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Inflation Targeting: Prospects and Problems

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Inflation Targeting and Optimal Monetary Policy
Michael Woodford

The Macroeconomic Effects of Inflation Targeting
Andrew T. Levin, Fabio M. Natalucci, and Jeremy M. Piger

The Role of Policy Rules in Inflation Targeting
Kenneth N. Kuttner

Is Inflation Targeting Best-Practice Monetary Policy?
Jon Faust and Dale W. Henderson

Practical Problems and Obstacles to Inflation Targeting
Laurence H. Meyer

Panel Discussion: Inflation Targeting
Ben S. Bernanke, Otmar Issing, and Donald L. Kohn

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Editors' Introduction

Jeremy M. Piger and Daniel L. Thornton

These conference proceedings consist of extremely thoughtful and provocative papers and discussions on critical and ancillary issues that constitute the essence of the inflation targeting (IT) debate—including a provocative discussion of IT by three of the world's top policymakers. The breadth and depth of the analysis by these conference participants is remarkable—virtually no relevant stone of the IT debate is left unturned. We cannot possibly do justice to the participants' contribution in this introduction. With this proviso, we first discuss several of the most important lessons we learned from the conference papers and discussions and their possible implications for future research. We then discuss what our prominent panel of policymakers has to say about IT, especially with respect to these issues. We emphasize that our brief introduction cannot adequately reflect all of the subtleties and nuances of the positions taken; our summary is a poor substitute for reading the entire conference proceedings.

Nutters, NETers, LETers, Flexible ITers, Super Flexible ITers, etc.

Perhaps the most recurrent theme in the conference proceedings is the extent to which IT provides room for, or alternatively limits, policymakers' discretion to pursue other objectives—most frequently, stabilizing the real economy. Faust and Henderson's thoughtful and systematic analysis of whether IT constitutes "best practice" monetary policy addresses this issue directly. They note that the IT perspective is bolstered by the "now nearly universally accepted" fact that there is "no long-run Phillips curve trade-off of the traditional variety" (p. 120). They then distinguish between those who believe there is no exploitable trade-off between inflation and the output gap in the short run—NETers—and those who believe that there is a "limited" exploitable trade-off—LETers. While these views are distinct, Faust and Henderson note that "it is sometimes difficult to tell which view various parties take" (p. 122). In part, this is because some LETers believe that the degree of exploitability is "quite low." It is also because "virtually everyone agrees that demand shocks push us toward a *singular economy* perspective" (p. 122). That is, in many standard models, the appropriate policy response to demand shocks for NETers and LETers is isomorphic, or nearly so. The agreement with respect to demand shocks substantially narrows the important difference between NETers and LETers. Faust and Henderson suggest that one's view about how policy should respond to supply shocks provides a "litmus test for deciding whether one is in the NET or LET camp" (p. 122). While they do not address the question directly, their analysis seems to suggest that all NETers are likely to be ITers. On the other hand, not all ITers are NETers. Indeed, they suggest that "many, if not most, advocates of the ITF [inflation-targeting framework] are LETers" (p. 121).

Faust and Henderson note that, in their lexicon, NETers are not what Mervyn King has termed "inflation nutters"—those who consider inflation the sole policy objective—because NETers believe that, given the economic structure, stabilizing prices is "the best we can hope for" (p. 121). In commenting on Faust and Henderson, however, Ben Friedman notes that "for practical purposes…these two positions [NETers and nutters] are isomorphic" (p. 147). From this discussion, we conclude that nutters are LETers who believe that the central bank should pursue other objectives only in rare circumstances—nutters fail the Faust-Henderson's NETer litmus test.

It is clear from these proceedings that the extent to which there is an exploitable short-run trade-off between inflation and the output gap—the extent to which the NETer view of policy is correct—is an important issue of the IT debate. Faust and Henderson

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note that the NETer view can arise in models where the economy is enormously complex—Milton Friedman and Robert Lucas—or "fortuitously" simple—Rotemberg and Woodford (1997), King and Wolman (1999), and Goodfriend and King (2001). While NETers, per se, appear to be rare, theoretical analyses indicate that the "tension" between inflation and output stabilization is much smaller than previously thought. In his survey of the theoretical literature on "optimal monetary policy," Woodford concludes

> recent literature on the welfare consequences of alternative monetary policies finds that there is less tension between inflation stabilization and properly defined real stabilization objectives than traditional (non-welfare-theoretic) literature on monetary stabilization policy has often suggested. It is not a bad first approximation to say that the goal of monetary policy should be price stability. (p. 23)

Woodford notes that there are some instances where deviations from perfect price stability is optimal policy. For example, it is not optimal in instances where complete price stability is infeasible—where the natural rate of interest is temporarily negative or not efficient—e.g., where the existence of frictions make it desirable to have the nominal rate more stable than the natural rate. Woodford notes that while interest rates are smoothed considerably under optimal policy in these circumstances, "this does not require too much variation in inflation" because the variance trade-off is "quite flat near the extreme of full inflation stabilization" (p. 24).

Woodford also notes that full stabilization of prices is not generally optimal in models where prices of different commodities are impacted differentially by economic shocks. He notes, however, that "as long as the price index to be stabilized is appropriately chosen, complete stabilization of a price index is found (in calibrated models) to be nearly optimal" (p. 25). Not surprisingly, an analogous conclusion arises in models where wages are as sticky as or more sticky than prices. Likewise, the existence of market power or the existence of distorting taxes creates situations where "it will not be possible to simultaneously stabilize inflation and the welfare-relevant output gap." Nevertheless, Woodford notes that even in such circumstances,

> the degree of variability of inflation under an optimal policy may be quite modest… because the relative weight that should be placed on the goal of output stabilization, relative to the weight on inflation stabilization, may not be large. (p. 26)

In her discussion of Woodford's paper, Stephanie Schmitt-Grohé notes that most of the theoretical work that Woodford surveys uses dynamic, stochastic general equilibrium models that require a "simplifying assumption" to obtain "an analytical characterization of optimal policy" (p. 43). She then reports on the findings of some recent work using "recent advances in computational economics… that make it feasible and simple to compute higher-order approximations to the equilibrium conditions of a general class of large stochastic dynamic general equilibrium models" (p. 43). In a model that allows for sticky prices, money demand, distortionary taxes, and a role for fiscal variations in the price level, she finds that, when the model is calibrated to the U.S. economy, the mean and standard deviation of inflation for optimal policy "is close to zero"—the NETer view is approximately correct (p. 44). Moreover, she reports that "the inflation-volatility tax-rate-volatility trade-off is resolved in favor of inflation stability not only for degrees of price stickiness observed in the U.S. economy, but also for much lesser degrees of price stickiness" (p. 44). She then notes that this conclusion is robust to a model with capital accumulation.

Despite the growing theoretical evidence in favor of inflation stabilization, the tension between inflation stabilization and output stabilization remains a central issue in the IT debate. In his excellent discussion of practical problems and obstacles to inflation targeting, Larry Meyer characterizes the issue by making a distinction between what he terms inflation targeting and inflation targets. He notes that inflation-targeting countries generally operate with both an explicit numerical inflation target and a hierarchical mandate, under which "central banks are restricted in pursuing other objectives *unless price stability has been achieved*" (p. 151, emphasis added). In contrast, under a dual mandate "monetary policy is directed at promoting both full employment and price stability, *with no priority expressed*, and with the central bank responsible for balancing these objectives in the short run" (p. 151, emphasis added).

Meyer favors an explicit inflation target as part of a dual mandate, but opposes an inflation-targeting

regime with a hierarchical mandate. Meyer believes that central banks can control the long-run average rate of inflation—"with respect to inflation, the buck literally does stop at the central bank" (p. 152). But his desire for a dual mandate stems from the belief that "at the margin," central banks "can damp movements in output around its potential level." It is less clear, however, whether he believes that stabilizing output around its potential level requires a sacrifice of inflation stabilization, or whether he adheres to what he describes as Chairman Greenspan's "unique vision" of monetary policy. According to Meyer, Greenspan believes that *synergies* exist "between the two objectives for monetary policy—price stability and damping fluctuations around full employment" (p. 153). He notes that Chairman Greenspan "is generally viewed as being a hawk when it comes to containing inflation and a dove when it comes to quickly providing support for a weakening economy" (p. 153). Whatever his belief, Meyer argues that an inflation-targeting regime with a hierarchical mandate is a non-starter for the United States—there is "no chance that the Congress would accept a regime with a hierarchical mandate that raised the profile of price stability and diminished the responsibility of the FOMC for stabilization policy" (p. 154).

In his discussion of Meyer's paper, Lars Svensson argues that the hierarchical/dual mandate distinction is not useful. He notes that with quadratic loss functions of the type that are frequently used by economists to represent the central bank's objective function, the inflation target is a choice variable, but the output target is not—"the output target is subject to *estimation*, but it is certainly not subject to *choice*" (p. 161). Consequently, he suggests that there is only a hierarchical mandate for long-run inflation. Consistent with Woodford's interpretation, he suggests that the dual mandate is reflected in the choice of the weight that policymakers give to inflation stabilization relative to output stabilization:

> Since *all inflation targeters are flexible inflation targeters*, in the sense that they are concerned about stability of the real economy… we can, if we like, talk about inflation targeters as having a dual mandate. But, as long as we know that we are talking about different verbal descriptions of monetary policy loss functions of the kind stated above, I do not find the dual/hierarchical mandate distinction helpful. (p. 162, emphasis added)

Taxonomy aside, the important question in the IT debates is: How much inflation stability are policymakers willing to give up to gain some quantity X in the stability of output? Meyer recognizes that inflation-targeting regimes have become more flexible over time, but he believes that the hierarchical mandate nevertheless imposes an inappropriate and unnecessary constraint on the flexibility of monetary policymakers as they try to balance their objectives of price stability and full employment. From this perspective, this critical issue in the IT debate appears to hinge on the assumption that policymakers must give up one thing to get another. We now turn to this aspect of the conference proceedings.

Transparency, Accountability, Credibility, etc.

There appears to be widespread agreement among the conference participants that the essential elements of IT are (i) an explicit long-run inflation objective and (ii) a commitment to transparency. The latter is closely linked to credibility and, most importantly, the belief that having a credible long-run inflation objective generates a "win-win" situation for the central bank—a commitment to low and stable inflation not only makes conducting monetary policy easier but simultaneously results in better stabilization outcomes.

Woodford notes that, in some models, uncertainty about the long-run inflation rate "worsens the trade-off between inflation variability and output-gap variability that is available to the central bank" (p. 18). Friedman makes the identical point (p. 146). The idea that low and stable inflation has desirable consequences for the real economy seems to be at the heart of the "synergies" that Meyer indicates are a hallmark of Greenspan's vision of monetary policy. In commenting on Levin, Natalucci, and Piger, Uhlig reaches a similar conclusion. Specifically, he compares 10-year standard deviations of inflation and real output growth for the United States over the period 1940-2002 and concludes that "these figures seem to suggest that an environment of low and stable inflation helps to reduce output volatility and support economic activity" (p. 85).

It is certainly the case that there is some level of inflation variability where the commitment to a long-run inflation objective is not credible. If this is so and if there is a significant improvement in the inflation/output variability trade-off associated with

a credible inflation target, it is reasonable to expect ITers to have a hierarchical mandate, at least, as Meyer defines it. The hierarchical mandate will be a natural consequence of the fact (or at least belief) that thresholds exist for the mean inflation rate and inflation variability, such that a policy which allows these measures to stay consistently above these thresholds generates less-favorable results for things that policymakers and the public care about, e.g., the real economy.

There are, of course, other reasons for transparency. Faust and Henderson note that Lucas pointed out that "what constitutes optimal policy is inextricably linked with public expectations about policy" (p. 122). In addition, noting that the overnight interest rate is of "negligible importance for economic decisionmaking," Woodford states "not only do expectations about policy matter, but, at least under current conditions, very little *else* matters" (p. 16). Moreover, he notes that "actual changes in overnight rates required to achieve the desired changes in incentives can be much more modest when expected future rates move as well" (p. 17). Hence, according to Woodford the effectiveness of policy depends critically on the central banker's ability to "manage expectations."

Transparency and the Practice of IT. Assuming that the hallmark of transparency is honesty, there appears to be concern that some transparent (and hierarchical) central banks are not being honest. Meyer relates a story where he was taken aside by "two of the leading central bankers in the world" and told that "good central bankers never admit they pursue stabilization policy" because "such an admission would reduce the confidence of the public in your commitment to price stability and therefore undermine your credibility and effectiveness as a monetary policymaker" (p. 152). He expressed confusion that the "way to build credibility was to lie…" (p. 152).

Faust and Henderson address this point noting that a "folk wisdom" of central banking is that "central banks should 'do what they do, but only talk about inflation' " (p. 132). Expressing concern analogous to Meyer's, they suggest that perhaps "we should stop praising the ITF and other central banks for their commitment to transparency; instead we should lament the fact that central banks cannot publicly discuss the pursuit of their multiple mandates" (p. 132).

Friedman underscores this point, but adds a concern. Arguing that "language matters," Friedman suggests that

> it is not too great a leap to conjecture that one consequence of constraining the discussion of monetary policy to be carried out entirely in terms of an optimal inflation trajectory will be that concern for real outcomes will atrophy, or even disappear from policymakers' consideration altogether. Nor is it unreasonable to suppose that the hope that this eventuality will ensue is, for some advocates, a motivation for favoring inflation targeting in the first place. (p. 148)

While it is possible that there is an ideological battle between the near-NETer-LETers and other LETers, we are inclined to believe that the real issue is a lack of agreement in the profession—and particularly among policymakers—about the circumstances where (i) monetary policy can effectively stabilize output and (ii) the costs of such stabilization actions. To illustrate this point, we note that in his discussion of Meyer's hierarchical/dual mandate distinction, Svensson argues that it is particularly "misleading to say that inflation targeters have a hierarchical mandate but the Fed does not" (p. 162). Svensson argues that by inserting "sustainable" before "employment" in the mandate as expressed in the Federal Reserve Act—to promote effectively the goals of maximum employment, stable prices, and moderate long-term interest rates—the Fed's mandate can be interpreted as describing a loss function where some positive, but unstated weight is given to stabilizing the output gap. He argues that this is not "substantially different" from the Reserve Bank of New Zealand's Policy Target Agreement, which suggests that in pursuit of its price stability objective, it shall "seek to avoid unnecessary instability in output, interest rates and the exchange rate" (p. 162). We note, however, that Meyer suggests that he believes that Chairman Greenspan "also believes that low, stable inflation contributes to strong productivity growth and hence to a higher maximum sustainable rate of economic growth," providing yet "another reason why maintaining low stable inflation has significant payoffs for economic performance" (p. 153). From this perspective, the Fed's mandate need not be inconsistent with that of a central banker who gives no weight to stabilizing output in the loss function. Meyer is quick to point out that he believes "that the other members of the FOMC have less faith in this principle than the Chairman" (p. 153). Our point is not that the FOMC's stated mandate is hierarchical or dual or that Chairman Greenspan is

a NETer and not a LETer (we simply don't know). Rather, our point is that this example and much of the analysis and discussion by conference participants suggests that a core issue (if not *the* core issue) in the IT debate is the extent to which and the precise circumstances under which central banks can and should stabilize output. Because this requires responses to "supply shocks" rather than demand shocks, it would seem that specific analyses of the types of supply shocks that central bankers should respond to and the potential costs associated with such responses would be a good place to start.

In any event, there is agreement among Bernanke, Faust and Henderson, Meyer, Svensson, Uhlig, and Woodford that, in Woodford's words, "it would be desirable for central banks to commit themselves to the pursuit of explicit target criteria that involves real variables as well as inflation" (p. 27). Woodford notes that this would "increase transparency, facilitating the public's ability to correctly anticipate future policy" and, echoing a point made by Meyer, "help to dispel some of the resistance to the adoption of inflation targeting in countries like the United States" (p. 27).

What's the Advantage of IT?

Faust and Henderson argue that "the first goal of best-practice [monetary policy] is to get mean inflation *right*" (p. 124, emphasis added). They then note that a purpose of IT is to "anchor long-run inflation expectations," by leaving "little room for misunderstanding this objective." That being said, it is natural to ask: Why must the long-run inflation objective be explicit? Why can't it be fuzzy? The unquestionable existence of "control error" suggests that inflation targeting is inherently fuzzy from the public's perspective. This is illustrated in Faust and Henderson's discussion of best-practice monetary policy. They note that many IT central banks have "target ranges" for the IT. Under their interpretation of best-practice monetary policy, "a target range is purely descriptive in that it states that inflation will be within the range $\pi^* \pm \theta$ [the inflation target plus/minus a positive fixed amount] most of the time" (p. 125). They note that "no incident of inflation crossing the boundary is evidence of central bank misbehavior; only excessive frequency of being outside the interval constitutes such evidence" (p. 125). They note too that "excessive frequency of being inside the range is also evidence of misbehavior" for a central bank that professes to have other non-inflation policy objectives (p. 125). The point is that given such an interpretation, it may take the public some time (with the length of time determined in part by the nature of the control errors, assuming their existence) to determine whether the central bank is in fact attempting to achieve its stated inflation objective or is misbehaving with respect to it.

Meyer suggests that having an explicit inflation objective should (i) "contribute to anchoring inflation expectations," (ii) "improve the coherence of the deliberations and the policy outcomes" by ensuring a consensus among policymakers about the desired long-term inflation rate, and (iii) "enhance the ability of bond market participants to anticipate the future course of monetary policy…thereby improving the effectiveness of policy" along the lines discussed by Woodford (p. 154).

Levin, Natalucci, and Piger (LNP) attempt to assess on empirical grounds whether or not inflation targeting has made a difference for economic performance. In the tradition of the existing literature on this topic, LNP ask whether the economic performance of a group of countries that have adopted IT differs substantially from a group of countries that have not. LNP first investigate whether the data are consistent with the claim that inflation expectations are anchored by inflation targeting. Using private-sector inflation forecasts for industrial countries obtained from surveys, LNP find that the unconditional volatility of these inflation forecasts is not noticeably different between IT and non-IT economies. Digging deeper however, LNP find that the source of volatility does seem to differ. In particular, LNP find that for non-IT economies, long-run inflation forecasts exhibit a highly significant correlation with past realized inflation. In contrast, this correlation is largely absent for the IT countries. LNP argue that this is suggestive evidence that the inflation-targeting central banks have been quite successful in delinking expectations from realized inflation. It is also consistent with the claim that IT anchors inflation expectations.

LNP also investigate whether there is any difference in the dynamics of actual inflation between IT and non-IT economies. Again, they find no evidence that inflation has been unconditionally less volatile in IT vs. non-IT economies. However, they again find evidence that the source of this volatility differs. In particular, shocks to core CPI inflation are substantially less persistent in the group of IT economies than in the non-IT economies. In particular, it is difficult to reject the hypothesis that core CPI inflation follows a random walk in most of the non-

IT economies, whereas this hypothesis can be easily rejected for most of the IT economies. LNP note that this suggests that inflation dynamics in the non-IT economies display a substantial propagation component that augments shocks, whereas inflation dynamics in the IT economies quickly revert to the mean following a shock.

LNP also consider a group of emerging-market economies who have adopted IT more recently. For these recent adopters they confirm the result, found by others for industrial IT economies, that the adoption of inflation targeting does not lead to an immediate reduction in long-term inflation expectations. In this sense, the true benefits of IT may become apparent only after the regime has gained sufficient credibility.

In discussing their work, Harald Uhlig does not question their findings, noting that "The correlations found by the authors seem to be there, and they can be read as a list of interesting differences between countries that have formally adopted inflation targeting and those that have not" (p. 82). He does, however, question their interpretation of these results. He questions LNP's division of countries into ITers and non-ITers, noting that the Bundesbank is classified as a non-ITer by LNP. He notes that (i) it is widely accepted that the Bundesbank ignored violations of its money growth targets "if it helped in pursuing some other, important goal—most notably price stability," (ii) the money growth targets were derived in large part to be consistent with the Bundesbank's "underlying goal regarding the desired rate of inflation," and (iii) the public debates about monetary policy "were practically always in terms of inflation" (p. 82).

Uhlig then asks, even if IT has anchored inflation expectations, "how helpful has that been for the variables that we ultimately care about?" Noting that the standard deviation of inflation has been higher for ITers than non-ITers and that output growth variability has been essentially the same, Uhlig suggests that "based on these numbers alone, one certainly would not want to make the case that adopting inflation targeting is a good idea" (p. 83). Acknowledging that his unconditional perspective may be misleading because ITers may have been hit by larger shocks or started with less favorable initial conditions, Uhlig concludes "much more work than is in this paper is required before it is possible to conclude that inflation targeters have been more successful in containing shocks hitting the economy than nontargeters have been" (p. 83).

Uhlig also suggests a reinterpretation of LNP's finding that inflation volatility has been more persistent for non-ITers. Noting that in models of the New Keynesian variety,

> low-frequency volatility of inflation is OK, but high-frequency volatility is bad for the economy and leads to an overall lower level of economic activity. If this is what would happen with inflation targeting, which seems to be what the empirical results suggest, then this would be an argument against inflation targeting, not for it. (p. 84)

Finally, Uhlig notes that IT has frequently arisen endogenously—it occurs "when the economic situation was sufficiently bad" (p. 84). He suggests that this not only accounts for the failure to adopt inflation targeting by the United States and the European Monetary Union, but requires that analyses of the effectiveness of IT must account for fiscal considerations and other structural reforms—"The interesting question remains whether inflation targeting has contributed above and beyond fiscal consolidation or general institutional reforms" (p. 84).

IT and the Rules Versus Discretion Debate

Faust and Henderson effectively ask: Is IT best "viewed as a 'rule' or the exercise of 'discretion' "? They note that ITers appear to have different views about that, but that these differences appear to be definitional, so that, in their view, IT is "a typical example of discretion in the classical sense" (p. 119). Nevertheless, it is clear that many if not most ITers consider IT to be a rule in the modern sense of a policy rule, e.g., a Taylor rule. That is, IT is a rule as defined by Woodford,

> a rule under which the central bank's commitment is defined by a *target* for certain variables at a certain distance in the future, together with a commitment to organize deliberations about policy actions around the question of whether the contemplated actions are consistent with the target. (p. 20)

Moreover, many ITers, such as Woodford, argue that a commitment to such a policy rule has important consequences for the effectiveness of monetary policy.

In his careful analysis of "The Role of Policy Rules in Inflation Targeting," Ken Kuttner notes that the view of IT as "some sort of a monetary policy rule" stems, in large part, from the fact that the adoption of IT by many central banks and the "explosion of research on monetary policy rules" occurred at much the same time. Consistent with Woodford's definition, Kuttner notes that conditional rules "allow the policymaker to respond in a reasonable (or even optimal) manner to economic conditions" (p. 90).

Before assessing "empirically the extent to which IT can be described in terms of simple monetary policy rules" (p. 89). Kuttner undertakes a detailed and thoughtful analysis of important issues in the policy rule debate—ad hoc versus optimal policy rules, instrument rules versus targeting rules, rules describing outcomes versus rules based on commitment, and mechanical rules versus guidelines.

After a careful analysis of the "connection between various definitions of a policy rule…and IT as it is actually practiced" (p. 92), Kuttner undertakes a careful empirical analysis of "how well the behavior of IT central banks can be characterized by simple policy rules" (p. 94). Specifically, he estimates policy rules for three IT central banks, the Reserve Bank of New Zealand, the Bank of England, and Sweden's Riksbank, and for the Federal Reserve. The unique twist in Kuttner's analysis is the "use of the central bank's own published inflation and output forecasts, rather than econometric proxies for the relevant expectations" (p. 95). Indeed, the three central banks were chosen because they have "the longest track record of published, quantitative forecasts" (p. 95). Kuttner notes that these forecasts (i) reduce the data requirements and alleviate the need for two-stage GMM estimation, (ii) "are likely to be more reliable that those based on simple econometric models, and (iii) should "embody appropriate assumptions about the central banks' intended policy actions" (p. 95).

After noting some technical differences in the inflation target and forecasting by each of the IT central banks and the fact that "an explicit reaction function or instrument rule does not figure prominently in any of the three central bank's official publications" (p. 96), Kuttner begins by estimating a standard "Taylor rule" with a lagged interest rate term. Because none of the central banks, save the Reserve Bank of New Zealand, publishes an estimate of the output gap, Kuttner estimates the output gap under some reasonable assumptions. Kuttner finds that the estimates suggest that this simple policy rule "is a poor description of policy for all four central banks" (p. 99). The coefficient on inflation is significant only for Sweden, while the output gap coefficient was significant for three countries, but had the wrong sign for two—Sweden and the United Kingdom.

Estimates from a forward-looking Taylor rule fared better. All coefficients were correctly signed and statistically significant for New Zealand and the Taylor principle—defined as the long-run response of the nominal rate to inflation being greater than 1—was satisfied for all countries but the United Kingdom.

Because the estimates of the coefficient on the lagged interest rate were large, implying "an extremely high degree of interest rate smoothing," Kuttner investigates the possibility that this reflected "the omission of highly serially correlated variables from the instrument rule," possibly corresponding to the unobserved "judgment" terms emphasized in Svensson (2003), "rather than interest rate smoothing per se" (p. 101). He does this by including a variable that captures the " 'news' contained in the revisions in expectations embodied in the central banks' inflation and output forecasts" (p. 101). He finds that the results are more encouraging than for either of the previous specifications, but like the previous specifications, the results are best for New Zealand and Sweden. Importantly, Kuttner notes that the estimates support Rudebusch's (2002) "contention that at least some of the serial correlation in conventionally specified instrument rules represents a response to an omitted variable" (p. 103). He argues that the results demonstrate that IT central banks exercise judgment in setting policy. He notes that this "interpretation is particularly clean in the case of New Zealand," suggesting that "even the (arguably) most rule oriented of all the IT central banks apparently still exercises a great deal of judgment in setting policy" (p. 104).

Finally, Kuttner investigates the usefulness of the policy-rule framework for analyzing policy by estimating the correlation between the forecast inflation gap and the forecast change in the output gap. Kuttner shows that under pre-commitment (history dependence) this correlation will be positive "under the assumption of a backward-looking inflation process" and negative if the inflation process is forward looking. The correlation is estimated at four-quarter and eight-quarter horizons. In all but one case the correlation is negative, and the positive correlation is not statistically significant. The results under discretion were even less supportive for forward-looking policy. Kuttner notes that his

generally negative results "will come as no surprise to those familiar with the practice of IT." He also notes that "the lack of a sharp, qualitative difference between the Fed's behavior and that of the inflation targeters will probably do little to alter the priors of skeptics…who contend the policy makes little practical difference" (p. 107).

In her discussion, Monika Piazzesi applauds Kuttner's innovative use of central bank forecasts to estimate policy rules. She gives two reasons for being excited about looking at central bank projections that Kuttner did not mention. First, she notes that there is a great deal of uncertainty about the appropriate inflation measure to use. She observes that using central bank projections eliminates this problem and a host of others—if a central bank publishes projections of inflation and output "for different horizons, k, the only question is what horizon k to pick to estimate the policy rule. But picking k seems easy compared with the host of other problems that we run into otherwise" (p. 114). She then notes that if central bank projections of these variables are the "right" measure of the current belief of the central bank about these variables, "we may be able to estimate policy rules that are stable functions of the projection data" (p. 114).

She also suggests that projections might be used to investigate "what a model of the economy that gives rise to these projections would look like." For example, she suggests that it would be useful to know if these projections are biased, if they can be forecast with macroeconomic variables, if the projection errors are serially correlated, etc. She then suggests that the projection data might be used to distinguish whether the central bank has private information that is used in making policy decisions, and the extent to which central bank information is reflected in financial markets.

Pointing out that the Fed's Green Book forecasts are not necessarily the FOMC's forecasts, she cautions that "projection numbers may not be the numbers that ultimately influence policy decisions" (p. 115). Finally, she observes that central banks "may have incentives to distort there projection numbers," noting that inflation projections for IT central banks may play roles similar "to earnings projections by private firms" (p. 115).

Policymakers' Views on IT

While our panelists share the view that maintaining low and stable inflation has beneficial consequences for the real economy, they differed considerably on the desirability of IT. Of our three panelists, the most pro-IT was Ben Bernanke. In an apparent endorsement of Greenspan's belief in synergies between inflation and economic stabilization, Bernanke argued that "the Fed has built strong credibility as an inflation-fighter…and that this credibility has allowed the Fed to be relatively flexible in responding to short-run disturbances to output and employment without destabilizing inflation expectations" (p. 165). Despite these gains, Bernanke suggests "an incremental move toward inflation targeting" that "might help the Fed communicate better and perhaps improve policy decisions as well" (p. 165).

Specifically, Bernanke proposed that the FOMC announce a long-run inflation rate (OLIR)—the inflation rate the FOMC believes "achieves the best average economic performance over time with respect to *both* the inflation and output objectives" (p. 166). Recognizing that one of the impediments to adopting IT by the United States is the concern (expressed by several conference participants) that such a move would reduce the flexibility of policy to pursue other economic stabilization objectives, Bernanke recommends that in introducing the OLIR the FOMC should state that

> the FOMC regards this inflation rate as a long-run objective only and sets no fixed time frame for reaching it. In particular, in deciding how quickly to move toward the long-run inflation objective, the FOMC will always take into account the implications for near-term economic and financial stability. (p. 167)

Arguing that announcing the OLIR would not have "significant costs," Bernanke addresses the question: What are the benefits? Bernanke suggests five. First, "the announcement of the OLIR should serve as a useful clarification of the long-run objective of the Fed and would thereby provide a long-run 'anchor' to monetary policy." Second, "the OLIR should help participants in financial markets price long-term bonds and other financial assets more efficiently." Third, establishing the OLIR should "help to lower inflation risk in financial markets and other forms of contracting." Fourth, consistent with the synergies vision, it will "tend to stabilize long-term inflation expectations more broadly, which in turn would make short-run stabilization policy more effective." Finally, Bernanke notes that "although the announcement of the OLIR would not constrain

short-run policymaking in undesirable ways, it would nevertheless also help the market make inferences about the likely timing and extent of tightening and easing cycles, since, all else equal, the FOMC would want the inflation rate to move 'asymptotically' toward the long-run desired level" (p. 167). Bernanke also notes that the OLIR "would also serve as a reminder to policymakers to keep one eye on the long run at the same time that they are reacting to current developments in the economy" (p. 167).

Noting that "sharing the OLIR with the public would address the most important information asymmetry in the system: namely, the public's imperfect knowledge of the FOMC's objectives," Bernanke suggests that the OLIR be a "single number" and not a range (p. 168).

Finally, addressing the issue of the political feasibility of IT for the United States, Bernanke suggests that "the change of the type I am proposing would be acceptable to Congress as being within the spirit of existing legislation." To enhance that prospect, Bernanke suggests

> The FOMC might say to Congress: "We don't want long-run inflation to be too high, because low inflation promotes growth and productivity. On the other hand, inflation shouldn't be too low, because we want to have all the room we need to respond to the dangers that deflation poses for output and employment. We pose the objective in terms of inflation only because that is what the Fed can control in the long run." (p. 168)

Benanke's colleague on the Board of Governors, Don Kohn, undertakes a similar analysis, but arrives at a different conclusion. Kohn agrees that "price stability—or its approximation at very low inflation—is the appropriate primary long-term objective of monetary policy, and achieving this objective is the way that policy can best contribute to the long-term welfare of the country" (p. 179). Nevertheless, he suggests that "adopting IT, even in its softer versions, would be a slight shift along the continuum of constrained discretion in the direction of constraint, and the benefits of such a shift are unlikely to outweigh its costs" (p. 179).

Kohn suggests that the adoption of an explicit long-run inflation objective "would result in less-than-optimal attention being paid to stabilizing the economy and financial markets," because "IT implies putting higher priority on hitting a particular inflation objective over the intermediate run than the Federal Reserve has done" (p. 180). To illustrate this point, he cites the "opportunistic disinflation period" from 1983 to 1997, a period when "the Federal Reserve was well aware that inflation was running above levels consistent with price stability but concentrated on keeping inflation from rising, not on reducing it" (p. 180). He notes that the Fed's "broader focus was especially evident in the reaction to the threat to financial stability in the fall of 1998 and in the very aggressive easing in early 2001" (p. 180). Kohn notes that "such responses would in theory be available under flexible IT," but wonders "what would happen in practice."

As for the benefits of IT, Kohn notes that "the bulk of studies show that interest rates and inflation are no more predictable in IT economies," and suggests that "the burden of proof should be on the advocates of IT to show that it would improve economic performance in non-IT economies—by providing either greater cyclical stability or better resource allocation" (p. 180).

Echoing concerns raised by Meyer, Friedman, and others, Kohn notes that for flexible ITers "communication tends to be clear but not especially transparent": "Those other goals are the tough messy stuff that does not fit into the IT framework very well" (p. 181). In apparent agreement with Ben Friedman that "words matter," Kohn notes "There is also a risk that communication will drive policy, and so those (other) goals end up with less-than-optimal attention" (p. 181). In the end, in contrast with Bernanke, Kohn concludes

> IT is not a cure-all for communication problems…it might not even help much in the markets where it really counts, and that if simplicity of communications drives policy, IT might lead to inferior economic outcomes. (p. 181)

As for the politics of IT, Kohn notes that

> unlike most other central banks, which operate in a parliamentary system, we do not have a "government" to interact with… If we moved toward setting a goal for ourselves, *perhaps even if we just defined price stability*, we would need to consult carefully with both houses of the Congress and the Administration and would need to judge what, short of legislation, constituted a veto by any of the people with whom we were consulting. This process would be subtle and difficult—but absolutely essential to

> protect our independence and preserve our democratic legitimacy. (p. 181, emphasis added)

With respect to the idea of defining price stability—"publishing a number or reference range that makes more concrete our long-term inflation objective, without making a commitment to achieve that objective in any given time frame"—Kohn notes that he is still trying to make up his mind "on the balance of costs and benefits of taking this step" (p. 181). Nevertheless, he expresses skepticism of the benefits and suggests that the costs are associated with "any tendency for this definition to morph into a target that unnecessarily constrains actions" and notes that "the pressure to elevate price stability over economic stability…would be accentuated by the fact that the latter goal would not have a numerical value."

In the final analysis Kohn concludes that

> those who propose changes from a good system have a high burden of proof. The marginal benefits from improving a good regime, by definition, are not likely to be high. And any change must deal with the uncertainties created by the law of unintended consequences. I have yet to be convinced that for the United States inflation targeting has jumped those hurdles. (p. 183)

Otmar Issing is also skeptical of the benefits of IT. After a careful analysis of the major developments in our understanding of the effectiveness of monetary policy since the 1960s, Issing notes that the "consensus view" is that the management of monetary policy should be delegated to an "independent central bank" and that policymakers should "treat the natural rate of unemployment as a given, and not try to push unemployment below its natural rate" (p. 170). He also notes that

> The awareness of the limitations of monetary policy was also coupled with a better understanding of the possible costs of inflation and the recognition that a low-inflation environment is a necessary precondition for long-run growth and an efficient allocation of resources. (p. 170)

While acknowledging that IT has been successful—particularly "for countries starting from high levels of inflation"—he notes that other central banks have shown that "success in the management of monetary policy is not confined to inflation-targeting central banks" (p. 171). This stems, in part, from the adoption of the consensus view of the necessity of maintaining a low-inflation environment. Defining IT as a "monetary policy framework that accords overriding importance to the maintenance of price stability," Issing suggests that IT "offers no practical guidance for the conduct of monetary policy beyond identifying the primary objective" and "from a scientific perspective…imposes few empirically testable restrictions on the implementation of monetary policy" (p. 171).

Consequently, Issing focuses his remarks on a narrower definition of IT consistent with a "monetary policy framework based on the adoption of a monetary policy rule in which forecasts of future inflation play a central role, either in the form of the so-called instrument rules or of target rules" (p. 171). Issing argues a major drawback of instrument rules is that inflation forecasts are not "sufficient statistics on the state of the economy" necessary for the conduct of monetary policy (p. 173). He then notes that

> Even in an ideal world in which the models producing the forecast are properly specified, the policymakers are not interested in the result of the forecast per se but instead aim at a consistent economic picture—or, to put it differently, they aim at identifying the relevant shocks underlying the forecasts and how different types of disturbances to the economy imply different kinds of policy responses. The relation between forecasts and underlying shocks is clearly one-to-one in many simple stylized models used in the monetary policy literature, but this relation clearly breaks down once we depart from that simple set-up. So, once again, forecasts of a few macrovariables cannot be sufficient as statistics to determine monetary policy action. (p. 173)

Issing notes that target rules are immune from this problem because they generate output and inflation forecasts that are consistent with the minimization of the proper loss function. He notes, however, that models underlying most targeting rules "neglect any role that might be played by the monetary aggregate or financial frictions in the determination of price developments" (p. 173). Moreover, after suggesting that "model misspecification is something that economists and econometricians have some difficulty acknowledging," Issing notes that "most advocates of inflation targeting…ulti-

mately rely on a view of the economy whose essence can be captured by no more than three equations… with monetary quantities playing no role" (p. 173). While noting that some economists regard such models as "internally consistent and elegant," Issing argues that because "it rests upon what can certainly be regarded as extreme assumptions about the role of money in the economy…a central bank can legitimately question the usefulness of [such] a model for monetary policy-setting" (p. 174).

Furthermore, apparently following up on his earlier observation that "the structure of the economy changes over time in a way that is difficult to anticipate and perceive in real time…makes the debate on the aims of monetary policy and its appropriate framework so difficult to settle" (p. 169), Issing notes that "there are instances that standard macroeconomic models, which, by definition, are constructed to replicate normal conditions and regularities in the economy, cannot capture and incorporate" (p. 176). Issing notes that on such occasions, "careful judgment" and "consideration of non-standard indicators and different interpretations of the evidence become especially relevant" (p. 176).

In the end, Issing concludes that "there is no clear-cut evidence to suggest that generally, and according to some well-specified criteria, one specific framework should be preferred to all others." He argues that the success of the United States and the euro area confirm "something that I have always believed: there is no 'single' or 'best' way to conduct monetary policy and that different approaches or frameworks can lead to successful policies and/or be better adapted to different institutional, economic, and social environments" (p. 177).

Over the past two decades, a number of central banks have adopted explicit inflation targeting as a framework for conducting monetary policy. Further, there is an active debate, perhaps most notably in the United States, regarding whether non-IT central banks should adopt the practice. The conference proceedings address the core issues surrounding the potential benefits, drawbacks, and feasibility of IT adoption, providing evidence from both a theoretical and empirical perspective. The authors, discussants, and panelists have provided a wealth of useful information to inform the debate over IT.

Inflation Targeting and Optimal Monetary Policy

Michael Woodford

Since the early 1990s, an increasing number of countries have adopted explicit inflation targets as the defining principle that should guide the conduct of monetary policy. This development is often credited with having brought about substantial reductions in both the level and variability of inflation in the inflation-targeting countries, and is sometimes argued to have improved the stability of the real economy as well.[1]

Inflation-forecast targeting, as a systematic decision procedure for the conduct of monetary policy, was developed at central banks like the Reserve Bank of New Zealand, the Bank of Canada, the Bank of England, and the Bank of Sweden on a trial-and-error basis, with little guidance from the academic literature on monetary policy rules. But the growing popularity of inflation targeting has more recently led to an active literature that seeks to assess the desirability of such an approach from the standpoint of theoretical monetary economics. This literature finds that an optimal policy regime—one that could have been designed on a priori grounds to achieve the highest possible degree of social welfare—might well be implemented through procedures that share important features of the inflation-forecast targeting that is currently practiced at central banks like those just mentioned. At the same time, the normative literature finds that one ought, in principle, to be able to do better through appropriate refinement of the practices developed at these banks.

Here I survey some of the most important conclusions of this literature. I shall begin by reviewing some of the respects in which inflation targeting as currently implemented represents a step toward what the theory of optimal monetary policy would recommend. In the final section of the paper, I then summarize some of the more important respects in which an optimal policy regime would go beyond current practice. Finally, as a concrete illustration of some of the general remarks that have been made about the form of an optimal policy rule, in an appendix I briefly discuss the quantitative character of optimal policy in the context of the small econometric model for the United States presented in Giannoni and Woodford (forthcoming).

