Czech experience with alternative monetary strategies.

[12] The three strategies used a similar framework. Each year, a forecast of CPI inflation was projected in accordance with the intermediate targets. For more information, see the *CNB Annual Reports* from 1993–98. For information on the May exchange rate turbulence, see the CNB working paper *"Koruna Exchange Rate Turbulence in May 1997."*

Figure 1 Intermediate Targets (1993–1997)



Note: Variables are defined as follows. M2 Targets show the annual monetary targets (in percent, left-hand scale), which were declared as intervals. The last target was set in 1996 for December 1997. M2 (%) shows the annual growth of broad money (in percent, left-hand scale). The Koruna Index shows the values of the exchange rate index (right-hand scale). The koruna was pegged to a basket of currencies (65 percent DM, 35 percent USD). EX Bands show the targeted fluctuation band (right-hand scale) for this index with parity equal to one. The width was increased in 1996 to 7.5 percent. The band was abolished after the crisis in May 1997.

It is important to note that there are certainly constraints imposed on monetary policy by the transitional period, as well as by the openness of economy. However, the implied short-term costs of these constraints, such as the costs of reversals in capital flows, are present no matter which monetary strategy is chosen by the central bank. Hence, these costs should not be attributed to a particular monetary strategy. We would like to stress that inflation targeting did not remove these costs. The advantage of inflation targeting was that it offered several attractive properties that the other (already mentioned) strategies did not have. Some of the advantages that inflation targeting offered were as follows:

- It was designed to gain effective control over the formation of inflation expectations. Unlike previous non-binding annual forecasts, inflation targeting implied the unambiguous declaration of the medium-term disinflation path as a public commitment of the CNB. Accordingly, economic agents were provided with a medium-term nominal anchor on which they could base their expectations and decision-making processes.

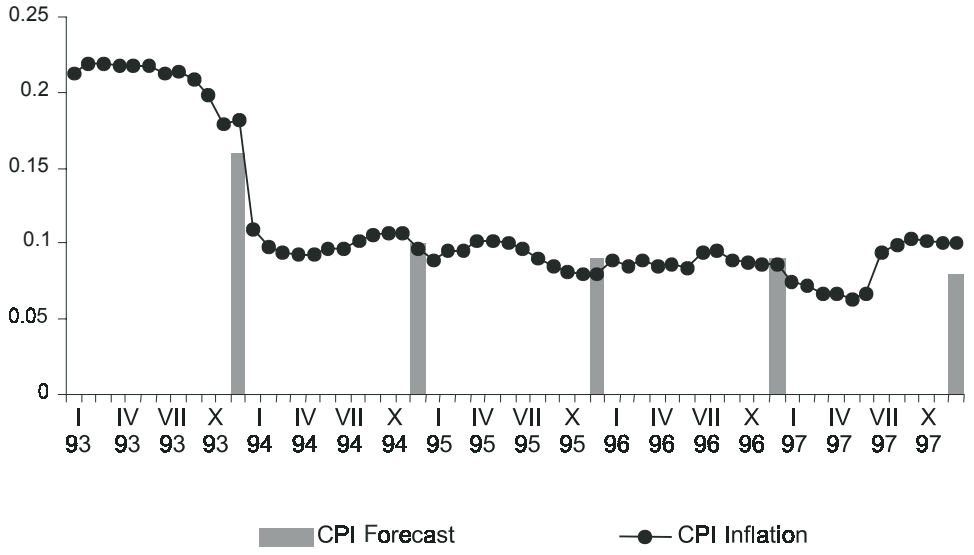
- It provided a framework that integrates a number of relevant economic indicators (including the previously used intermediate targets). As a result, decisions are based on a much broader set of information. Hence, the probability that monetary settings will be subject to errors resulting from

the unstable relationship between the two variables (operative and intermediate targets) is much lower. Interestingly, prior to the emergence of inflation targeting, the CNB was successful in forecasting inflation (see Figure 2) because the inflation forecasts then used a broader set of inputs than the frameworks in which the intermediate targets were derived.

- It provided a tool for screening out the primary transitional price shocks from "market" inflation pressures. In the Czech approach, the concept of *net inflation* excluded the primary impact of price corrections and the effects of changes in indirect taxes.

- Lastly, it provided a tool for dealing with external shocks. A mechanism of caveats has become available to policymakers, and increased flexibility in the short run.

Figure 2 Inflation Forecasts (1993–97)



Note: *Variables are defined as follows. CPI Forecast shows annual forecasts for CPI inflation (in percent). As a part of its annual monetary programs, the Czech National Bank published forecasts for several key economic variables, including CPI inflation. CPI Inflation shows the observed values of CPI inflation (in percent).*

IMPLEMENTING INFLATION TARGETING IN THE CZECH REPUBLIC

Recent comparative studies[13] demonstrate that in all countries, implementation of inflation targeting has several common features, such as announcement of explicit targets and an increase in transparency. The Czech approach has these features as well. Specifically, inflation targets play the role of a commitment for the CNB towards the general public. The publication of key documents has increased the transparency of monetary policy significantly.[14] The comparative studies also show that there are features that are specific to each country, such as the measure of inflation and identification of caveats. We would like to describe three specific features of the Czech approach to inflation targeting:

- the concept of *net inflation* filters out the primary impact of administered price corrections;
- a sequence of targets defines the disinflation path; and
- in the short run, caveats add flexibility in the case of exogenous shocks.

The concept of *net inflation* was introduced in order to exclude administered prices and changes in indirect taxes from the targeted index.[15] As a result, interest rates are not set with respect to primary supply side shocks such as increases in regulated prices of energy. However, that does not mean that secondary effects are not considered during the decision-making process.

The gradual specification of inflation targets has been used as an important tool of monetary policy in order to settle expectations on disinflation path (See Table 1). On one hand, it was clear that the long-term target for Czech monetary policy should be the EU inflation rate. On the other hand, in 1997 there was a significant gap between EU inflation and inflation in the Czech Republic.[16] The CNB could have proclaimed EU inflation as its medium-term target and specified a time horizon of several years during which inflation should converge to this target. However, under this strategy, inflation expectations would not have been efficiently anchored. There was a need to define a targeted disinflation path in order to demonstrate that inflation would not accelerate in the

[13] See Bernanke et al. (1999) and Fry et al. (1999) for a comparison of the various approaches to inflation targeting.

[14] Inflation targeting was adopted at the Board meeting on December 21, 1997, and was announced with a press release explaining the new strategy. In April 1999, the CNB made public the *CNB Strategy.* In this document, the strategy of convergence to the EU inflation level in 2005 was explained. Apart from these strategic documents, the CNB started publishing quarterly Inflation Reports. The first Inflation Report was published in April 1998.

[15] Details are elaborated in the first Inflation Report. In December 1997, the net inflation index was calculated backwards for the purposes of inflation targeting by the Czech Statistical Office. The consumer basket 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 percent of the consumer price index. It covers 663 of its 754 items. It is worth noting that owing to this definition, the index of net inflation can be modified from year to year if there is a change in the government approach towards price corrections. For example, in 1997 taxis became a sector regulated by local authorities. Hence, taxi fares were excluded from the net inflation index.

[16] This long-term target was declared by the *CNB Strategy*. In 1997, the inflation gap was 7 percent.

first period of inflation targeting and that each year inflation targets would be lowered, step by step, until they converge to the ECB target.

Table 1 Inflation Targets

Target Specification	Net Inflation	Band	The Announcement
December 1998	6.00	±0.5	December 1997 (Introductory Press Release)
December 1999	4.50	±0.5	December 1998 (Press Release)
December 2000	4.50	±1	December 1997 (Introductory Press Release)
December 2005	2	±1	April 1999 (The CNB Strategy, Internet)

Note: In December 1997, the Board explained its new monetary strategy in the Introductory Press Release. Two explicit targets were announced: the "orientation target" for December 1998 and the medium-term target for December 2000. These two targets defined the slope of the disinflation path. The medium-term target was decisive for monetary policy decisions. The orientation target was implemented in order to anchor expectations. In December 1998, the Board announced the annual target for December 1999. In April, 1999, the Board released the document, The CNB Strategy, according to which the inflation targets will be set on a path converging to the long-term target up to December 2005, according to two rules: (i) targets will converge to the long-term target; and (ii) the CNB will not accelerate inflation.

The Czech economy is very open to both goods and financial flows. As a result, external shocks have a large impact on domestic developments. For this reason, a set of caveats[17] has been applied that would justify deviations from the medium-term inflation target. Specifically, substantial deviations in commodity prices and major deviations in the exchange rate not connected to domestic economic fundamentals and natural disasters (or similar extraordinary events) were announced by the CNB as factors that would be costly if monetary policy reacted to them in the short run. However, once these shocks have unwound, inflation would be kept on track to meet the long-term target.

[17] The list of caveats includes both external as well as some domestic factors such as large volatility in food prices.

EXPERIENCE OF THE FIRST TWO YEARS

Inflation targeting has given a new framework for the decision-making process. Internally, the decision-making process has come to focus squarely on inflation developments.[18] The minutes of the meeting demonstrate that changes in the two-week repo (repurchase agreement) rate, which has been an operating instrument of Czech monetary policy since 1995, have been based on deviations of the inflation outlook from the targeted disinflation path.[19]

This clear focus has eliminated the conflict between intermediate and long-term targets that was a disadvantage of earlier strategies. Under inflation targeting, the importance of various indicators is unambiguously (although implicitly) determined by their weight in transmission from the repo rate to the inflation outlook. From the minutes of the meeting, one can identify several important categories of factors that effect transmission and, consequently, the inflation outlook:[20]

- efficiency and structural changes on financial markets;
- domestic demand for goods and growth in the capacity of the economy;
- export and import of goods and capital;
- imported inflation (including structural changes in the effective exchange rate);
- price correction in the segment of administered prices; and
- changes in the expectations of domestic economic agents.