1. ADVANTAGES OF AN EXPLICIT TARGET FOR MONETARY POLICY

Discussions of the desirability of inflation targeting for one country or another are often at cross purposes because of differing implicit assumptions about precisely what inflation targeting would mean. It is thus perhaps useful to be clear from the outset about what I regard to be the defining features of the approach to the conduct of policy with which I am concerned. Probably the most critical feature is the existence of a publicly announced, quantitative target that the central bank is committed to pursue, the pursuit of which structures both policy deliberations within the central bank and communications with the public. As should become clear from the discussion below, it is more important in my view that there should be an explicit *target* for policy than that it should be (in any strict sense) an *inflation* target. In my view, the most distinctive and most important achievement of the inflation-targeting central banks has not been the reorientation of the goals of monetary policy toward a stronger emphasis on controlling inflation—this has occurred, but it has been a worldwide trend over the past two decades, neither limited to nor even necessarily

[1] For surveys of early experiences with inflation targeting, see Leiderman and Svensson (1995) and Bernanke et al. (1999). King (forthcoming) offers an optimistic assessment of the improvements made in the conduct of monetary policy in the United Kingdom under inflation targeting. For a more skeptical review of the lessons that can be gleaned from experience to date, see Ball and Sheridan (forthcoming).

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most associated with the innovators in inflation targeting, and has hardly required a fundamental change in the traditional concerns of central bankers—but rather the development of an approach to the conduct of policy that focuses on a clearly defined target, that assigns an important role to quantitative projections of the economy's future evolution in policy decisions, and that is committed to a high degree of transparency as to the goals of policy, the decisions that are made, and the principles that guide those decisions.

It is useful to begin by discussing why it is desirable for a central bank to commit itself to an explicit target as the goal of its policy. The proposal that banks should do so runs contrary to a common instinct of central bankers, according to which it is wise to say as little as possible in advance about what one may do in the future. Because central banking is a complex task, the argument goes, any explicit target or policy rule would prove to be a straightjacket, preventing the full exercise of the judgment of central bankers on behalf of society when unanticipated circumstances arise, as they invariably do. Furthermore, even if a formula could be developed that would adequately describe what a good central banker should do, announcing it publicly would only invite second-guessing by the public and politicians of policy decisions that are best left in the hands of professionals. The best approach, then, is to delegate the task to the best possible people, grant them full discretion, and require as little public comment as possible on the way they practice their arcane art.

But while it is true that central banking is complex, reasoning of this kind misses a fundamental point about the kind of problem that a central bank is called upon to solve. Central banking is not like steering an oil tanker, or even guiding a spacecraft, that follows a trajectory that depends on constantly changing factors, but that does *not* depend on the vehicle's own expectations about where it is heading. Because the key decisionmakers in an economy are forward-looking, central banks affect the economy as much through their influence on *expectations* as through any direct, mechanical effects of central bank trading in the market for overnight cash. As a consequence, there is good reason for a central bank to commit itself to a systematic approach to policy that not only provides an explicit framework for decisionmaking within the bank, but that is also used to explain the bank's decisions to the public.

1.1 Central Banking as Management of Expectations

One important advantage of commitment to an appropriately chosen *policy rule* is that it facilitates public understanding of policy. It is important for the public to understand the central bank's actions, to the greatest extent possible, not only for reasons of democratic legitimacy—though this is an excellent reason itself, given that central bankers are granted substantial autonomy in the execution of their task—but also in order for monetary policy to be most effective. For not only do expectations about policy matter, but, at least under current conditions, very little *else* matters. Few central banks of major industrial nations still make much use of credit controls or other attempts to directly regulate the flow of funds through financial markets and institutions. Increases in the sophistication of the financial system have made it more difficult for such controls to be effective, and in any event the goal of improvement of the efficiency of the sectoral allocation of resources stressed above would hardly be served by such controls, which (if successful) inevitably create inefficient distortions in the relative cost of funds to different parts of the economy.

Instead, central banks restrict themselves to interventions that seek to control the overnight interest rate in an interbank market for central bank balances (for example, the federal funds rate in the United States). But the current level of overnight interest rates *as such* is of negligible importance for economic decisionmaking; if a change in the overnight rate were thought to imply only a change in the cost of overnight borrowing for that one night, then even a large change (say, a full percentage point increase) would make little difference to anyone's spending decisions. The effectiveness of changes in central bank targets for overnight rates in affecting spending decisions (and hence ultimately pricing and employment decisions) is wholly dependent upon the impact of such actions upon other financial-market prices, such as longer-term interest rates, equity prices, and exchange rates. These are plausibly linked, through arbitrage relations, to the short-term interest rates most directly affected by central-bank actions; but it is the expected future path of short-term rates over coming months and even years that should matter for the determination of these other asset prices, rather than the current level of short-term rates by itself.

Thus the ability of central banks to influence expenditure, and hence pricing, decisions is critically dependent upon their ability to influence market expectations regarding the *future path* of overnight interest rates and not merely their current level. Better information on the part of market participants about central bank actions and intentions should increase the degree to which central bank policy decisions can actually affect these expectations, and so increase the effectiveness of monetary stabilization policy. Insofar as the significance of current developments for future policy are clear to the private sector, markets can to a large extent "do the central bank's work for it," in that the actual changes in overnight rates required to achieve the desired changes in incentives can be much more modest when expected future rates move as well.[2]

The importance of being able to influence expectations about future policy through means other than the announcement of a new operating target for the overnight interest rate becomes especially clear when the zero lower bound on nominal interest rates prevents further interest-rate cuts, in an environment where aggregate nominal expenditure is nonetheless too low. This is the situation that Japan has faced for more than four years now, and recently there has been considerable discussion in the United States as well as to whether the Fed is not nearly "out of ammunition" with which to fight a possible threat of deflation. The key to avoiding deflation and economic contraction under such circumstances, as Eggertsson and Woodford (2003) show, is to be able to credibly commit to looser monetary policy in the future.[3] This requires explicit discussion of the way in which policy will be conducted in the future; furthermore, Eggertsson and Woodford show that the kind of commitment that is needed can be best expressed in terms of a commitment to a form of *price-level target*, which the central bank is committed to eventually hitting, even if the zero bound requires the target to be undershot for some period of time. While one might alternatively imagine a direct commitment regarding the length of time for which interest rates will remain low, the optimal continuation time will depend on how real conditions in the economy develop (that cannot yet be perfectly foreseen); it is thus easier to explain the kind of commitment that is actually appropriate by explaining the target that will have to be met in order for the zero interest-rate policy to be abandoned.

The existence of an explicit target for policy has similar advantages under more ordinary circumstances as well. An obvious consequence of the importance of managing expectations is that a transparent central-bank decisionmaking process is highly desirable. This has come to be widely accepted by central bankers over the past decade. (See Blinder et al., 2001, for a detailed and authoritative discussion.) But it is sometimes supposed that the most crucial issues are ones such as the frequency of press releases or the promptness and detail with which the minutes of policy deliberations are published. Instead, from the perspective suggested here, what is important is not so much that the central bank's deliberations themselves be public, as that the bank give clear signals about what the public should expect it to do in the future. The public needs to have as clear as possible an understanding of the rule that the central bank follows in deciding what it does. Inevitably, the best way to communicate about this will be by offering the public an explanation of the decisions that have already been made; the bank itself would probably not be able to describe how it might act in all conceivable circumstances, most of which will never arise.

The *Inflation Reports* of the leading inflation-targeting central banks provide good practical examples of communication with the public about the central bank's policy commitments. These reports do not pretend to give a blow-by-blow account of the deliberations by which the central bank reached the position that it has determined to

[2] There is evidence that this is already happening, as a result of both greater sophistication on the part of financial markets and greater transparency on the part of central banks, the two developing in a sort of symbiosis with one another. Blinder et al. (2001, p. 8) argue that, from early 1996 through mid-1999, one could observe the U.S. bond market moving in response to macroeconomic developments that helped to stabilize the economy, despite relatively little change in the level of the federal funds rate; furthermore, they suggest that this reflected an improvement in the bond market's ability to forecast Fed actions before they occur. Statistical evidence of increased forecastability of Fed policy by the markets is provided by Lange, Sack, and Whitesell (2001), who show that the ability of Treasury bill yields to predict changes in the federal funds rate some months in advance has increased since the late 1980s.

[3] The basic point about the importance of commitment regarding future policy was first made by Krugman (1998); Eggertsson and Woodford (2003) present a fully dynamic analysis and characterize the optimal policy commitment in an optimizing model with staggered price-setting. The conclusion obtained by Auerbach and Obstfeld (2003) is not fundamentally different: In their analysis, it is actually only the expected money supply at the time of exit from the liquidity trap that matters, so that open market operations while in the trap are effective only to the extent that they are understood as implying a commitment to a higher money supply *after* the zero bound ceases to bind.

announce; but they do explain the *analysis* that justifies the position that has been reached. This analysis provides information about the bank's systematic approach to policy by illustrating its application to the concrete circumstances that have arisen since the last report; and it provides information about how conditions are likely to develop in the future through explicit discussion of the bank's own projections. Because the analysis is made public, it can be expected to shape future deliberations; the bank knows that it should be expected to explain why views expressed in the past are not later being followed. Thus a commitment to transparency of this sort helps to make policy more fully rule-based, as well as increasing the public's understanding of the rule.

It might be argued that it should be enough for a central bank to *follow* a systematic rule in its conduct of policy, without also needing to explain it to the public. If one assumes rational expectations on the part of the public, it would follow that the systematic pattern in the way that policy is conducted should be correctly inferred from the bank's observed behavior. Yet while it would be unwise to choose a policy whose success depends on its *not* being understood by the public—which is the reason for choosing a policy rule that is associated with a desirable rational expectations equilibrium—it is at the same time prudent not to rely too heavily on the assumption that the public will understand policy perfectly regardless of the efforts that are made to explain it. Insofar as explanation of the policy rule to the public does no harm under the assumption of rational expectations, but improves outcomes under the (more realistic) assumption that a correct understanding of the central bank's policy commitments does not occur automatically, then it is clearly desirable for the central bank to explain the rule that it follows.

The advantages of a public target when the private sector must otherwise forecast future policy by extrapolating from experience are shown in a recent analysis by Orphanides and Williams (forthcoming). In the Orphanides-Williams model, private agents forecast inflation using a linear regression model, the coefficients of which are constantly reestimated using the most recent observations of inflation. The assumption of forecasting in this manner (on the basis of a finite time-window of historical observations), rather than a postulate of rational expectations, worsens the trade-off between inflation variability and output-gap variability that is available to the central bank. Allowing inflation variations in response to "cost-push" shocks for the sake of output-gap stabilization is more costly than it would be under rational expectations, because temporary inflation fluctuations in response to the shocks can be misinterpreted as indicating different inflation objectives on the part of the central bank. Orphanides and Williams then show that a credible commitment to a long-run inflation target—so that private agents do not need to estimate the long-run average rate of inflation, but only the dynamics of transitory departures from it—allows substantially better stabilization outcomes, though still not quite as good as if private agents were to *fully* understand the equilibrium dynamics implied by the central bank's policy rule. This provides a nice example of theoretical support for the interpretation given by Mervyn King (forthcoming) and others of practical experience with inflation targeting, which is that tighter anchoring of the public's inflation expectations has made possible greater stability of *both* real activity and inflation.

1.2 Avoiding the Pitfalls of Discretionary Policy

There is also a further, somewhat subtler, reason why explicit commitment to a target or policy rule is desirable, given the forward-looking behavior of the people in the economy that one seeks to stabilize. It is not enough that a central bank have sound objectives (reflecting a correct analysis of social welfare); that it make policy in a systematic way, using a correct model of the economy and a staff that is well-trained in numerical optimization; and that all this be explained thoroughly to the public. A bank that approaches its problem as one of optimization under *discretion*—deciding afresh on the best action in each decision cycle, with no commitment regarding future actions except that they will be the ones that seem best in whatever circumstances may arise—may obtain a substantially worse outcome, from the point of view of its own objectives, than a bank that commits itself to follow a properly chosen policy *rule*. As Kydland and Prescott (1977) first showed, this can occur even when the central bank has a correct quantitative model of the policy trade-offs that it faces at each point in time, and the private sector has correct expectations about the way that policy will be conducted.

At first thought, discretionary optimization might seem exactly what one would want an enlightened central bank to do. All sorts of unexpected events

constantly occur that affect the determination of inflation and real activity, and it is not hard to see that, in general, the optimal level of interest rates at any point in time should depend on precisely what has occurred. It is plainly easiest, as a practical matter, to arrange for such complex state-dependence of policy by having the instrument setting at a given point in time be determined only after the unexpected shocks have already been observed. Furthermore, it might seem that the dynamic programming approach to the solution of intertemporal optimization problems provides justification for an approach in which a planning problem is reduced to a series of independent choices at each of a succession of decision dates.

But standard dynamic programming methods are valid only for the optimal control of a system that evolves mechanically in response to the current action of the controller. The problem of monetary stabilization policy is of a different sort, in that the consequences of the central bank's actions depend not only upon the sequence of instrument settings up until the present time, but also upon private-sector expectations regarding future policy. In such a case, sequential (discretionary) optimization leads to a suboptimal outcome because, at each decision point, prior expectations are taken as *given*, rather than as something that can be affected by policy. Nonetheless, the predictable character of the central bank's decisions, taken from this point of view, do determine the (endogenous) expectations of the private sector at earlier dates, under the hypothesis of rational expectations: A commitment to behave differently, that is made credible to the private sector, could shape those expectations in a different way; and because expectations matter for the determination of the variables that the central bank cares about, in general, outcomes can be improved through shrewd use of this opportunity.

The best-known example of a distortion created by discretionary optimization is the "inflation bias" analyzed by Kydland and Prescott (1977) and Barro and Gordon (1983). In the presence of a short-run "Phillips curve" trade-off between inflation and real activity (given inflation expectations) and a target level of real activity higher than the one associated with an optimal inflation rate (in the case of inflation expectations also consistent with that optimal rate), these authors showed that discretionary optimization leads to a rate of inflation that is inefficiently high on average, owing to neglect of the way that pursuit of such a policy raises inflation expectations (causing an adverse shift of the short-run Phillips curve). A commitment to an inflation target is one obvious way of eliminating the temptation of suboptimal behavior of this particular kind.

However, many central bankers would argue that they have absorbed the lesson of the Kydland-Prescott and Barro-Gordon models and are able to avoid systematically higher inflation than is desirable, without any need for advance commitments regarding future policy. For example, they may view themselves as using their discretion to minimize a loss function that differs from the ones assumed by Kydland and Prescott or Barro and Gordon in a way that eliminates the high predicted average rate of inflation in the Markov equilibrium associated with discretionary policy.

In response to this, it is important to note that the distortions resulting from discretionary optimization go beyond simple bias in the *average* levels of inflation or other endogenous variables; this approach to the conduct of policy generally results in suboptimal *responses to shocks* as well. For example, various types of real disturbances can create temporary fluctuations in what Wicksell called the "natural rate of interest," meaning that the level of nominal interest rates required to stabilize both inflation and the output gap varies over time (Woodford, 2003, Chap. 4). However, the amplitude of the adjustment of short-term interest rates can be more moderate—and still have the desired size of effect on spending and hence on both output and inflation—if it is made more *persistent*, so that when interest rates are increased, they will not be expected to quickly return to their normal level, even if the real disturbance that originally justified the adjustment has dissipated. Because aggregate demand depends upon expected future short rates as well as current short rates, a more persistent increase of smaller amplitude can have an equal affect on spending. If one also cares about reducing the volatility of short-term interest rates, a more inertial interest-rate policy of this kind will be preferable; that is, the anticipation that the central bank will follow such a policy leads to a preferable rational-expectations equilibrium (Woodford, 1999a; 2003, Chap. 7). But a central bank that optimizes under discretion has no incentive to continue to maintain high interest rates once the initial shock has dissipated; at this point, prior demand has already responded to whatever interest rate expectations were held then, and the bank has no reason to take into account any effect upon demand at an earlier date in setting its current interest rate target.

This distortion in the dynamic response of interest rate policy to disturbances cannot be cured by *any* adjustment of the way in which alternative possible future paths for the economy are ranked (assuming that the ranking depends only on the future paths of inflation and other welfare-relevant variables); instead, policy must be made *history-dependent*, i.e., dependent upon past conditions even when they are no longer relevant to the determination of the current and future evolution of the variables that the bank cares about. In general, no *purely forward-looking* decision procedure—one that makes the bank's action at each decision point a function solely of the set of possible paths for its target variables from that time onward—can bring about optimal equilibrium responses to disturbances. Discretionary optimization is an example of such a procedure, and it continues to be when the bank's objective is modified, if the modified policy objective still involves only the future values of the welfare-relevant variables. A commitment to use policy to achieve a pre-specified *target*, instead, can solve this problem if the target is defined in a way that incorporates the proper history-dependence.[4]

The advantages of an explicit target in solving this kind of problem are especially clear in the case of a binding zero lower bound on interest rates, as discussed by Eggertsson and Woodford (2003). When the natural rate of interest is temporarily negative, the zero bound may prevent stabilization of inflation and the output gap at their desirable long-run average levels, as such an equilibrium would require a temporarily negative nominal interest rate. The key to preventing an undesirably sharp deflation and economic contraction is to convince people that the price level will eventually be raised, rather than being stabilized at whatever level it may fall to in the period during which the zero bound binds. A central bank that is expected to optimize under discretion will *not* be expected to subsequently undo the price decline that occurs during the "liquidity trap" because the absolute level of prices is not welfare-relevant; it will therefore simply stabilize inflation and the output gap once this again becomes possible, accepting whatever level of prices happens to exist at that time. A commitment in advance to the achievement of a price level target—a target that is not allowed to shift down even if actual prices undershoot it for many quarters in a row, owing to the zero bound[5]—will instead create expectations of the right sort. The farther prices fall while the economy is in the "trap," the greater the expected future price increases will be; and this automatic increase in expected inflation will tend to prevent prices from falling very far, or demand from contracting very much, in the first place.

It is furthermore desirable not simply that a central bank have a private intention of this sort, but that it be publicly committed to such a target. First, a public commitment is likely to make it easier for the central bank's policy deliberations to remain focused on the right criterion—the criterion with the property that systematic conformity to it leads to an optimal equilibrium—rather than being tempted to "let bygones be bygones." And second, the benefits associated with commitment to a history-dependent policy depend entirely on this aspect of policy being *anticipated* by the private sector; otherwise, it *would* be rational to "let bygones be bygones." There is no point to a secret commitment to the future conduct of policy in accordance with a history-dependent rule while the private sector continues to believe that the central bank will act in a purely forward-looking fashion; thus the target should be explained as clearly as possible to the public and shown to be guiding the bank's decisions.

1.3 Targeting Procedures as Policy Rules

It follows from the above discussion that there are important advantages to a central bank's commitment to conduct policy in accordance with a rule that can be explained to the public in advance. I turn now to the advantages of the particular type of rule that is followed by the inflation-targeting central banks. This is a rule under which the central bank's commitment is defined by a *target* for certain variables at a certain distance in the future, together with a commitment to organize deliberations about policy actions around the question of whether the contemplated actions are consistent with the target.

Much of the theoretical discussion of "rules versus discretion" since the seminal contribution of Kydland and Prescott (1977) has supposed that the conduct of policy in accordance with a "rule" would mean something rather different from this.

[4] The kind of modified inflation target that leads to optimal responses to the kinds of fluctuations in the natural rate of interest described above is derived in Giannoni and Woodford (forthcoming, Section 1.3).

[5] As Eggertsson and Woodford (2003) show, under an optimal policy the price-level target would actually shift *up* in response to the target misses during the period in which the zero bound is binding, and to a greater extent the greater the target misses and the longer they persist.

On the one hand, an important branch of the literature on policy rules has emphasized the importance of limiting central bank discretion, in the sense of any scope for the exercise of judgment as to the nature of current conditions. A rule is then considered, by definition, to be a prescription of a fairly mechanical type, the dictates of which are unambiguous; it cannot pretend to allow optimal responses to all of the different types of shocks that an economy may face, and indeed it is often asserted that adherence to a rule means abandoning any concern for the stabilization of real variables. Inflation forecast targeting as actually practiced is nowhere as rigid a framework as this; in particular, projections of the economy's future evolution under alternative possible actions play a central role in policy deliberations, and these projections, even when disciplined by the use of a quantitative model, allow a rich range of information about current conditions to be taken into account in a way that could not be easily specified in advance by a computer program.

Alternatively, another branch of the literature identifies "commitment" with a once-and-for-all choice (at some initial date) of an optimal state-contingent plan for the central bank, which is implemented afterward by simply observing the state of the world each period and executing the instrument setting called for at that date and in that state. Under the conception of rule-based policy in this literature, the central bank may in principle pay attention to disturbances of all sorts; but there is no role in a specification of the policy commitment for any mention of *targets* for variables other than the instrument of policy itself (i.e., for anything besides a state-contingent *operating target* for the overnight interest rate).

The type of rule actually followed, at least in principle, by central banks like the Bank of England is a policy rule of a different sort. Svensson (1999, 2003a) defines a *targeting rule* as a commitment to adjust the bank's policy instrument as necessary to ensure that at each decision point the economy's future evolution is still projected to satisfy a certain *target criterion*. For example, in the case of the Bank of England, the target criterion is that CPI inflation should be projected to equal 2 percent per annum at a horizon eight quarters in the future.[6] This is a "higher-level" specification of a policy rule than the kind generally considered in the two literatures just referred to, since it leaves unspecified precisely what policy actions will be required in any given circumstance to conform to the rule. Implementation of the policy is only possible using a model of the economy (likely to be supplemented, in practice, by judgmental adjustments on the part of the monetary policy committee [MPC]), with which projections of the economy's evolution under alternative hypothetical policy decisions can be constructed.

Commitment to a decision procedure of this kind has important advantages over both of the other two conceptions of a monetary policy rule.[7] Achievement of the advantages of policy commitment—in particular, avoidance of the inflationary bias of discretionary policymaking—does not require one to give up on stabilization policy. Not only may policy adjust in response to disturbances, but it may adjust differently to each of an uncountable number of different types of disturbances, the nature of which need not even be specifiable in advance.

This is also true, in principle, under the conception of a policy rule as a commitment to a prespecified state-contingent instrument path. But in practice one cannot imagine computing such an instrument rule in advance, and announcing one's commitment to it, unless one artificially assumes that the number of different types of disturbances that could occur is extremely limited. This is a highly limiting assumption, given that in order to compute in advance the optimal dynamic response to a given shock, it is necessary not simply to specify which equations of one's model that it perturbs, but also to give a detailed quantitative specification of the dynamics of the shock—exactly how persistent it is expected to be, how far in advance it can be predicted, and so on. Shocks of a given type—for example, variations in government spending owing to the outbreak of war—that differ in the degree to which they are unanticipated or the length of time for which they are expected to last imply different optimal adjustments of the policy instrument. Thus they must be treated as *different shocks* in a complete specification of the optimal state-contingent instrument rule.

Of course, one can specify a quantitative model of the economy with a fairly small number of inde-

[6] Before December 2003, the target criterion instead required that an alternative measure of inflation, RPIX inflation, equal 2.5 percent eight quarters in the future. For discussion of the role of this criterion in the conduct of monetary policy in the United Kingdom, see Vickers (1998) and Goodhart (2001).

[7] For further discussion, see Svensson (1999, 2003a), Svensson and Woodford (forthcoming), Giannoni and Woodford (2002), and Woodford (2003, Chap. 7).

pendent shocks (no more than the number of endogenous variables in the model) and estimate a joint stochastic process for those shocks using historical data. This method is often used, for example, in specifying the kind of stochastic model that is used for "stochastic simulation" exercises evaluating alternative simple policy rules. And it may well be possible to calculate a complete specification of the optimal state-contingent instrument path for such a model. But it would be highly unlikely for a central bank to be willing to commit itself to follow a rule simply because it has been shown to be optimal in such an exercise.

For central bankers always have a great deal of highly specific information about the kind of disturbances that have just occurred, which are always somewhat different from those that have been faced at other times. Hence even if it is understood that, "typically," disturbances to the level of military purchases have had a coefficient of serial correlation of 0.9 at the quarterly frequency, there will often be grounds to suppose that the conflict that is currently looming is likely to be either more persistent or less persistent than the "typical" one has been in the past. And it is unlikely that central bankers will be willing to commit themselves to stick rigidly to a rule that is believed to lead to outcomes that would be optimal in the case of "typical" disturbances, even in a case in which they are aware of the economy instead being subjected to "atypical" disturbances. For a proposed policy rule to be of practical interest, it must instead be believed that the rule is compatible with optimal (or at least fairly good) outcomes for the extremely large number of possible types of disturbances. Yet if one were to try to write out the optimal state-contingent instrument path, allowing separate terms for each of the possible (finely grained) types of disturbances that might actually be faced, such a description of optimal policy would be completely unwieldy.

Giannoni and Woodford (2002) instead show that if the central bank's policy commitment is described in terms of a relation among endogenous variables that the bank is committed to bring about—rather than in terms of a mapping from exogenous states to the instrument setting—it is possible, in a large class of policy problems, to find a rule that is *robustly optimal*, in the sense that the same rule (with given numerical coefficients) continues to be optimal regardless of the assumed statistical properties of the (additive) disturbance terms in the model. Indeed, the target criterion that the authors derive characterizes optimal policy even if the disturbance terms in the model structural equations are actually composites of an extremely large (not necessarily finite) number of different types of real disturbances. This is possible because (as illustrated in the next section) the optimal target criterion is derived from certain first-order conditions that characterize an optimal evolution of the economy, and these first-order conditions do not involve the additive disturbance terms in the structural relations.

A rule of this kind represents a policy commitment that a central bank could reasonably make, despite its awareness that it will constantly be receiving quite fine-grained information about current conditions. For a belief that the target criterion represents a sound basis for judging whether policy is on track does not require the central bank to believe that all shocks are alike, or even that all of the possible types of disturbances to which it may have to respond can all be listed in advance. At the same time, a public commitment to the target criterion tells the public in advance what it should expect with regard to the *outcome* to be achieved by policy. This is actually what the public most needs to be able to forecast well, and this is the aspect of the public's expectations that the central bank needs to influence, to achieve the benefits that are available in principle from policy commitment.

2. THE CASE FOR PRICE STABILITY

As noted above, the most important innovation of the inflation-targeting central banks, in my view, is the organization of policy deliberations around the achievement of an explicit target, quite apart from the type of target that happens to be chosen. But another distinctive feature of inflation targeting, of course, is that the target is for some measure of *inflation*; while control of inflation has always been an important concern of central bankers, inflation targeting has given special, and sometimes exclusive, emphasis to this goal, and debates about the desirability of inflation targeting are often primarily discussions of the desirability of such a strong emphasis on inflation. Here I review what the theory of optimal monetary policy has to say about this.

First of all, the modern (micro-founded) literature on the real effects of monetary policy provides ample justification for the conventional wisdom of central bankers—that it is better for inflation to be both low and stable. It has been understood for some time that *expected* inflation creates distortions by increasing the opportunity cost of holding (non-

interest-earning) money, leading to the inefficient use of real resources to economize on the use of money in transactions; this was the basis for the celebrated analysis of the optimal rate of inflation (which actually turned out to be mild deflation) by Friedman (1969).[8] However, models that incorporate some reason for prices to not adjust fully and instantaneously to changing market conditions—whether these involve infrequent price changes or simply slow updating of the information on which prices are being set—imply that unanticipated variations in the inflation rate create real distortions as well, by causing prices that adjust at different times (or that are being set on the basis of different information sets) to become misaligned with one another.

So price stability has important advantages, in helping the market mechanism to work more effectively. Still, should this stabilization objective be given priority over others, such as stabilization of real economic activity or employment? I shall argue, below, that it should not be an *absolute* priority; but the recent literature on the welfare consequences of alternative monetary policies finds that there is less tension between inflation stabilization and properly defined real stabilization objectives than the traditional (non-welfare-theoretic) literature on monetary stabilization policy has often suggested. It is not a bad first approximation to say that the goal of monetary policy should be price stability.

2.1 When Full Price Stability Is Optimal

Even when one grants that the economy is subject to exogenous real disturbances of many sorts—including various types of "supply shocks," i.e., disturbances that shift the "natural rate of output," the level of output that would occur in an equilibrium with fully flexible prices—it is possible for the optimal monetary policy to be one that maintains completely stable prices in the face of these disturbances and instead allows real activity to vary. In particular, this is true in a wide variety of "sticky price" or "sticky information" models (under varying assumptions about how many price-setters revise their prices or update their information in a given interval of time), as discussed in Woodford (2003, Chap. 6), where (i) the equilibrium fluctuations in the real allocation of resources *would* be optimal if only all prices were perfectly flexible and set on the basis of fully up-to-date information and (ii) there are only aggregate shocks, so that in a flexible-price equilibrium all goods would have the same price. These hypotheses allow for the existence of a wide range of types of real aggregate disturbances that should affect the natural rate of output—for example, exogenous variation in technology, in preferences regarding labor supply or impatience to consume, or in government purchases—though it does not allow for certain kinds of "supply shocks," such as variations in the degree of market power in labor or product markets, or variations in tax rates.

The basic intuition is fairly simple.[9] The deadweight losses due to relative price distortions can be completely eliminated, in principle, by stabilizing the aggregate price level. For the aggregate price level is stabilized by creating an environment in which suppliers who choose a new price (under full information) have no desire at any time to set a price different from the average of existing prices. Then (because the average price level never changes), the price desired by any supplier that reconsiders its price is always the same, regardless of the number of future periods for which the price is expected to remain fixed and regardless of how incomplete the supplier's information may be about current market conditions. All new prices are then always chosen to equal the average of existing prices, and as a result the average price never changes. And all goods prices must eventually equal that same, constant value, so that inefficient relative-price dispersion due to price stickiness or information imperfections will not exist.

Furthermore, in such an environment, the equilibrium real allocation of resources will be the same as if all prices were fully flexible and set under perfect information. For by hypothesis, in that case suppliers would also all choose a common price equal to the current price index. Since they are able to charge this price at all times despite the infrequency of their reconsideration of their prices or the limitations of the information that they can use in adjusting prices, neither the stickiness of prices nor that of information has any effect on equilibrium behavior. Since, by hypothesis, the equilibrium allocation of resources would be optimal under full information and full price flexibility, it is optimal under the monetary policy that fully stabilizes prices.

[8] Friedman's argument remains correct in the case of a wide range of different ways of modeling the source of the demand for money; see, e.g., Woodford (1990).

[9] It is presented in the case of a model of staggered pricing by Goodfriend and King (1997). The fact that a similar conclusion is obtained in the case of "sticky information" is illustrated by the analysis of Ball, Mankiw, and Reis (2003).

2.2 Qualifications

The conditions under which full price stability can be shown to be an optimal policy are in some respects quite general; for example, the conclusion does not depend on fine details of how many prices are set a particular time in advance or left unchanged for a particular length of time. Nonetheless, the conditions assumed above are quite special in other respects—at least as an exact description of reality—and it is likely that some degree of deviation from full price stability is warranted in practice. Some of the more obvious reasons for this are sketched here.

First of all, complete price stability may not be *feasible*. In the argument sketched above, I have supposed that it is possible to use monetary policy to maintain an environment in which a supplier with flexible prices and full information would never wish to change its price. Often there will exist a state-contingent path for short-term nominal interest rates consistent with such an equilibrium; it is shown in Woodford (2003, Chap. 4) that this requires that the interest rate track the Wicksellian *natural rate of interest*—the real rate of return that would prevail in an equilibrium with flexible prices and full information—which varies in response to real disturbances. However, it is possible that at some times (as a result of exogenous real disturbances of a particular sort) the natural rate of interest is temporarily negative; if so, there cannot be an equilibrium in which the nominal rate of interest is equal at all times to the natural rate, and hence no equilibrium in which inflation is zero at all times. As a result, a policy will have to be pursued that involves less volatility of the short nominal interest rate in response to shocks, and some amount of price stability will have to be sacrificed for the sake of this.

Varying nominal interest rates as much as the natural rate of interest varies may also be desirable as a result of the "shoe-leather costs" involved in economizing on money balances. As argued by Friedman (1969), the size of these distortions is measured by the level of nominal interest rates, and they are eliminated only if nominal interest rates are zero at all times. Taking account of these distortions—from which we have abstracted thus far[10]—provides another reason for the equilibrium with complete price stability, even if feasible, not to be fully efficient; for as Friedman argues, a zero nominal interest rate will typically require expected *deflation* at a rate of at least a few percent per year.

And taking account of these distortions affects more than the optimal *average* rate of inflation. As with distorting taxes, it is plausible that the deadweight loss resulting from a positive opportunity cost of holding money is a convex function of the relative price distortion, so that temporary increases in nominal interest rates are more costly than temporary decreases of the same size are beneficial. In short, monetary frictions provide a further reason to reduce the *variability* of nominal interest rates, even taking as given their average level. (At the same time, reducing their average level will require less variable rates, because of the zero floor.) Insofar as these costs are important, they too will justify a departure from complete price stability, in the face of any real disturbances that cause fluctuations in the natural rate of interest, to allow greater stability of nominal interest rates.

Yet while both of the factors just mentioned justify some departure from complete price stability, it is not clear that the volatility of inflation should be very great under an optimal policy, even when such factors are taken account of. For example, Rotemberg and Woodford (1997) characterize optimal policy for an estimated model of the U.S. economy, when a constraint that the mean federal funds rate must remain at least a certain number of standard deviations (greater than two) above zero is imposed as a substitute for the zero bound (that still allows a linear characterization of optimal policy). Even though the real disturbance processes in their model imply greater volatility of the natural rate of interest than many would assume (a standard deviation between 3 and 4 percentage points), they find that optimal policy involves an average rate of inflation only slightly greater than zero (11 basis points!) and not much variability of inflation (a standard deviation only 40 percent as large as the actual variability of U.S. inflation over their post-1980 sample period). Interest rates *are* smoothed considerably in the optimal policy, relative to what would be required to fully stabilize inflation, but this does not require too much variation in inflation, as their estimated model implies a variance trade-off that is quite flat near the extreme of full inflation stabilization.

[10] The hypothesis above that the equilibrium allocation of resources was efficient under flexible prices required, among other things, that transactions frictions of this kind be abstracted from. The economies referred to in the previous section are "cashless," or at least near-cashless economies, in which transactions frictions are unimportant. See Woodford (2003) for details.

For the same reason, taking account of the distortions created by high nominal interest rates in a model with transactions frictions justifies only a relatively modest degree of inflation variation for the sake of greater stability of nominal interest rates, at least if the transactions frictions are calibrated at an empirically realistic magnitude. Woodford (2003, Chap. 6) finds that when transactions frictions are calibrated to match facts about U.S. money demand, the penalty on nominal interest-rate variations that can be justified on welfare-theoretic grounds is a good bit smaller than the one assumed in Rotemberg and Woodford (1997). Hence in the case that the available trade-off between interest-rate variability and inflation variability is the one estimated by Rotemberg and Woodford, the degree of inflation variability that could be justified on this ground would be even smaller than in their paper.

Even apart from these grounds for concern with interest-rate volatility, the class of models for which full price stability is optimal is a special one in several respects. One obvious restrictive assumption in the argument sketched above is that there are assumed to be no shocks that would require the relative prices of any goods to vary over time in an *efficient* equilibrium (i.e., the shadow prices that would decentralize an optimal allocation of resources involve no variation in relative prices). If, instead, an efficient allocation of resources requires relative price changes, due to asymmetries in the way that different sticky-price commodities are affected by shocks, then full stabilization of a symmetric index of prices is not generally optimal, as shown by Aoki (2001) and Benigno (forthcoming) in the context of two-sector models with asymmetric disturbances.

Nonetheless, it may still be possible to define an *asymmetric* price index, with the property that stabilization of this index is optimal, at least a good approximation to optimal policy, as these authors show.[11] If the model is symmetric except for the frequency of adjustment of different types of prices, then the optimal price index to stabilize puts more weight on the prices of the goods with "stickier" prices; this provides a theoretical justification for targeting an appropriately constructed measure of "core" inflation, rather than a standard consumer price index. But as long as the price index to be stabilized is appropriately chosen, complete stabilization of a price index is found (in calibrated examples) to be nearly optimal.

Similarly, the analysis sketched above assumed flexibility of wages. While this is a familiar assumption in sticky-price models used for pedagogical purposes, many empirical models imply that wages are as sticky as prices, and possibly more so.[12] But real disturbances almost inevitably require real wage adjustments in order for an efficient allocation of resources to be decentralized. And if *both* wages and prices are sticky, it will then not be possible to achieve all of the relative prices associated with efficiency simply by stabilizing the price level—specifically, the real wage will frequently be misaligned, as will be the relative wages of different types of labor if these are not set in perfect synchronization.

In such circumstances, complete price stability may not be a good approximation at all to the optimal policy, as Erceg, Henderson, and Levin (2000) show. Nonetheless, one can show once again that stabilization of an appropriately weighted average of prices and wages may still be a good approximation to optimal policy; it is even fully optimal in special cases (Woodford, 2003, Chap. 6). Thus concerns of this kind are not so much reasons not to pursue price stability as they are reasons why care in the choice of the index of prices (including wages) that one seeks to stabilize may be important.

Finally, even when wages are flexible (or there are efficient labor contracts) and all disturbances have symmetric effects on all sectors of the economy, the flexible-price equilibrium level of output need not be welfare-maximizing. Both market power and the existence of distorting taxes imply that in reality, the equilibrium level of economic activity is likely to be too low on average.[13] When this is true, not only is the flexible-price equilibrium level of output different from the (first-best) optimal level, but except in special cases, real disturbances will not shift these two quantities to

[11] Benigno (forthcoming) applies this idea to an analysis of optimal stabilization objectives for a monetary union in which different regions are affected asymmetrically by real disturbances. In this application, the optimal inflation target for the monetary union does not necessarily put weights on the national inflation rates that are proportional to the shares of those country's products in the union-wide consumption basket.

[12] See, e.g., Amato and Laubach (2003), Christiano, Eichenbaum, and Evans (2001), Altig et al. (2002), Smets and Wouters (2002a,b), and Giannoni and Woodford (forthcoming).

[13] This does not occur in the model of Rotemberg and Woodford (1997), owing to the assumed presence of an output subsidy that offsets the consequences of the market power of the monopolistically competitive suppliers of differentiated goods.

quite the same extent (in percentage terms).[14] This means that the gap between the level of output associated with a policy that maintains stable prices (which is the same as the flexible-price equilibrium output, as explained above) and the optimal level of output will be time-varying. If we write the aggregate-supply relation as a relation between inflation and the welfare-relevant "output gap" (i.e., the gap between the actual and efficient levels of output), an additional exogenous "cost-push" term appears. As a consequence, it will not be possible to simultaneously stabilize inflation and the welfare-relevant output gap.[15]

Yet even so, the degree of variability of inflation under an optimal policy may be quite modest. This is because the relative weight that should be placed on the goal of output-gap stabilization, relative to the weight on inflation stabilization, may not be large. (This is illustrated in the welfare-based loss function for the model of Giannoni and Woodford, forthcoming, presented in the appendix.) There is a straightforward reason for this. In a variety of optimizing models with sticky prices, it is shown in Woodford (2003, Chap. 6) that the loss function that corresponds to a quadratic approximation to expected utility involves a relative weight on output-gap stabilization that is proportional to the coefficient on the output gap in the short-run aggregate-supply relation. This means that the same underlying microeconomic factors that lead to a relatively flat aggregate-supply relation—and thus imply that fluctuations in nominal aggregate demand have large effects on output relative to their effects on prices—*also* imply that the welfare losses associated with fluctuations in the level of aggregate real activity are small relative to the welfare losses that result from the misalignment of prices that are not adjusted with perfect synchronization when inflation varies.

It follows that, while the welfare-theoretic loss functions derived for the estimated models of Rotemberg and Woodford (1997) and Giannoni and Woodford (forthcoming) involve stabilization goals other than inflation stabilization, by far the largest coefficients are those on the inflation stabilization goal. Given this, optimal policy will still be focused to an important degree on inflation stabilization. While the considerations sketched in this section give one ample reason to consider the consequences of monetary policy for the evolution of variables other than inflation, it will nonetheless make sense to think of the optimal policy rule as a "flexible inflation targeting rule."

3. IMPROVING THE PRACTICE OF INFLATION-FORECAST TARGETING

I turn now to some ways in which an optimal forecast-targeting procedure for the conduct of monetary policy, from the perspective of the theoretical literature summarized above, would differ from inflation-forecast targeting as it is currently practiced by the central banks that have led the way in developing this approach to monetary policy. Of course, the precise details of an optimal procedure depend on the details of one's model of the monetary transmission mechanism, and it can hardly be argued that there is yet a consensus about the correct model to use for one country, let alone a model that can be claimed to apply equally to all countries. Nonetheless, it seems that one can draw at least a few broad lessons about the character of optimal policy rules from the analyses that have been undertaken thus far, and that these differ enough from current practice to allow some suggestions for improvement.

3.1 The Target Criterion Should Involve More Than Inflation

The official target criterion of the Bank of England—ensuring that projected CPI inflation eight quarters in the future should always equal 2 percent per annum—refers only to the projected future value of a particular measure of U.K. inflation. While other inflation-targeting central banks are often less explicit about the precise way in which current policy decisions are supposed to be determined by their inflation targets, it is very generally the case that there is an explicit target *only* for (some measure of) inflation and no commitment to take into account the projected paths of any other variables. Hence debates about the desirability of inflation

[14] King and Wolman (1999) and Khan, King, and Wolman (2002) analyze a model in which it is optimal to fully stabilize prices in response to technology shocks, despite the existence of an inefficiently low steady-state level of output. This result, however, depends on the assumption of special isoelastic functional forms for both preferences and technology, and also on the assumption of zero steady-state government purchases; deviations from any of these assumptions will result in full price stability no longer being optimal. Also, even under the assumed specification, other types of real disturbances imply that it will not be optimal to fully stabilize inflation, as Khan, King, and Wolman show. See Woodford (2003, Chap. 6) for further discussion.

[15] Even when the average level of output is efficient, the flexible-price level of output and the efficient level may be differently affected by certain kinds of real disturbances. As noted above, these include variations in market power or in the level of tax distortions.

targeting in countries such as the United States often assume that such an approach to policy would mean a sole concern with inflation stabilization.

An optimal policy, instead, will not involve complete stabilization of inflation except under fairly special circumstances, as discussed in the previous section. In general, an optimal policy will involve some degree of temporary variation in the inflation rate in response to real disturbances, for the sake of greater achievement of other stabilization objectives. The degree to which this matters in practice will depend on the quantitative specification of one's model of the economy; but an identification of inflation targeting with what Svensson (1999) calls "strict inflation targeting" makes it too easy for opponents of inflation targeting to argue that it would prevent the central bank from responding in appropriate ways to changing economic conditions.

It is sometimes argued that a coherent monetary policy requires "a single objective," so that stabilization objectives in addition to inflation stabilization should play no role in the conduct of monetary policy, despite the admitted desirability of these ends.[16] It is true that a simultaneous commitment to stabilize two different variables using a single policy instrument will, in general, represent a promise that cannot possibly be fulfilled. But a commitment to a single *target criterion*, on the basis of which the instrument of policy is to be adjusted, does not require that this criterion involve only a single *variable*. The target criterion may well be a linear combination of projections for several different variables (just as it may also involve inflation projections at more than one horizon). In general, an optimal target criterion will be of this form. For example, in the case of the Giannoni-Woodford model of the U.S. monetary transmission mechanism discussed in the appendix, the optimal target criterion involves not only projected inflation, but also real-wage and output-gap projections. A lower projection of real wage growth or of the (welfare-relevant) output gap will justify acceptance of a higher projected inflation rate. Nonetheless, there is a single well-defined measure at each point in time of whether policy remains on track.

[16] A related view asserts that other goals may be introduced only to the extent that they do not interfere with achievement of the inflation target. However, absolute priority of the inflation target would not seem to leave any room for stabilization of output or other variables, unless the inflation target is not understood to require stabilization of inflation to the greatest extent possible. Such formulations are thus hopelessly vague about what the policy commitment actually promises.

It is not obvious, of course, that actual inflation-targeting central banks do not take into account other stabilization objectives in their policy decisions, despite their use of an official rhetoric that suggests a strict inflation target. Commentators such as Bernanke et al. (1999) and Svensson (1999) argue that all actual inflation-targeting central banks are "flexible inflation targeters" that trade off inflation stabilization against other stabilization objectives. Furthermore, it is often argued that a particular advantage of inflation-forecast targeting as a policy rule is precisely that it allows monetary policy to be used to reduce the short-run effects of disturbances on real variables (such as the output gap), while retaining firmly anchored medium-term inflation expectations, and hence reducing the degree of inflation variability that is required to achieve a given degree of stability of the real variables.

I do not doubt that actual inflation-targeting central banks do take some account of real objectives. For example, the introductory summary of the Bank of England's *Inflation Report* always presents a chart of the Bank's current real GDP projection as well as its inflation projection—and the GDP projection is always discussed *first*, even if it is solely the inflation projection that is cited as showing that policy is on track. But it would be desirable for central banks to commit themselves to the pursuit of explicit target criteria that involve real variables as well as inflation. For one thing, if the criteria on which policy is actually based include projections for other variables, it would increase transparency, facilitating the public's ability to correctly anticipate future policy, to explain policy in this way. In addition, greater frankness about this aspect of banks' policy commitments would help to dispel some of the resistance to the adoption of inflation targeting in countries like the United States. In particular, it would show that adoption of a targeting framework by the Federal Reserve need not imply any departure from the Fed's current legal mandate—which requires it to pursue full employment as well as price stability—and hence need not wait for Congressional authorization.[17]

3.2 A "Medium Term" Target Is Not Enough

Many would argue that the reason that inflation-targeting central banks have only an unqualified,

[17] On the issue of whether the adoption of inflation targeting in the United States would require new legislative authority, see also Goodfriend (forthcoming).

time-invariant target for inflation—rather than a target criterion that takes account of output projections, or other variables, as well—is that the inflation target represents only a "medium-term" goal that leaves unspecified the precise transition path by which the medium-term goal is to be reached. (This is explicit in the case of the Bank of England's official target criterion. Only the rate of inflation eight quarters in the future must equal the time-invariant target rate; nearer-term inflation projections are allowed to vary.) The appropriate *medium-term* inflation target can be stated in an unqualified, time-invariant form, it is argued, because there is no substantial trade-off between the inflation rate and real variables this far in the future. Other stabilization goals are instead appropriately taken into account in choosing among the possible nearer-term transition paths that are consistent with the medium-term target.

In fact, the sort of optimal target criteria that can be derived using the method of Giannoni and Woodford (2002) involve much nearer-term projections than those that are officially targeted by the Bank of England or other inflation-targeting central banks. For example, while the targeting criteria discussed in the appendix involve weighted averages of projections for many different future quarters, it is the projection for one or two quarters in the future that receives the greatest weight. Thus the optimal target criteria do not merely describe the state that one wishes to reattain once the effects of recent disturbances have worked themselves out; they also characterize the optimal transition dynamics following a disturbance.

A simple example may be useful in clarifying this. Suppose that the prices of individual goods are re-optimized at random intervals as proposed by Calvo (1983), but that all prices are fixed a quarter in advance, so that even those new prices that are chosen in quarter t take effect only beginning in quarter $t+1$. Suppose furthermore that, between the occasions on which the optimality of a given price is reconsidered, it is automatically indexed to an aggregate price index (but, again, the aggregate price index of the quarter before the one in which the price will apply), as proposed by Christiano, Eichenbaum, and Evans (2001). In a simple model with fixed capital and no labor-market frictions, this results in an aggregate-supply relation of the form[18]

$$\pi_t - \pi_{t-1} = \kappa E_{t-1} x_t + \beta E_{t-1}(\pi_{t+1} - \pi_t) + u_{t-1}, \tag{3.1}$$

where π_t is the quarter-t inflation rate, x_t is the (welfare-relevant) output gap, u_{t-1} is an exogenous (mean-zero) random disturbance at date $t-1$, κ is a positive coefficient, and β is the discount factor of the representative household. Exogenous fluctuations in the "cost-push" term u_{t-1} as a result of various real disturbances then create a tension between the goals of inflation stabilization and output-gap stabilization.

Under the microeconomic foundations proposed for the aggregate-supply relation above, the appropriate welfare-theoretic stabilization objective corresponds to minimization of a loss function of the form[19]

$$E_{t_0} \sum_{t=t_0}^{\infty} \beta^{t-t_0} \left[(\pi_t - \pi_{t-1})^2 + \lambda (x_t - x^*)^2 \right], \tag{3.2}$$

where both the optimal output gap x^* (positive in the empirically realistic case) and the positive relative weight λ depend on model parameters. Because it is assumed that prices are automatically indexed to a lagged aggregate price index, inflation creates distortions in the model only to the extent that the aggregate inflation rate *differs* from that in the previous quarter; hence policy should aim to stabilize the *rate of change* of inflation, rather than its absolute level.[20] As we shall see, however, this does not mean that it is not desirable for the central bank to commit to a fixed long-run inflation target.

Let us consider now the problem of conducting policy from some date t_0 onward so as to minimize (3.2), subject to a constraint

$$\pi_{t_0+1} = \bar{\pi}_{t_0}. \tag{3.3}$$

This last constraint prevents the policy authority from choosing a policy at date t_0 that fails to internalize the effects of policy at t_0 (insofar as it could have been forecasted in the previous quarter) on the inflation-output trade-off faced in quarter t_0-1. Choosing a policy commitment from date t_0 onward in the absence of any such constraint would result in selection of a policy that is not *time-consistent*,

[18] This is essentially the form of aggregate-supply relation proposed by Fuhrer and Moore (1995), and a simplified version of the aggregate-supply blocks of the empirical optimizing models of Christiano, Eichenbaum, and Evans (2001), Altig et al. (2002), Smets and Wouters (2002a, 2002b), and Giannoni and Woodford (forthcoming).

[19] For details of the derivation, see Woodford (2003, Chap. 6).

[20] The conclusion that the absolute level of inflation has no consequences for welfare is extremely special to the simple case considered here, and surely not realistic, as discussed in Woodford (2003, Chap. 7). For similar analyses of the form of optimal target criteria when there is no indexation, or only partial indexation, see Svensson and Woodford (forthcoming) and Giannoni and Woodford (forthcoming).

for one *would* commit to a policy at all later dates that took account of these effects. If the constraint $\bar{\pi}_{t_0}$ is chosen (as a function of the state of the world in quarter t_0) in a "self-consistent" way, the optimization problem just posed can be solved by a time-invariant policy rule. Furthermore, if one reconsiders the desirability of following the policy rule at any later date, then (assuming that one's model of the economy and policy objectives have not changed in the meantime) one would continue to find that the same time-invariant policy rule would continue to solve the corresponding constrained optimization problem looking forward from the later date.[21]

Finally, let us suppose that the component of aggregate real expenditure that is sensitive to interest rates is also determined a quarter in advance, so that the output gap x_t cannot be affected by monetary policy decisions later than quarter $t-1$.[22] It follows that monetary policy can affect only the evolution of inflation and the component of the output gap that is forecastable a quarter in advance, and that the possible stochastic paths for these variables that can be achieved by any monetary policy are the set of processes consistent with relation (3.1) for $t \geq t_0 + 1$.

The first-order conditions for the optimization problem just stated are then of the form

$$\pi_{t+1} - \pi_t + \varphi_t - \varphi_{t-1} = 0 \tag{3.4}$$

$$\lambda\left(E_t x_{t+1} - x^*\right) - \kappa\varphi_t = 0 \tag{3.5}$$

for each $t \geq t_0$, where φ_{t-1} is the Lagrange multiplier associated with constraint (3.1) for each $t > t_0$, and φ_{t_0-1} is a multiplier associated with the constraint (3.3). These conditions, together with the constraints, determine the optimal state-contingent evolution of inflation and the forecastable component of the output gap; the unforecastable component of the output gap, of course, is exogenously given.

How should monetary policy be conducted to ensure that this desired state-contingent evolution of inflation and output is realized? Applying the method of Giannoni and Woodford (2002), one can eliminate the Lagrange multiplier from equations (3.4) and (3.5), and show that one must have

$$\left(\pi_{t+1} - \pi_t\right) + \phi\left(E_t x_{t+1} - E_{t-1} x_t\right) = 0 \tag{3.6}$$

for each $t \geq t_0$, where $\phi \equiv \lambda/\kappa > 0$. This in turn implies that

$$\pi_{t+1} + \phi E_t x_{t+1} = \pi^* \tag{3.7}$$

for each $t \geq t_0$, where π^* is a constant, the value of which will depend on the initial constraint $\bar{\pi}_{t_0}$. For any value of π^*, there exists a self-consistent specification of the initial constant under which optimal policy satisfies (3.7) for all $t \geq t_0$. Thus the optimal long-run inflation target π^* is not determined within this model.[23]

Optimal policy, then, must arrange that (3.7) holds at each date, or equivalently, that

$$E_t\left[\pi_{t+1} + \phi x_{t+1}\right] = \pi^*. \tag{3.8}$$

(This alternative form emphasizes that the terms in the target criterion can be affected only by monetary policy decisions in quarter t or earlier.) Conversely, one can show that if policy ensures that (3.8) is satisfied at each date $t \geq t_0$, the unique nonexplosive rational-expectations equilibrium consistent with the policy commitment solves the optimization problem stated above. Hence (3.8) is an optimal *target criterion* for the central bank's policy decision in quarter t.

In the model sketched above, the central bank cannot expect to affect whether (3.8) holds in quarter t through adjustment of the interest rate i_t in that quarter, for the predetermination of the interest-sensitive component of expenditure implies that unforecastable interest-rate changes have no effect on aggregate demand. The central bank's period-t policy decision should then be a commitment $i_{t+1,t}$ regarding its operating target for the interest rate in quarter $t+1$. The value of $i_{t+1,t}$ should be chosen so as to lead the central bank to project that (3.8) is satisfied, conditional on the state of the economy in quarter t.[24] The expectation that $i_{t+1,t}$ will be chosen in this way in each quarter $t \geq t_0$, and that the

[21] See Woodford (2003, Chap. 7) for further discussion. A policy that solves a problem of this form is "optimal from a timeless perspective," as discussed in Woodford (1999b).

[22] For models of aggregate demand with this property, see Woodford (2003, Chap. 5). This kind of predetermination of interest-sensitive aggregate expenditure is a feature of many empirical optimizing models, such as Rotemberg and Woodford (1997), Amato and Laubach (2003), Christiano, Eichenbaum, and Evans (2001), Altig et al. (2002), and Giannoni and Woodford (forthcoming), along with many ad hoc macroeconometric models.

[23] The addition of even small frictions can break the indeterminacy of the optimal long-run inflation target, as discussed in Woodford (2003, Chap. 7). In practice, one can be certain that the optimal long-run inflation target is not far from zero; it could even be slightly below zero.

[24] Note that in the model sketched here, both $E_t\pi_{t+1}$ and $E_t x_{t+1}$ should be affected by the bank's choice of $i_{t+1,t}$, assuming that the bank's announcement of its target for the following quarter is credible to the private sector.

central bank will then act to ensure that $i_{t+1} = i_{t+1,t}$ in the following quarter, will then imply the desired state-contingent evolution of inflation and output.

The proposed policy rule involves a constant long-run inflation target, since satisfaction of (3.8) each quarter implies that one must have

$$\lim_{T\to\infty} E_t \pi_T = \pi^* \tag{3.9}$$

at all times t. And it would surely be desirable for the central bank to emphasize to the public its commitment to a policy that implies (3.9), as this should help to anchor long-run inflation expectations (which would never be allowed to vary in an optimal equilibrium). Nonetheless, a commitment to ensure that (3.9) is satisfied at all times is not *sufficient* for optimality; many different sorts of transitory responses to disturbances would be equally consistent with it.

Nor is it clear what a central bank is committing itself to do if it pledges to ensure that (3.9) is satisfied at all times. Condition (3.9) does not place any restrictions on the behavior of interest rates over any finite horizon; hence it is not clear what one would be able to monitor about a central bank's decisions in order to verify that it is indeed acting in conformity with its supposed commitment. Condition (3.8), instead—together with the expectation that (3.8) will also hold at all future dates—does imply a particular rational-expectations equilibrium value for $E_t i_{t+1}$ and so one could monitor, at least in principle, whether $i_{t+1,t}$ is chosen in accordance with it.

The same is true in the case of a "medium term" target that refers to a specific future date. Condition (3.8) implies that

$$E_t\left[\pi_{t+k} + \frac{\lambda}{\kappa} x_{t+k}\right] = \pi^* \tag{3.10}$$

must also hold at all times, for any $k \geq 1$, in an optimal equilibrium. So one might imagine that it would suffice for the central bank to commit to ensure that (3.10) holds at all times, where k might be eight quarters in the future. But if $k > 1$ this condition does not suffice to determine a unique non-explosive rational-expectations equilibrium, in the context of the model set out above. For any commitment of the form

$$E_t\left[\pi_{t+1} + \frac{\lambda}{\kappa} x_{t+1}\right] = \pi^* + u_t, \tag{3.11}$$

where u_t is an exogenous random variable satisfying

$$E_t u_{t+k-1} = 0,$$

suffices to determine an equilibrium, for the same reason that (3.8) does, though the equilibrium will not be the optimal one (the one determined by (3.8) except when $u_t = 0$ at all times). Yet ensuring that (3.11) holds at all times is consistent with commitment (3.10); thus all of the different equilibria corresponding to different choices of the process $\{u_t\}$ are equally consistent with a commitment of the form (3.10). It follows that a commitment to ensure (3.10) fails to determine a unique equilibrium, and indeed it fails to uniquely determine the required interest-rate policy on the part of the central bank.

A well-known argument for the desirability of a target criterion referring only to inflation two years in the future is provided by Svensson (1997). In the simple model used in that paper for illustrative purposes, the optimal target criterion (in the sense of Giannoni and Woodford, forthcoming) is shown to be of this form. But this results because in that model, an interest-rate decision by the central bank has no effect on inflation until two years later. It is also true in the case of the model sketched above, in which inflation can only be affected by monetary policy decisions in the previous quarter, that the optimal target criterion involves a forecast of inflation one quarter in the future; if the assumed delay were longer, the optimal target criterion would look farther into the future.

However, empirical models of the monetary transmission mechanism do *not* commonly imply delays of greater than a quarter before monetary policy is able to affect inflation, even if (because of various sorts of inertia in the transmission mechanism) the models imply that the effects of disturbances on the inflation rate are greatest only after several quarters. For example, the aggregate-supply relation (3.1) assumed above has the property that a demand disturbance (due to monetary policy or some other source) that raises output above its natural rate for several quarters will steadily increase inflation for several quarters, with the full effect on inflation being observed only after output has returned to its natural level. Nonetheless, optimal policy is described by a target criterion (3.8) that involves only a one-quarter-ahead inflation forecast. A similar result is obtained in the more complex model of Giannoni and Woodford (forthcoming), discussed in the appendix: The optimal target criteria involve forecasts at many future horizons, but the weight is greatest on the forecasts for the nearest horizon at which the variables in question can still be affected by the current policy decision.

This should not be surprising; if the target criterion is to completely determine a policy decision at each date, it must specify what defines an acceptable outcome at the nearest date that can still be influenced by policy, and not merely what must happen later, at dates that can be influenced by *later* policy decisions. The preference for "medium term" target criteria at inflation-targeting central banks represents a preference for *incomplete* specifications of the banks' policy commitments. This probably reflects a greater degree of certainty about the desirability of the particular aspect of policy about which the commitment is being made, and this is understandable. One can indeed state with greater confidence that it is desirable for medium-term inflation expectations to be highly stable (and to suggest a plausible value for the target π^*) than one can argue for the desirability of a particular criterion such as (3.8) that should be satisfied by the transition dynamics for inflation following a temporary disturbance.

Nonetheless, it is possible to make an argument for a particular near-term target criterion such as (3.8) that is surprisingly robust. For example, it might be thought better to leave the transition dynamics following disturbances unspecified on the grounds that the optimal transition dynamics will look very different in the case of different types of disturbances. Yet Giannoni and Woodford (2002) show that it is possible quite generally to find a target criterion that applies regardless of the character of (additive) disturbances, yet which is sufficiently specific to uniquely determine the transition dynamics in response to any type of disturbance.

It is sometimes proposed, in discussions of inflation-forecast targeting, that a suitable form of central bank commitment that is specific enough about the desired transition dynamics to determine an appropriate policy action involves specification of a medium-term inflation target, together with a specification of the *rate* at which policy should seek to restore inflation to the target level when it deviates from it. A commitment of this form can be expressed in terms of a near-term target criterion of the form

$$E_t\pi_{t+1} = \pi^* + \mu(\pi_t - \pi^*), \tag{3.12}$$

where $0 < \mu < 1$ indicates the rate at which departures from the target should be eliminated; thus such a proposal amounts to a near-term target criterion, and not simply a medium-term inflation target. However, it is not generally possible to express a robustly optimal target criterion (in the sense of Giannoni and Woodford, 2002) in a form like this—one that makes no reference to the projected path of any variable other than inflation. A robustly optimal criterion such as (3.8) implies a particular rate of convergence of $E_t\pi_{t+k}$ to π^* as k is made large, but this will differ depending on the recent history of disturbances; it is only the criterion (3.8), which involves the output-gap projection as well, that represents a robust criterion for optimality.

3.3 Constant-Interest-Rate Projections Are an Inappropriate Basis for Policy

One way that inflation-targeting central banks resolve the problem that their medium-term inflation target alone does not suffice to determine a particular current interest-rate decision—at least according to their official rhetoric—is by asking what *constant* interest-rate setting over the forecast horizon would result in a projection consistent with the medium-term target criterion and then choosing a current interest-rate operating target at that level. For example, the Bank of England's *Inflation Reports* justify current policy by showing that a projection based on the assumption that the interest rate will remain at the current level for the next two years indicates projected RPIX inflation equal to 2.5 percent eight quarters from now.[25] This does not, however, mean that such banks constrain themselves to actually maintain a constant interest rate for two years at a time; instead, a new interest-rate setting is to be chosen each time the projection exercise is repeated.[26]

This "solution" to the problem of the incompleteness of the policy commitment represented by the medium-term target has the advantage of being simple to explain to the public—as long as the public is not sophisticated enough to ask what it really means—but has a number of unappealing implications.[27] First of all, many optimizing models of the monetary transmission mechanism have

[25] Former MPC member Charles Goodhart (2001) describes himself as having tried to set interest rates in this way, and says "This was, I thought, what the exercise was supposed to be" (p. 177). Heikensten (1999) describes the similar procedure used by the Bank of Sweden.

[26] Indeed, Goodhart (2001) lists as an advantage of the constant-interest-rate projection-based procedure that "no one infers any commitment from the MPC to abide by that assumption in the future, nor is the credibility of the MPC damaged when, having made this assumption in a forecast one month, it decides to change interest rates even in the next month" (pp. 174-75).

[27] Goodhart (2001) reviews what he calls "the prima facie case against" this approach before offering his defense of it. Other critical discussions include Leitemo (2003), Svensson (2003b), and Honkapohja and Mitra (2003).

the property first demonstrated by Sargent and Wallace (1975) for a rational-expectations IS-LM framework, namely, that the equilibrium path of the price level (and hence of the inflation rate) is *indeterminate* under the assumption of a fixed nominal interest rate (or indeed, any exogenously specified interest-rate process).[28] If such a model were to be used for the central bank's projection exercise, the staff would be unable to compute predicted paths for inflation or other variables under the hypothesis of any constant level of nominal interest rate, and so unable to assert that one particular level would imply satisfaction of the target criterion.[29]

Alternatively, many backward-looking models (including optimizing models in which expectations are assumed to be based on extrapolation from past time series) have the property discussed by Friedman (1969), namely, that maintaining a constant nominal interest rate indefinitely will lead to explosive inflation dynamics, through a Wicksellian "cumulative process."[30] Goodhart (2001) suggests that the Bank of England's model has this latter property and that, as a result, "the rate of change of most variables visible at the two-year horizon in the Bank's forecast generally (though not invariably) tends to persist, and on occasion to accelerate, in the third and subsequent years" (p. 171). In this case, it is possible to ask which constant interest rate would imply satisfaction of the target criterion at a certain finite horizon, but only at the expense of making it clear that hitting the target at (say) the eight-quarter horizon does *not* also imply expecting to hit it in subsequent quarters. Hence it cannot be the case that one expects to be content to maintain the constant-interest-rate policy indefinitely, even in the absence of any developments that cannot already be foreseen.[31]

In fact, there is no reason to suppose that the constant interest-rate path represents the bank's best current estimate of the future path of interest rates. This is at least implicitly conceded by the Bank of England in its published discussions of the accuracy of its projections.[32] In these discussions, the Bank gives exclusive attention to the projections that it also publishes in the *Inflation Report*, in which an interest-rate path is assumed that corresponds to current market expectations, rather than to the projections conditional on the constant interest-rate path, even though the latter ones are given primary emphasis in the justification of policy. It is evident that the Bank does *not* regard the constant interest rate assumption as the best available forecast of its behavior. For if it did, it would want to test the accuracy of the projections made under that assumption, rather than under whatever contrary assumptions might be made by traders in financial markets.

Thus the auxiliary assumption that is used to allow the forecast-targeting procedure to determine an interest-rate recommendation has the consequence that the targeting procedure is based on forecasts that are not actually believed, even in the Bank itself. Such a procedure has the paradoxical implication that the central bank may choose a policy under which it does *not* truly expect the target criterion to be satisfied, though it may believe that it would be under the counterfactual hypothesis of the constant interest rate.

Such a state of affairs can hardly be defended as conducive to transparency in the conduct of monetary policy. If policy is genuinely based on constant-interest-rate conditional projections, then one's policy decisions are not aimed at ensuring satisfaction of the target criterion that is announced to the public; and the projections published by the central bank are not accurate forecasts that should better help the private sector to correctly anticipate the economy's evolution. On the other hand, if the central bank genuinely does expect the target criterion to be satisfied, then policy is not actually determined in the way that the official rhetoric implies that it is; and if the forecasts are unbiased, then they are not the kind of forecasts that they are officially described as being.

The kind of forecast-targeting procedure recommended by Svensson and Woodford (forthcoming) as a way of implementing optimal monetary policy

[28] See Woodford (2003, Chap. 4) for further discussion.

[29] Leitemo (2003) discusses possible interpretations of the constant-interest-rate projection exercise that would allow it to yield a policy recommendation even in the case of a forward-looking model of the transmission mechanism; but these do not eliminate the other unappealing features of such a procedure.

[30] See Bullard and Mitra (2002) and Preston (2002) for analyses of forward-looking models with least-squares learning by the private sector.

[31] If one's model currently implies that inflation will depart significantly from the target rate at the three-year horizon if interest rates are maintained at their current level for that long, then it also implies that one should expect that a year from now—barring unforeseen developments—if interest rates have been maintained at their current level, it will then be forecasted that inflation will depart from the target at the *two-year* horizon if interest rates are not changed. Hence one cannot expect that interest rates should remain at their current level for an entire year, even in the absence of any "news."

[32] See the Bank of England's *Inflation Reports* of August 2001 and August 2002.

is of a different sort. In this procedure, one projects the economy's future evolution under alternative contemplated policy decisions, assuming that in future decision cycles the central bank will *again act to ensure satisfaction of the target criterion*. This amounts to asking what action is needed to project that the criterion should be satisfied in the current period, taking as given that it is expected to be satisfied in later periods (as a result of the policy actions to be taken in those periods). Such a calculation yields a determinate outcome as long as there is a determinate rational-expectations equilibrium implied by the target criterion; this is always the case if the target criterion is selected according to the method of Giannoni and Woodford (2002).

Thus policy should be based on a projection exercise that includes a model of the central bank's own future behavior—one that is furthermore consistent with the procedure that it actually follows in making its policy decisions. This is the kind of projection exercise used as the basis for policy decisions at some central banks, notably the Reserve Bank of New Zealand, which also publishes some information about the non-constant interest-rate path implicit in its projections, along with its projections for inflation and other variables.

Goodhart (2001) objects that such a procedure is impractical, on the grounds that it would be much more difficult for a monetary policy committee to reach agreement on an entire future path for interest rates than to decide only about the current interest rate each time they meet. But the procedure described by Svensson and Woodford (forthcoming) does not involve a multidimensional decision problem in each decision cycle. As with the constant-interest-rate projection method, one makes a decision for the current period only, on the basis of projections of the future that (necessarily) incorporate a hypothesis about future policy; the hypothesis about future policy is simply a more realistic one than the notion that interest rates will not change, regardless of how inflation and output evolve. And there is no greater need for agreement among the members of the policy committee about that particular aspect of the model specification than about the other assumptions involved in making projections for the future.

Goodhart (2001) also argues that revealing a projected non-constant path for interest rates is problematic, because "any indication that the MPC is formally indicating a future specific change in rates...would be taken to indicate some degree of commitment" (p. 175). This is clearly a delicate issue regarding the proper explanation and the public's subsequent interpretation of the central bank's projections. Yet the experience in New Zealand suggests that it is possible to reveal interest-rate projections to the public without being understood to have made an advance commitment about the path of the official cash rate. Moreover, a "fan chart" for the path of interest rates, like those that the Bank of England currently publishes for its inflation and output projections, ought to make it clear that the bank is not committing itself to a definite path; rather, the expected evolution will depend on a variety of contingencies that can at best be assigned probabilities.

If necessary for the reasons to which Goodhart (2001) refers, it would be preferable to base policy on projections conditioned on predicted future policy, and to publish inflation and output projections of that sort, without any mention of the interest-rate path implicit in these projections, than to base policy on projections conditional upon a model of policy that one knows to be false. But there are likely to be advantages to publication of the interest-rate projections. One of the crucial ways in which central banks affect the economy is through the effects that their announcements have on expectations regarding the future path of short-term interest rates, expectations that then determine longer-term bond yields, asset prices, and exchange rates, which in turn affect spending, employment, wage-setting, and price-setting decisions. The current level of overnight interest rates is in itself of little importance for most economic decisions; the real significance of central bank decisions about the overnight rate is what they are taken to signal about the likely path of interest rates months and years into the future. Given the importance to a central bank of steering expectations of future interest rates in a desirable way, it would seem that revealing to the public the expected future path of rates implied by the bank's policy commitments should help it to better achieve its goals.

3.4 Advantages of a History-Dependent Target Criterion

A notable feature of the kind of projection exercises upon which policy is currently based at banks like the Bank of England is that they are *purely forward-looking*. By this I mean that the decision made at any time is a function solely of the policy committee's judgment about the possible paths from now on for inflation and other variables (if

any) relevant to its target criterion; past conditions are irrelevant except insofar as these have an effect on what it is possible to achieve from now on. Of course any projection-based decision procedure will be forward-looking; but under a procedure like the Bank of England's (at least as Goodhart, 2001, describes it), the past is irrelevant because the target criterion is a time-invariant function of the projected future path of the target variable (RPIX inflation).

One might think that forward-looking behavior of this kind is a necessary feature of optimal policy—that "bygones should be bygones" for a rigorous optimizer. But as explained above, this is not correct in the case of the optimal control of a forward-looking system. If it were, there would be no flaw in the reasoning of a purely discretionary policymaker. When the private sector is forward-looking, expectations regarding future policy matter for what can be achieved at any point in time, and outcomes can generally be improved through a judicious commitment regarding future policy. This requires, however, that policy be expected to be conducted at the later date in a way that is *history-dependent*—that is, in a way that depends on the earlier conditions (at the time at which it was desirable to alter expectations) as well as upon conditions at the time that the action is taken.

This history-dependence can be incorporated into a forecast-targeting procedure through the use of a history-dependent target criterion to evaluate whether the economy's projected evolution from now on should be considered to be consistent with the bank's general policy commitments. This means that the acceptable projections for the target variables looking forward should depend on recent *past* conditions.[33] This is a further reason why, under an optimal regime, the *short-term* target for inflation will be time-varying, even though there is likely to be a constant long-run inflation target, around which the short-term target fluctuates. The way in which an optimal short-term target criterion is likely to be history-dependent is illustrated in the discussion in the appendix (of the optimal target criteria in the case of the estimated model of Giannoni and Woodford, forthcoming).

A particularly clear example of the advantages of a history-dependent target criterion is the situation currently faced by the Bank of Japan, in which the zero lower bound on nominal interest rates has been reached and yet deflation continues, so that further monetary stimulus is desirable. As I have already mentioned, the main lever by which monetary policy can still affect the economy under such circumstances is by changing expectations regarding the future conduct of policy: Committing to a more expansionary policy *later* than would otherwise have been pursued. But this requires that policy not be expected to be conducted later in accordance with a purely forward-looking target criterion. For example, Eggertsson and Woodford (2003) show that the expectation that the central bank will remain committed to the forward-looking pursuit of a low (time-invariant) inflation target—and hence will adjust interest rates so as to be consistent with the target as soon as this can be done without violation of the zero lower bound — can lead to a disastrous outcome when real disturbances result in a temporarily negative natural rate of interest. This analysis suggests that the problem of the Bank of Japan at present is not that it is not understood to be committed to a non-negative inflation target, but that it is expected to pursue its tacit inflation target in a purely forward-looking manner, with the implication that the (unwanted) price declines that occur while the zero bound constrains policy will never be undone.

A commitment to a time-invariant inflation target would be more likely to avoid the problem caused by the zero bound, of course, if the target were set several percentage points above zero, as advocated by Summers (1991). But this would result in substantial losses of another sort, those created by chronic inflation. The optimal policy rule, as Eggertsson and Woodford show, would instead involve commitment to a history-dependent target criterion, resulting in temporary inflation after a period in which the zero bound constrained policy; in addition, a greater amount of inflation would occur the longer the zero bound continued to bind and the greater the cumulative deflation that occurred during that time. A low inflation rate would again be targeted once a sufficient period of time passed in which the zero bound

[33] The optimal target criterion (3.8) in the simple example above might seem not to confirm this principle, as it involves only forecasts of π_{t+1} and x_{t+1}. But in that model, inflation is not technically a "target variable," because it is the rate of inflation acceleration, rather than the absolute rate of inflation, that enters the loss function (3.2). A purely forward-looking target criterion would then be one that involves only the projected future paths of the output gap and of *inflation acceleration*. The target criterion (3.8) is not of this form, as it implies a commitment to eventually reverse past increases in the inflation rate. We could alternatively adopt (3.6) as a target criterion, and this would also be optimal. This criterion involves only the projected acceleration of inflation in period $t+1$, not the absolute rate of inflation. However, the criterion is history-dependent because of its dependence on the value of $E_{t-1}x_t$.

did not prevent the central bank from hitting its target. Credible commitment to a history-dependent policy of this kind would create the desired kind of expectations while the economy is in the "liquidity trap"—so that the deflation and output contraction at that time should remain quite modest—without requiring chronic inflation during normal times and creating an "inflation scare" during the period in which the economy is reflated as it exits from the trap.

4. CONCLUSIONS

Inflation-forecast targeting, as currently practiced at central banks such as the Bank of England, represents an important innovation in decision procedures with regard to monetary policy, one that has moved the actual practice of leading central banks closer to the ideal that would be recommended on the basis of economic theory. The organization of the decision process around the achievement of an explicit, quantitative target that is also communicated to the public, and a commitment to the explanation of policy decisions to the public in terms that allow verification of the central bank's commitment to its putative target are important improvements upon prior procedures. They can both help to safeguard a central bank against the trap of discretionary policymaking, and help the private sector to more accurately anticipate future policy, increasing the effectiveness of policy. The introduction of *targeting rules* as a way of specifying policy commitments is also an important conceptual advance, allowing commitments to be stated in a way that incorporates a kind of flexibility that is of considerable practical value, while being specific about the aspects of policy that are most critical for anchoring private-sector expectations.

At the same time, current practice falls short of the theoretical ideal sketched in this paper in some notable respects. Perhaps the most important of these is the exclusive emphasis on "medium term" targets that leave unspecified the basis on which a particular nearer-term path toward that target is to be preferred. At best, this represents a significant degree of vagueness about the criterion that is actually used to make policy decisions. It may also indicate that the choice among alternative near-term paths for the economy is still made on a discretionary basis that will ensure suboptimal policy even when decisions are made by an omniscient monetary policy committee with a perfect understanding of social welfare. The question whether it would be practical for central banks to commit themselves to more explicit nearer-term target criteria, of the form indicated by the theory of optimal monetary policy rules, should be an important issue for further study by central bankers and monetary economists alike.

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Appendix

AN OPTIMAL TARGETING RULE FOR THE MODEL OF GIANNONI AND WOODFORD (FORTHCOMING)

Here I summarize the quantitative form of the optimal targeting rule derived by Giannoni and Woodford (forthcoming) in the context of a small, empirical optimizing model of the U.S. monetary transmission mechanism. The desirability of this precise rule depends, of course, on the details of the quantitative model, many of which are highly debatable. Nonetheless, it may be useful to consider this example of an optimal policy rule for an estimated model, as an illustration of some of the general points made in the text about the likely character of an optimal policy rule.

The model of Giannoni and Woodford incorporates both wage and price stickiness, with random intervals between the times at which both individual wages and prices are reconsidered, as in the theoretical analysis of Erceg, Henderson, and Levin (2000). In addition, both wages and prices are allowed to be indexed to the previous quarter's index of prices between the occasions on which they are re-optimized, as proposed by Christiano, Eichenbaum, and Evans (2001). The degrees of indexation of both wages and prices are treated as free parameters to be estimated, as in Smets and Wouters (2002a, 2002b), but our parameter estimates indicate the best fit under the assumption of full indexation of both wages and prices, as assumed by Christiano, Eichenbaum, and Evans. Both wages and prices are also determined a quarter in advance. On the demand side of the model, the preferences of the representative household are assumed to allow for habit persistence, and the best fit is obtained when the habit-persistence coefficient takes the largest allowable value, so that utility depends on the *change* in real expenditure rather than its level. In addition, real private expenditure is determined two quarters in advance. The several free parameters of the model are estimated by minimizing the distance between the predicted impulse responses of four variables (output, inflation, the real wage, and the short-term nominal interest rate) to a monetary policy shock and those implied by an unrestricted VAR model of the same four time series. The parameter estimates are consistent with the sign restrictions implied by theory, and several restricted versions of the model—a restricted model with no indexation to the lagged price index, a restricted model with flexible wages, and a restricted model with no habit persistence—can each be statistically rejected.

Here I summarize the implications for optimal policy of treating the best-fitting parameter values as representing the literal truth. First of all, the estimated model implies that maximization of the expected utility of the representative household corresponds to minimization of a quadratic loss function of the form

(A.1)

$$E_0 \sum_{t=0}^{\infty} \beta^t \begin{bmatrix} \lambda_p \left(\pi_t - \gamma_p \pi_{t-1}\right)^2 \\ +\lambda_w \left(\pi_t^w - \gamma_w \pi_{t-1}\right)^2 + \lambda_x \left(x_t - \delta x_{t-1} - x^*\right)^2 \end{bmatrix},$$

where π_t is an index of goods price inflation between quarter $t-1$ and quarter t, π_t^w is an index of wage inflation, and x_t is the output gap (log real output relative to a "natural rate of output" that varies in response to several types of real disturbances). The discount factor is calibrated to equal 0.99 (to imply a realistic long-run average real rate of return), while the model's estimated parameters imply the values $\lambda_p = 0.9960$, $\lambda_w = 0.0040$, $\lambda_x = 0.0026$, and $\delta = 0.035$ for the coefficients of the loss function.

The fact that prices are indexed to a lagged price index implies that it is inflation acceleration, rather than the rate of inflation as such, that creates distortions, as in the simpler model discussed in the text. The fact that wages are also sticky implies that wage inflation also creates distortions, even when the rate of goods price inflation is stable; because wages are indexed to the lagged price index, it is actually wage inflation relative to lagged price inflation that measures this distortion. Finally, because of habit persistence, the distortions associated with fluctuations in the output gap are not proportional simply to a sum of squared deviations of the output gap each period from its optimal level, but rather to a sum of squared deviations of the output gap from an increasing function of the previous quarter's output gap. However, the weight δ on the lagged output gap turns out to be quite small, despite the existence of substantial habit persistence.

We also find that the estimated parameter values imply a very small relative weight on the wage-inflation stabilization objective relative to the price-inflation stabilization objective. This is not because wages are found to be flexible, but because other

estimated parameters imply larger distortions resulting from misalignment of prices than from misalignment of wages. The relative weight on the output-gap stabilization objective implied by the parameter estimates is also quite small; this follows directly from the estimation of parameters that imply only weak responses of wage and price inflation to variations in the output gap, as discussed in the text.

An optimal policy for the estimated model—and one with the desirable property that it is optimal *regardless* of the assumed statistical properties of the disturbances, and not solely in the case of disturbance processes of the kind implied by the estimated model for the historical sample period—can be implemented by a targeting procedure of the following kind.[34] First, in each quarter t, the central bank intervenes in the money markets (through open market operations, repurchases, standing facilities in the interbank market for central bank balances, etc.) so as to implement the interest rate target $i_{t,t-1}$ announced in quarter $t-1$. As in the simpler model discussed in the text, the fact that wages, prices, and spending are all predetermined for a quarter implies that nothing can be gained from allowing variations in interest rates that are not forecastable in the previous quarter.

Second, in the quarter-t decision cycle, the bank must choose an operating target $i_{t+1,t}$ to announce for the following quarter. This is chosen in order to imply a projected evolution of (wage and price) inflation from quarter $t+1$ onward that satisfies a target criterion of the form

$$F_t(\pi) + \phi_w\left[F_t(w) - w_t\right] = \bar{\pi}_t, \tag{A.2}$$

where $\bar{\pi}_t$ is a target value that has been determined in quarter $t-1$. Here for each of the variables $z = \pi, w$, the expression $F_t(z)$ refers to a weighted average of forecasts of the variable z at various future horizons, conditional on information at date t:

$$F_t(z) \equiv \sum_{k=1}^{\infty} \alpha_k^z E_t z_{t+k}, \tag{A.3}$$

where the weights α_k^z sum to 1. Thus the coefficient ϕ_w is actually the sum of the weights on real-wage forecasts at different horizons, k. We observe that the target criterion can be thought of as a wage-adjusted inflation target.