One can categorize the two years of inflation targeting in the Czech Republic into several episodes. The comparison of their different features illustrates the CNB's policy rule. Until March 1998, inflation expectations were not in line with the targeted disinflation path.[21] This inconsistency was due to backward-looking expectations, as well as to the inflation signals sent by the January adjustment of administered prices, the secondary impact of deregulation, and increased exchange-rate uncertainty. As a result, at the beginning of 1998, the inflation outlook was revised upwards and indicated a possibility of overshooting the 1998 target. As a response, the repo rate was increased by 0.25 percent to 15 percent in March 1998 (See Figure 3).

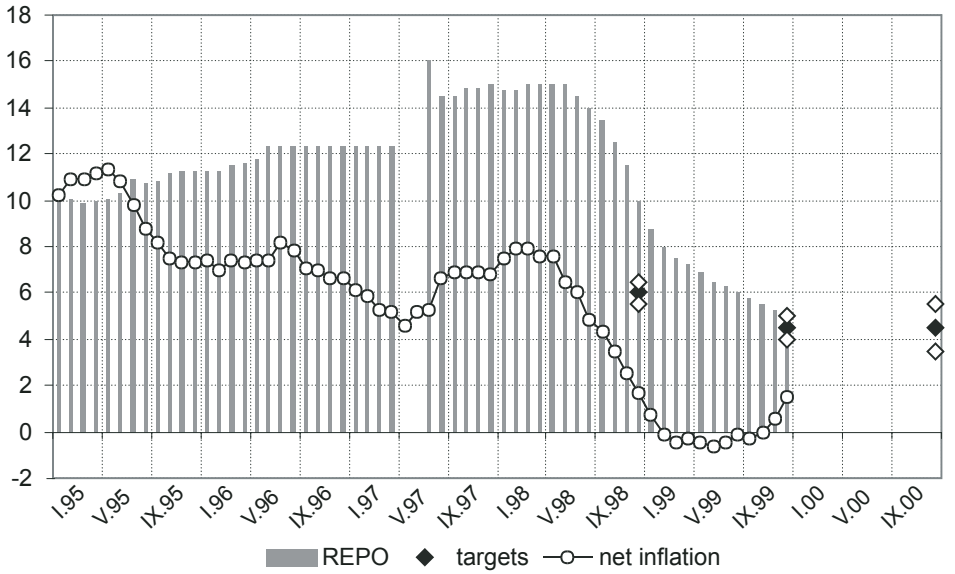
[18] The survey on monetary strategies shows that this is the experience of other countries as well (See Fry et al., 1999).

[19] The Inflation Reports include minutes of the meeting recording in a fairly detailed way the discussion of the Board on monetary policy issues. The minutes are placed on the Internet 12 days after the meeting.

[20] Some estimates of the Czech monetary transmission are presented in Mahadeva and Šmídková (1999).

[21] This discrepancy can be seen from the inflation projections and forecasts made by various institutions such as the Czech National Bank, the Ministry of Finance, trade unions, and analysts. Some of those making projections even increased their annual inflation projections that had been higher than the 1998 inflation target in February 1998. See *Prognóza makroekonomického vývoje v roce 1998* (Pohledy 1997, říjen), *Odhady ČNB se nezdají být reálné* (HN, 26.2.1998), and *Inflace poroste více, míní ministerstvo* (MF Dnes, 13.2.1998).

Figure 3 Inflation Record: Net Inflation (1995–1999)



Note: In 1997, the key inflation target for the decision-making process was set for December 2000. The orientation target for December 1998 was also made public. The target for December 1999 was made public in 1998. The repo rate is an operational target of the CNB. In May 1997, during the koruna turbulence, it climbed to 75 percent. Net inflation has been the targeted variable since 1998, and the arguments for every change in the repo rate have been explained in the publicly available minutes.

During the second quarter of 1998, inflation stopped accelerating thanks to several factors. One was weaker domestic demand. At the same time, the koruna appreciated, owing to a falling current account deficit, as well as to the narrowing of the gap between productivity growth and wage increases. In addition, external factors started playing an important role. The exogenous reduction in inflation caused by the fall in world commodity and producer prices was called *borrowed disinflation*. Concerning the inflation outlook, the effect of borrowed disinflation was neutralized by wage cost pressures. Hence the inflation outlook was not modified, and the repo rate remained unchanged during this period.