Third, it is also necessary, as part of the quarter-t decision cycle, for the central bank to choose the target $\bar{\pi}_{t+1}$ for the following quarter. This is chosen so as to ensure that future policy will be conducted in a way that allows the bank to project (conditional on its current information) that another target criterion, of the form

$$F_t^*(\pi) + \phi_w^* F_t^*(w) + \phi_x^* F_t^*(x) = \pi_t^*, \tag{A.4}$$

should be satisfied, where the expressions $F_t^*(z)$ are again weighted averages of forecasts at different horizons (but with relative weights α_k^{z*} that may be different in this case) and π_t^* is another time-varying target value, once again a predetermined variable. In this case the criterion specifies a target for a wage- and output-adjusted inflation projection.

In this last procedure, optimality requires that the target value be given by an expression of the form

$$\pi_t^* = \left(1 - \theta_\pi^*\right)\pi^* + \theta_\pi^* F_{t-1}^1(\pi) + \theta_x^* F_{t-1}^1(w) + \theta_x^* F_{t-1}^1(x), \tag{A.5}$$

where the expressions $F_t^1(z)$ are still other weighted averages of forecasts at different horizons, with relative weights α_k^{z1} that again sum to 1, and π^* is an arbitrary constant.[35] Note that the optimal target value depends on the previous quarter's forecasts of the economy's subsequent evolution; this is an example of the history dependence of optimal target criteria, discussed generally in the text.

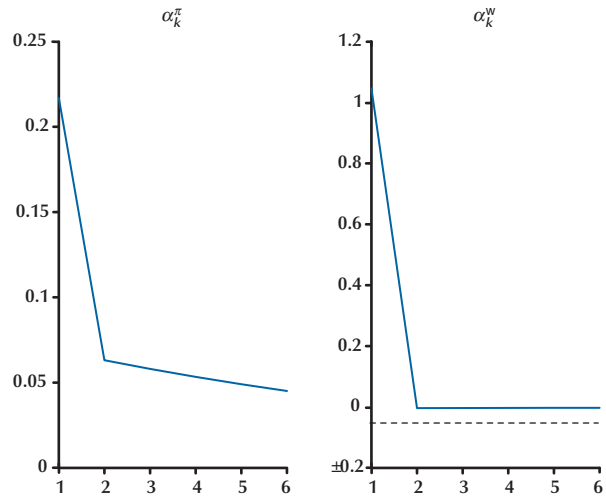
The estimated parameter values imply the following numerical coefficients in the optimal target criteria. In the case of the short-term criterion (A.2), the coefficient ϕ_w is equal to 0.565.[36] Thus if unexpected developments in quarter t are projected to imply a higher future level of real wages than had previously been anticipated, policy must ensure that projected future price inflation is correspondingly reduced. This is because of a desire to stabilize (nominal) wage inflation as well as price inflation,

[34] Because the empirical model is quarterly, it is simplest to discuss the policy process as if a policy decision is also made once per quarter, even though in reality most central banks reconsider their operating targets for overnight interest rates somewhat more frequently than this. The discussion should not be taken to imply that it is optimal for the policy committee to meet only once per quarter; this would follow only if (as in the model) all other markets were also open only once per quarter.

[35] Note that in the model considered here, as in the simpler model discussed in the text, there is no welfare significance to any absolute inflation rate, only to changes in the rate of inflation and to wage growth relative to prices. There is therefore no particular inflation rate that could be justified as optimal from a timeless perspective.

[36] Here and below, the coefficients are presented for a target criterion where the inflation rate is measured in annualized percentage points.

Figure A1



NOTE: Relative weights on projections at different horizons in the short-run target criterion (A.2). The horizontal axis indicates the horizon k in quarters.

and under circumstances of expected real wage growth, inflation must be curbed in order for nominal wage growth to not be even higher.

The relative weights that this criterion places on projections at different future horizons are shown in Figure A1. The two panels plot the coefficients α_k^π and α_k^w as functions of the horizon k. Note that in each case the quarter for which the projections receive greatest weight is one quarter in the future. This is also the first quarter in which it is possible for wage or price inflation to be affected by the choice of $i_{t+1,t}$, according to the estimated model. However, while the real-wage projection that matters is primarily the projected growth in real wages between the present quarter and the next one, substantial weight is also placed on projected inflation farther in the future; in fact, the mean lead $\Sigma_k \alpha_k^\pi k$ is between 10 and 11 quarters in the future in the case of the inflation projection $F_t(\pi)$. Thus the short-run target criterion is a (time-varying) target for the average rate of inflation that is projected over the next several years, adjusted to take account of expected wage growth, mainly over the coming quarter. Roughly speaking, optimal policy requires the central bank to choose $E_t i_{t+1}$ in quarter t to head off any change in the projected average inflation rate over the next several years that is due to any developments not anticipated in quarter $t-1$ (and hence reflected in the current target $\bar{\pi}_{t-1}$). This is a criterion in the spirit of inflation-forecast targeting as currently practiced at central banks such as the Bank of England, except that projected wage growth matters as well as price inflation, and that the target shifts over time.

In the case of the long-term criterion (A.4), instead, the numerical coefficients of the target criterion are given by

$$\phi_w^* = 0.258, \qquad \phi_x^* = 0.135.$$

In this case, output-gap projections matter as well; a higher projected future output gap will require a reduction in the projected future rate of inflation, just as will a higher projected future real wage. The numerical size of the weight placed on the output-gap projection may appear modest; but as we shall see below, the degree of variability of output-gap projections in practice is likely to make this a quite significant correction to the path of the target criterion.

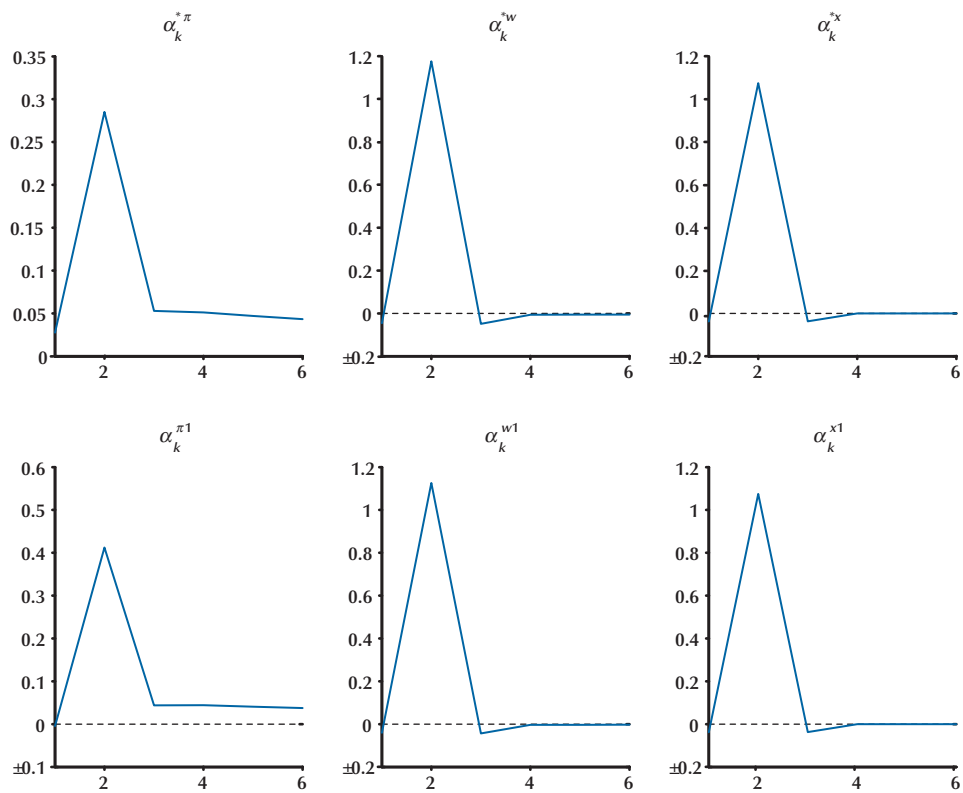
The relative weights on forecasts at different horizons in this criterion are plotted in the panels in the first row of Figure A2. We observe that in the case of this criterion, the projections that mainly matter are those for two quarters in the future; the criterion is nearly independent of projections regarding the quarter after the current one. Hence it makes sense to think of this criterion as the one that should determine the central bank's intended policy two or more quarters in the future (and hence its choice in quarter t of the target $\bar{\pi}_{t+1}$ to constrain its choice in the following period of $i_{t+2,t+1}$); but this criterion should not be thought of as a primary determinant of whether the bank's intended policy in period $t+1$ is on track. The projections that receive the greatest weight under this criterion are those for the same quarter (quarter $t+2$) that will receive the greatest weight in the targeting procedure for which $\bar{\pi}_{t+1}$ provides the target value.

Finally, the coefficients of the rule (A.5) determining the target value for the long-term criterion are given by

$$\theta_\pi^* = 0.580, \qquad \theta_w^* = 0.252, \qquad \theta_x^* = 0.125.$$

The weights in the projections (conditional on information in the previous quarter) at various horizons are plotted in the second row of Figure A2. Here, too, it is primarily projections for two quarters in the future that matter in each case. Roughly speaking, then, the target value for the wage- and output-

Figure A2



NOTE: Relative weights on projections at different horizons in the long-run target criterion. Panels in the first row indicate the projections in (A.4), while the second row indicates the projections from the previous quarter that define the target value π_t^*.

adjusted inflation projection two quarters in the future is high when a similar adjusted inflation projection (again, for a time two quarters in the future) was high in the previous quarter.

Thus forecasting exercises, in which the central bank projects the evolution of both inflation and real variables many years into the future under alternative hypothetical policies on its own part, play a central role in a natural approach to the implementation of optimal policy. A forecast of inflation several years into the future is required in each (quarterly) decision cycle in order to check whether the intended interest-rate operating target for the following quarter is consistent with the criterion (A.2). In addition, the time-varying medium-term inflation target $\bar{\pi}_t$ must be chosen each period on the basis of yet another forecasting exercise. While the long-run target criterion (A.4) primarily involves projections for a time only two quarters in the future, the choice of $\bar{\pi}_{t+1}$ requires that the central bank solve for a projected path of the economy in which (A.4) is satisfied not only in the current period, but in all future periods as well. Hence this exercise as well requires the construction of projected paths for inflation and real variables extending many years into the future. The relevant paths, however, will not be constant-interest-rate projections, but rather projections of the economy's future evolution given how policy is expected to evolve. Indeed, the projections are used to select constraints upon the bank's own actions in future decision cycles, by choosing both the interest-rate operating target $i_{t+1,t}$ and the adjusted inflation target $\bar{\pi}_{t+1}$ in period t.

Commentary

Stephanie Schmitt-Grohé

Woodford concludes his review of what the theoretical literature on optimal monetary policy has to say about the desirability of price stability with the following statement: "It is not a bad first approximation to say that the goal of monetary policy should be price stability." It follows from this conclusion that the findings of the theoretical literature on optimal monetary policy can be interpreted as supportive of inflation targeting. However, it does not imply that there should be a single target variable—namely, inflation. Optimal policy, as Woodford explains, can only under quite special circumstances be described solely in terms of the behavior of inflation.

Woodford argues that even when full price stability fails to be optimal, near price stabilization is optimal in many cases. In particular, Woodford discusses that near stabilization of an appropriately defined price index continues to be optimal (i) in environments where negative real rates in combination with the zero bound on the nominal interest rate make a path of zero inflation impossible, (ii) in environments where asymmetric shocks require relative price changes, (iii) in sticky-wage models, and (iv) even in cases where the flexible-price equilibrium is not efficient, due to the presence of (possibly time-varying) market power or distorting taxes.

I would like to expand on this discussion and add to the list of environments in which near price stability is optimal. Also, I would like to give some more specific examples. Most of the theoretical work Woodford surveys uses dynamic, stochastic general equilibrium models that contain some specific simplifying assumption that make it possible to accurately characterize optimal policy using only linear approximations to the model and that allow for an analytical characterization of optimal policy. Absent those simplifying assumptions, one would have to use higher-order approximations to the equilibrium conditions for welfare calculations. Recent advances in computational economics have delivered algorithms that make it feasible and simple to compute higher-order approximations to the equilibrium conditions of a general class of large stochastic dynamic general equilibrium models (see, for instance, Sims, 2000, and Schmitt-Grohé and Uribe, 2004a). Several authors have applied this toolkit to studying the welfare consequences of monetary policy in environments without the special assumption needed to make the linear approach work. And I will report findings on the desirability of price stability from this more numerically oriented branch of the literature.

Academic economists in the past have not always arrived at the conclusion that price stability should be a central objective of monetary policy. In particular, many of the theoretical environments that were used to study optimal policy in the 1980s assumed that there are no impediments to instantaneous adjustment of factor and product prices. In such environments, price stability in the sense of a constant price level over time does not in general represent the optimal monetary policy prescription. Rather, under optimal monetary policy, prices move over time in such a way as to eliminate the opportunity cost of holding money, that is, optimal policy follows the Friedman rule. The opportunity cost of holding money is the nominal interest rate, and, thus, optimal monetary policy calls for a constant and zero nominal interest rate. With nominal interest rates constant, prices move in response to changes in real interest rates, and fall on average at the real rate of interest.

In addition, Chari, Christiano, and Kehoe (1991) show that in a world in which the Friedman rule is optimal, optimal monetary policy is associated with high inflation volatility. In Chari, Christiano, and Kehoe, the reason why inflation is highly volatile under the optimal policy is that the government is using surprise inflation as a non-distorting fiscal

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Table 1

Desirability of Price Stability in an Optimal Monetary and Fiscal Policy Problem

Variable	Mean	Standard deviation	Autocorrelation
Flexible-price economy			
π	–3.66	6.04	–0.04
R	0	0	—
Sticky-price economy			
π	–0.16	0.17	0.04
R	3.85	0.56	0.87

NOTE: Inflation, π, and the nominal interest rate, R, are expressed in percentage points.

SOURCE: Schmitt-Grohé and Uribe (2004b).

instrument. Specifically, it is assumed that the government can levy distortionary income taxes and can issue nominal non-state-contingent debt. In financing innovations to its budget, the government can therefore either adjust distortionary income taxes or adjust real public liabilities through an appropriate price level change. In the theoretical environment of Chari, Christiano, and Kehoe surprise changes in the price level are non-distorting, whereas changes in the tax rates are distorting. As a consequence, the optimal fiscal and monetary policy mix calls for stable tax rates and highly volatile inflation rates.

Clearly, this branch of the theoretical literature is at odds with the goal of price stability. In the mid-1990s, rigidities in product and factor price adjustment found renewed attention in monetary economics. Under sticky prices, both the predictions about the optimal level and the volatility of inflation may change. First, authors such as Goodfriend and King (1997) showed that in simple models with price stickiness but no money, the optimal inflation rate is zero at all times and under all circumstances. Khan, King, and Wolman (2003) show that if one is to introduce money into the sticky-price model, a tension arises between nominal interest rate stabilization at zero—to minimize the distortions associated with money—and the sticky-price friction, which calls for constant prices at all times and under all circumstances. Khan, King, and Wolman show that for realistic calibrations of their model, the optimal level of inflation is just –76 basis points. (In their calibration, the Friedman rule would call for inflation of –293 basis points and, absent the monetary distortion, optimal policy is associated with zero inflation.) That is, the optimal long-run inflation rate is not that different from the one that is optimal in a sticky-price model without money.

Schmitt-Grohé and Uribe (2004b) study optimal monetary and fiscal policy in a model with (i) sticky prices, (ii) money demand, (iii) distortionary taxation, and (iv) a fiscal role for price level variations. In that economy, as in the work of Chari, Christiano, and Kehoe (1991), price level variations are desirable because they allow the fiscal authority to finance surprises in its budget by inflating or deflating the real value of government debt rather than via changes in distortionary income tax rates. Therefore, there exist additional reasons to deviate from price stability beyond those present in Khan, King, and Wolman.

Yet, for a model calibrated to the U.S. economy, Schmitt-Grohé and Uribe (2004b) find that under the Ramsey policy, the mean of inflation and its standard deviation is close to zero. As shown in Table 1, in the sticky-price economy, the Ramsey optimal mean rate of inflation is only –0.16 percent and the optimal inflation volatility 0.17 percent. By contrast, under fully flexible prices, the mean inflation rate is –3.66 percent and the standard deviation of inflation is 6.04 percentage points.

Furthermore, Schmitt-Grohé and Uribe (2004b) show that the inflation-volatility tax-rate-volatility trade-off is resolved in favor of inflation stability not only for degrees of price stickiness observed in the U.S. economy, but also for much lesser degrees of price stickiness. This point is illustrated in Figure 1, which shows on the horizontal axis the degree of price stickiness as measured by a parameter θ. When prices are perfectly flexible, then the parameter θ is equal to zero. As the parameter θ increases, prices become more sticky. The value of price stickiness estimated for the U.S. economy is 4.4. The graph shows that even for a degree of price stickiness ten times smaller than the value estimated for the postwar U.S. economy, the optimal inflation volatility is below 1 percent per year. These findings are further support for Woodford's conclusion that, in most existing work, price stability should be the central goal of optimal monetary policy.

This conclusion is based on evidence that relies exclusively on models without an accumulable factor of production. Next, I discuss some evidence on the desirability of price stability in models where

physical capital is a factor of production and can be accumulated. The basic elements of the model with capital accumulation are, as in the one discussed above, that money facilitates purchases of goods, product markets are monopolistically competitive, the government must finance a stochastic stream of public consumption either with lump-sum or income taxes, and prices are sticky à la Calvo (1983). The production technology is described by some homogenous-of-degree-one function and is subject to shocks to total factor productivity ($z_t F(K_t, H_t)$). The evolution of capital is given by $K_{t+1} = (1-\delta) K_{t-1} + I_t$. In Schmitt-Grohé and Uribe (2003), we compute welfare in that economy under a number of alternative monetary and fiscal policy arrangements. One of the policies considered is one in which the inflation rate is held forever constant. We refer to that policy as inflation targeting. We compute the welfare consequences for the various rules under the assumption that business cycles are driven by government purchases and total factor productivity shocks. We calibrate the model to the U.S. economy.

We consider monetary policy rules of the type

$$(1)\quad R_t = \alpha_R R_{t-1} + \alpha_\pi \pi_{t-j} + \alpha_y y_{t-j}, \qquad \text{for } j = -1, 0, +1,$$

where a hat over a variable indicates log-deviations from its non-stochastic steady-state value and

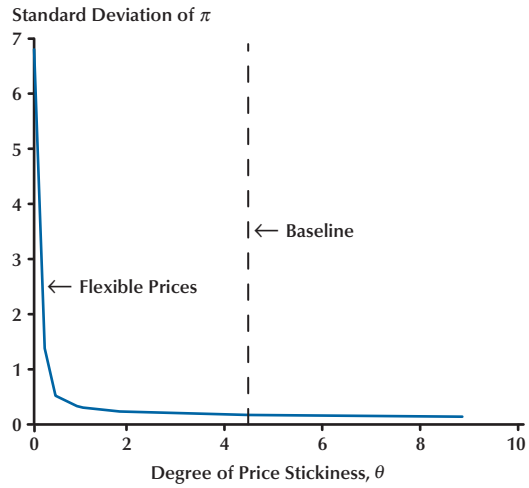
$$(2)\qquad R_t = R_{t-1} + \alpha_\pi \pi_t + \alpha_y \ln y_t / y_{t-1}.$$

The variable measuring the output gap here is $\hat{y}_t$, which denotes the deviations of output from the non-stochastic steady state. Related studies typically use a different measure of the output gap—namely, one that measures the log-difference between the actual level of output and the one that would obtain in a model without price-adjustment frictions. (This is what Woodford refers to as the properly defined real stabilization objective.) Note that this is not simply the difference of output from a linear time trend, rather this is a highly sophisticated concept. To be able to estimate that output gap, one needs to know what the current realizations of the shocks are and one has to know exactly where the nominal frictions lie and how to compute the flexible-price equilibrium.

The advantage of the interest rate feedback rule given in equation (2) is that it puts even fewer informational requirements on the monetary authority. To implement this rule, all the central bank needs to know are the current values of output and inflation, the past value of the nominal interest rate and output,

Figure 1

Degree of Price Stickiness and Optimal Inflation Volatility



NOTE: The baseline value of θ is 4.4. The standard deviation is measured in percent per year.
SOURCE: Schmitt-Groh! and Uribe (2004b).

and the central bank's inflation target, π^*. The inflation target is needed to compute $\hat{\pi}_t$. Note that this rule does not require knowledge of the non-stochastic steady state; in particular, it is not necessary to know the non-stochastic steady-state value of output or the nominal interest rate.

For each case that we consider, we find that the highest level of welfare is attained under a policy of inflation targeting—that is, when the central bank conducts policy in such a way that in equilibrium the inflation rate is equal to its non-stochastic steady-state value at all times. This finding suggests that even in models with capital, money, and distorting taxes (but flexible wages), price stabilization should be the overriding goal of policy. Table 2 illustrates this point for the case that all taxes are lump-sum and the economy is cashless. Similar results hold for the monetary economy and in the presence of distorting taxes. Inflation targeting yields at least as much welfare as any of the optimized rules considered. Thus it provides further evidence that inflation stability is desirable.

The table suggests two other interesting results. One is that it is optimal not to respond to output. This is reflected in the fact that the optimal response coefficient on output is zero in almost all cases. The second is that the welfare differences

Table 1

Desirability of Price Stability in a Model with Capital Accumulation

	α_π	α_y	α_R	Welfare	Welfare cost
I. Monetary policy: $\hat{R}_t = \alpha_\pi \hat{\pi}_{t-i} + \alpha_y \hat{y}_{t-i} + \alpha_R \hat{R}_{t-1}$					
		Smoothing			
Current-looking ($i = 0$)	3	0	0.9	–628.2180	0
Backward-looking ($i = 1$)	3	0	2.8	–628.2207	0.0004
Forward-looking ($i = -1$)	3	0	–2.3	–628.8657	0.0886
		No smoothing			
Current-looking ($i = 0$)	3	0	—	–628.2193	0.0002
Backward-looking ($i = 1$)	3	–1.2	—	–629.2988	0.1477
Forward-looking ($i = -1$)		The equilibrium is indeterminate			
II. Monetary policy: $\hat{R}_t - \hat{R}_{t-1} = \alpha_\pi \hat{\pi}_t + \alpha_y[\hat{y}_t - \hat{y}_{t-1}]$					
	3	0	—	–628.2180	0
III. Monetary policy: inflation targeting $\hat{\pi}_t = 0$					
				–628.2175	–0.00007

NOTE: (i) R_t denotes the gross nominal interest rate, π_t denotes the gross inflation rate, and y_t denotes output. (ii) For any variable x_t, its non-stochastic steady-state value is denoted by x, and its log-deviation from steady state by $\hat{x}_t \equiv \ln(x_t/x)$. (iii) In all cases, the parameters α_π, α_y, and α_R are restricted to lie in the interval [–3,3]. (iv) Welfare is defined as follows: Let $V(s_t)$ denote the equilibrium level of lifetime utility of the representative household in period t given that period's state s_t. Then welfare is defined as $V(s)$. (v) The welfare cost is relative to the optimal current-looking rule with smoothing and is defined as the percentage decrease in the consumption process associated with the optimal rule necessary to make the level of welfare under the optimized rule identical to that under the alternative policy considered. Thus, a positive figure indicates that welfare is higher under the optimized rule than under the alternative policy considered. (vi) Computations are based on a second-order approximation.

SOURCE: Schmitt-Grohé and Uribe (2003).

between the various optimized rules and inflation targeting are negligible from a welfare point of view as long as the central bank has the option to smooth interest rates over time.

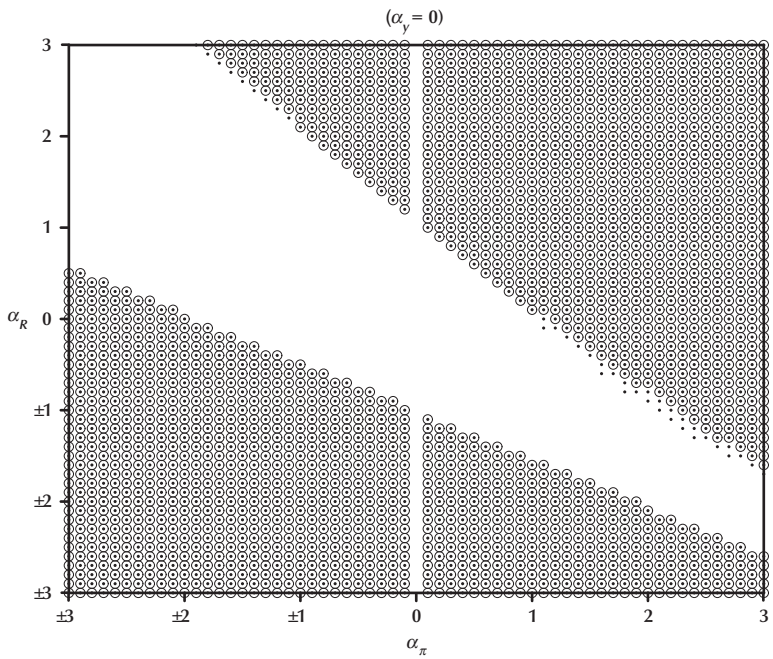
The second point raises an interesting issue. Clearly, one would like to know what the optimal monetary policy is. But, at the same time, it is also important to gauge how costly it would be to pursue a policy that is not the optimal one but something that one could realistically implement in practice. For example, the optimal policy prescription presented by Woodford in the appendix (drawing on Giannoni and Woodford, forthcoming) is based on an estimated model with wage and price stickiness. Consequently, one would expect the optimal policy to be quite complex, and indeed so it is. Its characterization involves not only current values but also infinite-lead polynomials of wages, prices, and a sophisticated output gap measure. So it is natural to ask how much of a quantitative difference it would make in terms of welfare to follow this optimal policy prescription as opposed to a much simpler one. In addition, it would be useful to know whether it is important to get the response coefficients exactly right or whether there exists a large family of rules that are associated with welfare levels that are very close to the level of welfare associated with the optimum. These are quantitative questions that are necessarily model specific.

As a first pass on this question, I will present some numerical results from the economy studied in Schmitt-Grohé and Uribe (2003) described above. In that particular framework there may be very little difference between a large number of monetary policies that the central bank can follow. The economy of Schmitt-Grohé and Uribe (2003) differs from the Giannoni and Woodford economy in several dimensions. Our model features capital accumulation, whereas the Giannoni and Woodford economy does not. On the other hand, the Giannoni and

Figure 2

Determinancy Regions and Welfare in the Model with Capital

$R_t = \alpha_R R_{t\pm1} + \alpha_\pi \pi_t$



NOTES: A dot represents a combination of parameters for which the equilibrium determinate. A circle de [illegible] not [illegible] the welfare co [illegible] optimized rule (i.e., α_π [illegible] α_y [illegible] α_R [illegible] 0.05 percent.
SOURCE: Schmitt-Groh [illegible] ! and Uribe (2003).

Woodford framework features habit formation, sticky wages (which is an important difference, as it makes price stabilization less desirable), and some decision lags that make that framework match estimated empirical impulse responses. Ours is not an estimated model.

Figure 2 shows regions of the interest rate feedback rule coefficients α_R and α_π introduced in equation (1) for which the welfare cost of following that policy (as opposed to the optimized rule) is at most 5 one-hundredths of 1 percent of the consumption stream associated with the optimized rule. In these computations the output response coefficient is held constant at zero ($\alpha_y = 0$). The graph shows that the region of parameters for which the equilibrium is unique is virtually the same as the region for which the welfare costs are below 5 basis points. This suggests that from a welfare point of view, it does not really matter to which values the central banks sets the response coefficients in the interest rate feedback rule as long as they render the equilibrium determinate. Similar results hold for the feedback rule given in equation (2), with α_y equal to its optimized value of zero (see Schmitt-Grohé and Uribe, 2003).

My last comment concerns the implementation of inflation targeting. In particular, one interesting issue is whether the emphasis on price stability that comes out of the theoretical literature on optimal monetary policy implies that interest rates should respond little to output measures. Suppose the central bank chooses to implement its policy objectives by following a feedback rule for the short-term nominal interest rate that it controls. The results presented in Table 2 indicate that the optimal response coefficient on the output gap should be zero, where the output gap is defined as the log-deviation of output from steady state. As we show in Schmitt-Grohé and Uribe (2003), the welfare losses

from choosing a non-zero coefficient on output can be large. We find values in excess of one-tenth of 1 percent of the stream of consumption associated with the optimized rule.[1] The argument that responding to output can lead to relatively sizeable welfare losses has been criticized on the grounds that the output measure used in the monetary policy rule is "not the right one." The argument goes that, were one instead to use an output gap measure based on the difference between actual output and the output that would arise in a world without nominal frictions, then the welfare losses from responding to output in the feedback rule would be much smaller.

In practice the central bank may not be able to construct this sophisticated output gap measure and will instead use a simple measure that is much more akin to log deviations from a constant trend. Furthermore, one can show that if the output gap is interpreted as the difference of the quarterly output growth rate from some constant, then welfare losses associated with responding to that measure of output are small as well. Under such a rule it is still optimal not to respond to output (see the second panel of Table 2). However, Schmitt-Grohé and Uribe (2003) show that the welfare differences between a zero output coefficient and an output coefficient between –3 and 3 is at most 0.03 percentage points of the consumption stream associated with the best feedback rule. This welfare loss is relatively small.

These findings suggest that when implementing inflation targeting through interest rate feedback rules it may suffice to respond to variations in inflation alone. Second, a reason for policymakers to abstain from responding to output variations is that such behavior may have significant welfare consequences if the policymaker does not have the proper output gap measure. It is important to keep in mind that the optimal policy behavior advocated here does not have stabilization of inflation as its ultimate objective, but instead the maximization of welfare. Thus, even though the implementation of the optimal policy takes the form of a rule that responds little to variations in the level of aggregate activity, this does not imply that the reasons for adopting this policy are that the policymaker does not fully internalize the welfare consequences of output fluctuations. One caveat is that these recommendations stem from an analysis in which factor prices are assumed to be fully flexible. It remains to be shown in future work how large the welfare costs or benefits of responding to output are in a world with sluggish factor price adjustments.

[1] In a simple model in which complete inflation stabilization is optimal, Rotemberg and Woodford (1997, Table 2) report the value of a loss function that is a linear transformation of the unconditional expectation of the utility function for various values of the feedback rule coefficients α_π and α_y. For example, for values of $\alpha_\pi = 1.5$ and $\alpha_y = 0.5$, the loss function is 8.72, whereas for $\alpha_\pi = 10$ and $\alpha_y = 0$, it is only 0.93. These numbers suggest that not responding to output is desirable and that higher output response coefficients are associated with lower unconditional welfare. However, from those numbers one cannot tell whether the welfare losses would be large or small in terms of units of consumption.

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The Macroeconomic Effects of Inflation Targeting

Andrew T. Levin, Fabio M. Natalucci, and Jeremy M. Piger

1. INTRODUCTION

Over the past 15 years, explicit inflation targeting (IT) has been adopted by an increasing number of central banks, and a substantial body of literature has emphasized the advantages of this approach as a framework for monetary policy.[1] Nevertheless, empirical analysis has yielded little evidence of any macroeconomic effects of IT. For example, the landmark study of Bernanke, Laubach, Mishkin, and Posen (1999) concluded that the first few countries to adopt IT did not experience any short-run gains in lower output costs of disinflation. Most recently, Ball and Sheridan (forthcoming) considered a wide range of macroeconomic indicators for Organisation for Economic Cooperation and Development (OECD) economies and found no statistically significant differences between the IT and non-IT countries.

In this paper, we evaluate the extent to which IT exerts a measurable influence on expectations formation and inflation dynamics. For the industrialized economies, we address this question by comparing time-series data since 1994 for five IT countries (Australia, Canada, New Zealand, Sweden, and the United Kingdom) with that of seven non-IT countries (the United States, Japan, Denmark, and four of the five largest euro area members—namely, France, Germany, Italy, and the Netherlands).[2] For these economies, we analyze the behavior of medium- and long-term inflation expectations using Consensus Economics Inc. semiannual surveys of market forecasters, and we employ the methods of Stock (1991) and Hansen (1999) to obtain median-unbiased measures of persistence for total and core consumer price inflation (CPI). Finally, since the experience with IT in the emerging market economies (EMEs) is mainly limited to the past few years, our analysis of these economies follows an event-study approach similar to that of Bernanke et al. (1999).

For the industrialized economies, our evidence indicates that IT has played a significant role in anchoring long-run inflation expectations. For the United States and the euro area, private-sector inflation forecasts (at horizons up to ten years) exhibit a highly significant correlation with a three-year moving average of lagged inflation.[3] In contrast, at the longest horizons this correlation is largely absent for the five IT countries, indicating that these countries' central banks have been quite successful in delinking expectations from realized inflation.[4]

We also find that actual inflation exhibits mark-

[1] See Leiderman and Svensson (1995), Bernanke and Mishkin (1997), Bernanke et al. (1999), Schaechter, Stone, and Zelmer (2000), Corbo, Landerretche, and Schmidt-Hebbel (2001), Mishkin and Schmidt-Hebbel (2001), Neumann and von Hagen (2002), Benati (2003), Goodfriend (forthcoming), and Svensson and Woodford (forthcoming).

[2] To avoid consideration of structural breaks midway through the sample, our analysis excludes Norway and Switzerland (which adopted explicit inflation targets in 2000 and 2001, respectively) as well as Finland and Spain (which moved from IT to euro area membership). See Dueker and Fisher (1996).

[3] In related work, Gurkaynak, Sack, and Swanson (2003) find evidence that shifts in private-market perceptions about long-term inflation account for a substantial proportion of the degree to which U.S. long-term bond rates are highly sensitive to federal funds rate surprises. See also Bernanke and Kuttner (2003), Bonfim (2003), and Kozicki and Tinsley (2001a,b).

[4] For results regarding the effects of IT on short-term inflation expectations, see Johnson (2002, 2003) and Gavin (2004).

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edly lower persistence in IT countries.[5] For example, even with only a decade of quarterly data, we can clearly reject the null hypothesis of a unit root in core CPI inflation for Canada, New Zealand, Sweden, and the United Kingdom. Inflation persistence is estimated to be quite low in these countries, with the 90 percent confidence interval for the largest autoregressive root excluding 0.7 in all cases. By contrast, the unit-root null hypothesis cannot be rejected for the United States, the euro area, or Japan.[6]

For the EMEs, the initial experience with IT appears to be largely consistent with that observed by Bernanke et al. (1999) for the industrialized countries.[7] In particular, our event-study approach confirms that the adoption of IT is not associated with an instantaneous fall in private-sector inflation forecasts, especially at longer horizons. Since measures of potential output and the natural unemployment rate are notoriously difficult to construct for EMES, we have not attempted to compute sacrifice ratios for these episodes; however, informal assessment suggests that the adoption of IT was not associated with a marked reduction in the output costs of disinflation.

It should be noted that the absence of instantaneous gains from IT is not necessarily inconsistent with substantial macroeconomic effects over a period of a decade or more. If an economy has already been experiencing low and stable inflation for an extended period, then the adoption of a formal IT regime might not have any immediate benefit—the delinking of expectations from realized inflation would only become visible at some later date when the economy was hit by a substantial shock. On the other hand, if IT is adopted at a point of relatively high or volatile inflation, then the private sector might reasonably be skeptical about the likely duration of the regime, and hence its inflation expectations would only adjust gradually (cf. Erceg and Levin, 2003).

Finally, our analysis underscores the key role of institutional considerations in determining inflation expectations. In particular, as emphasized by Kohn (forthcoming), the volatility of long-term inflation expectations for a number of IT countries is roughly similar to that of some non-targeters such as the United States. Since our analysis suggests that the IT countries have succeeded in delinking inflation expectations from lagged inflation, the ongoing fluctuations in long-term expected inflation for these countries are evidently related to shifting views about the long-term course of monetary policy (e.g., the probability that Sweden or the United Kingdom might join the European Monetary Union).

The remainder of this paper is organized as follows. For the industrial economies, section 2 presents our findings on the determination of inflation expectations, section 3 reports our results regarding inflation persistence, and section 4 presents evidence regarding macroeconomic volatility. For the EMEs, section 5 provides an overview of IT arrangements, and section 6 presents our event-study analysis of the initial effects of IT. Section 7 summarizes our conclusions and discusses some areas for future research.

2. INFLATION TARGETING AND INFLATION EXPECTATIONS IN INDUSTRIALIZED ECONOMIES

In this section we begin our analysis of the macroeconomic effects of IT by investigating the behavior of inflation expectations in our sample of IT and non-IT economies. We are primarily interested in whether inflation expectations, particularly at longer horizons, are relatively more anchored in IT economies.

To measure inflation expectations, we use survey results collected by Consensus Economics. Twice each year, market forecasters are polled regarding their inflation forecasts at horizons of one to ten years. The mean panelist forecast serves as our measure of inflation expectations. We obtained these forecasts from 1994 to the present for each of the countries in our samples, with the exception of Denmark. In the results presented here, the "euro average" we form is a weighted average of France, Germany, Italy, and the Netherlands using GDP shares

[5] Siklos (1999) finds evidence of a decline in inflation persistence in some IT countries; see also Kuttner and Posen (1999). Using a sample of more than 100 countries, Kuttner and Posen (2001) find evidence that inflation-targeting countries experience lower inflation persistence. Corbo et al. (2001) find that IT is associated with lower long-term effects of inflation innovations compared with the non-IT countries.

[6] As shown in section 3, we find that the unit root null hypothesis can be rejected for U.S. total CPI inflation but not for core CPI inflation. A number of studies have considered the extent to which recent U.S. inflation data exhibits less persistence than that of a random walk; cf. Barsky (1987), Evans and Wachtel (1993), Fuhrer and Moore (1995), Brainard and Perry (2000), Taylor (2000), Cogley and Sargent (2002, 2003), Kim et al. (2001), Stock (2002), Pivetta and Reis (2001), Levin and Piger (2002), and Benati (2002). For estimates of inflation persistence for other countries, see also Ravenna (2000) and Batini (2002).

[7] See also Ammer and Freeman (1995), Laubach and Posen (1997), Almeida and Goodhart (1998), and Corbo et al. (2001).

as weights. Thus, our non-IT sample consists of this euro average, Japan, and the United States.

Figure 1 displays the inflation expectation series for four forecast horizons: one, three, five, and six-to-ten years ahead. Note that in many cases, the series drift downward over the early part of the sample. To account for this nonstationarity, the empirical results presented in subsequent sections focus on first differences of the expectation series.

2.1 Volatility of Inflation Expectations

As a first pass at investigating these data, Table 1 presents the standard deviation of the first difference of the expectations series for the four forecast horizons plotted in Figure 1.

Overall, the results in Table 1 suggest that inflation expectations are not noticeably more volatile in non-IT vs. IT economies. Indeed, expectations for the euro average and the United States are less volatile than the average for the IT economies at every forecast horizon and display similar or less volatility than most of the individual IT economies. On the other hand, Japanese inflation expectations are much more volatile than the other economies, particularly at longer horizons.

These results are consistent with those of Kohn (forthcoming), who used Consensus Economics' measures of inflation expectations and found that the volatility of changes in inflation expectations in Germany and the United States are no higher than those in Canada, Sweden, and the United Kingdom. Nevertheless, even if the unconditional volatility of inflation expectations is no less in IT economies, expectations may still be more anchored in IT economies in that they are less responsive to macroeconomic developments. That is, two countries with identical inflation expectation volatility may have such volatility for very different reasons. For example, suppose that IT has anchored inflation expectations in the United Kingdom, making them less responsive to macroeconomic fluctuations. In this case, inflation expectations may still be unconditionally relatively volatile, due to, say, institutional uncertainty surrounding the possible adoption of the euro.

2.2 Sensitivity of Expectations to Realized Inflation

We now estimate the sensitivity of inflation expectations to realized inflation in IT and non-IT countries. In particular, we estimate a pooled regression in which the left-hand-side variable is the first difference of inflation expectations and the right-hand-side variable is the first difference of lagged realized CPI inflation. Formally, we estimate the following equation:

$$\Delta\pi_{i,t}^{(q)} = \lambda_i + \beta\Delta\bar{\pi}_{i,t} + \varepsilon_{i,t}, \tag{1}$$

where $\pi_{i,t}^{(q)}$ is an expectation of inflation q years in the future in country i, formed at time t, and $\bar{\pi}_{i,t}$ is a three-year moving average of inflation in country i ending at time t. Equation (1) is estimated for our sample of both IT economies and non-IT economies, yielding an estimate of β for each set of countries. Given the relatively high level of expectations volatility in Japan, and the fact that economic performance in Japan has been quite different from that in the euro area and the United States over this sample period, we also present estimates for a non-IT sample consisting of the euro average and the United States only.