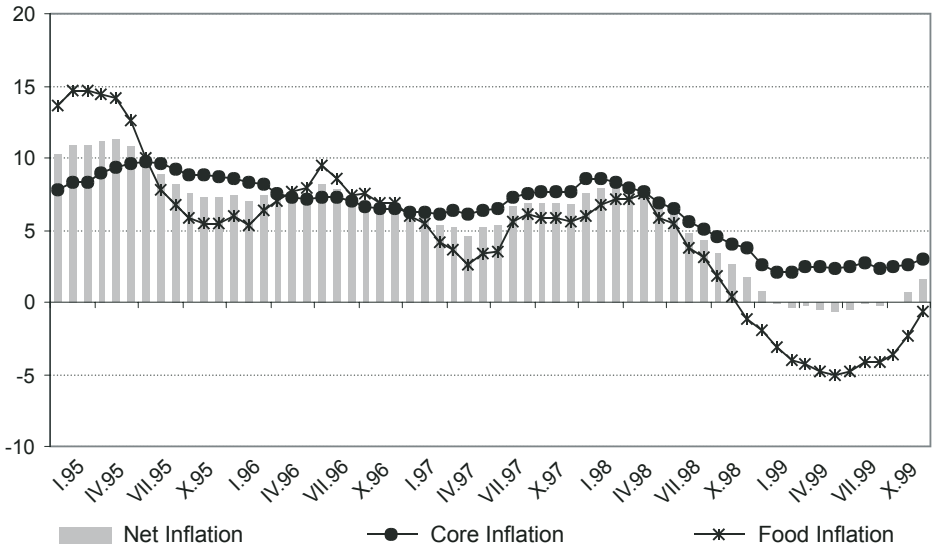
In the second half of 1998, domestic demand pressure was weak. A major disinflation impulse came from the effects of borrowed disinflation. According to Czech National Bank estimates, the external price shock slowed net inflation by 1–2 percent in six months. There was an additional effect due to the inflation expectations that were formed by this positive external shock. Consequently, the speed of disinflation was fairly rapid. In response to this new situation, the inflation outlook was revised downwards, and a possibility of underestimating the 1998 target emerged. Moreover, the revision to the inflation outlook signaled that disinflation would be faster than the targeted path for net inflation required. In response to this development, the CNB started

lowering the repo rate from level of 15 percent in several cuts. The last larger reduction came in January 1999 when the repo rate was at 8.75 percent.

In the first half of 1999, both demand and cost inflation pressures were weak. The process of disinflation slowed down significantly, since the effect of borrowed disinflation diminished. However, it was replaced to some extent by a shock to food prices (See Figure 4). As a result of this shock and of lags in transmission, the inflation outlook was revised downwards several times. The repo rate was lowered in a series of small reductions to a level of 6.5 percent. In the second half of 1999, domestic inflation pressures remained weak. Wage increases were moderate owing both to expectations adapting to the low inflation and to slow growth. On the other hand, the external environment was in a situation inverse to the one in 1998, and net inflation started to converge to the targeted path. Hence interest rates arrived at a level of 5.25 percent in November 1999.

It is important to note that the size of the cutback did not fully reflect the divergence of the inflation outlook from the targeted path, since both the shock to commodity prices and the shock to food prices were evaluated as typical "caveat" situations. The central bank intentionally compromised on the credibility of its short-term targets in order to avoid excessive volatility in domestic variables that would have been the consequence of full neutralization of the two positive price shocks. The central bank also took into account that if the inflation target is below the short-term target during disinflation, it does not imply that there is a danger of deflation. It implies that the inflation rate converges to the medium-term target faster. As a result of this approach, the 1998 and 1999 targets were not met.

Figure 4 Caveats: Core versus Food Inflation (1995–1999)



Note: The CNB targets net inflation. The approximate weight of food inflation in net inflation is 40 percent. The approximate weight of core inflation in net inflation is 60 percent. In 1999, core inflation fluctuated between 2 and 4 percent while food prices continued falling.

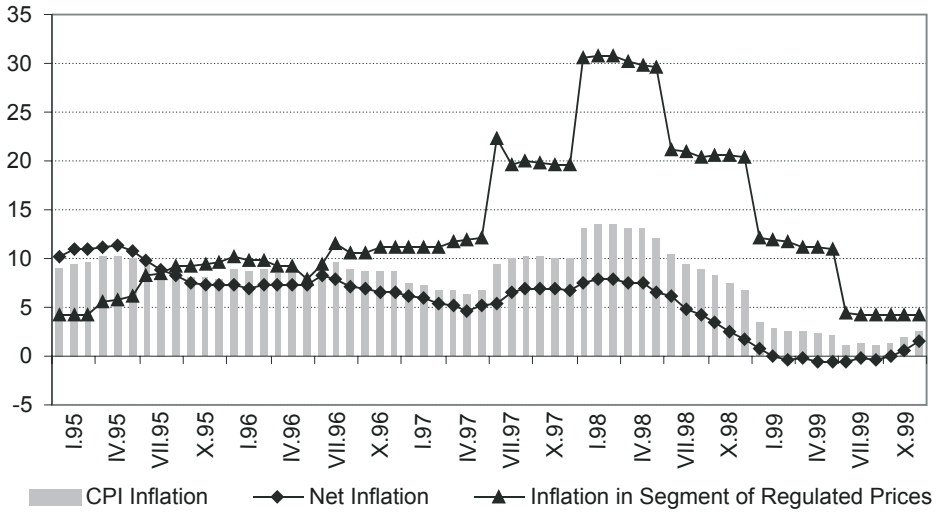
SOME LESSONS FROM THE CZECH EXPERIENCE

The Czech experience from disinflating with inflation targeting in the years 1998–1999 offers several lessons to other potential inflation targeters. The first lesson is that disinflation may come in waves that are difficult to synchronize with end-year inflation targets. For example, in 1998 average annual net inflation (5.7 percent) was consistent with the 1998 target, but in December, net inflation was below the targeted interval by 3.8 percent. If there is a possibility to introduce a targeted corridor instead of targets that must be hit every December, it is worth considering since credibility is less demanding to achieve within longer time span. In the Czech case, preference was given to end-year targets since they corresponded to the previously used annual money targets as well as to the annual inflation forecasts. Consequently, they were comprehensible to the general public, and they were able to anchor expectations more efficiently.

Second, caveats should be introduced ex ante, and they should reflect how an open economy affects the flows of goods and capital. In the Czech case, by coincidence, inflation targeting was introduced in a period of very low inflation abroad. In addition, prices of some important commodities, such as oil prices, dropped unexpectedly in 1998. Their dampening impact on net inflation was intensified by the fall in food prices in 1999. Although disinflation was the aim of monetary policy, the experience of the positive price shock was difficult to explain. Although formal caveats were introduced a year later, a partial loss of credibility already burdened the whole strategy of inflation targeting.

Third, during transition, it helps to exclude administratively regulated prices. In the Czech case, the targets were specified in terms of net inflation. This helped to reduce the volatility in key economic variables. Figure 5 illustrates that corrections to administered prices were extensive during the first year of inflation targeting. In addition, the changes in the pace of the corrections proved to be relatively sizable in the corresponding fiscal years. In the absence of a medium-term fiscal plan, it would hardly have been feasible to specify the inflation targets several years in advance in terms of CPI inflation. The cost of an accepted solution was that CPI inflation was not directly anchored and that it took several months to explain the new concept of net inflation to the public.

Figure 5 Price Corrections: CPI versus Net Inflation (1995–1999)

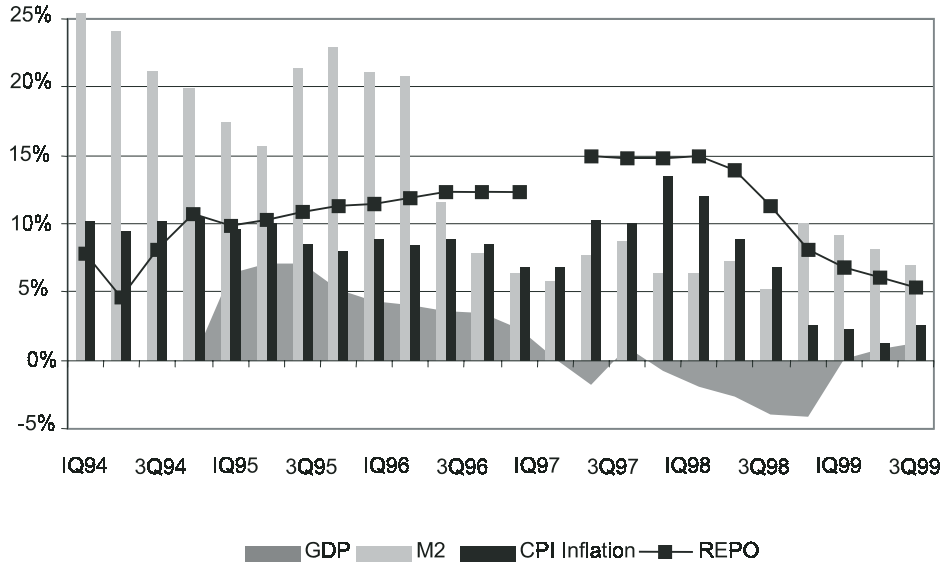


Note: The CNB targets net inflation. The approximate weight of net inflation in CPI inflation is 81.7 percent. The weight of inflation in the segment of regulated prices in CPI inflation is 18.3 percent.

Fourth, economic indicators confirmed that it would have been very difficult to base monetary decisions on the relationships between the operational target, money and prices. Figure 6 illustrates that there were periods during which the repo rate remained unchanged while growth in the money supply either slowed down or increased owing to other factors such as a change in exchange rate risk, financial innovations and regulatory rules. More importantly, after inflation targeting had been introduced, broad money started signaling a need for monetary restriction while the prospects for inflation indicated a need for easing of the policy. Such a need implies that pure money targeting would have been a controversial strategy. As was mentioned previously, uncertainty about monetary transmission would have been costly in any monetary framework. Inevitably, it reduced the quality of the inflation forecasts. One of the reasons why the 1998 target was underestimated was that the impact of fiscal restriction on demand was also underestimated.[22] However, under inflation targeting, the uncertainty was reduced, because a wider range of economic relationships was considered during the decision-making process, and some of them were more stable than those used in pure monetary targeting.