Table 2 reports estimates of the relationship between realized inflation and expected inflation at several different forecast horizons. These estimates suggest that longer-run inflation expectations have been much less responsive to actual inflation devel-

Table 1

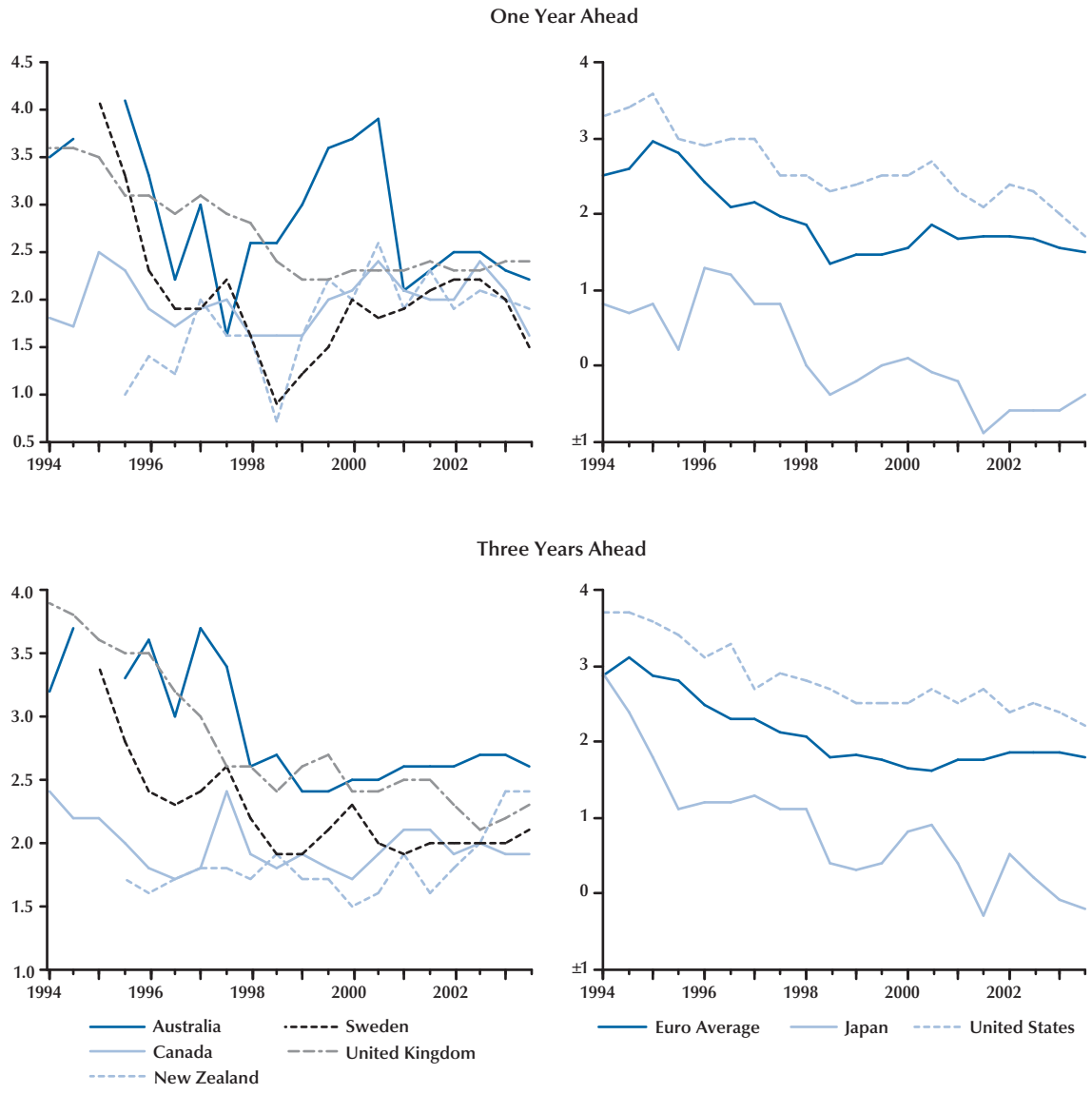
Standard Deviation of Change in Inflation Expectations (1994-2003)

	Horizon (years ahead)			
	1	3	5	6-10
IT sample				
Australia	0.76	0.36	0.41	0.16
Canada	0.33	0.23	0.17	0.21
New Zealand	0.53	0.19	0.16	0.13
Sweden	0.44	0.24	0.19	0.26
United Kingdom	0.16	0.17	0.17	0.21
IT mean	0.44	0.24	0.22	0.19
Non-IT sample				
Euro average	0.22	0.14	0.15	0.10
Japan	0.42	0.40	0.39	0.66
United States	0.25	0.21	0.16	0.11

NOTE: This table contains the standard deviation of the first difference of the mean inflation forecast collected by Consensus Economics Inc. over the period 1994 through the second half of 2003. The "euro average" is a weighted average of France, Germany, Italy, and the Netherlands, using GDP shares as weights.

Figure 1

Inflation Expectations

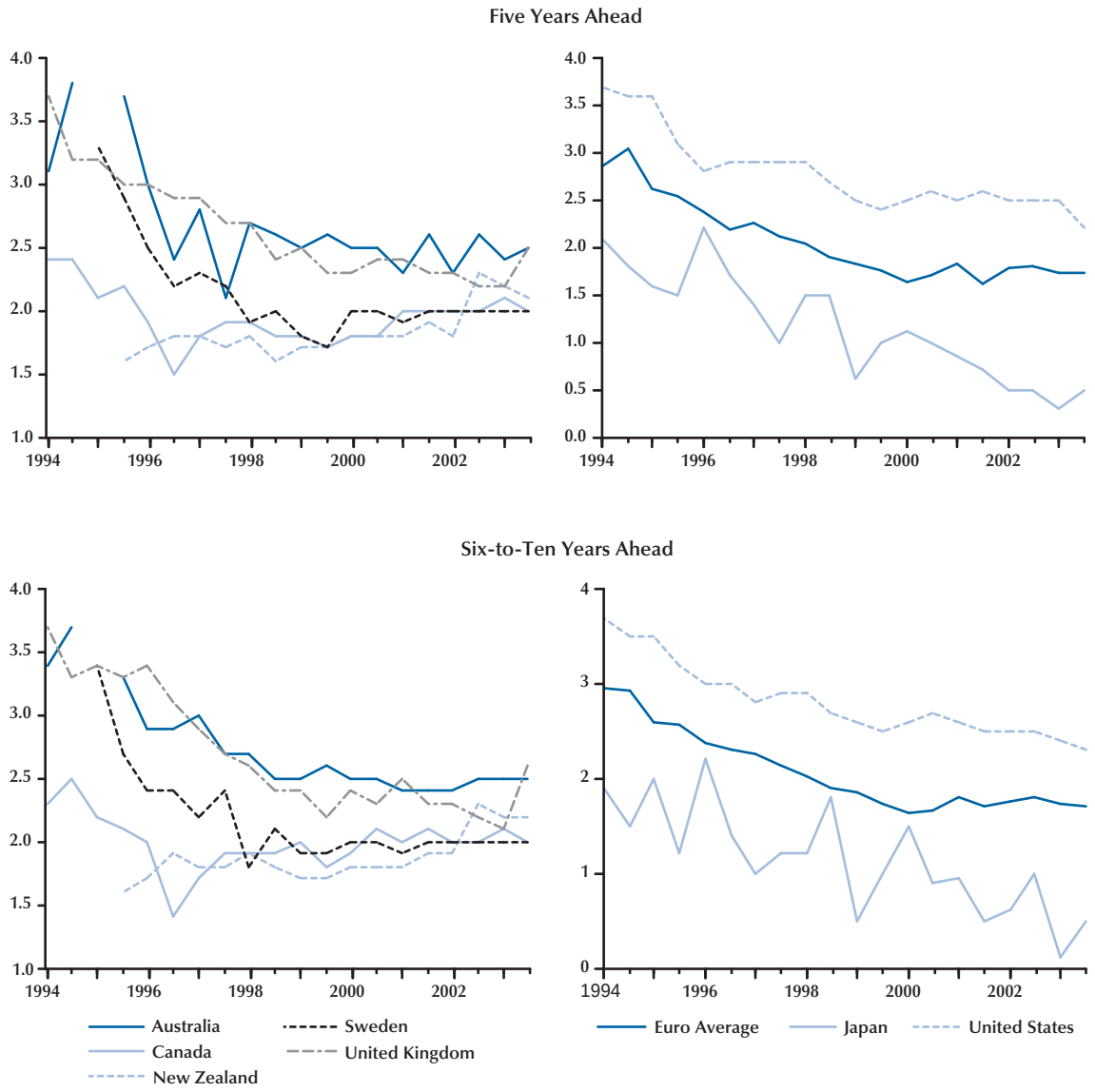


opments in IT countries than in non-IT countries. At the five-year horizon, the estimated response of the change in expected inflation to the change in lagged actual inflation in non-IT economies is over three times that in IT economies. At the six-to-ten-year horizon, the estimated response in non-IT economies is still around 25 basis points, whereas the estimated response in IT countries is close to zero and statistically insignificant. This suggests that IT central banks have been quite successful in delinking expectations from realized inflation. The final row of the table demonstrates that these results are robust to removing Japan from the non-IT group.

Some have argued that, in the United States, the Federal Reserve pursued a policy of "opportunistic disinflation" during the early years of our sample and that the dynamics of inflation are likely different in the years following this disinflation. To investigate this possibility, we estimated equation (1) for U.S. data only, over a sample beginning in 1998 rather

Figure 1 cont'd

Inflation Expectations



NOTE: This figure contains the mean inflation forecast collected by Consensus Economics Inc. over the period 1994 through 2003. "Euro average" is a weighted average of France, Germany, Italy, and the Netherlands, using GDP shares as weights. For Japanese five-year-ahead and six-to-ten year-ahead expectations, the observation for the second half of 1997 was missing. This was replaced by the median of the six adjacent observations for this figure.

than in 1994. Over this period, the estimated response of five-year-ahead inflation expectations on lagged three-year average inflation is 0.34, with a standard error of 0.13, which is similar to the estimate of 0.36 obtained for the U.S. data over the sample beginning in 1994. Also, it is interesting to note that the most recently obtained observation for five-year-ahead U.S. inflation expectations, released by Consensus Forecasts in mid-October of 2003, declined from 2.5 to 2.2 percent, which corresponds to a decline in lagged three-year average inflation from 2.5 to 2.3 percent.

These findings are broadly consistent with those reported by Castelnuovo, Nicoletti-Altimari, and

Table 2

Estimated Response of Change in Inflation Expectations to Change in Realized Inflation

	Horizon (years ahead)			
	1	3	5	6-10
IT	0.00	0.20	0.09	0.01
	(0.10)	(0.06)	(0.05)	(0.05)
Non-IT	–0.03	0.25	0.29	0.24
	(0.17)	(0.11)	(0.11)	(0.08)
Euro area and United States	–0.06	0.30	0.34	0.24
	(0.19)	(0.12)	(0.11)	(0.08)

NOTE: This table holds estimates of β from equations (1) and (2) applied to both IT and non-IT economies over the period 1994-2003. Standard errors are in parentheses. Estimation was performed via generalized least squares assuming cross-sectional heteroskedasticity. Similar results are obtained when estimation is performed via a seemingly unrelated regression.

Palenzuela (2003; CNP), who analyzed the relationship between changes in long-term expected inflation (at a horizon of six-to-ten years) and changes in one-year-ahead expected inflation. Using Consensus Economics' survey data for the period 1995-2002, CNP obtained regression coefficients of 0.21 for the United States, 0.31 for Switzerland, and 0.43 for Japan, compared with an average coefficient of 0.13 for the five IT countries in our sample. For the euro area, CNP used the sample period 1999-2002 and obtained a regression coefficient of 0.08, closer to that of IT economies than non-IT economies.

Finally, it is interesting to note that Ball and Sheridan (forthcoming) found that one-year-ahead inflation expectations are about one-third less responsive to realized inflation developments in IT economies than in non-IT economies, but this difference is not statistically significant. This evidence is consistent with the results in Table 2 for forecast horizons of one and three years. However, it seems reasonable that IT, by revealing a long-run trend rate of inflation, would have its greatest chance of success at anchoring long-horizon expectations.

Indeed, the results in Table 2 suggest that long-run inflation expectations are substantially more anchored in IT economies.[8]

[8] For more discussion of Ball and Sheridan (forthcoming), see Gertler (forthcoming).

3. INFLATION TARGETING AND INFLATION DYNAMICS IN INDUSTRIALIZED ECONOMIES

In the previous section, we studied the behavior of inflation expectations in IT and non-IT economies. In this section we turn our analysis to the dynamics of actual inflation. We are particularly interested in whether inflation persistence is lower in IT countries than in non-IT countries.

3.1 A Look at the Data

Our data consist of inflation rates for our sample of IT economies (Australia, Canada, New Zealand, Sweden, and the United Kingdom) and non-IT economies (Denmark, France, Germany, Italy, the Netherlands, Japan, and the United States). We also consider a euro-area average inflation rate, which is average inflation across the 12 countries that have adopted the euro; the sample period runs from the first quarter of 1994 to the second quarter of 2003 for all countries.

For each country, we analyze two measures of inflation, the first based on the total CPI and the second based on the core CPI, measured as the total CPI less food and energy prices. Inflation is calculated as the annualized quarterly percentage change in the price index. All data were obtained from the OECD. We identify three specific cases in which exogenous shifts in tax rates resulted in large transitory fluctuations in the inflation series. These consist of the introduction of the goods and services tax (GST) in Australia in the third quarter of 2000; large changes in cigarette taxes in Canada in the first two quarters of 1994; and an increase in the consumption tax in Japan in the second quarter of 1997. As shown by Franses and Haldrup (1994), such outliers can induce substantial downward bias in the estimated degree of persistence. Thus, before analyzing the inflation series, we replace the outliers with interpolated values (the median of the six adjacent observations that were not themselves outlier observations). The total and core CPI inflation rates for each country are shown in Figure 2.

3.2 Methodology

To measure inflation persistence, we estimate a univariate autoregressive process for each inflation series:

$$\pi_t = \mu + \sum_{j=1}^{K} \alpha_j \pi_{t-j} + \varepsilon_t, \quad (2)$$

Figure 2

Inflation Rates

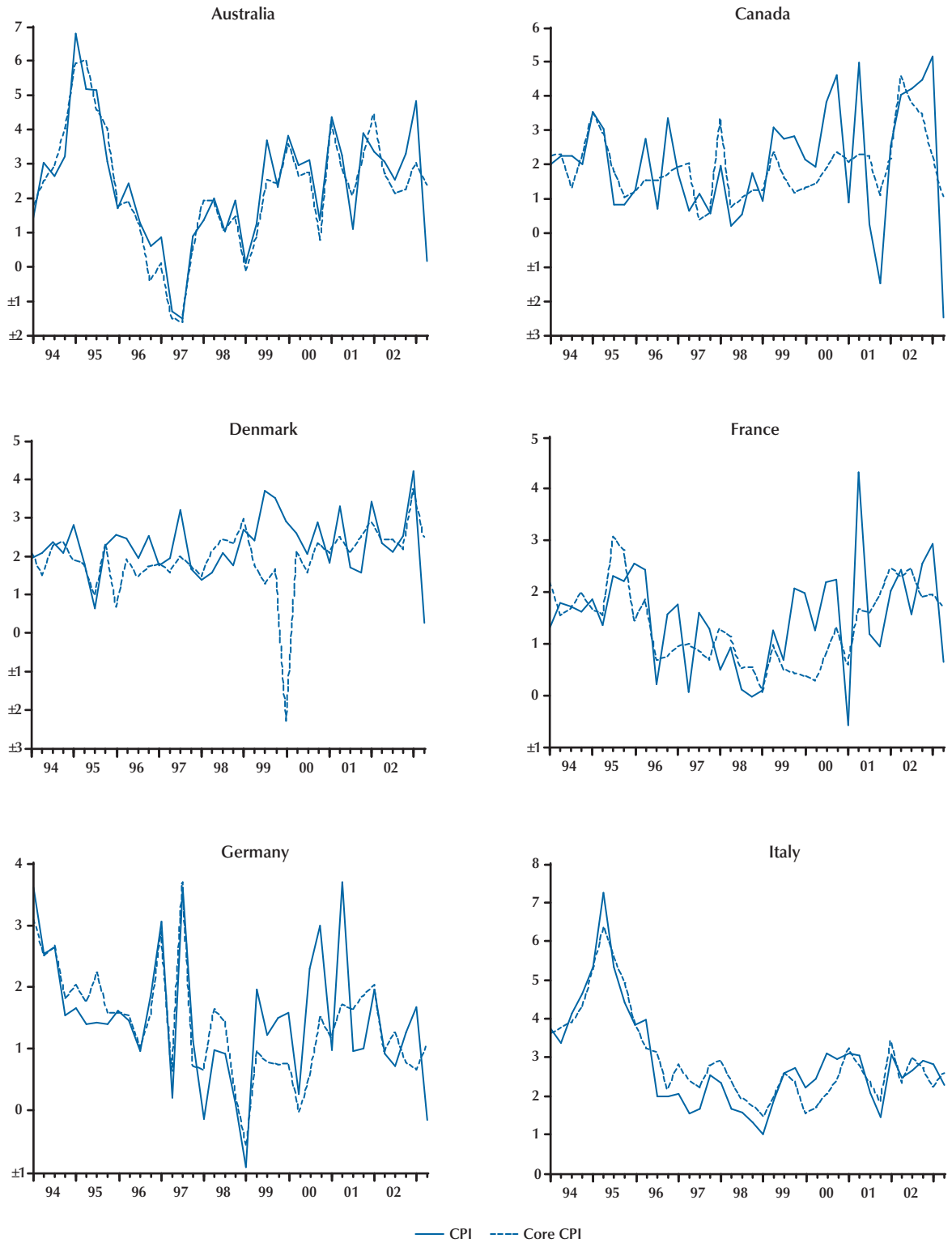


Figure 2 cont'd

Inflation Rates

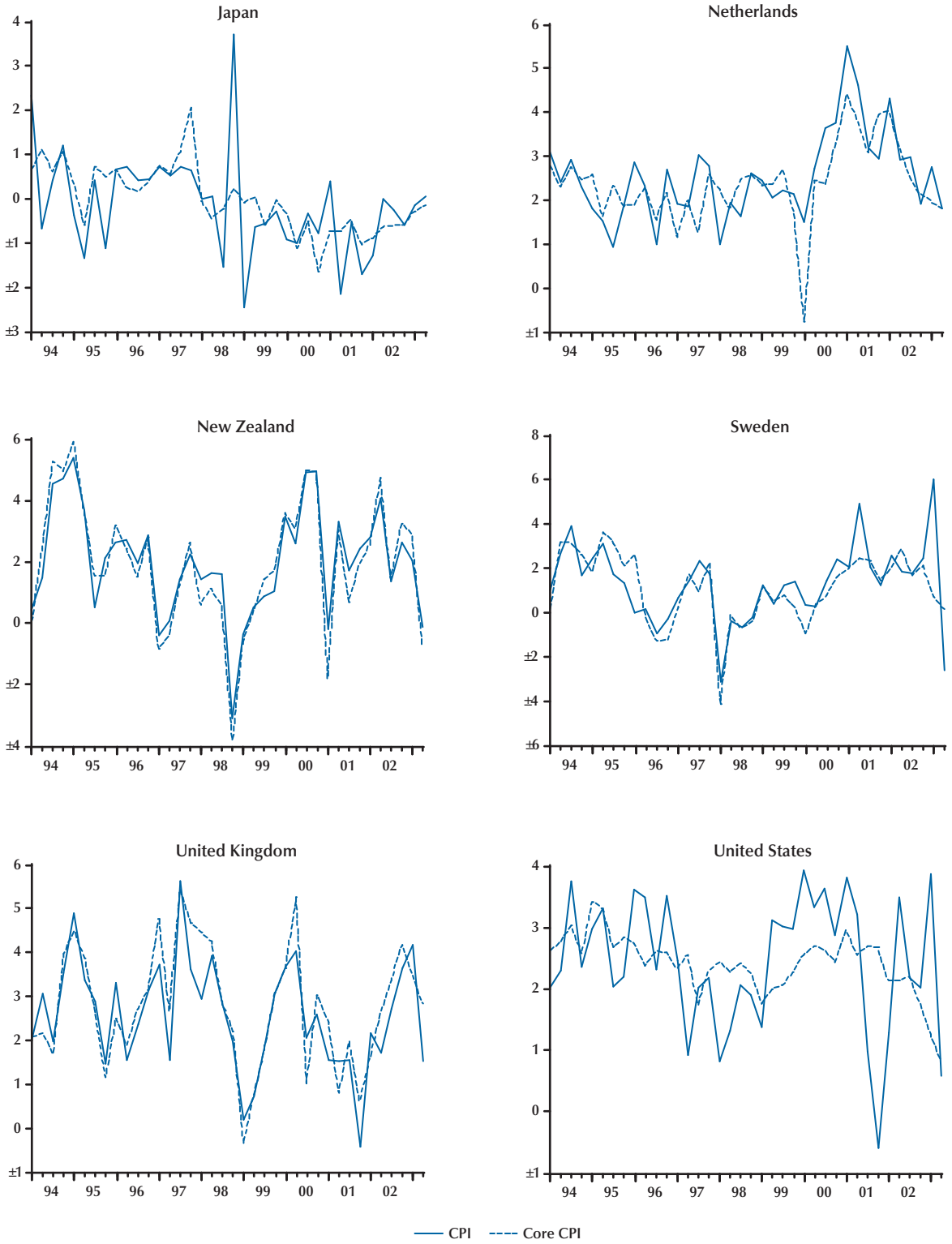


Table 3

Persistence Estimates for Inflation

	Core CPI		Total CPI	
Country	Median unbiased	Upper 95th percentile	Median unbiased	Upper 95th percentile
IT countries				
Australia	0.70	1.02	0.47	0.80
Canada	0.27	0.63	–0.22	0.21
New Zealand	0.24	0.60	0.25	0.61
Sweden	0.16	0.54	0.04	0.44
United Kingdom	0.33	0.68	0.06	0.45
Non-IT countries				
Denmark	0.66	1.00	–0.74	–0.23
Euro area	0.84	1.06	0.87	1.06
France	0.75	1.04	0.91	1.07
Germany	0.77	1.04	0.81	1.05
Italy	0.88	1.07	0.88	1.07
Netherlands	0.39	0.74	0.51	0.83
Japan	0.82	1.05	0.72	1.03
United States	1.04	1.10	0.54	0.86

NOTE: For each country in the sample, this table records the median unbiased estimate and the upper bound of the two-sided 90 percent confidence interval for the largest autoregressive root of core and total CPI inflation, estimated over 1994:Q1–2003:Q2. Estimates were computed based on Stock (1991), using equation (2).

where ε_t is a serially uncorrelated, homoskedastic random error term. To obtain a scalar measure of persistence from equation (2), we use the largest autoregressive root, denoted ρ and defined as the largest root of the characteristic equation $\lambda^K - \sum_{j=1}^{K} \alpha_j \lambda^{K-j} = 0$. The largest autoregressive root has intuitive appeal as a measure of persistence, as it determines the size of the impulse response, $\frac{\partial \pi_{t+j}}{\partial \varepsilon_t}$, as j grows large. We apply the procedures developed in Stock (1991) to obtain median unbiased estimates and an upper 95th percentile estimate, which is the upper bound of a two-sided 90 percent confidence interval.

As a robustness check, we also consider an alternative measure of persistence, namely, the sum of the autoregressive coefficients, $\alpha \equiv \sum_{j=1}^{K} \alpha_j$. As noted by Andrews and Chen (1994), α also has intuitive appeal as a measure of persistence, as it is monotonically related to the cumulative impulse response of π_{t+j} to ε_t. We construct a median unbiased and upper 95th percentile estimates for α using the "grid bootstrap" procedure of Hansen (1999). This technique simulates the sampling distribution of the t-statistic $t = \frac{\alpha - \alpha}{se(\alpha)}$ over a grid of possible true values for α to construct confidence intervals with correct coverage.

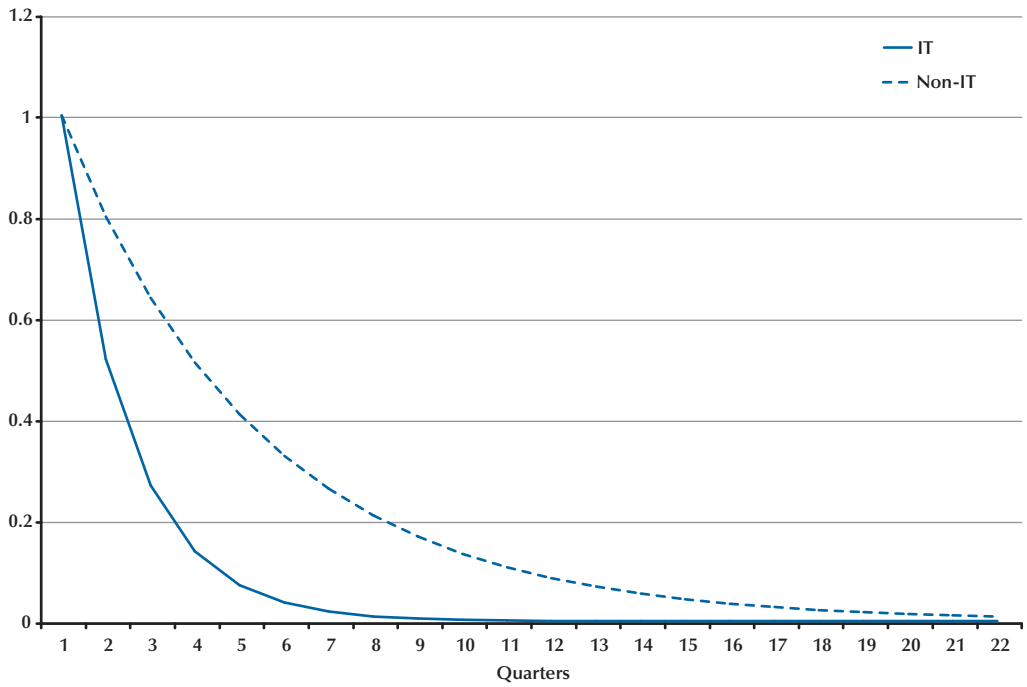
To estimate (1), an autoregressive lag order K must be chosen for each inflation series. For this purpose, we utilize Akaike information criterion, the information criterion proposed by Akaike (1973), with a maximum lag order of $K = 4$ considered. The lag order chosen for each series is reported in Appendix Table A1.

3.3 Persistence Estimates

We begin by discussing persistence estimates for the core CPI. Table 3 presents these results for each country in the sample. Note that values less than unity for the upper 95th percentile estimate imply that a unit root can be rejected for this series

Figure 3

Average Impulse Response Functions Based on Core CPI



at the 5 percent level of significance (based on a one-tailed test).

Consider first the results for the non-IT economies. Table 3 demonstrates that for Denmark, the euro area, Japan, and the United States, the upper 95th percentile estimate is above unity, suggesting that core CPI inflation in these economies displays behavior consistent with a unit-root process. The median unbiased estimate is also quite high in general, above 0.8 for the euro area, Japan, and the United States.

The results for the IT countries stand in contrast to those for the non-IT economies. For Canada, New Zealand, Sweden, and the United Kingdom, the upper 95th percentile estimate is less than unity, meaning that the unit root null hypothesis can be rejected for these series. This is true even though the sample size of roughly 40 observations is relatively short. Indeed, the median unbiased estimate is roughly 0.3 or less for these countries, which suggests a *white noise* process for inflation.

We now turn to the results for total CPI inflation, also shown in Table 3. In this case, the evidence is more mixed for the non-IT economies. In particular, while the unit-root null hypothesis cannot be rejected for both the euro area and Japanese inflation rates, it is rejected for both Denmark and the United States. For the IT economies, inflation persistence is again estimated to be quite low, with the unit-root null hypothesis rejected for all five IT countries. Australia displays the highest median unbiased point estimate of approximately 0.5 (similar to the estimate for the United States), while the remaining four countries have median unbiased estimates of less than 0.3.[9]

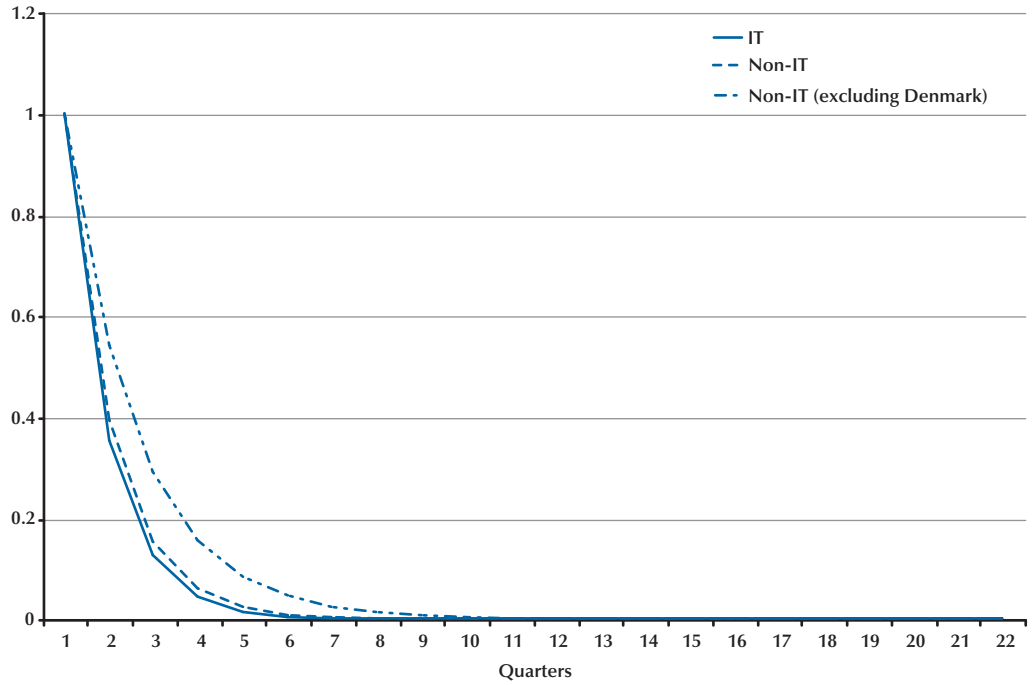
3.4 Impulse Response Functions

An intuitive way to interpret our measures of inflation persistence is to compute an impulse response function, which gives the response of inflation at various future dates to a shock that occurs today. Figure 3 displays average impulse response functions based on core CPI inflation both for the five IT countries in our sample and for a non-IT sample consisting of Denmark, the euro area,

[9] Note that estimated Australian inflation persistence is high relative to the other IT economies for both core and total CPI inflation. We have also estimated inflation persistence for the Australian CPI excluding mortgage interest and obtained similar results to those for the total CPI.

Figure 4

Average Impulse Response Functions Based on Total CPI



Japan, and the United States.[10] The figure makes clear that inflation shocks are much less persistent in the sample of IT economies. For example, nearly half of a one-unit shock to inflation in the IT economies has worn off after just one quarter, and 90 percent after just four quarters. By contrast, for the non-IT sample, it is four quarters before half of the effect of a one-unit shock has dissipated and eleven quarters before this effect has fallen by 90 percent.

Impulse response functions can also help in understanding the relationship between our results and those of Ball and Sheridan (forthcoming), who found no significant difference in the persistence of total CPI inflation for IT and non-IT industrial economies. Figure 4 gives the average impulse response functions for total CPI inflation. Consistent with Ball and Sheridan, the impulse response functions for IT and non-IT economies are nearly identical, suggesting there are less-obvious differences in persistence between IT and non-IT economies.

The results for total CPI inflation are influenced by the averaging of persistence estimates across countries for the purpose of computing the impulse response functions, which masks important details about individual countries. For example, Denmark displays considerable negative serial correlation for total CPI inflation, which lowers the average impulse response function for non-IT economies. This can be seen in Figure 4, which also plots an average impulse response function for the non-IT group, excluding Denmark, and suggests greater differences in persistence between the IT and non-IT group.

4. MACROECONOMIC VOLATILITY IN INDUSTRIAL ECONOMIES

4.1 Output Volatility

One potential explanation for their damped levels of inflation persistence is that IT countries have practiced an active monetary policy, quickly stamping out deviations of inflation from target levels.

[10] Following Ball and Sheridan (forthcoming), the average impulse response functions are computed by first averaging the autoregressive (AR) coefficients across groups of countries and then computing an impulse response function based on these average coefficients. For simplicity, the impulse response functions are calculated based on an AR(1) representation for inflation, with the AR(1) coefficients taken from the median unbiased estimates for α reported in Appendix Table A2. Thus, the impulse response functions are a smoothed version of an impulse response function based on the full set of autoregressive coefficients.

Table 4

Standard Deviation of Core CPI Inflation and Real GDP Growth (1994-2003)

	Standard deviation, output	Standard deviation, inflation	$VAR(\pi_t)/VAR(\varepsilon_t)$
IT countries			
Australia	2.54	1.73	2.04
Canada	2.03	0.93	1.23
New Zealand	3.97	2.10	1.16
Sweden	3.29	1.58	1.19
United Kingdom	1.33	1.37	1.24
IT mean	2.63	1.54	1.37
Non-IT countries			
Denmark	3.34	0.90	1.07
Euro area	2.01	0.68	2.39
France	2.42	0.75	2.08
Germany	2.28	0.87	1.36
Italy	1.80	1.14	3.41
Netherlands	4.34	0.90	1.29
Japan	1.46	0.75	1.73
United States	2.17	0.50	2.25

If this were the case, one would expect to see heightened levels of output volatility in IT countries where the monetary authority manipulated the output gap to reverse shocks to inflation (cf. Cecchetti and Ehrmann, 1999). To investigate this potential explanation, the first column of Table 4 also reports the standard deviation of real gross domestic product (GDP) growth computed from 1994 to the present for our sample of IT and non-IT economies.

As is apparent from the table, IT economies do not seem to display heightened volatility of real GDP growth relative to non-IT economies. In particular, the five IT economies are spread relatively evenly throughout the distribution of GDP volatility. This suggests that the low levels of inflation persistence in IT countries have *not* come at the expense of heightened output-growth volatility. This suggests that IT has improved the tradeoffs policymakers face in these countries.[11]

4.2 Inflation Volatility: Propagation or Shocks?

All else being equal, the relatively low levels of inflation persistence documented for IT countries should suggest relatively low levels of unconditional inflation volatility in these countries. However, as the second column of Table 4 documents, since 1994 the standard deviation of core CPI inflation does not appear to have been lower in IT economies relative to non-IT economies. Indeed, each IT economy has had higher inflation variance over this period than Denmark, the euro area, Japan, and the United States.

Using the autoregression in (2), the volatility of inflation can be decomposed into two sources: one due to the variance of the shocks to the auto regression and one due to the propagation of shocks through the autoregressive dynamics. The final column in Table 4 gives one measure of this decomposition—the ratio of the total variance of the inflation series to the variance of shocks to the autoregression. With the exception of Australia, these ratios are only slightly above unity in the IT countries, consistent with a white noise process for the inflation series. By contrast, this ratio is near or above 2.0 in the euro area, Japan, and the United States. Thus, it appears that the volatility of inflation in these non-IT economies contains a substantial propagation component, while in the IT countries the initial impact of shocks accounts for nearly all inflation variance. That overall variance is roughly

[11] For evidence regarding changes in output volatility across countries see van Dijk, Osborn, and Sensier (2002) and Stock and Watson (forthcoming).

similar in the two economies suggests that shocks to inflation in IT countries have been large relative to non-IT countries, and, had these economies not experienced low levels of inflation persistence, inflation volatility would have been even higher.

5. THE CHARACTERISTICS OF INFLATION TARGETING IN EMERGING MARKET ECONOMIES

In recent years, a growing number of EMEs have adopted IT as the main anchor guiding monetary policy.[12] During the mid-to-late 1990s, monetary aggregates became increasingly difficult to gauge, due to instability in money demand, while financial crises contributed to the widespread collapse of exchange rate pegs. As a result, many EMEs turned to IT as the only nominal anchor still viable.

The seminal papers on IT in emerging markets were aimed at identifying the prerequisites for successful adoption, based on the experience of industrial countries.[13] Subsequent analysis centered on special issues for EMEs, including fiscal dominance and the role of exchange rates.[14] Finally, a number of recent studies have analyzed the initial effects of IT for EMEs in Eastern Europe and Latin America.[15]

This section investigates the experience of EMEs, focusing on the circumstances under which they adopted IT and on some of the distinctive features and problems in the emerging market context. The next section considers the effects of IT in these economies, focusing in particular on the impact on inflation expectations.

Chile introduced IT in 1991. After gaining independence in 1990, the central bank of Chile faced a significant increase in inflation following expansionary policies in 1989 and the oil price spike related to the first Gulf War. Having already unsuccessfully experienced two exchange rate–based stabilization programs in the past and with monetary aggregates difficult to control due to instability in money demand, IT was the only viable alternative. A key feature of the Chilean experience has been the gradual approach to disinflation, which has produced low inflation without suffering excessively large output costs. Chile had an exchange rate band around a crawling peg until August 1999; it has since adopted a fully floating exchange rate regime. IT in Chile has been generally successful in bringing down inflation, even though a strong fiscal position and a sound financial system played an important role in supporting this performance.

Israel's monetary policy framework has been centered on the coexistence of two nominal goals, the inflation target and a crawling exchange rate band, supported by one instrument, the interest rate. Following the 1985 stabilization program, characterized by a fixed but adjustable nominal exchange rate, at the beginning of 1992 Israel adopted an explicit inflation target. Inflation has been successfully reduced from double digits to practically zero. However, the emergence of a conflict between the two nominal objectives often required sterilized foreign exchange intervention, with associated quasi-fiscal costs and weakening of the central bank's credibility. With the widening of the band to 36 percent and the setting of a clear hierarchy of priorities, this conflict appears now to have lessened.

The successful experience of Chile and Israel paved the way for the adoption of IT in other EMEs. In East Asia, the first country to introduce this monetary policy framework was South Korea. Before the adoption of IT in 1998, monetary policy had been conducted by deciding on monetary aggregates as an intermediate target. However, following rapid structural changes experienced by financial markets in the 1990s, the M2 aggregate began to show unstable movements. With the 1997 financial crisis forcing the abandonment of the exchange rate peg, Korea turned to IT as the only nominal anchor for monetary policy still available. Thailand and the Philippines shared a similar experience and adopted IT in 2000 and 2002, respectively.

A trend toward more-flexible exchange rates has also been observed in some of the transition economies of Central and Eastern Europe. Following price liberalization and exchange rate devaluation in the early years of transition, most countries resorted to exchange rate pegs to stabilize their price levels. However, a sharp appreciation of the real exchange rate generated large balance-of-payment

[12] Since Chile and Israel first introduced IT in the early 1990s, EMEs that have formally instituted IT include Brazil, Colombia, the Czech Republic, Hungary, South Korea, Mexico, Peru, the Philippines, Poland, South Africa, and Thailand. See Table 5 for details.

[13] See, for instance, Masson, Savastano, and Sharma (1997) and Agenor (2000).

[14] See Amato and Gerlach (2002), Blejer et al. (2000), Cukierman, Miller, and Neyapti (2002), and Mishkin (2000).

[15] Fraga, Goldfajn, and Minella (2004) is a comprehensive study of the performance of IT in EMEs, with special attention to the Brazilian case. For further lessons from Latin America, see Calderon and Schmidt-Hebbel (2003), Corbo and Schmidt-Hebbel (2001), and Mishkin and Savastano (2002). For analysis of IT in transition economies, see Jonas and Mishkin (2003).

problems, forcing some countries to abandon the peg and float their currencies: the Czech Republic in May 1997 after currency turbulence and the Slovak Republic and Poland in 1998. Hungary never adopted a fully floating exchange rate, but has been living with a ±15 percent exchange rate band since 2001.

In need of a new nominal anchor, the Czech Republic was the first country to adopt IT at the beginning of 1998. Poland followed suit in mid-1998. In contrast, Hungary's move to IT has been more gradual, with a progressive widening of the exchange rate band and the introduction of IT in 2001.[16]

Mexico and Brazil were the first (and the largest) Latin American countries to introduce an IT regime. In Mexico, after floating the peso in December 1994, the central bank tried to maintain its monetary targeting regime for a few years. Due to the unreliability of the relationship between the monetary base and inflation, however, the stance of monetary policy was difficult to assess and the Bank of Mexico lacked a nominal anchor to guide inflation expectations. IT was the natural candidate: It was introduced gradually and adopted in 1999.