[22] See Inflation Reports (1999) for a more detailed analysis.

Figure 6 Monetary Transmission: Repo Rate, M2 and Prices (1994–1999)

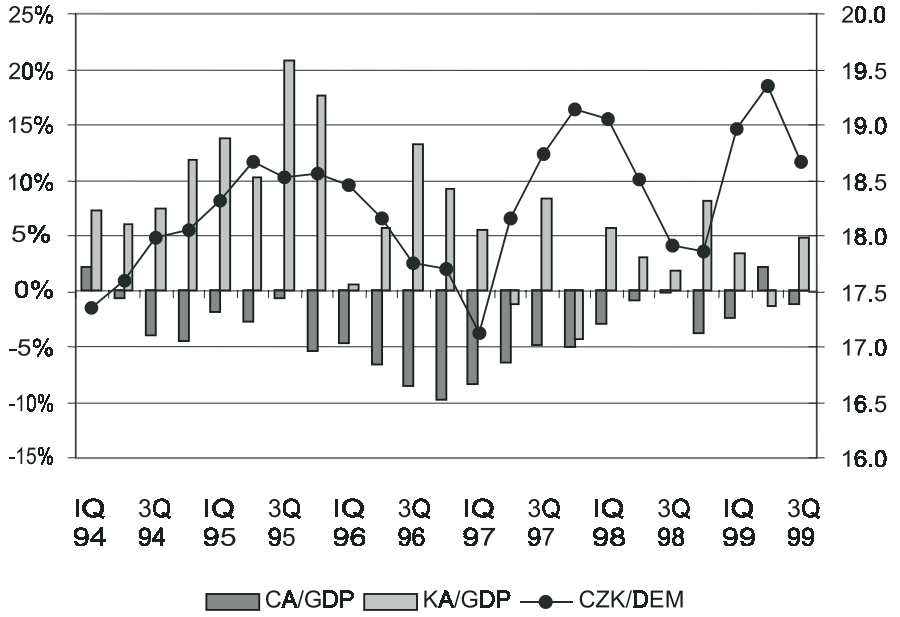


Note: The indicators are defined as follows: GDP is the annual growth rate of real GDP. M2 is the annual growth rate of broad money. CPI Inflation is the annual inflation rate. REPO is the operational instrument of Czech monetary policy

A fifth point is that after financial liberalization, the transitional economy enters the group of emerging market economies and becomes subject to capital flows. Figure 7 illustrates the scope of the problem in the Czech case. It was one of the benefits of inflation targeting that the volatility of the koruna exchange rate could cushion the impact of these flows on the domestic economy to some extent.[23] This does not imply that exchange rate developments hamper currency stability over a longer horizon. In a period of six years (1994–1999), the koruna depreciated vis-à-vis the Deutsche Mark by 7 percent (the average rate was 18.3 CZK/DM), and the imbalance on the current account, which peaked at an unsustainable level in 1997, was corrected. However, this does bring up the question of whether the monetary condition index should be used as a short-term indicator of monetary policy stance rather than the repo rate alone and whether foreign exchange interventions should be used to smooth volatility in the exchange rate.

[23] In periods of large flows, there must be some adjustment in either the exchange rate or other nominal variables. For example, after the exchange-rate band was broadened in February 1996, money growth became more stable. However, since the koruna was pegged to a basket of currencies, the CZK/DM rate fluctuated, even in 1995.

Figure 7 Exchange Rate: Volatility versus Stability (1994–1999)



Note: The indicators are defined as follows: CA/GDP is the ratio of the current account to nominal GDP. KA/GDP is the ratio of the capital account to nominal GDP. CZK/DM is the koruna exchange rate vis-à-vis the DM. The DM is used as a reference currency since Germany is the major trading partner of the Czech Republic.

PRECONDITIONS FOR USING INFLATION TARGETING IN TRANSITION

In previous sections, we argued that inflation targeting had been a good strategy to achieve disinflation according to the Czech experience. In this section, we would like to stress that several important preconditions were met in the Czech case. It may be the case that these same conditions have not been met in other countries in transition, and hence the Czech experience may not be transferred a priori. We find it useful to classify factors that determine the success of inflation targeting in a transitional country into three categories:

(i) preconditions: priority to price stability, an adequate macroeconomic and institutional framework, sufficiently accumulated know-how of the central bank;

(ii) domestic constraining factors: an insufficient legal framework and incomplete information on the medium-term reform strategy; and

(iii) external constraining factors: international financial turbulence, large changes in world prices.

Public support giving high priority to a stable currency is a very important precondition. A distinguishing feature of the Czech reform strategy has been the priority attached to domestic price stability[24] while some other transitional economies have adjusted their framework to the requirements of external competitiveness.[25] The respect for a stable currency "built into" Czech economic developments was compatible with inflation targeting. The general preferences of society have helped to introduce this strategy, although it could appear costly in the short run.

The second precondition that was met in the Czech case is the consistency of the macroeconomic and institutional framework in which the CNB operates with inflation targeting. The CNB is independent of the government and has sole responsibility for the conduct of monetary policy. And even more importantly, throughout the transition this independence has been put into practice and demonstrated in the domain of both monetary instruments and goals. Inflation remained moderate during the transitional period. The independence of monetary policy was not undermined by a loss of fiscal discipline. The principle of a balanced central budget was followed throughout the transitional period, and public sector borrowing remained moderate.[26] Hence, there was neither a problem of fiscal dominance nor of hyperinflation in the Czech case.

Third, a certain level in the development of financial markets required for inflation targeting had been reached before 1998. The money market, as well as the foreign exchange market, also had overcome its embryonic stages and had become well-developed. Thus, the foreign exchange market could help cushion short-term volatility under the floating regime. Similarly, money market instruments had become available to the central bank.[27] Fourth, the CNB had acquired sufficient know-how on forecasting activities so important for inflation targeting. It is worth mentioning again the quality of the inflation forecasts shown in Figure 1.

There were two groups of limiting factors that reduced the credibility of inflation targeting. As was pointed out previously, these factors are likely to have affected the outcomes of any monetary strategy. The first group consisted of domestic factors. In this case, the legal framework was not sufficiently developed. Some important laws (e.g. the bankruptcy law) were introduced only at later stage of the transition process, as were some important regulatory bodies (e.g. the Securities Commission).[28] As a consequence, in the first two years of inflation targeting, some important mechanisms of monetary transmission were weaker or slower than expected. For example, the

[24] Not only has the koruna enjoyed remarkable stability in the course of recent developments, after World War I, the currency of the newly formed Czechoslovak Republic had been the only one in the region to avoid hyperinflation. The relatively modest monetary overhang was a favorable feature of the macroeconomic situation also in the post World War II era.

[25] For example, Hungary and Poland used crawling peg regimes.

[26] The ratio of public debt to GDP decreased from 19 percent in 1993 to 14 percent in 1998 (See CNB *Inflation Report*, April 1999).

[27] In the first half of the 1990s, interest rates could not have been effective instruments for the CNB, owing to the embryonic stage of the money market.

[28] Two important laws were adopted as late as April 1998: the Act on Bankruptcy and Settlement and the Act on the Securities Commission, which functions as a regulatory body for the capital market.

sensitivity of credit supply to decreasing interest rates was reduced by gradual changes in the legal framework in which banks allocated their portfolios.[29]

This group also had insufficient information on the transitional strategy. Owing to the absence of a medium-term fiscal plan that would include the scenario of price corrections and targets for fiscal deficits, monetary policy was confronted with a higher degree of uncertainty. In particular, administered price corrections and changes in the tax system were usually announced during preparatory work on the annual budget. Moreover, the scale of expected price corrections was sometimes changed during the fiscal year.[30] This was in sharp contrast to a monetary strategy that maintained a publicly announced medium-term inflation target. This contrast implied that one important source of information for monetary decisions was missing, since fiscal and wage medium-term projections were not available from the government and trade unions.

These examples demonstrate that the central bank may be confronted with additional uncertainty during transition because the central bank has to predict what other important players such as the government and trade unions are going to do instead of using their own publicly announced plans. The assessment of the economic situation has been further complicated by the problem of a "hidden debt." In 1998, the level of official debt declared previously was inflated by the preliminary estimates of the fiscal costs of the transition process. Including the debts of transitional institutions with the contingent government liabilities has been estimated to lead to a doubling of the official public debt.[31] This implies that the central bank learned about the true size of the fiscal deficit ex post. Again, although "fiscal surprises" made inflation targeting more difficult, they would, nevertheless, be costly in any monetary framework.

The second category of constraining factors was the external environment. The late 1990s did not provide a stable international environment since international financial turbulence, as well as sizable changes in world prices, affected open economies. It is generally recognized that extensive openness presents a dilemma to small open economies that target inflation, since external shocks have a large impact on the domestic economy, and they imply either the costly volatility of some important variables or temporary deviation of inflation from the target. Typically, the dilemma is overcome by the mechanism of caveats. Caveats help the public distinguish a policy error from a desirable, temporary deviation of inflation from the target. If the external shock is temporary, the central bank does not react with its instruments. In the case of a permanent shock, changes in both instruments and caveats are resorted to.