In Brazil, the *real* plan introduced in 1994 successfully reduced inflation from above 2000 percent to 1.5 percent in 1998. However, the Brazilian government was not as successful in implementing much-needed fiscal reforms. Following concerns about the fiscal balance, the real came under speculative attack at the end of 1998 and collapsed in January 1999. The central bank acknowledged the need to put in place a nominal anchor and, after sharply raising interest rates to slow the fall of the currency, introduced an IT regime in June 1999.

In Colombia and Peru, some characteristics of an IT regime were already present in the first half of the 1990s.[17] However, many important features were missing, including the publication of inflation reports, multi-year targets for inflation, transparency, etc. We therefore set the IT adoption date in September 1999 for Colombia and January 2002 for Peru.[18]

In South Africa, following financial liberalization and other structural developments in the 1990s, the changing relationship between growth in money supply, output, and prices made explicit monetary growth targets less and less useful. In 1998, M3 growth guidelines started to be accompanied by informal targets for inflation, and in early 2000 a formal IT framework was finally introduced.[19]

After having investigated the circumstances under which these EMEs adopted IT, we are now interested in the main characteristics of these regimes, particularly compared with industrial countries. Table 5 summarizes the main features of IT in EMEs. There are several points worth noting. First of all, the current inflation targets are relatively low and not much higher than they are in industrial countries.[20] The experience of EMEs with respect to the disinflation process has varied, with some countries following a gradual approach and others being more aggressive. Overall, as shown in Figure 5, most of the countries have been successful in bringing down inflation from double digits to single digits.[21] But what should the appropriate target level be for EMEs? It is sometimes argued that central banks in EMEs should aim for somewhat higher rates of inflation than industrial economies, due to the presence of the Balassa-Samuelson effect. This is still an open question.

Second, EMEs seem split in choosing either a target point with a range around it or a target range. When countries choose a target point, the range is always ±1 percent.[22] Instead, when they choose a target range, this can be as narrow as 1 percent and as wide as 3.5 percent.[23] Only one country, Thailand, has chosen a target range with a lower threshold of 0 percent. It remains an open question whether a

[16] The ±15 percent exchange rate band was introduced in May 2001, and the rate of crawl was eliminate only in October 2001.

[17] These include some degree of central bank independence, the announcement of explicit numerical targets for the one-year-ahead inflation rate (often in conjunction with the government economic program), etc.

[18] The experience of Colombia is similar to Brazil's, where, after unsuccessfully defending the exchange rate band in September 1999, the authorities let the currency float and adopted IT as the nominal anchor. For Peru, we refer to the January 2002 Monetary Program, which states that "As of this year, the Central Reserve Bank of Peru (BCRP) has adopted an Explicit Inflation Targeting system." Other authors (e.g., Fraga, Goldfajn, and Minella, 2004) set the adoption date in 1994.

[19] See Casteleijn (2001).

[20] With the exception of Brazil, the inflation targets are included in a range between 0 and 6 percent. If we also exclude Colombia, the Philippines, and South Africa, the targets are centered on 2 to 3 percent.

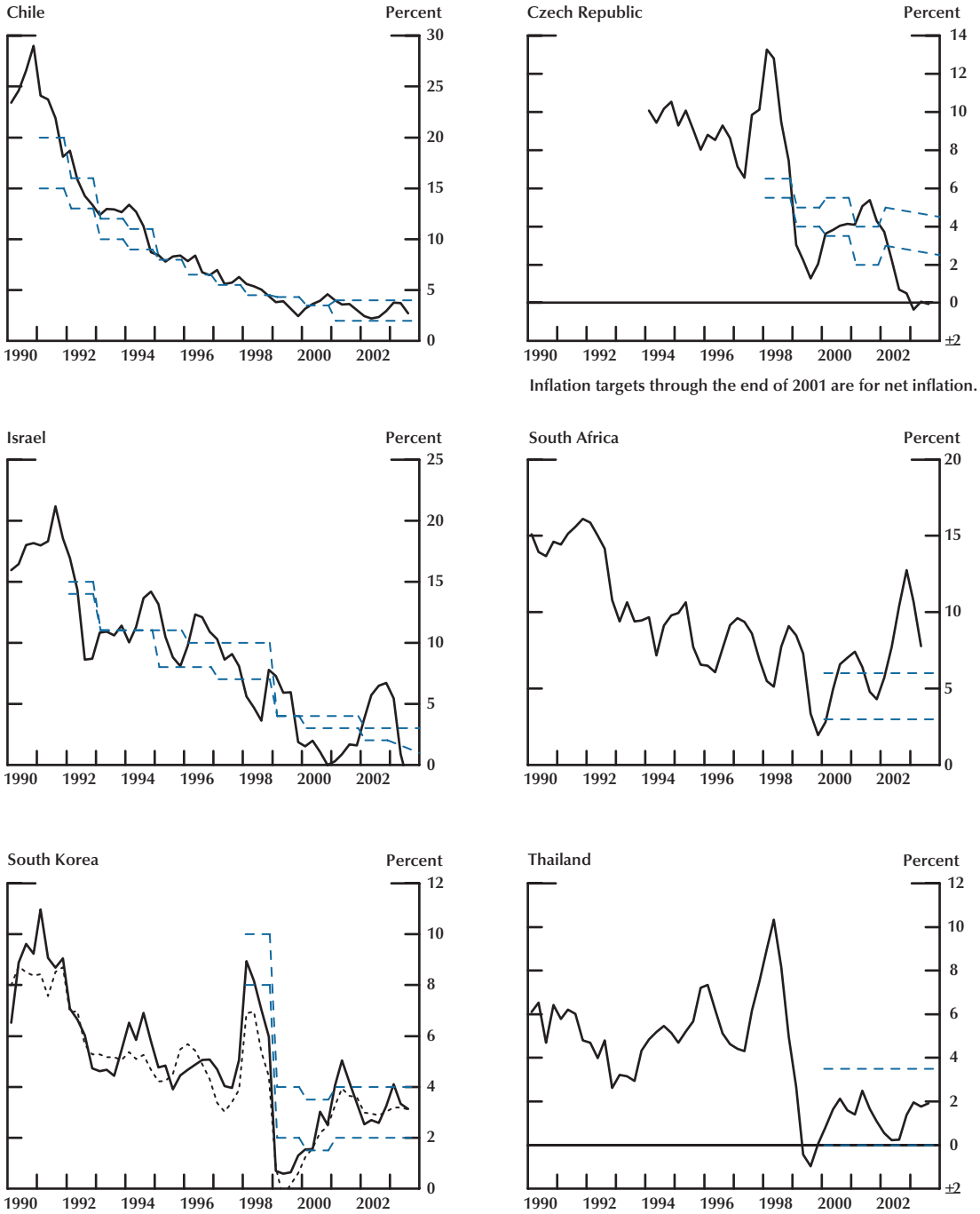
[21] CPI 12-month percent changes in November 2003 were at or below 5 percent in 10 of 13 countries. The exceptions are Brazil, Colombia, and Hungary, with inflation at 11.1, 6.1, and 5.6 percent, respectively.

[22] Only one country, Brazil, has a range of ±2.5 percent (for 2004 and 2005).

[23] Brazil, again, is the only exception to this regularity. See Table 5 for details.

Figure 5

Inflation Rates and Targets (quarterly inflation rates are year over year)

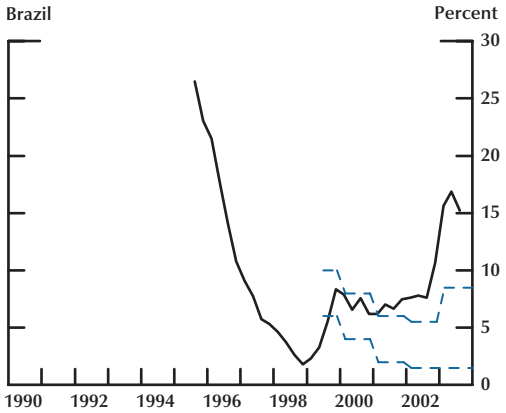


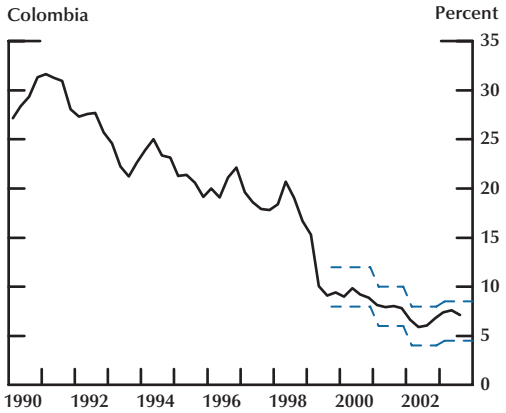
Inflation targets through the end of 2001 are for net inflation.

Since 2000, core inflation (the dotted line) has been targeted; previously, CPI (the solid line) was targeted.

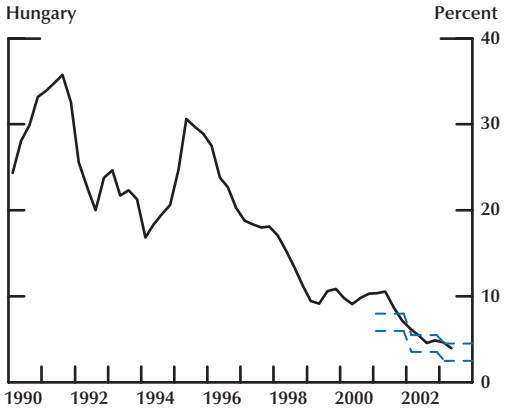
Figure 5 cont'd

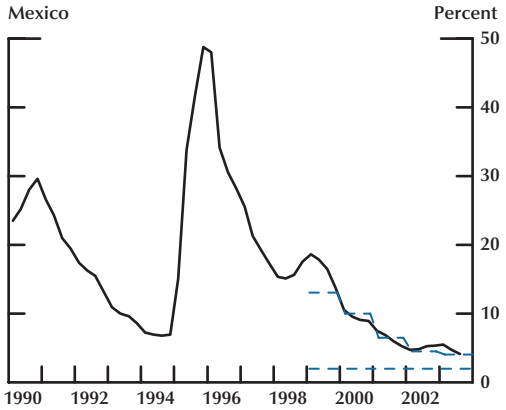
Inflation Rates and Targets (quarterly inflation rates are year over year)





The band of ± 2 percent was made explicit in 2003.





The lower band was made explicit in 2003.

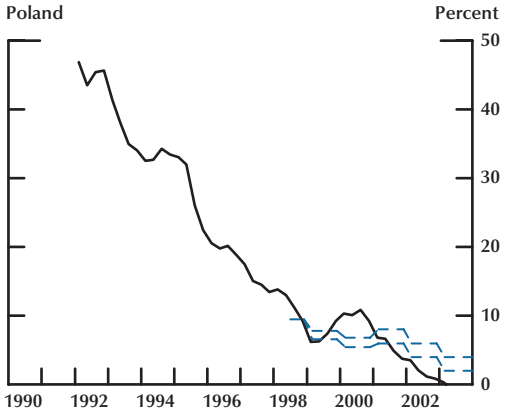
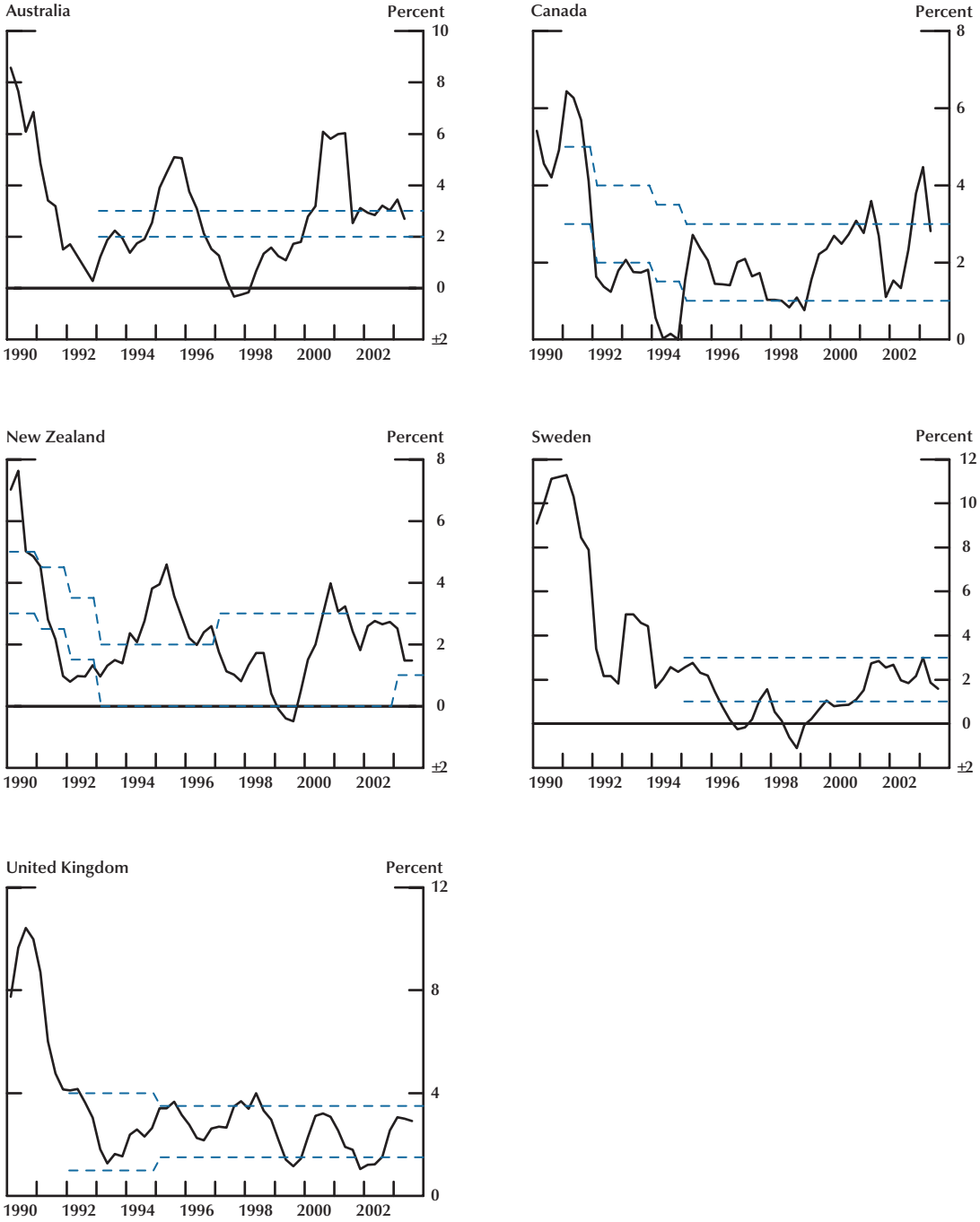


Figure 5 cont'd

Inflation Rates and Targets (quarterly inflation rates are year over year)



Beginning in 1995 the target is a point at 2.5 percent. We show a ± 1 percent band around the target as the Bank of England is required to send a letter to the Chancellor if inflation is more than 1 percent from the target.

Table 5

Features of IT Regimes in Developing Countries

	Brazil	Chile	Colombia	Czech Republic	Hungary	Israel
Date first issued	Jun 1999	Jan 1991	Sep 1999	Jan 1998	Aug 2001	Jan 1992
Current target	1.5-8.5	2-4 centered at 3	6	3-5 declining to 2-4	3.5 ±1	1-3
Target duration	5.5 ± 2.5 (2004) 3.5 ± 2.5 (2005)	Medium term	5-6 (2004)	Through Dec 2005	3.5 ±1 (2004) 2 (long term)	2003 onward
Inflation measure	National consumer price index (IPCA): a measure of inflation in 9 metro areas plus 2 other urban areas	CPI; central bank monitors core inflation (which excludes vegetable, fruit, and fuel prices	CPI	CPI	CPI	CPI
Target announcement	Set by National Monetary Council, composed by finance minister, planning minister, and central bank president	Central bank in consultation with government	Jointly by government and central bank	Central bank	Central bank	Minister of finance in consultation with prime minister and governor of central bank
Inflation report	Yes	Yes	Yes	Yes	Yes	Yes
Published forecast	Yes	Yes	Yes	Yes	Yes	No
Other objectives	—	—	—	—	±15% band around parity with Euro	±36% crawling band around parity with a currency basket representing Israel's foreign trade
Mandate	Price stability, sound financial system	Price stability, functioning payments system	Price stability	Price stability	Price stability	Price stability
Other features	Letter from central bank president to minister of finance if target breached	—	—	—	—	Public explanation when deviations from target are greater than ±1%

Korea	Mexico	Peru	Philippines	Poland	South Africa	Thailand
Apr 1998	Jan 1999	Jan 2002	Jan 2002	Jun 1998	Feb 2000	May 2000
3 ±1	3 ±1	2.5 ±1	4.5-5.5	3 ±1	3-6	0-3.5
2.5-3.5 (average 2004-2006)	Around 3 (medium term)	2004	4-5 (2004)	2.5 ±1 (medium term)	2004	2004
Core inflation (CPI inflation minus non-cereal agricultural products and petroleum-based products)	CPI	CPI	CPI, although four core inflation measures are monitored by the central bank	CPI	CPI (excluding mortgage interest costs)	Core CPI (excluding raw food and energy prices)
Central bank in consultation with government	Central bank	Central bank	Set and announced jointly by central bank and government	Central bank	Central bank	Government in consultation with central bank
Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	No	No	Yes
—	—	Foreign exchange operations	—	—	—	—
Price stability	Price stability, sound financial system, functioning payments system	Price stability	Price stability conducive to balanced and suitable economic growth, monetary stability, convertibility of currency	Price stability, necessary in building the permanent foundation of long-term economic growth	Price stability, sound financial system	Price stability
—	—	—	Letter from central bank governor to president when target breached			Public explanation when target breached

target point or a target range should be chosen. In favor of the target point, it should be noted that the point appears to be more effective in focalizing inflation expectations. And the range around it still allows for some flexibility in the event of forecast errors or unexpected events. In the presence of a target range, instead, the thresholds sometimes seem to be assuming life on their own.

Third, following the earlier experience of industrial countries, most EMEs moved away from one-year-ahead inflation targets and adopted multi-year targets or some definition of a medium-term target.[24] This can be interpreted as a sign that the disinflation process from high levels of inflation has come close to an end, forcing these countries to "think medium-term" and develop a more operational concept of price stability.

Fourth, most EMEs target the CPI because it is well understood by the public and quickly available.[25] Despite this, emerging and advanced countries have at least two main differences in their respective CPI baskets. First, the share of food is larger in EMEs. This implies a more volatile CPI, since food prices are related to weather conditions and therefore tend to move more unpredictably. Second, regulated prices have a greater impact in EMEs, especially during the early years of the disinflation process. Consequently, it is more difficult for the central bank to effectively control inflation, with potential damage to the central bank's credibility.[26] However, while targeting core inflation would probably be more appropriate, a measure of inflation that disregards food and regulated prices might not reflect the cost of living, putting the public support for an independent central bank at risk.

Finally, EMEs seem to be moving away from previous attempts to control two objectives, inflation and the exchange rate, with one instrument.[27] In fact, only Hungary and Israel still have a band for the nominal exchange rate. There are several reasons why EMEs may want to pay greater attention to exchange rates than industrial countries. First, with large shocks and sizable capital flows, neglecting the exchange rate may generate unwelcome volatility. Second, in countries with historically high inflation, the exchange rate may work as a focal point for inflation expectations.[28] Third, since firms and governments in EMEs borrow mainly in foreign currency, large depreciations may increase the burden of foreign-denominated debt, producing a massive deterioration of balance sheets and increasing the risks of a financial crisis.[29] However, most EMEs have decided to focus their efforts primarily on controlling inflation and have abandoned the idea of managing extensively the exchange rate, which can be interpreted as an additional sign of their intention to embrace a fully fledged IT regime.

6. THE EFFECTS OF INFLATION TARGETING IN EMERGING MARKET ECONOMIES

In considering the effects of IT in EMEs, we begin by focusing on inflation expectations. For each country for which data are available, Figure 6 plots (i) realized inflation (measured as Q4/Q4); (ii) one-year-ahead expected inflation (on a Q4/Q4 basis), where the expectation is formed in the fourth quarter of the current year; and (iii) long-run (6 to 10 years) inflation expectations, where the expectation is formed in the fourth quarter of the current year. Inflation expectations are again measured based on surveys conducted by Consensus Economics. The figure contains data for three years before and after the adoption date. The data used in creating Figure 6 are shown in Appendix Table A3.

We begin by considering long-term inflation expectations. The main result is that, *as in industrial countries, IT does not seem to have had a large initial impact on long-term expected inflation*. In other

[24] This is true for Brazil, Chile, the Czech Republic, Hungary, Israel, South Korea, Mexico, and Poland.

[25] Exceptions are Brazil, South Korea, South Africa, and Thailand. Other countries (Chile and the Philippines) monitor some measures of core inflation.

[26] Two broader issues are related to the central banks' ability to control inflation in EMEs. One has to do with the Balassa-Samuelson effect, which implies an appreciation of the real exchange rate either via higher inflation or via an appreciation of the nominal exchange rate. The second issue has to do with the difficulty of forecasting inflation. This is true after a regime change, during disinflation from high inflation levels, and because of EMEs' sensitivity to commodity prices and disproportionate dependence on capital flows.

[27] A strategy of dual objectives was originally adopted in some EMEs to speed up the disinflation process. The introduction of exchange rate flexibility became necessary to resolve the tension between maintaining the disinflationary momentum and guarding against a loss of competitiveness. As the disinflation process continued, the bands were typically broadened and subsequently abandoned as they became a source of policy conflict, undermining the credibility of the inflation target. The experience of Hungary in January, June, and December 2003 highlights the risks of combining IT and exchange rate management in periods of speculative attacks and large swings in market sentiment.

[28] Depreciations have historically tended to have larger inflationary effects in EMEs, as pass-through effects have been faster.

[29] For the discussion on the composition of the CPI basket and the role of the exchange rate in EMEs, we relied on Amato and Gerlach (2002).

Figure 6

Event Study: IT in EMEs

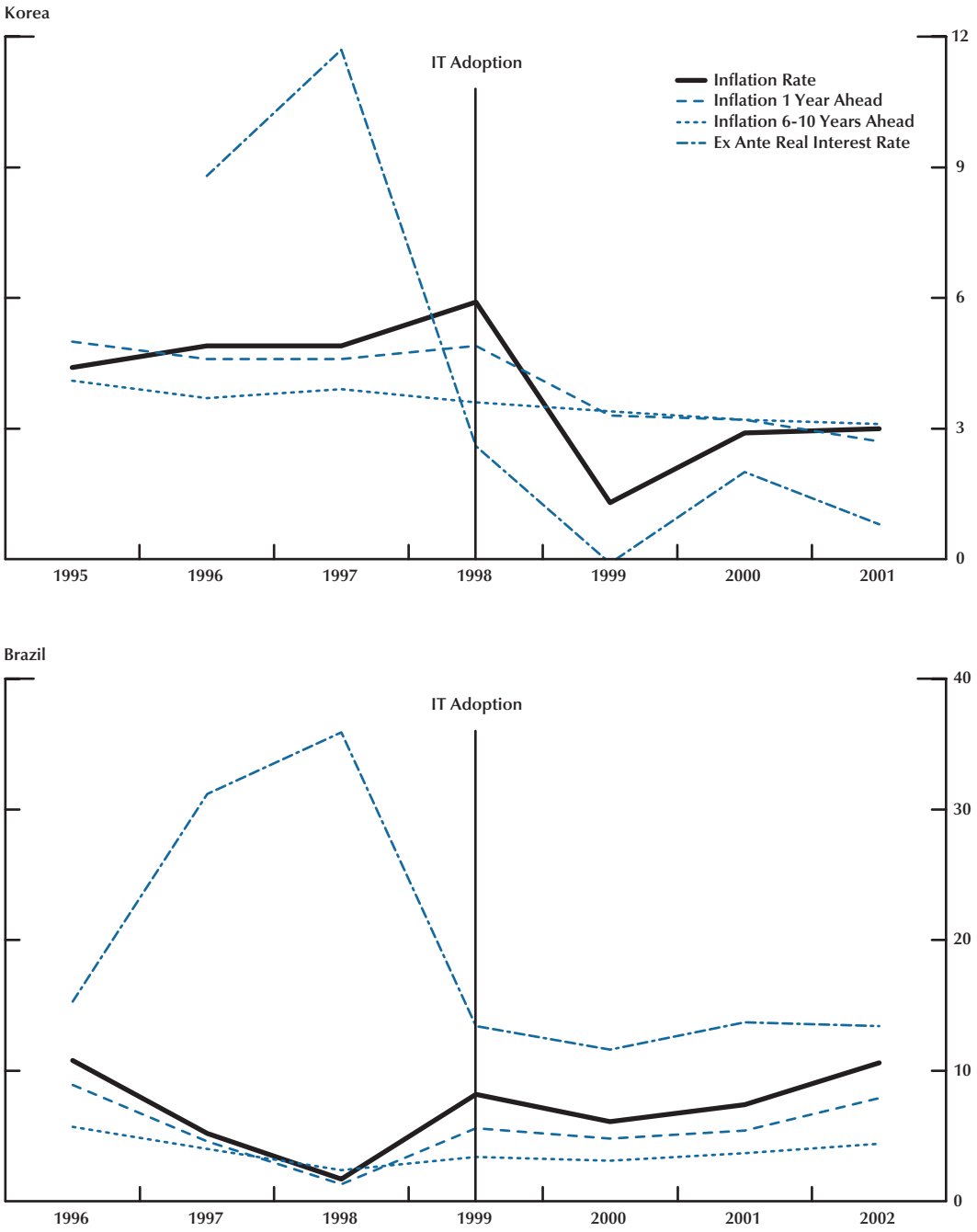
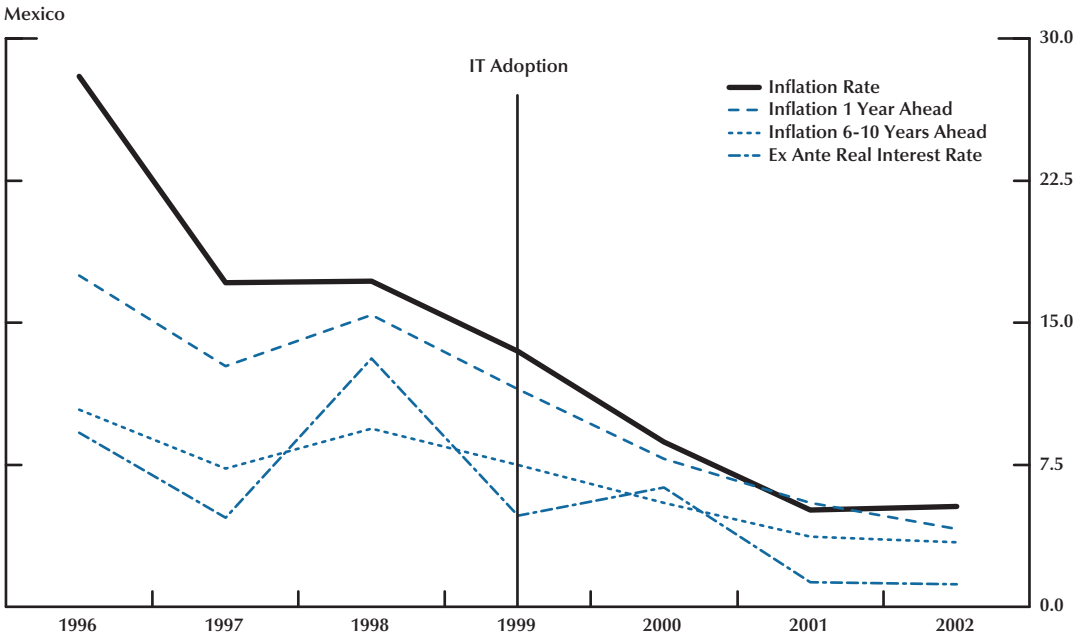


Figure 6 cont'd

Event Study: IT in EMEs



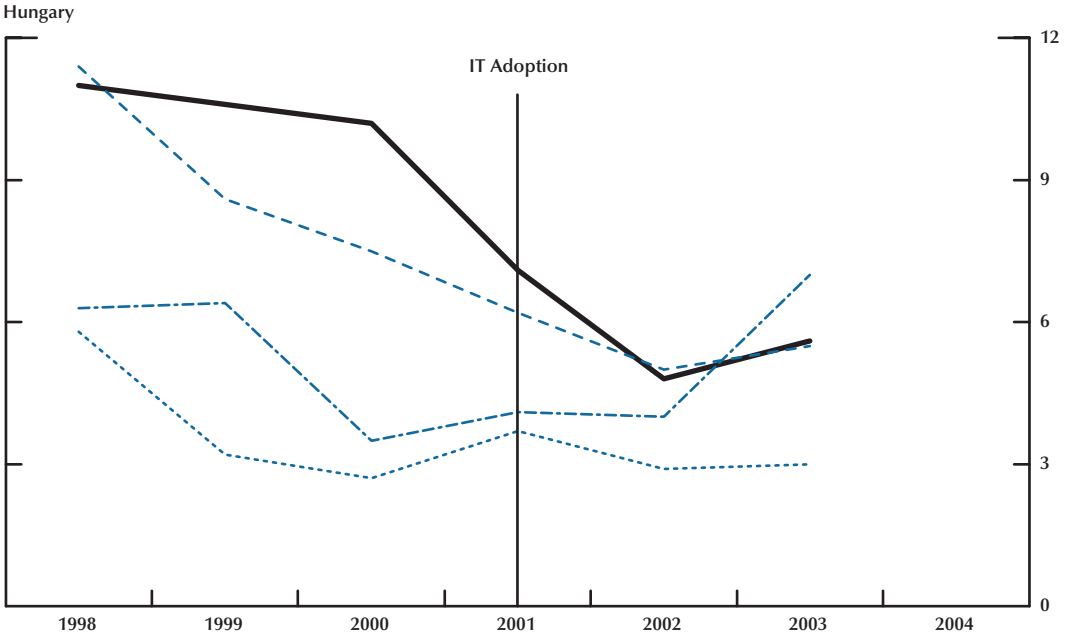
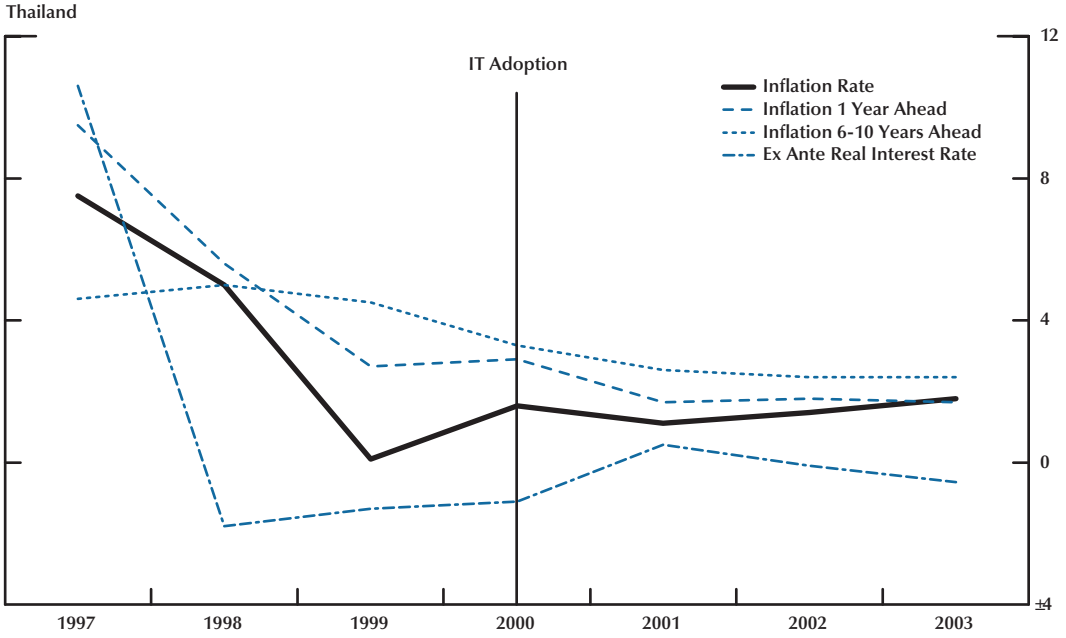


Figure 6 cont'd

Event Study: IT in EMEs



words, long-term inflation expectations did not change dramatically at the time of the adoption of IT. Consider Brazil: Inflation expectations were 2.4 percent at the end of 1998, when the *real* came under attack, down from nearly 6 percent in 1996. They were up to only 3.4 in 1999, when IT was introduced after the collapse of the currency, even though actual inflation jumped to 8.2 percent from 1.7 percent in the previous year. Inflation expectations continued to decline in 2000, down to 3.1 percent, with actual inflation still above that level, at 6.1 percent. Inflation expectations rose only slightly afterwards, up to 4.4 percent, well below actual inflation. The main point, therefore, is that inflation expectations in Brazil started to decline *before* the adoption of IT and continued to do so afterwards, edging up again 2 years later, but always remaining below actual inflation.

A similar path can be observed in other countries. In South Korea, inflation expectations have been declining since 1995, well before the adoption of IT, and continued to fall smoothly, at small decrements, through 2001, down 1 percent in total. Actual inflation rose only 1 percent after the financial crisis, in 1998, but dropped to 1.3 percent in 1999, well below long-term inflation expectations. In 2001, actual inflation was at a level consistent with long-term expectations. In Mexico, apart from 1998, inflation expectations dropped dramatically, from 10.4 percent in 1996 to 7.5 percent in 1999 and 3.4 percent in 2002. The introduction of IT does not seem to have affected significantly this downward trend in inflation expectations. Moreover, inflation expectations have been consistently below actual inflation, even immediately after the 1994-95 crisis, when the difference was almost 20 percent. At the end of 2002, long-term expectations were 2 percent below actual inflation. In Thailand, inflation expectations have declined since 1998, with a noticeable drop in 2000, when IT was adopted, but have been well above actual inflation since 1999. Finally, inflation expectations in Hungary were coming down before IT was introduced and actually rose the year of the adoption.[30] However, they remained stable, at around 3 percent in 2003, even though actual inflation rose almost 1 percentage point.

[30] For Colombia, we don't have inflation expectations for the year after the adoption of IT, but there is still a clear downward trend beginning in 1997. In Peru, the decline in long-term inflation expectations began before IT was introduced in 2002, but was very gradual. For the Czech Republic and Poland we don't have data available for the years before adoption of the IT. However, inflation expectations have been declining since the adoption of IT. Finally, we don't have any data available for Chile and Israel (the early adopters) or for the Philippines and South Africa.

Table 6

Relative Success in Hitting Inflation Targets (standard deviation from midpoint)

Country	Standard deviation
Brazil	5.4
Chile	1.9
Columbia	2.1
Czech Republic	3.1
Hungary	1.1
Israel	2.6
Mexico	2.1
Poland	2.7
South Africa	3.6
Korea	1.3
Thailand	0.7
Australia	1.7
Canada	1.2
New Zealand	1.6
Sweden	1.3
United Kingdom	0.9

NOTE: Inflation is measured as a quarterly, annualized rate. For Columbia, inflation deviations are based on CPI inflation, although the target is based on net inflation through 2001. In accordance with the target, inflation deviations for South Korea are based on CPI inflation through 1999 and on core inflation thereafter.

What about short-term inflation expectations? Is there any evidence that the introduction of IT lowered one-year-ahead expectations? The conclusion is similar to the case of long-term inflation expectations: There is no evidence of any dramatic reduction in short-term inflation expectations, neither for the year IT was introduced nor for the following year. There seems to be, instead, a gradual decline of these expectations over time, with differences on a country-by-country basis.[31]

[31] For example, in Brazil, in line with long-term inflation expectations, short-term expectations rose the year of the introduction of IT, declined the following year, and rose again in the next couple of years. In Hungary, short-term inflation expectations declined both the year IT was introduced and the following year. However, a downward trend was already evident in the previous three years. A similar story holds for Mexico, with short-term expectations gradually declining over time, well before the introduction of IT. In Korea and Thailand, short-term expectations actually rose the year IT was adopted and dropped significantly the year after. Interestingly, this was the only year of such an increase, with both the previous and the following three years showing declines.

In summary, the evidence from inflation expectations suggests that, while expectations declined when IT was introduced and continued to do so subsequently, the downward trend was evident even before the switch to IT, in line with the experience of industrial countries. This does not necessarily mean that IT was ineffective, as it is plausible that, in the absence of IT, "bad" monetary policies could have offset previous gains in reducing inflation.

An alternative way to evaluate the medium-term performance of IT in EMEs would be to calculate sacrifice ratios for these countries, along the line of similar studies for industrial countries. However, EMEs are characterized by rapid structural changes, making the estimate of potential output extremely difficult and maybe even unreliable. One possibility is to look at short-term ex ante real rates (shown in Figure 6 and Appendix Table A3). Consider Brazil, for example. Short-term real rates were very high before the introduction of IT, at almost 36 percent in 1998, came down to 13.4 percent in 1999, but remained around that level for the following three years. Monetary policy was very tight, and this makes it more difficult to evaluate the performance of IT as a monetary policy framework. In Mexico, short-term real rates were very high in 1998, but declined substantially the year IT was introduced, down to nearly 5 percent. After rising in 2000, they were around 1 percent in 2001 and 2002. In this case, it seems reasonable to conclude that the successful reduction of inflation cannot be entirely attributed to tight monetary policy, leaving some scope for crediting IT. This is even more evident in Korea, where short-term real rates dropped the year of the introduction of IT, from nearly 12 percent to 2.6 percent, and remained low afterward, and in Thailand, where real rates were negative even the two years before the introduction of IT. In summary, while in some countries real rates were very high when IT was introduced, in other countries real rates were low and inflation was still successfully reduced.

In EMEs the adoption of IT has been frequently associated with overshooting and undershooting of the targets. An alternative way to evaluate the medium-term performance of the IT framework in EMEs is to look at the frequency of overshooting and undershooting. Table 6 shows the standard deviation of inflation from the midpoint of the target range for each of the countries considered in Figure 5. Not surprisingly, industrial countries generally display a lower standard deviation than EMEs. Among

EMEs, Brazil is the worst performer, followed by South Africa, while South Korea and Thailand are the best performers, with standard deviations even lower than that of Australia. Possible explanations for the higher standard deviation of inflation in EMEs include the difficulty of controlling and forecasting inflation in the developing world, the larger shocks EMEs face, and the lower credibility central banks have in countries with a history of high inflation.

In conclusion, the record to date suggests that inflation targeters in emerging markets have been relatively successful in reducing inflation, although the record is still fairly short for most of the countries. It is still not completely obvious, however, the extent to which this reduction can be credited entirely to IT as a monetary policy framework. It might be the case that part of the success of IT in EMEs is attributable to the global downward trend in inflation rates. It remains also to be seen whether the fairly strong performance of these countries will be sustained over a longer horizon.

7. CONCLUSION

Our analysis of the past decade of experience for the industrial countries suggests that IT has played a role in anchoring inflation expectations and in reducing inflation persistence. Of course, because we have focused on reduced-form evidence, we have not addressed the extent to which certain country-specific factors may account for the differences we have documented across IT and non-IT economies. For example, many of the IT countries in our sample are small, open economies, which might be expected to have very different inflation dynamics from the large, mostly closed economies that dominate our non-IT sample.

Nevertheless, our results are broadly consistent with the implications of the expectations-augmented Phillips curve:

$$\pi_t = \pi_{t+1} + \phi y_t + \varepsilon_t, \tag{3}$$

where $\hat{\pi}_{t+1}$ is the one-period-ahead forecast of inflation, y_t is the current output gap, and ε_t is an aggregate supply shock. When the central bank has an transparent and credible inflation target, π^*, then the private sector's inflation forecast corresponds to $\hat{\pi}_{t+j} = \pi^*$ at some reasonable forecast horizon, j. In this case, actual inflation will depend on expected output gaps over the next j periods and on the current aggregate supply shock. Thus, inflation will tend to exhibit relatively little intrinsic persistence in response to transitory supply shocks; the observed degree of inflation persistence may depend largely on the persistence of output gap fluctuations. As a result, under IT, a key challenge for the central bank may be to keep output close to potential by moving promptly to offset aggregate demand shocks.