The Czech experience should provide a clear lesson that in a very open economy, the central bank should from the very beginning build inflation targeting credibility on both the history of successfully made targets and on a transparent, well-focused communication strategy. It is important that the communication strategy works with caveats that have been introduced ex ante

[29] Banks were subject to changes in legal framework as well as in regulatory rules that increased their need for building up reserves. Hence money supply grew slowly even in a period of cuts in nominal interest rates.

[30] Figure 4 shows that in 1998, the caretaker government proceeded with price corrections faster than the social democratic government did the following year.

[31] According to a Ministry of Finance press release (July 1999), during the transition the government directed some expenditures outside the budget system to transformation institutions. Off-budget operations, together with a large number of state guarantees that were issued without creating reserves, have built up a hidden and implicit public debt. Hidden public liabilities were estimated to be about 15 percent of GDP.

since in very open economy, the width of the inflation target cannot cover volatility of external variables. The communication strategy should carefully explain the evaluation of external developments and their consequences for monetary decisions. In the period of 1998–1999, external factors sent favourable impulses and helped set inflation expectations on the targeted disinflation path. However, the credibility of the new monetary strategy was reduced because in the first year of inflation targeting it was very difficult to explain why the 1998 target was undershot.

INFLATION TARGETING MOVES THE CENTRAL BANK TO THE POLICY FRONTIER

In policy discussions about the Czech approach to inflation targeting, it has been claimed to be a bold strategy since there are important constraining factors that may reduce its credibility.[32] With the benefit of hindsight, we would like to modify this statement in the following way. Constraining factors implied by transition make monetary decisions in any framework more difficult. The costs imposed by them should not be linked directly to inflation targeting. However, inflation targeting makes these constraints more visible and, as a result, the requirements on the quality of decisions as well as on communication strategy are more demanding.

A switch to inflation targeting has an effect analogous to increasing the independence of the central bank, since it moves the central bank to the centre of economic discussions.[33] In this strategy, the formal independence of the central bank is fully realised. Specifically, the CNB announced inflation targets according to its own assessment on what would be the least costly disinflation path for ensuring convergence to EU inflation. In 1997, there was no medium-term reform plan that would give a sufficient guideline in that respect. Hence, inflation targeting has been linked to some extent to realizing goal independence.[34] This step has been balanced from the side of the CNB with a significant "voluntary" increase in transparency that has not been required by the legal framework.

The Czech experience shows that in a transitional economy, inflation targeting can move the central bank to the edge of the policy frontier. It is worth noting that if the inflation target is declared ahead of other medium-term policy targets, such as the fiscal plan or consensus on moderate wage increases, the central bank explicitly or implicitly initiates coordination of economic policies and the emergence of important institutions. This is not a standard role for the independent central bank in developed democracies. However, in emerging democracies, it appears warranted that the central bank carries part of the burden of reform.

[32] See proceedings from *The CNB Workshop on Inflation Targeting* (1999).

[33] Goodhart (1994) argues that enacting the central bank independence places the central bank into the political arena, since its actions must be better justified and presented.

[34] It is not complete goal independence, because the long-term target is derived from the convergence criteria towards the EU.

REFERENCES

Allen, Ch., and K. Šmídková, 1998, "Voucher Privatisation, Households' Demand for Consumption Goods and Financial Assets and Implications for Macroeconomic Policy," *Economics of Transition*, Vol. 6 (1).

Annual Reports, 1993–1998, Czech National Bank, Prague.

Bernanke, B. S., T. Laubach, F. S. Mishkin, and A. S. Posen, 1999, *Inflation Targeting: Lessons from the International Experience* (Princeton: Princeton University Press).

Czech National Bank, *The CNB Workshop on Inflation Targeting*, 1999, Proceedings (Prague).

Fry, M., J. De Anne, L. Mahadeva, S. Roger, and G. Sterne, 1999, *Monetary Policy Frameworks in a Global Context,* CCBS, Bank of England, the Governors' Symposium (London).

Goodhart, C .A. E., 1994, "Central Bank Independence," *Journal of International and Comparative Economics*, No. 3.

Hrnčíř, M., and K. Šmídková, 1999, "The Czech Approach to Inflation Targeting," in *Workshop on Inflation Targeting*, Proceedings, Czech National Bank, Prague.

Inflation Reports, 1998–99, Czech National Bank, Prague.

Mahadeva, L., and K. Šmídková, 1999, "Inflation Targeting in the Czech Republic," in *Choice of Intermediate Monetary Policy Targets*, CCBS, Bank of England, London.

Pohledy, 1997, *Prognóza makroekonomického vývoje v roce 1998*, Bulletin published by Czech-Moravian Confederation of Trade Unions, October.

Šmídková, Kateřina, Jiri Behounek, Tibor Hledik, Josef Jilek, Miroslav Kostel, Ivana Matalikova, Dana Rottova, and Jana Stankova, 1998, "Koruna Exchange Rate Turbulence in May," Czech National Bank Working paper No. 2 (Prague: Czech National Bank).

The CNB Strategy (1999), Czech National Bank, Prague.

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