In contrast, if the central bank's inflation objective is not transparent or credible, the private sector's rational forecast of medium-to-long-run inflation will depend on the recent behavior of actual inflation (cf. Erceg and Levin, 2003). For the simplest case in which $\hat{\pi}_{t+1} = \hat{\pi}_{t-1}$, it is evident that inflation will tend to exhibit a high degree of intrinsic persistence, even in response to temporary supply shocks or fluctuations in aggregate demand.[32]

Our investigation of the early experience with IT in EMEs confirms that—as in the industrial countries—the adoption of IT has generally not been associated with an instantaneous adjustment of inflation expectations. Furthermore, while most of these EMEs have succeeded in reducing average inflation to very low levels, the volatility of inflation has remained quite high, with relatively frequent overshooting and undershooting of the target bands. Such volatility is not necessarily surprising, given that most of the EMEs are small and highly sensitive to global economic fluctuations. Thus, additional research and experience will be helpful in fine-tuning the implementation of IT and ensuring its positive contribution to macroeconomic stability.

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[32] See also Orphanides and Williams (forthcoming).

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Appendix

Table A1

AIC Lag Selection

Country	Lag choice—core CPI	Lag choice—total CPI
IT countries		
Australia	1	1
Canada	1	1
New Zealand	1	1
Sweden	1	1
United Kingdom	1	1
Non-IT countries		
Denmark	2	1
Euro area	2	4
France	1	3
Germany	3	3
Italy	1	1
Netherlands	1	1
Japan	2	3
United States	4	4

Table A2

Alternative Persistence Estimates for Inflation

	Core CPI		Total CPI	
Country	Median unbiased	Upper 95th percentile	Median unbiased	Upper 95th percentile
IT countries				
Australia	0.77	1.05	0.59	0.85
Canada	0.45	0.73	0.12	0.46
New Zealand	0.43	0.72	0.44	0.73
Sweden	0.44	0.7	0.28	0.58
United Kingdom	0.5	0.77	0.34	0.64
Non-IT countries				
Denmark	0.48	1.07	–0.05	0.28
Euro area	0.88	1.08	0.76	1.24
France	0.79	1.06	0.76	1.24
Germany	0.74	1.09	0.65	1.17
Italy	0.91	1.07	0.89	1.07
Netherlands	0.53	0.79	0.6	0.89
Japan	0.81	1.10	0.5	1.14
United States	1.03	1.16	0.36	0.87

NOTE: For each country in the sample, this table records the median unbiased estimate and the upper bound of the two-sided 90 percent confidence interval for the sum of the autoregressive coefficients of core and total CPI inflation, estimated over 1994:Q1–2003:Q3. Estimates were computed based on Hansen (1999), using equation (2).

Table A3

Event Study: IT in EMEs

	Years from IT Adoption						
	–3	–2	–1	0	1	2	3
Brazil				**1999**			
π_t	10.8	5.2	1.7	8.2	6.1	7.4	10.6
$\hat{\pi}_t^{(s)}$	8.9	4.6	1.3	5.6	4.8	5.4	7.9
$\hat{\pi}_t^{(l)}$	5.7	4.0	2.4	3.4	3.1	3.7	4.4
$\hat{r}_t$	15.3	31.2	35.9	13.4	11.6	13.7	13.4
Hungary				**2001**			
π_t	11.0	10.6	10.2	7.1	4.8	5.6	NA
$\hat{\pi}_t^{(s)}$	11.4	8.6	7.5	6.2	5.0	5.5	NA
$\hat{\pi}_t^{(l)}$	5.8	3.2	2.7	3.7	2.9	3.0	NA
$\hat{r}_t$	6.3	6.4	3.5	4.1	4.0	7.0	NA
Korea				**1998**			
π_t	4.4	4.9	4.9	5.9	1.3	2.9	3.0
$\hat{\pi}_t^{(s)}$	5.0	4.6	4.6	4.9	3.3	3.2	2.7
$\hat{\pi}_t^{(l)}$	4.1	3.7	3.9	3.6	3.4	3.2	3.1
$\hat{r}_t$	NA	8.8	11.7	2.6	–0.1	2.0	0.8
Mexico				**1999**			
π_t	28.0	17.1	17.2	13.5	8.7	5.1	5.3
$\hat{\pi}_t^{(s)}$	17.5	12.7	15.4	11.5	7.8	5.5	4.1
$\hat{\pi}_t^{(l)}$	10.4	7.3	9.4	7.5	5.5	3.7	3.4
$\hat{r}_t$	9.2	4.7	13.1	4.8	6.3	1.3	1.2
Thailand				**2000**			
π_t	7.5	5.0	0.1	1.6	1.1	1.4	1.8
$\hat{\pi}_t^{(s)}$	9.5	5.6	2.7	2.9	1.7	1.8	1.7
$\hat{\pi}_t^{(l)}$	4.6	5.0	4.5	3.3	2.6	2.4	2.4
$\hat{r}_t$	10.6	–1.8	–1.3	–1.1	0.5	–0.1	–0.5

NOTE: For the years surrounding the switch to IT, this table shows the inflation rate (π_t); expected inflation one year in the future ($\hat{\pi}_t^{(s)}$); expected inflation six to ten years in the future ($\hat{\pi}_t^{(l)}$); and the ex-ante real interest rate, $\hat{r}_t$, measured as the policy rate less $\hat{\pi}_t^{(s)}$. All variables are measured in the fourth quarter of the given year.

Commentary

Harald Uhlig

INTRODUCTION AND SUMMARY OF THE PAPER

Inflation targeting has become the new gospel for conducting monetary policy. Its merits have been stressed repeatedly by a large literature, most recently by Michael Woodford (2004). The appeal is obvious. Monetary economists have concluded that, by and large, monetary policy cannot do much more than achieve some desired level of inflation. Even to the extent that monetary policy can have an influence on real activity, this lever should be used only with great caution, as it may endanger the reputation to effectively fight inflation over the longer-term horizon, if used opportunistically. The argument of Kydland and Prescott (1977)—that monetary policy pursuing short-term goals in a discretionary, opportunistic manner is worse than a policy committed to and sticking to an a priori well-chosen course of action—is fundamental and well understood. Inflation targeting is often advertised as a way for monetary policy to achieve an additional degree of this desirable commitment. Inflation targeting is furthermore sold as an effective communications policy, as it makes the public focus on inflation as the macroeconomic variable (among those the public cares about) that is most effectively influenceable by monetary policy. In sum, inflation targeting is an appealing idea on a priori theoretical grounds.

But inflation targeting has long moved beyond the realm of academic conferences and scholarly journals. It actually may have had its origins in the practical choices undertaken by some central banks, and it is now in use by a large variety of central banks around the world. Thus, the interesting question is whether inflation targeting is also appealing because of the experiences gained in practice. This is, in essence, the question asked by Andrew Levin, Fabio Natalucci, and Jeremy Piger (hereafter, LNP) in their paper. Their paper follows several other, similar papers in the recent literature, most notably Ball and Sheridan (forthcoming). LNP investigate the experience of inflation targeters and non-targeters since 1994 in a number of Organisation for Economic Cooperation and Development (OECD) countries. They also evaluate the experience with inflation targeting in a number of emerging market economies.

In contrast to Ball and Sheridan as well as several other previous papers, LNP find a number of clear differences between inflation targeters and non-targeters. They investigate inflation forecasts at a number of horizons and find that the changes in inflation forecasts are correlated with lagged averages of inflation for non-targeters but uncorrelated for inflation targeters. They find that inflation is more persistent for non-targeters. While the difference is rather small for inflation measured by the consumer price index (CPI), it becomes substantial once the attention is focused on core inflation, i.e., leaving out prices for food and energy, thus refining the results by Ball and Sheridan (forthcoming), who focused only on CPI inflation. LNP document that gross domestic product (GDP) growth volatility is the same for targeters and non-targeters, but inflation volatility is higher for inflation targeters, but argue that this is due to experiencing larger shocks rather than the monetary policy strategy itself. As for emerging market economies, they document that the introduction of the inflation target moves inflation expectations down gradually: The transition is a smooth one and not characterized by a break at the introduction of IT.

This is all fascinating. It is well-crafted research, providing us with a wealth of additional insights and differences between countries that have adopted inflation targeting and those that have not. The choice of empirical relations these authors look at—for example, the variety of links between inflation forecasts and inflation or the persistence of core inflation—is well chosen in that these are some of

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the key dimensions where one would believe a priori that inflation targeting may make a difference. The choices are creative in that some of these dimensions have not received sufficient attention before. The documentation on the details of inflation targeting in a number of emerging market economies will be useful input into further research into these issues.

ASSESSMENT

I shall by and large not quarrel with the empirical findings. The correlations found by the authors seem to be there, and they can be read as a list of interesting differences between countries that have formally adopted inflation targeting and those that have not. There is an issue regarding the bias in their estimate of the regression coefficient of inflation forecasts on current inflation: However, this issue is not the key concern I have about this paper, and I shall discuss it last.

Rather, I shall quarrel with the interpretation of these findings. The title of the paper already suggests that the authors are not merely interested in uncovering correlations, but in documenting causation, interpreting these numbers as macroeconomic effects of inflation targeting. In short, they wish to have a reader read these findings as an answer to the policy question of interest: Does inflation targeting matter? And even if the authors abstained from any interpretation in that direction, this would be the question foremost on the mind of any reader of their paper.

I am skeptical that such a causal interpretation is legitimate. In particular, I am wondering about four issues. First, which central bank should be classified as inflation targeting? That is, is this classification useful? Second, has inflation targeting been beneficial for the variables of ultimate interest, i.e., for reducing the level and volatility of inflation, for reducing the volatility of output growth, and perhaps for increasing the level of economic activity? Third, the adoption of inflation targeting seems to me to be largely a choice endogenously explained by some of the variables under investigation: This is true in the OECD sample, but it is particularly true for the emerging market economies. For example, fiscal restraint there probably matters far more than the adoption of a formal inflation target. Finally, given all the supposed benefits of inflation targeting, one has to wonder what central banks did before inflation targeting and whether inflation targeting will help prevent bad monetary policy in the future.

WHICH CENTRAL BANKS PURSUE INFLATION TARGETING?

In his comments on the Ball-Sheridan paper, Mark Gertler (forthcoming) pointed out that classifying countries in the run-up to the European monetary union as non-inflation targeters seems a bit arbitrary in light of the fact that there were some rather explicit preconditions in terms of achieved inflation rates for entering the monetary union. This applies to the LNP paper as well. More generally, where is the big difference between a central bank that pursues the goal of price stability as a prerequisite to monetary union and a central bank that issues official statements about its price stability goals? Do we really think that printing fan charts of inflation in monthly reports can make a substantial difference in monetary policy?

Take the case of the Bundesbank, a non-inflation targeter according to the classification in LNP. Indeed, officially, the Bundesbank has pursued money growth rate targeting for many years. But, as has been noted by a number of authors, the Bundesbank has always chosen to ignore violations of the announced money growth rate target, if it helped in pursuing some other, more important goal—most notably price stability. Secondly, the money growth rate target has been derived from some underlying goal regarding the desired inflation rate, even if that may not have been stated as explicitly as, say, by the Bank of England. Finally, public debates about monetary policy choices by the Bundesbank rarely evolved around keeping or violating money growth rate targets: Rather, the debates were practically always in terms of inflation.

The literature has drawn a distinction between central banks that attach a high weight to inflation versus central banks that pursue inflation targeting (which is also consistent with a low weight on inflation in the objective function of the central bank); it has also emphasized that the distinction between targeters and non-targeters is a distinction regarding their communication strategies. But if the communication, however done, ends up leading to a public discussion and evaluation of monetary policy choices regarding achieved levels of inflation and implications for inflation rates in the future (as was undoubtedly the case for the Bundesbank) and if by contrast public debates focus on exchange rate movements and the general state of the economy rather than on keeping or violating some inflation

target (even if the appropriate fan charts are printed in some monthly bulletin), isn't it a bit artificial to call such a bank an inflation targeter and the Bundesbank a non-targeter? One could argue that successful inflation targeting should precisely lead to the end of the discussion about likely inflation rates in the future and that the debate should therefore shift to other issues. But this misses the point. Inflation targeting presumably works only if the central bank is somehow held accountable for violating its inflation goals: If a reaction in the public debate is unlikely even when violations occur, and if the central bank that is officially targeting inflation does not care either, then inflation targeting takes place on paper only. Indeed, this is precisely the argument that has been made regarding money growth rate targeting for the Bundesbank: It applies with similar force to inflation targeting.

Moreover, proponents of inflation targeting typically argue for "flexible inflation targeting," which seems to mean that central banks also weigh in objectives other than pursuing their inflation target when making their policy choices. For example, a central bank targeting a particular rate of inflation may decide to pursue a looser monetary policy in a recession and a tighter monetary policy in a boom, even if this leads to medium-term violations of their inflation target, as long as this is all explained well to the public. Interestingly, money growth rate targeting can be viewed as accomplishing precisely this. If a central bank pursues a particular rate of money growth, calculated as the sum of desired inflation and average economic growth and subtracting average changes in the velocity of money, then money growth will be high; thus, monetary policy will be loose precisely when economic growth falls short of the average, and the other way around. Money growth rate targeting has gone out of fashion, but it almost certainly is a better way to implement "flexible inflation targeting" than a policy that rigidly enforces a particular inflation rate period by period! So, perhaps, the Bundesbank should be classified as a flexible inflation targeter, while other central banks that rigidly focus on inflation in their reports should be excluded from this category. Since the issue at stake is whether flexible inflation targeting should be used or not, the categorization by LNP (using categorizations put forth by a number of previous authors, obviously, so they are not to blame) could be entirely misleading.

HAS INFLATION TARGETING BEEN BENEFICIAL?

Despite the arguments given above, I shall proceed with the categorization and the results in LNP as the working hypothesis regarding the differences between inflation targeters and non-targeters. The key policy question in light of this experience is: Has inflation targeting been beneficial? More precisely, has inflation targeting been beneficial for the variables of ultimate interest, i.e., for reducing the level and volatility of inflation, for reducing the volatility of output growth, and perhaps for increasing the level of economic activity? It may be nice (if true) that long-run inflation expectations are anchored more firmly for inflation-targeting countries, but how helpful has that been for the variables we ultimately care about?

Here, the inflation targeters do not seem to fare well. Table 4 in LNP reveals that the standard deviation of inflation for inflation targeters has been 1.54, but only 0.81 for non-targeters, while output growth volatility has been essentially the same (2.63 versus 2.48). Based on these numbers alone, one certainly would not want to make the case that adopting inflation targeting is a good idea.

The authors stress that this unconditional perspective is misleading because inflation-targeting countries may have been hit by larger shocks or have started from economic conditions that were worse. Indeed, this argument is at the heart of the Ball-Sheridan (forthcoming) paper: If one takes initial conditions into account, most of the differences between inflation targeters and non-targeters are explained by "regression to the mean."

Would the authors here reach the same conclusion? That would then say only that there really is no substantive difference in economic activity due to the introduction of inflation targeting; and this again does not provide an argument in favor of introducing IT (nor, obviously, an argument against it). It seems to me that much more work than is in this paper is required before it is possible to conclude that inflation targeters have been more successful in containing shocks hitting the economy than non-targeters have been. One could do this, it seems to me, by more finely identifying the shocks hitting these economies with, say, a multivariate VAR, and to then assess their impact on monetary policy choices as well as inflation expectations.

Examining Figure 1 in the LNP paper reveals that inflation expectations gradually kept declining

for the non-targeters, but not so for the inflation-targeting countries. While one could debate whether inflation expectations have declined too much in Japan, overall this figure does indicate to me that the non-targeters have been more successful in bringing inflation down to the (currently) most desired level, somewhere between 1 percent and 3 percent. Inflation targeting does not strike me as virtuous monetary policy if the target is too high! The analysis also reveals that the inflation forecasts had similar volatility across both groups of countries: While there may have been more external shocks in the targeting countries, I am nonetheless surprised that the targeters apparently were not able to offset these shocks sufficiently to anchor long-term expectations more firmly.

Finally, the authors document that inflation volatility has been of a more transitory rather than persistent nature for targeters than for non-targeters. In particular, the response of core CPI is more transitory in targeting countries. So, perhaps one could make the case that inflation targeting leads to a shift of inflation volatility from the low-frequency spectrum to higher frequencies. But would that be desirable? Probably not. Recent models of the New Keynesian variety allow for some indexation of otherwise sticky prices to past or to expected inflation: In these models, ongoing inflation or predictable inflation (or deflation, for that matter!) is not particularly harmful. Instead, the economic distortions mainly come from distorting relative prices between firms that can adjust their prices in response to current shocks and firms that cannot. In short, in these models, low-frequency volatility of inflation is ok, but high-frequency volatility is bad for the economy and leads to an overall lower level of economic activity. If this is what would happen with inflation targeting, which seems to be what the empirical results suggest, then this would be an argument against inflation targeting, not for it.

ENDOGENEITY

An overarching problem in moving from interpreting the correlations as indicating causation is the endogeneity of the introduction of inflation targeting. While this could help the case in favor of inflation targeting (for example, if countries with highly volatile inflation adopt inflation targeting, one cannot blame that high volatility on inflation targeting), one should not move to a causal interpretation, given the evidence currently presented. Put differently, inflation targeting is probably often introduced in the aftermath of some mild or strong crisis or some general overhaul of institutional structures.

The endogeneity issue is already important for the OECD countries under consideration. For example, inflation targeting was introduced in the United Kingdom alongside a whole set of institutional changes, most notably a greater degree of independence for the Bank of England. Indeed, one can read the Ball-Sheridan (forthcoming) paper as arguing that inflation targeting was typically introduced when the economic situation was sufficiently bad. By contrast, things "look OK" in the United States and the European Monetary Union. The need to introduce inflation targeting there simply has not been as pressing, so it has not been done.

The endogeneity issue is of even stronger force for the emerging market economies investigated by LNP. A number of recent papers in the literature have documented that fiscal consolidation and reform have been of greatest importance in allowing monetary policy to pursue the goal of price stability. As an example, the currency board in Argentina did not break down because the central bank lacked commitment, but rather because the fiscal situation deteriorated. Likewise, the dramatically high inflation rates in Russia at the beginning of the 90s were not a choice by central bankers uninterested in the pursuit of price stability, but rather were because the only way to finance government expenditures in the absence of a functioning tax system (aside from borrowing) was seignorage.

These fiscal considerations are key in evaluating the success or failure of monetary policy reforms in emerging market economies. They are largely absent in the paper at hand and should be investigated seriously in future research following up on LNP.

The interesting question remains whether inflation targeting has contributed above and beyond fiscal consolidation or general institutional reforms. To answer this question, one would need to find a clever instrument for the introduction of inflation targeting, one uncorrelated with these other forces. Finding a convincing instrumental variable seems to be a thorny problem here, but one worthy of attention. For example, one might try the fraction of academics on the boards of central banks (who may presumably be more inclined to move toward the academically appealing idea of inflation targeting); but even this might just be a consequence of general reforms. An alternative is to control more

Figure 1

Annual U.S. Inflation Rates

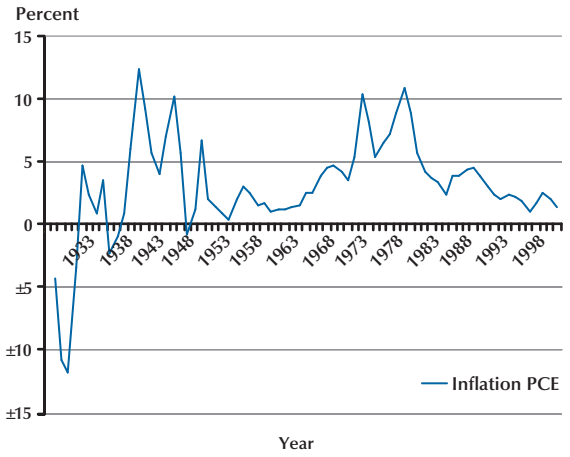
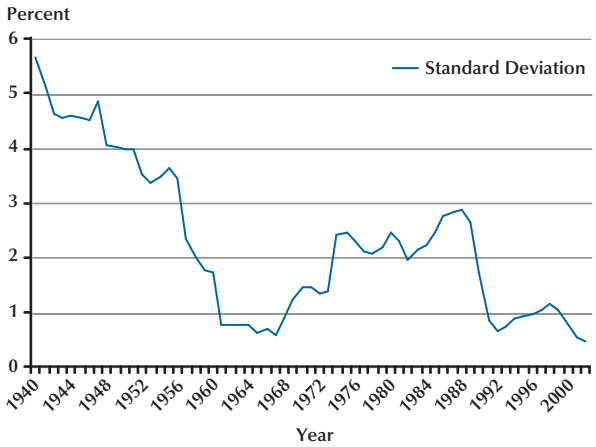


Figure 2

Inflation 10-Year Standard Deviation (U.S.)



carefully for variables indicating reforms, e.g., the ratio of fiscal deficits to GDP and the like.

The authors are careful in not overstating their results, and that is good. For example, they say that "it is not completely obvious, however, the extent to which [the reduction in inflation] can be credited... to IT." They observe that the reduction in inflation expectations is gradual and that no sharp break can be observed at the time of its introduction. This all seems to me to be in line with the view that the introduction of inflation targeting at some point is simply a step that typically happens in countries undergoing reform.

WHAT DID CENTRAL BANKS DO BEFORE THERE WAS INFLATION TARGETING?

The paper investigates the episode since 1994 to evaluate the macroeconomic effects of inflation targeting. That may be a rather short period to evaluate the success or failure of certain monetary policy principles. Of course, inflation targeting did not exist before that time (to my knowledge). So, for example, what did the Fed do as a non-targeter (but perhaps recently influenced by the targeting debates) before inflation targeting was a policy option? Was monetary policy necessarily much worse?

Figure 1 shows inflation in the United States, using annual data on the personal consumption expenditures, taken from the national income and product accounts (NIPA) tables published by the Bureau of Economic Analysis. There were several episodes of low inflation, like the 1930s, the 1950s and 1960s, and the episode since the early 1980s. But not all low-inflation episodes are equal. Figure 2 shows the evolution of the volatility of inflation, calculated as the standard deviation of annual inflation over the preceding ten years. One can now see more clearly than in Figure 1, that there have been two episodes in which U.S. monetary policy has been successful in stabilizing inflation. These standard deviations are low in the 1960s as well as in the 1990s. Both episodes look remarkably similar in that regard. Obviously, one needs to keep in mind that these standard deviations are "backward looking," i.e., a low standard deviation plotted for a particular year really means that inflation has been stable in the preceding ten years up to and including the year in question.

It is interesting to compare the inflation volatility with the corresponding volatility in real output growth (see Figures 3 and 4). While the literature occasionally emphasizes a trade-off between these volatilities (see, e.g., Uhlig, 2001), these figures show substantial comovement between both volatilities for the United States. These figures seem to suggest that an environment of low and stable inflation helps to reduce output volatility and support economic activity.

From that perspective, both the 1950s and 1960s as well as the 1980s and 1990s have been particularly successful episodes of U.S. monetary policy (or may have been episodes in which monetary policy was "lucky" due to the absence of major disruptions such as oil price shocks). These success-

Figure 3

Comparing 10-Year Standard Deviations (U.S.)

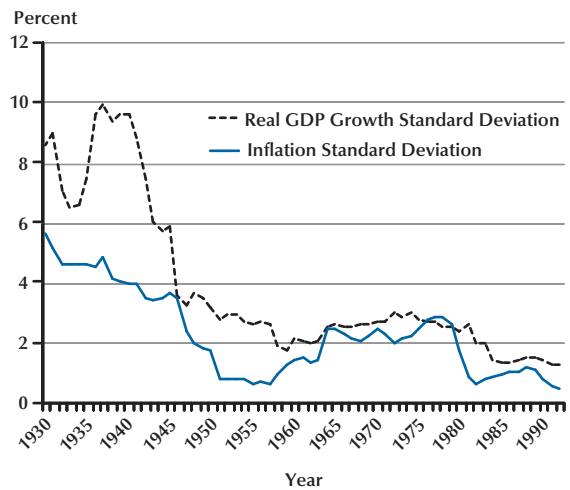
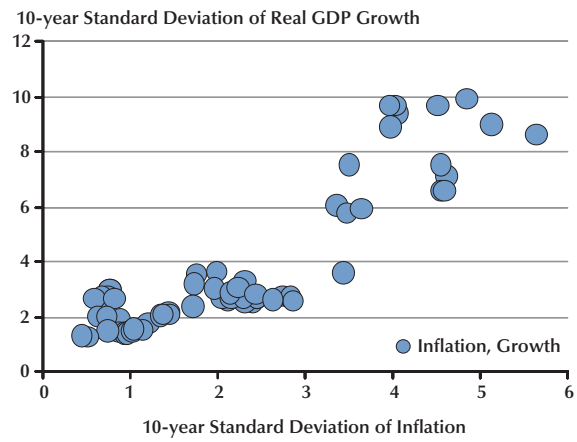


Figure 4

Scatter Plot of 10-Year Standard Deviations: Inflation Versus Real GDP Growth, U.S., 1940-2002



ful episodes were achieved without an explicit inflation-targeting regime. I doubt that introducing an explicit inflation-targeting regime could have produced better monetary policy during these episodes. The post-1994 comparison by LNP focuses on an episode in U.S. monetary policy that already was very successful: It is therefore not surprising that one has a hard time interpreting the evidence presented by LNP as making a strong enough case for the introduction of inflation targeting in the United States.

What is much more crucial, though, is the question of how one can avoid an episode like the 1970s (or, even more dramatically, an episode like the one before 1950), in which inflation volatility and output volatility were both high. Can we really be confident that political forces will continue to appoint central bankers to the FOMC who understand the benefits of low and stable inflation, who understand the importance of sticking to rules rather than using discretion, and who continue to put these principles into practice? As an "insurance," wouldn't it be wonderful to somehow enshrine some of these principles underlying the currently successful U.S. monetary policy for the future? Here is where the real issue lies. And here is where inflation targeting can help. Once an explicit inflation target has been announced and once the Fed explains its policy choices in terms of this target, a repeat of the 1970s or a repeat of the episode prior to the 1950s still cannot be ruled out. But it will be more difficult, since it would require a more clearly visible deviation from principles established before. These are sunshine days for U.S. monetary policy, and there is wide agreement among monetary policymakers as well as academics as to the key goals of monetary policies and the principles underlying good conduct. Enshrining them now supports a longer life for this type of monetary policy.

AN ESTIMATION BIAS

A key claim in the LNP paper is that inflation forecasts are more highly correlated with past inflation in non-targeting countries than in inflation-targeting countries. The authors have also documented, however, that inflation is more volatile—in particular—at high frequencies, in inflation-targeting countries. This leads to a bias in their coefficient estimate.

Consider their regression equation (1),

$$\Delta\pi_t^{(q)} = \lambda + \beta\Delta\pi_t + \varepsilon_t\,, \tag{1}$$

where π_t is the inflation rate, $\hat{\pi}_t^{(q)}$ is the q-period-ahead forecast of inflation, and Δ denotes the change in the variable in question. Suppose that inflation is the sum of some persistent process ζ_t—a random walk, say—plus i.i.d. noise υ_t,

$$\pi_t = \zeta_t + \upsilon_t\,.$$

Thus, $\Delta\pi_t$ is a noisy signal about the change $\Delta\zeta_t$

of the inflation trend. Given some other source of signal about the trend change as well as some prior view, the best forecast will be some weighted average of the recent change in inflation as well as the other source of information and the prior, with the weights proportional to the precision of the signal. Put differently, the larger the variance of the noise υ_t, the lower the weight of $\Delta\pi_t$ in the inflation forecast and thus the lower the coefficient β. Econometrically, the regressor $\Delta\pi_t$ is a noisy version of the "true" regressor $\Delta\zeta_t$, leading to a downward bias in β, which is the larger the larger is the variance in υ_t (i.e., the larger is the high-frequency volatility in inflation). Since the authors find higher high-frequency volatility in inflation for inflation targeters, it is therefore not surprising that the correlation of inflation forecasts with current inflation is lower than for non-targeting central banks.

Obviously, the other explanation for the lower correlation is that the variance of the trend changes, $\Delta\zeta_t$, is lower or even zero for inflation targeters, as they are fixing the desired level of inflation, whereas it may be trending for non-targeters. This could and should all be sorted out in a fully specified model, including a signal-extraction-type equation for generating the forecast. The figures given in the paper are suggestive that, indeed, desired inflation is subject to larger changes in the non-targeting countries, as the authors suggest. As argued above, this does not imply that inflation targeters have been more successful with respect to the variables we care about, namely, low and stable inflation. This economic issue is thus probably of greater relevance than the econometric issue of the estimation bias. Still, the bias deserves more attention and estimation of a more appropriate model.

CONCLUSIONS

This paper is interesting, creative, and informative. It deepens our knowledge about the differences between countries that have adopted inflation targeting and those that have not. I do not believe that the paper can empirically support the conclusion that adopting an inflation target leads to more successful monetary policy; nor does it allow the opposite conclusion. More research is needed to get at the issue of causation: This research seems feasible to do and should be done.

What, then, is one to conclude? Should central banks, specifically, the Federal Reserve or the European Central Bank (ECB), adopt some version of inflation targeting? It seems to me that the case really rests in the power of the logic of the argument, not in the empirics presented by LNP. Both the Federal Reserve and the ECB keep on emphasizing that keeping inflation low and stable is the best contribution they can make to promote economic activity. Furthermore, both central banks try to minimize the distortions on financial markets caused by monetary policy: They do so by communicating changes in monetary policy stances in advance and by avoiding to "turn the wheels" too fast. Keeping long-run inflation expectations stable and reasonably low (but perhaps not too low) is of great importance to both these central banks. Thus, setting a clear goal for medium- and long-term inflation and discussing the policy choices also, although presumably not exclusively, in terms of how quickly and in which way they will achieve these goals can only help the Fed and the ECB to pursue their desired policies yet more effectively. Inflation targeting for these central banks would not change their policies as they are currently pursued, but rather would modify their existing communications. Inflation targeting will neither lead to dramatic changes nor will it end the search for better monetary policy. Inflation targeting will not preclude the discussion of other policy objectives for monetary policy: Instead, it allows for a compartmentalization and structuring of the arguments. Furthermore, it may help to enshrine the current wisdom that low and stable inflation is a key goal for monetary policy, thus helping to avoid another return to inflationary episodes like the 1970s and the corresponding distortions to economic activity. In sum, inflation targeting is an addition to current communications and discussions about monetary policy and offers a gradual improvement by helping to further organize the internal as well as public debate on monetary policy choices and by helping to commit both the public and the central banks to keeping inflation low and stable. Viewed this way, inflation targeting is a good idea and should be adopted both by the Fed and the ECB.

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The Role of Policy Rules in Inflation Targeting

Kenneth N. Kuttner

> No rule is so general, which admits not some exception.
>
> —Robert Burton, *Anatomy of Melancholy*

1. INTRODUCTION

More than 13 years have elapsed since the Reserve Bank of New Zealand's pioneering introduction of a formal inflation target in 1990, a framework subsequently adopted by at least 21 other central banks. Collectively, these 22 countries represent more than 132 country-years of experience with inflation targeting (IT).[1] This accumulation of experience has led to a growing understanding of the practical and institutional features of the policy; see, for example, Bernanke et al. (1999), Sterne (2002), Mishkin and Schmidt-Hebbel (2002), and Truman (2003). Roughly in parallel with central banks' embrace of IT, there has been an explosion of research on monetary policy rules—spawned in no small part by Taylor's (1993) influential paper. This line of research has blossomed in recent years, especially with the theoretical contributions of Clarida, Galí, and Gertler (1999), Svensson (2003), Woodford (2003), and Giannoni and Woodford (2003a,b) on optimal policy rules, to name just a few.

Given these parallel developments in central banking practice and monetary theory, it is no surprise that a great deal of recent research has modeled IT as some sort of a monetary policy rule. Views differ on the usefulness of describing IT in these terms, however. Coming at the question from a practical standpoint, Bernanke et al. (1999) describe IT as a "framework" rather than as a rule. In a similar vein, Gavin (2004), characterizes IT as "management by objective," rather than as a well-defined policy rule. On the other end of the spectrum, Svensson (1999) defines IT as a monetary policy rule derived from an explicit optimization problem. Much of the difficulty in defining IT is due to its humble origins in central banking practice, and policymakers' pragmatic search for a suitable nominal anchor. Svensson's definition can therefore be seen as part of a broader effort to retrofit macroeconomic theory to a policy that was developed largely in the absence of a formal theoretical framework.[2]

Clearly, neither polar view can adequately characterize IT as it is actually practiced. For IT as a "framework" or a "management objective" to make any difference to macroeconomic outcomes, it must translate into some sort of change in central bank behavior. And this change, in turn, should have implications for the empirical policy rule used to describe policymakers' behavior. Similarly, surely no central bank sees itself as an automaton mechanically implementing a policy rule. The goal of this paper is therefore to determine where central banking practice lies on the "guidelines versus rules" spectrum and, specifically, to assess empirically the extent to which IT can be described in terms of simple monetary policy rules.

The task of characterizing IT in terms of a policy rule is complicated both by conflicting definitions of the term "policy rule" and by differing interpretations of what IT entails in practice, however. In an attempt to clarify what is meant by the term, section 2

[1] An annotated listing of inflation targeters can be found in Mishkin and Schmidt-Hebbel (2002). A similar list of inflation targeters appears in Truman (2003) and in each volume of the International Monetary Fund's *International Financial Statistics*.

[2] As Goldfeld (1984) quipped in a different context, "An economist is someone who sees something working in practice and asks whether it would work in principle."

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reviews the various definitions of "policy rule." Section 3 describes how IT is implemented and how this practice might be mapped into the sorts of rules summarized in the preceding section. Section 4 then characterizes the behavior of major IT central banks econometrically, with the various interpretations of "policy rule" as a guide. The novel feature of our empirical analysis is the use of central banks' own inflation and output forecasts, exploiting the overlapping nature of these forecasts in order to estimate the response of policy to new information. Section 5 concludes.

2. POLICY RULES: A GUIDE FOR THE PERPLEXED

The explosion in research on monetary policy rules has resulted in a proliferation of definitions of the term "policy rule." This has, not surprisingly, led to some confusion in the literature, and discussions of the topic often flounder on issues of terminology. Naturally, the answer to the question of whether IT can be described by a policy rule will depend a great deal on what exactly is meant by the term.[3] This section provides a brief review of some of the alternative definitions in an effort to clarify some of these issues.

Conditional Versus Unconditional Rules

The easiest rules to enforce, of course, are simple ones. And in the context of monetary policy rules, the simplest sort of rule would be something like the fixed money supply rule analyzed in Rogoff (1985) and King (1997). Such a "non-contingent" or unconditional rule represents an inflexible commitment to a nominal anchor and obviously prohibits any sort of response to economic conditions. In certain models, this kind of inflexibility can result from assigning a zero weight to output fluctuations in the central bank's loss function, a case King (1997) refers to as that of the "inflation nutter." Such a rule would, by construction, not allow the central bank to (optimally) offset the effects of supply shocks on output. And as pointed out by Rogoff (1985), such a rule would also prevent the central bank from accommodating nominal money demand shocks, potentially introducing more volatility in output and inflation. It is this sort of inflexible rule that was criticized by Friedman and Kuttner (1996), among others. Recent research has deemphasized these unconditional policy rules, however, and the focus now is much more on the design of flexible, conditional rules that allow the policymaker to respond in a reasonable (or even optimal) manner to economic conditions.

Ad Hoc Versus Optimal Rules

Among those "state contingent" rules that allow policy to respond to economic conditions, a broad distinction can be drawn between ad hoc policy rules relating the policy instrument to some selection of macroeconomic variables and those rules derived from an explicit optimization problem. Taylor's (1993) eponymous rule

$$i_t = r^* + \pi^* + 0.5\, x_t + 1.5(\pi_t - \pi^*) \tag{1}$$

is of course the best-known example of the former; here, i_t is the nominal policy interest rate, r^* is the equilibrium real rate of interest, π^* is the desired or "target" level of inflation, π_t is the current rate of inflation, and x_t is the output gap.[4] Another example is the inflation forecast–based (IFB) rule proposed by Batini and Haldane (1999), in which the nominal interest rate depends on a distributed lead of τ-period-ahead inflation forecasts made at time t, $\pi_{t+\tau,t}$ (ignoring interest rate smoothing for simplicity):

$$i_t = r^* + \pi^* + \sum_{\tau} \theta_\tau \pi_{t+\tau,t}\,. \tag{2}$$

By contrast, rules based on an explicit optimization problem are almost invariably based on setting policy in such a way as to minimize a loss function of the form

$$E_t \sum_{\tau=0}^{\infty} \delta^\tau [(\pi_{t+\tau} - \pi^*)^2 + \lambda x_{t+\tau}^2]. \tag{3}$$

The optimal response of the interest rate derived from (3) will in general not be given by (1) or (2), although it is often possible to reverse-engineer objective functions that would rationalize such rules. Nonetheless, these sorts of rules tend to produce reasonable (if not optimal) policy responses, provided the sum of the inflation coefficients exceeds unity, thus satisfying the Taylor principle. This observation has led to a vast literature comparing the performance of simple ad hoc rules, like Taylor's, with the optimal policy response for a variety of models. See,

[3] Bofinger (2000) also grapples with the problem of mapping IT into alternative definitions of a policy rule.

[4] To make the rule operational, Taylor used the current year-over-year inflation rate for π_t and linearly detrended output for x_t.

for example, Rudebusch and Svensson (1999) and Williams (2003).

Targeting Versus Instrument Rules

Probably the most familiar way to characterize the conduct of monetary policy is in terms of an *instrument rule* involving the policy instrument itself. Equations (1) and (2) are examples in which the nominal interest rate is the policy instrument. Although these examples are ad hoc rules, it would also be possible to insert the relevant structural relationships into the first-order condition from minimizing (3) to yield the optimal instrument rule for a particular model. A distinction is also sometimes made between *explicit* instrument rules involving predetermined macro variables (i.e., ones that do not depend on the current setting of the policy instrument) and *implicit* rules whose arguments are jointly determined with the policy instrument (as would typically be the case if the rule's arguments included forecasts). An explicit rule can be interpreted as a simple "recipe" for policy, while implementing an implicit rule (such as the IFB) requires that the policymaker account for the feedback between the instrument and the arguments of the rule.

A less familiar way to characterize policy is directly in terms of the targeted variables themselves, yielding what is referred to as a *targeting rule*. An *optimal* targeting rule could either take the form of simply pledging to minimize (3) (a "general" targeting rule in Svensson's terminology) or setting policy in such a way as to satisfy the first-order conditions from (3) describing the marginal trade-off facing the policymaker between output and inflation stabilization (a "specific" targeting rule). With a quadratic objective function, the first-order conditions imply a linear marginal trade-off between inflation and the output gap, such as those discussed in section 4. There are also ad hoc targeting rules involving only the central bank's goal variables, but which are not explicitly derived from an optimization problem. A prescription to achieve the desired inflation rate at a fixed horizon could be classified as a targeting rule of this type.

Because instrument rules can be derived from targeting rules (and vice versa), the distinction between the two is at some level artificial. The distinction is further blurred when a term involving the change in the interest rate is included in the objective function, presumably reflecting a preference for interest rate smoothing as in Giannoni and Woodford (2003a,b). In this case, the policy instrument would appear in the first-order condition, making the targeting rule indistinguishable from an implicit instrument rule.

Nonetheless, Svensson (2003) contends that formulating policy in terms of a targeting rule has several compelling advantages over an instrument rule. Chief among these is that targeting rules can more readily accommodate central bankers' "judgment" regarding special factors affecting inflation and output (macro models' ubiquitous "add factors"), as well as any unusual circumstances affecting the efficacy of the monetary transmission mechanism. Svensson shows that variables representing policymakers' judgment will typically enter the instrument rule formulation, rendering the implementation of policy by that route more complex and less intelligible. By contrast, these judgment variables do *not* appear in targeting rules. Intuitively, this is because the targeting rule embodies the central bank's imperative simply to do whatever it takes to achieve the appropriate balance between output and inflation stabilization, incorporating any judgment that might be appropriate in selecting the instrument setting needed to achieve the desired objective.

Rules Describing Discretion Outcomes Versus Rules Derived from a Commitment

Contributing to the terminological haze is the fact that the term "policy rule" has been used to describe both the outcome of discretionary policy setting (i.e., re-optimizing each period) *and* a condition that commits the central bank to potentially time-inconsistent actions in the future. In fact, as shown by Clarida, Galí, and Gertler (1999), a Taylor-like instrument rule can be derived as the optimal instrument rule for a central bank acting under discretion. This observation means it is difficult to discern in practice whether a central bank has acted in a purely discretionary fashion or tempered that discretion with some sort of commitment. Merely finding that monetary policy is well-described econometrically by a simple policy rule like Taylor's therefore does not necessarily imply any sort of commitment. This is not to say that optimal policy rules derived under discretion are the same as those derived under precommitment. Indeed, a generic feature of the latter is some degree of "history dependence"—i.e., for the policy response to depend not only on the current state of the economy, but the lagged state of the economy as well (typically,

the lagged output gap).[5] As a practical matter, however, it may be difficult to detect this sort of behavior, especially in the presence of an interest rate smoothing objective.

Mechanical Rules Versus Rules as "Guidelines"

Related to the discretion-versus-commitment dimension is the distinction between a rule that functions as a strict prescription for policy actions, versus one that serves as a looser "guideline" or "framework" for the conduct of monetary policy. This distinction has a long history. Simons (1936), for instance, interpreted a policy rule as completely precluding any intervention on the part of the "authorities." "Monetary rules," Simons wrote, "must be compatible with the reasonably smooth working of the system. Once established, however, they should work mechanically, with the chips falling where they may" (Simons, 1936, pp. 13-14). Clearly, it is this strict, mechanical interpretation that Bernanke et al. (1999) object to as a characterization of IT.[6]

It is also apparent that this is not what Taylor had in mind when he proposed his rule. "Policy rules are frequently written down in the form of a 'mechanical-looking' algebraic formula…But this does not mean that the only way that monetary policy rules can be used is for the central bank to follow them mechanically," Taylor wrote. "On the contrary, most recent proposals for monetary policy rules assume that they would be used as guidelines for policymakers, recognizing the need for some discretion in using the rule" (Taylor, 2000, p. 209).

Svensson's interpretation of a rule appears to be closer to that of Simon's than to Taylor's. He finds Taylor's looser interpretation of a rule "not sufficiently specific to be operational" on the grounds that "there are no rules for when deviations from the instrument rule are appropriate," which, he argues, creates an "inherent lack of transparency" (Svensson, 2003, p. 445). But Svensson *does* allow discretion to enter through the *arguments* of the policy rules: e.g., via judgmental adjustments to forecasts or the policymakers' assessment of the policy setting required to attain the optimal outcome.

3. WHAT DOES INFLATION TARGETING HAVE TO DO WITH POLICY RULES?

The goal of this section is to make a connection between the various definitions of a policy rule discussed above and IT as it is actually practiced. To that end, it first outlines three ways in which IT could be interpreted within the context of monetary macro models. Second, it summarizes the key features of IT as it is practiced by self-described inflation targeters. The section concludes by highlighting dimensions along which the practice of IT does (or does not) map into the theoretical characterizations of IT.

A Theoretical Taxonomy

Perhaps the weakest definition of IT is having some desired rate of inflation, π^*, (which need not be announced) and employing a reaction function or instrument rule that satisfies the "Taylor principle" of a greater-than one-for-one response to expected inflation, thus ensuring that eventually inflation returns to π^*. The reaction function may of course also include a response to the output gap. This could be called "weak form" IT. The reaction function need not be optimal, in the sense of being derived from an explicit loss minimization problem. Under this definition, even following a simple ad hoc Taylor-style rule will work. Galí (2002) and McCallum (2002), among others, define IT in this way.

A stronger definition of IT ("semi-strong form IT") restricts membership in the club to those central banks following an *optimal* monetary policy, i.e., setting policy in such a way as to minimize a relatively explicit loss function like (1) above. This is the definition in Svensson (1999).[7] This optimization need not be carried out subject to any sort of precommitment, however. Indeed, the optimal instrument rule derived under the assumption of discretionary, period-by-period optimization in Clarida, Galí, and Gertler (1999) is described as a rule that characterizes IT.

The strongest conceptual definition of IT ("strong-form IT") is in terms of optimal monetary policy under conditions of precommitment (or alter-

[5] Confusing matters still further: Considering only rules that depend on the *current* state of the economy, the optimal instrument rule under commitment is the same as that obtained under discretion with a smaller weight on output in the loss function (λ). See Clarida, Galí, and Gertler (1999).

[6] Even while arguing that a monetary rule should be mechanical, Simons (1936) recognized that an unconditional rule, such as a fixed supply of money, would probably be *too* inflexible.

[7] Svensson's (1999) definition goes even farther, defining IT narrowly as an optimal targeting rule, although it is not clear why optimal policy could not also be implemented with an instrument rule.

natively the "timeless" perspective). The optimal policy rule derived under these assumptions involves a commitment to a time-inconsistent course of future action on the part of the central bank: e.g., reducing inflation *today* by the promise to run negative output gaps *in the future*.[8] Svensson (1999) seems to be agnostic as to whether IT necessarily involves such a precommitment, although he argues that IT can, at least, help reduce or eliminate any inflation bias resulting from an above-equilibrium output target. The precommitment solution is clearly what King (1997) had in mind in his description of IT, however, and this is also apparently the view of Giannoni and Woodford (2003c).[9]

Inflation Targeting in Practice

Although the practice of IT is anything but uniform across countries, a number of elements are common to most self-declared inflation targeters. These include[10]

- An emphasis on long-run price stability as the principal goal of monetary policy: This is not to say that price stability is the *only* goal, however—only that other objectives can be pursued only to the extent that they are compatible with the inflation target.[11]
- An explicit numerical target for inflation and a timetable for reaching that target: Most are in the neighborhood of 2 percent, and all aim to achieve the target at a horizon of no more than two years.
- A high degree of transparency with regard to monetary policy formulation: Most inflation targeters publish a detailed report on general economic conditions and the outlook for inflation in particular, typically at a quarterly frequency. In some cases, these reports include numerical projections of key macroeconomic variables.
- A mechanism for accountability: Besides promoting transparency, the central banks' published inflation reports also provide a means for ex post evaluation of inflation performance. Failure to fulfill the inflation target may require the central bank to take specific steps. For example, should inflation deviate by more than 1 percentage point from its 2.5 percent target, the Governor of the Bank of England is obliged to submit an open letter to the Chancellor of the Exchequer explaining the reason for the deviation and presenting a timetable for a return to the target.

Although most inflation targeters share these four broad features, there is considerable variation in some of the specifics. At the level of implementation, for example, central banks differ with respect to choice of price index (overall versus "core" inflation) and the particular form of the target (point versus range). At a more substantive level, inflation targeters also differ as to "goal independence": those that are only "instrument independent" pursue a target set for them by the elected government, while those that are also "goal independent" set their own targets. There is also a great deal of heterogeneity with respect to exactly what central banks communicate—and how; these differences are cataloged in great detail by Fracasso, Genberg, and Wyplosz (2003).

It is also interesting to distinguish full-fledged inflation targeters from "near-inflation targeters" on the basis of these features. For example, some central banks—particularly those of emerging-market or post-communist countries—have set up most of the mechanics of IT, but lack the institutional means to make a long-run commitment to price stability. Carare and Stone (2003) and Stone (2003) refer to this regime as "Inflation Targeting Lite." Other central banks seem to have internalized the price stability objective without adopting all the trappings of outright IT. The Federal Reserve might be put into this category. Although it also operates under a dual mandate, in recent years price stability has been increasingly emphasized as the primary long-run goal of monetary policy.[12] Nonetheless, the Federal Reserve still lacks an explicit numerical inflation target, and as discussed in Kuttner and Posen (2001), its monetary policy formulation

[8] Or, in the case of Japan, *increasing* inflation today by the promise of running *positive* output gaps in the future, as in Eggertsson and Woodford (2003).

[9] Oddly, the empirical application in Giannoni and Woodford (2003c) is to the Federal Reserve, which is generally not considered a full-fledged inflation targeter.

[10] A similar list of features is given in Truman (2003).

[11] Debelle (2003) points out that Australia is something of an exception in this regard, in that the Reserve Bank of Australia operates under a dual mandate of price stability *and* full employment.

[12] In 1988, Greenspan stated: "We should not be satisfied unless the U.S. economy is operating at high employment with a sustainable external position and *above all* stable prices...By price stability, I mean a situation in which households and businesses in making their saving and investment decisions can safely ignore the possibility of sustained, generalized price increases or decreases" [Greenspan (1988), emphasis added].

remains considerably more opaque than that of the typical inflation targeter.[13]

Will the Real Inflation Targeter Please Step Forward?

The question now is how (and indeed whether) the central bank practices described above map into the various definitions of IT that have been proposed in the theoretical literature. Based on the institutional arrangements, which central banks qualify for membership in the IT club? And to what extent does this depend on the theoretical definition of IT one has in mind?

"Weak form" IT is so weak as to be almost vacuous. Under this definition, virtually every major central bank qualifies as an inflation targeter. It implies merely that the central bank acts in such a way as to eventually bring inflation back to its target, and says nothing about the nature of the policy used to get there. Thus, it would seem that the only requirement for entry into the IT club is having a reaction function coefficient of at least a certain size. And indeed since this condition is also a requirement for a well-behaved solution to conventional macro models, any country with a mean-reverting inflation rate would ipso facto qualify as an inflation targeter; only those with "unstable" inflation would fail the test.[14]

It is hard to find institutional evidence that any central bank conforms to either the "strong" or "semi-strong" forms of IT. The problem is that no central bank—inflation targeter or otherwise—currently conducts policy with reference to an explicit, publicly announced loss function or first-order condition. Nor is there any documentary evidence to suggest that policymakers choose between different policy options on the basis of any numerical estimate of the estimated "loss" associated with the various options. Thus, on the basis of Svensson's definition of IT as an optimal targeting rule, it would seem that *no* central bank qualifies as a bona fide inflation targeter.[15] Furthermore, even among self-proclaimed inflation targeters, only the Reserve Bank of New Zealand (RBNZ) publishes a forecast of the output gap, which is a key ingredient in conventional targeting rules.[16]

While no inflation targeter currently communicates in the language of optimization, all inflation targeters talk a great deal. Indeed, as noted above, communication is a central element of the practice of IT. Formalizing the role of this IT-induced transparency has presented a theoretical challenge, however. From an optimal control standpoint, it makes no difference whether the central bank keeps its first-order conditions to itself or explains them in detail to the public four times per year. Optimal policy will be the same either way.

One hypothesis is that transparency and accountability somehow allow the central bank to overcome the time consistency problem inherent in optimal monetary policy. One way to formalize this idea is to assume private information on the part of the central bank regarding its output or inflation objectives. Herrendorf (1998) and Faust and Svensson (2001) take this approach, as does Geraats (2002), explicitly in the context of the decision to publish a forecast. In Drazen and Masson (1994) and Agénor and Masson (1999), the private information has to do with the central bank's preferences: specifically, whether it is "strong" in the sense of assigning a low weight on output fluctuations in its loss function relative to a "weak" central bank. In the context of both sets of models, transparency plays a direct role in helping to reveal the unobserved private information. Less formally, King (1997) has argued that transparency, accountability, and a clearly defined objective all enhance central bank "credibility," defined as the ability to convince the private sector that it will carry out policies that may be time inconsistent, and thus implement the optimal state-contingent rule.

4. ESTIMATED POLICY RULES FOR THREE INFLATION TARGETERS AND THE FED

We now turn to the question of how well the behavior of IT central banks can be characterized by simple policy rules of the sort discussed earlier in section 2. We first consider conventional instrument rules relating the relevant short-term interest

[13] It is worth making a distinction between transparency in policy *formulation* versus transparency in *implementation*. The Federal Reserve has, of course, become much more transparent in the implementation of policy, especially since the practice of announcing changes in the funds rate target began in February 1994.

[14] In backward-looking models, failing to satisfy the Taylor principle typically results in explosive inflation; in forward-looking models, it can generate indeterminacies.

[15] In the spirit of Friedman (1953), it might be argued that central bankers act "as if" they were minimizing a loss function, even if they were not consciously aware that fact.

[16] Svensson (2000) contends this is an essential requirement for IT: "policy decisions are consistently motivated with reference to published inflation and output(-gap) forecasts."

rate to macroeconomic objectives, i.e., output and inflation. Specific targeting rules—that is, equations describing the optimal trade-off between output and inflation—are taken up later in the section.

Ideally, one would want to use these estimates to say which of the definitions of IT from section 3 best described the central banks' behavior. This is hard to do econometrically, unfortunately. Estimates of instrument rules or reaction functions may reveal something about whether the Taylor principle is satisfied, but without a fully and correctly specified macro model, it is difficult (if not impossible) to distinguish between optimal and ad hoc behavior on the part of the central bank. Similarly, the distinction between discretionary and precommitment-based policy is a very subtle one to discern empirically, although Kuttner and Posen (1999) suggest that precommitment-like behavior may explain the observed decline in inflation persistence among inflation targeters. At the very least, however, such estimates can provide some information as to how closely banks' behavior conforms to simple rules of one form or another.

This is, of course, not the first effort to describe central banks' behavior in terms of simple policy rules. What distinguishes this paper from much of the other work in the area is its use of the central banks' own published inflation and output forecasts, rather than econometric proxies for the relevant expectations.[17] This approach has a number of compelling advantages. First, it greatly simplifies the econometrics, reducing the data requirements and obviating the need for the two-stage GMM method used by Clarida, Galí, and Gertler (2000). Second, the central banks' own forecasts are likely to be more reliable than those based on simple econometric methods.[18] One reason is that the central banks' forecasts undoubtedly incorporate a great deal of information not in the macro time series, as well as informal "judgment" as to the most likely outcomes. It is this kind of an information advantage that Romer and Romer (2000) suggest accounts for the superior performance of the Federal Reserve's Green Book forecasts. Finally, the published forecasts presumably embody appropriate assumptions about the central banks' intended policy actions. Naive, unconditional econometric forecasts, on the other hand, may imply a path of policy at odds with central banks' intentions.

The analysis in this section focuses on three central banks: the RBNZ, the Bank of England, and Sweden's Riksbank. These three were chosen because they are the three inflation targeters with the longest track record of published, quantitative forecasts. Other seasoned inflation targeters, such as the Reserve Bank of Australia and the Bank of Canada, make use of detailed projections internally, but these projections have not been made available publicly. Instead, their published reports contain only more qualitative, impressionistic assessments of the outlook for inflation and output, which are less amenable to quantitative analysis.

Although all three of the central banks under study report some sort of a forecast every quarter, the nature of these forecasts differs considerably across banks. Since 1997, the Bank of England's *Inflation Report* has consistently reported projections for four-quarter inflation and real gross domestic product (GDP) growth (mean, median, mode, *and* a measure of uncertainty) for an eight-quarter forecast horizon. The Riksbank, since 1992, has published forecasts for Q4/Q4 real GDP growth and December/December consumer price index (CPI) inflation for the current year and the two following "out" years. The RBNZ reports projections over a longer forecast horizon than the other central banks, with some forecasts going out as long as 15 quarters. The RBNZ is also unique in that it is the only central bank ever to have published estimates and forecasts of the output gap—a key ingredient in typical targeting and instrument rules.

The three central banks do differ somewhat as to how they express their inflation targets. Over the period covered by the analysis in this paper, the Bank of England had a point target of 2.5 percent for the retail price index less mortgage-related items (known as the RPIX). The RBNZ's current Policy Targets Agreement (PTA) currently specifies a 1 to 3 percent range for overall CPI inflation. (From 1997 through 2002:Q3, the target range was 0 to 3 percent for core CPIX inflation.) The Sveriges Riksbank has a point target of 2 percent for overall CPI inflation, with a ± 1 percent tolerance around that target.

[17] Jansson and Vredin (2003) and Berg, Jansson, and Vredin (2002) use Riksbank forecasts in their analysis, and Huang, Margaritis, and Mayes (2001) utilize the RBNZ's published projections. For the United States, McNees (1986, 1992) uses the Federal Reserve's internal Green Book forecasts in estimating a forward-looking reaction function, an approach that has been adopted by Orphanides (2001) and Boivin (2003), among others.

[18] All three central banks regularly assess their own forecasting performance: see, for example, McCaw and Ranchhod (2002) for New Zealand, Pagan (2003) (and the references cited therein) for the Bank of England, and the "Materials for Assessing Monetary Policy" appendix to the Riksbank's March *Inflation Report*.

The policy assumptions underlying the three central banks' forecasts also differ on one key dimension. The Bank of England and Riksbank both report constant-interest-rate forecasts, in which the interest rate set by policy is assumed to remain unchanged over the forecast horizon. Leitemo (2003) has interpreted this as a policy rule in which the *current* interest rate is set at a level consistent with attaining the inflation target.[19] Vredin (2003) contends that interpretation is inconsistent with the Riksbank's policy; indeed, its *Inflation Report* has at times explicitly acknowledged that a significant divergence between the forecast and the target would require a change in policy. As discussed below, however, the Bank of England's and the Riksbank's two-year-ahead forecasts come reasonably close to their stated targets, at least since 1997. This observation, along with the well-known instability problems associated with constant-interest-rate rules, led Vredin (2003) to question whether these central banks' forecasts represent true constant-interest-rate forecasts.[20] Unlike other inflation targeters, the RBNZ conditions its forecasts on the time-varying interest rate given by the inflation-forecast-based rule used in the staff macro model.[21] In doing so, the RBNZ avoids the difficult methodological issues associated with constant-interest-rate projections and provides an outlook for interest rates and the economy that is arguably more coherent than those of the other central banks.

There are also subtle differences in the timing of the forecasts relative to the policy decisions. The Riksbank and the RBNZ both publish their forecasts on the same day on which interest rate decisions are made. Consequently, these two central banks' forecasts are conditioned almost by construction (given the time required to put together a new forecast) on the preceding period's interest rate. By contrast, the Bank of England publishes its inflation report two weeks after a Monetary Policy Committee meeting, and as a result its forecasts are conditioned on the current period's policy action. Thus, the Riksbank and RBNZ forecasts can be taken as predetermined with respect to the current-period interest rate, while those of the Bank of England cannot.

It is interesting to note that an explicit reaction function or instrument rule does not figure prominently in any of the three central banks' official publications, which tend to focus instead on the outlook for inflation, relative to its target, and a discussion of economic conditions more generally. This is not to say that instrument rules have been entirely ignored, however. Since 2000, the March issue of the Riksbank's *Inflation Report* has included an assessment of monetary policy using an econometrically estimated "rule of thumb" based on the Riksbank's own inflation forecasts.[22] According to Archer (2003), a Taylor-style rule is used internally at the RBNZ for assessing various policy options, and one (the May 2001) issue of the *Monetary Policy Statement* actually included such a rule-based assessment. Nikolov (2002) reports that Bank of England staff and the Monetary Policy Committee periodically review the implications of a variety of policy rules, although the output gap data used to implement these rules are not made public.

For comparison, we also include an analysis of Federal Reserve behavior based on the internal forecasts contained in the unpublished "Green Books," which are made public after a five-year lag.[23] This comparison is inexact at best, however, because the policy assumptions underlying the Green Book forecasts differ fundamentally from those embodied in the inflation targeters' forecasts. In particular, while some plausible path for the funds rate target is assumed in the Green Book, this policy does not necessarily correspond to the FOMC's intentions; nor is it generally the case over the period analyzed that the policy brings inflation back to a fixed target by the end of the forecast horizon.[24]

[19] Leitemo (2003) points out that such a constant-interest-rate rule is time inconsistent, as the interest rate required to achieve the target would be expected to change as the horizon advances, and derives a method for calculating the time-consistent equilibrium under such a constant interest rate rule.

[20] Noting that the Riksbank's two-year inflation forecast, since 1997, has never fallen outside of the 1 to 3 percent range, Leeper (2003) also questions the credibility of the Riksbank's constant-interest-rate assumption.

[21] Details of the RBNZ's IFB rule can be found in the appendix to Drew and Plantier (2000).

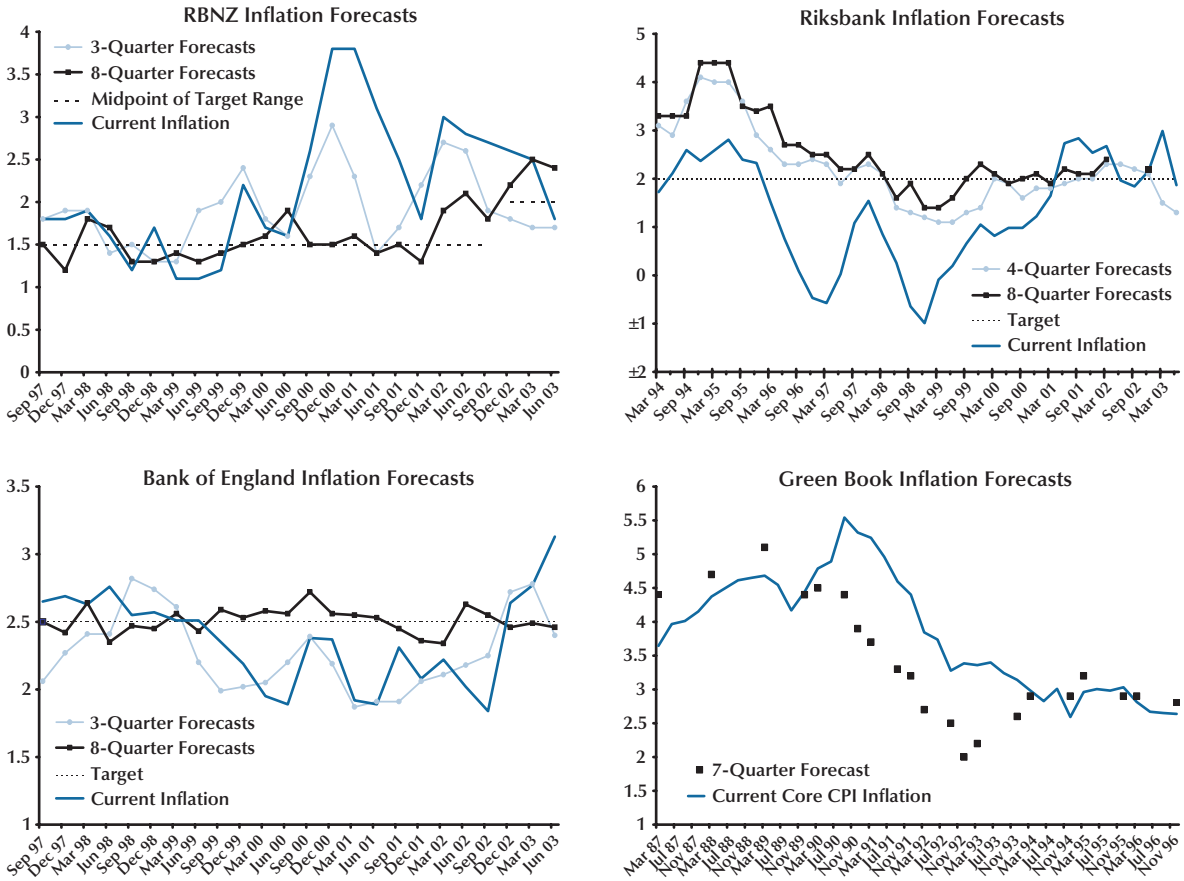
[22] The research underlying the rule of thumb described in the *Inflation Report* can be found in Jansson and Vredin (2003) and Berg, Jansson, and Vredin (2002).

[23] Pre-1997 Green Book data can be found at www.phil.frb.org/econ/forecast/greenbookdatasets.html.

[24] The baseline assumption is typically (though not always) a constant nominal funds rate; see Reifschneider, Stockton, and Wilcox (1997). Another possibility would be to use the biannually published "central tendency" forecast of the FOMC. Although this may conform to the FOMC's intentions more closely than the Green Book forecasts, the conditioning assumptions (inflation objective, interest rate path) are no clearer.

Figure 1

Inflation Forecasts and Targets



Properties of the Inflation Forecasts

We begin by simply examining the properties of the central banks' inflation forecasts. Figure 1 displays time series of the medium- and long-run forecasts, along with the current year-over-year inflation rate and (except for the United States) the inflation target. The figure reveals considerable variation in the relatively short-run three-quarter-ahead forecasts. Not surprisingly, the eight-quarter-ahead forecasts tend to fall much closer to the target. Sweden in the early- to mid-1990s is something of an exception, however, with even the two-year-ahead forecasts well above the target until 1996.[25] The Fed's forecast, shown in the lower right-hand panel, also exhibits a great deal of variation, which reached 5 percent in 1989 before falling to less than 2 percent with the disinflation that accompanied the 1991-92 recession.[26]

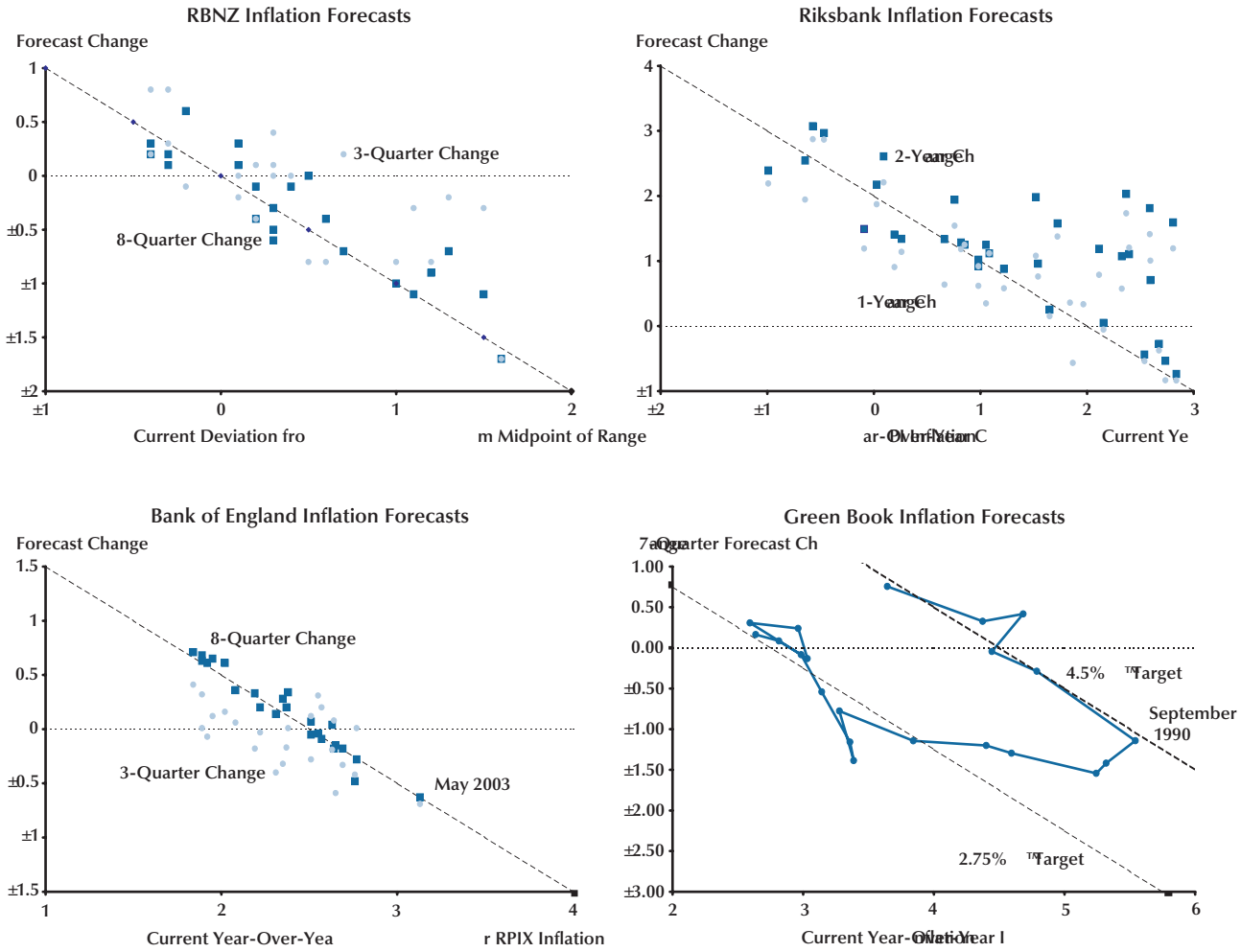
Another way to look at the same set of data is to plot the forecast *change* in the inflation rate against the deviation of current inflation from its target. Forecasts that implied a return to the target within the specified horizon would fall along a –45 degree line; for example, inflation 1 percent above target would imply a –1 percent forecast change. The eight-quarter-ahead forecasts for the RBNZ fall reasonably close to this –45 degree line, as shown in the upper left-hand panel of Figure 2. For the United Kingdom,

[25] According to Berg, Jansson, and Vredin (2002), this early stage of IT was one in which the Riksbank was still struggling to establish the credibility of its target.

[26] The Green Book's forecast horizon over the 1986-96 period varied between five and nine quarters, which is somewhat shorter than that of the inflation targeters. A seven-quarter-ahead horizon was therefore chosen so as not to lose too many observations.

Figure 2

Target Reversion of Inflation Forecasts



the eight-quarter-ahead forecasts (depicted in the lower left-hand panel) lie *very* close to the –45 degree line, which is perhaps to be expected given the way in which the Bank of England's forecasts incorporate recent policy actions. The Riksbank's forecasts in the upper right-hand panel are considerably more spread out, in part reflecting the experience in the mid-1990s when inflation was above its target and expected to rise still further. For all three inflation targeters, the three-quarter-ahead forecast inflation changes generally lie some distance from the –45 degree line, suggesting that most deviations from the inflation target are not expected to be fully reversed at such a short horizon.

The Fed's inflation forecasts, shown in the lower right-hand panel, display an interesting pattern. Prior to December 1990, the long-horizon Green Book forecasts tended to revert to a "target" of approximately 4.5 percent, depicted by the higher of the two –45 degree lines. (As noted above, this "target" reflects the assumptions implicit in the Green Book, rather than the intentions of the FOMC.) But as inflation fell during the course of the recession, the implicit "target" in the Green Book seems to have shifted down to roughly 2.75 percent.

Instrument Rules: Two Conventional Specifications

This section presents estimates of conventional instrument rules for the four central banks under study. We begin with the simplest of the simple rules:

Table 1

Estimates of the Taylor Specification of the Instrument Rule

Dependent variable = policy interest rate, *i*

	N	Coefficient on Intercept	Output gap	Inflation	Lagged *i*	Adjusted R^2	LM test for 2nd order auto-correlation
New Zealand	23	1.14	0.25	–0.04	0.83***	0.64	12.6
1997:Q4–2003:Q2		(0.78)	(0.17)	(0.23)	(0.13)		0.001
Sweden	38	0.17	–0.63***	0.27***	0.99***	0.96	8.43
1994:Q1–2003:Q2		(0.17)	(0.13)	(0.05)	(0.04)		0.014
United Kingdom	23	–0.79	–0.43*	0.27	1.12***	0.90	3.25
1997:Q4–2003:Q2		(0.61)	(0.22)	(0.28)	(0.11)		0.197
United States	40	0.68***	0.32***	0.10	0.81***	0.95	7.06
1987:Q1–1996:Q4		(0.33)	(0.08)	(0.14)	(0.07)		0.029

NOTE: ***/**/* Indicate significance at the 1/5/10 percent levels, respectively. Estimation is by ordinary least squares. Numbers in parentheses are standard errors. The LM test statistic for second-order autocorrelation is *N* times the R^2 from a regression of the residual onto all the regressors from the original regression and two lags of the residual. The *p* value from the χ^2 distribution is reported underneath the test statistic. For Sweden and the United Kingdom, the policy rate corresponds to the repo rate. For New Zealand, it is the 90-day bank rate, and for the United States, it is the federal funds rate. For New Zealand and the United Kingdom, the inflation rate used in the regression is the current-quarter "forecast" of four-quarter inflation. For Sweden, it is the four-quarter percentage change in the CPI. For the United States, it is the four-quarter percentage change in the CPI, excluding food and energy. Proxies for the output gap are constructed by accumulating the difference between the forecast growth rates of real GDP and an assumed rate of potential growth. The data appendix contains additional details.

the classic Taylor (1993) rule, giving the policy rate as a function of the current output gap and inflation deviation,

$$(4) \qquad i_t = (1-\rho)i^* + \beta\, x_{t,t} + \gamma(\pi_t - \pi^*) + \rho\, i_{t-1} + e_t,$$

where $x_{t,t}$ is the current estimate of the current output gap, π_t is the current four-quarter inflation rate, π^* is the target inflation rate, and i^* is the steady-state nominal rate of interest (i.e., the inflation target plus the equilibrium real rate of interest). The only addition to the canonical Taylor specification is the lagged interest rate term, whose conventional interpretation is in terms of interest rate "smoothing"—the partial adjustment of the policy instrument toward some underlying target rate. In this parameterization, the long-run response of the nominal rate to inflation is $\gamma/(1-\rho)$.

This is the point at which empirical research on policy rules must confront the uncomfortable fact that no central bank, except the RBNZ, consistently reports an estimate of the output gap, $x_{t,t}$.[27] As a practical matter, this obviously complicates any effort to model central bank behavior in terms of a policy rule involving the output gap.

Rather than abandon the task at this point, we proceed by constructing a proxy for the output gap. Our approach is to back out an implicit estimate of the output gap using the central banks' projections of real GDP growth. Two assumptions are needed to make this work: (i) an estimate of the *growth rate* of potential output and (ii) a terminal condition, i.e., the value of the output gap at the end of the forecast horizon. For (i), we make an educated guess as to the assumed growth rate of potential output, using information gleaned from published central bank sources. For (ii), we assume the output gap reverts to zero at the end of the forecast horizon, unless published information suggests otherwise. With these assumptions, a real-time estimate of the output gap can be constructed as the accumulated difference between the forecasts of real GDP growth and the assumed potential growth rate. Further details on the construction of the output gap proxy can be found in the appendix.

The results, shown in Table 1, suggest a simple rule like (4) is a poor description of policy for all

[27] The RBNZ reported quarterly output gap projections in its *Monetary Policy Statements* from December 1997 through November 1999 and again from December 2000 through March 2001. Annual averages have been published consistently throughout the 1997-2003 period.

Table 2

Estimates of the Forward-Looking Instrument Rule

Dependent variable = policy interest rate, *i*

		Coefficient on						
	N	Intercept	Current output gap	Growth forecast	Inflation forecast	Lagged *i*	Adjusted R^2	LM test for 2nd order auto-correlation
New Zealand	23	1.20	0.42**	0.50*	1.22**	0.75***	0.78	9.00
1997:Q4–2003:Q2		(0.61)	(0.19)	(0.26)	(0.53)	(0.10)		0.011
Sweden	38	0.06	–0.18	0.31**	0.65***	0.77***	0.97	3.95
1994:Q1–2003:Q2		(0.41)	(0.13)	(0.12)	(0.10)	(0.05)		0.138
United Kingdom	23	–2.34	–0.06	0.53	0.09	1.19***	0.90	4.68
1997:Q4–2003:Q2		(1.39)	(0.32)	(0.39)	(0.37)	(0.13)		0.096
United States	40	–0.62	0.39***	0.20	0.50***	0.70***	0.96	4.61
1987:Q1–1996:Q4		(0.52)	(0.08)	(0.17)	(0.15)	(0.06)		0.100

NOTE: ***/**/* Indicate significance at the 1/5/10 percent levels, respectively. Estimation is by ordinary least squares. Numbers in parentheses are standard errors. For New Zealand, Sweden, and the United Kingdom, the inflation forecast is the forecast change in the target inflation rate over the subsequent four quarters, minus the inflation target (or the midpoint of the range, in the case of New Zealand). For the United States, it is simply the forecast percentage change in the CPI over the subsequent four quarters, so the regression intercept also includes any implicit inflation target. The growth forecast is for real GDP growth over the subsequent four quarters, or in the case of New Zealand, the change in the output gap. See also notes to Table 1.

four central banks. For New Zealand, the coefficient on inflation is effectively zero, and none of the coefficients (except that on the lagged interest rate) is statistically significant. The results are slightly better for Sweden, which at least exhibits a statistically significant and positive response to inflation. The coefficient on the output gap has the wrong (negative) sign, however, and it is statistically significant. The results are also unsatisfactory for the United Kingdom. Like Sweden, the output gap coefficient is significant, but has the wrong sign. The inflation coefficient has the right sign, but it is statistically insignificant.[28] In the United States, we find a significant, positive coefficient on the output gap, but the coefficient on inflation is small and insignificant. The estimated ρ parameter on the lagged interest rate is large and highly significant in all cases, ranging from 0.81 for the United States to 1.12 for the United Kingdom, suggesting an implausibly high degree of interest rate smoothing. The R^2 are high—but only because of the explanatory power of the lagged interest rate.

An alternative to Taylor's specification, in the spirit of Clarida, Galí, and Gertler (2000), is to use forecasts of inflation and the output gap, or alternatively the current output gap estimate and the real GDP forecast,

$$i_t = (1-\rho)i^* + \beta_1 x_{t,t} + \beta_2 \Delta y_{t+k,t} + \gamma(\pi_{t+k,t} - \pi^*) + \rho\, i_{t-1} + e_t, \tag{5}$$

where $\Delta y_{t+k,t}$ and $\pi_{t+k,t}$ are the central bank's forecasts of real GDP growth and inflation over the subsequent k quarters. This specification is attractive, as it captures rational, forward-looking behavior on the part of the central bank. In addition, by explicitly including a forecast of inflation, the coefficients on the output terms are readily interpreted in terms of an output stabilization objective. By contrast, the output gap may appear in the Taylor specification as a predictor of inflation and may not imply a weight on output stabilization per se.

Results from estimating (5) appear in Table 2, with the horizon k set to four quarters. The results are generally somewhat better than for the backward-looking Taylor specification. The equation works very well for New Zealand, in the sense that the coefficients on the current gap, the growth forecast, and expected inflation are all significant and have the expected signs. It also works reasonably well for Sweden, where the parameter estimates on output

[28] One reason for the poor results could be the lack of any significant variation in inflation or the output gap since 1997. Ironically, the success of the Bank of England's IT policy seems to have made it more difficult to estimate a policy rule.

growth and year-ahead inflation are both highly significant.[29] The United Kingdom still yields poor results, however. None of the coefficients is significant, although the coefficients on forecast GDP growth and inflation at least have the correct signs. For the United States, the output gap and the inflation forecast both have the correct signs and are significant; in fact, the estimates look a lot like those reported in Clarida, Galí, and Gertler (2000). The Taylor principle seems to be satisfied for all but the United Kingdom. Interestingly, the implied long-run response of the interest rate to inflation is much larger for New Zealand and Sweden (4.88 and 2.82, respectively) than for the United States (1.34). But this may reflect a difference in the nature of the Green Book forecast which, unlike the inflation targeters', has not assumed a reversion of inflation toward an unchanged target. The estimated coefficients on the lagged interest rates are still quite large, ranging from 0.70 for the United States to 1.19 for the United Kingdom.

Instrument Rules: A "Reaction to News" Specification

One of the consistently unsatisfying results from conventional instrument rule estimates, like those presented above, is that the large estimates of ρ imply an extremely high degree of interest rate smoothing. Rudebusch (2002) argues that this reflects the omission of highly serially correlated variables from the instrument rule, rather than interest rate smoothing per se.

In a similar vein, Svensson (2003) shows that the optimal instrument rule for an inflation forecast targeter has the form

$$(6)\qquad i_t = (1-\rho)i^* + \beta\, x_{t+k,t} + \gamma(\pi_{t+k,t} - \pi^*) + \phi\, z_{t+k,t} + e_t,$$

where $z_{t+k,t}$ is the central bank's forecast of some appropriate "judgmental" adjustment term, which represents an omitted variable in the conventional instrument rule specification.[30] Indeed, as discussed above in section 2, it is the presence of these unobserved judgment terms that leads Svensson to argue for the superiority of formulating policy on the basis of targeting rules. Omitted, serially correlated judgment terms could, therefore, lead to a spuriously high degree of measured interest rate smoothing.

Our solution to this issue is a novel approach to estimating an instrument rule that, in principle, eliminates the serial correlation in the omitted judgment term and allows for a clearer distinction between interest rate smoothing and reaction to this omitted variable. The innovation is to examine the response of the policy rate to the "news" contained in the revisions in expectations embodied in the central banks' inflation and output forecasts.

This approach is derived quite simply by first adding a lagged interest rate term to the instrument rule (6),

$$(7)\qquad i_t = (1-\rho)i^* + \beta\, x_{t+k,t} + \gamma(\pi_{t+k,t} - \pi^*) + \phi\, z_{t+k,t} + \rho\, i_{t-1} + e_t,$$

and projecting it onto information available to the central bank at time $t-1$,

$$(8)\qquad i_{t,t-1} = (1-\rho)i^* + \beta\, x_{t+k,t-1} + \gamma(\pi_{t+k,t-1} - \pi^*) + \phi\, z_{t+k,t-1} + \rho\, i_{t-1} + e_{t,t-1}.$$

Subtracting (8) from (7) gives

$$(9)\qquad i_t - i_{t,t-1} = \beta\,(x_{t+k,t} - x_{t+k,t-1}) + \gamma(\pi_{t+k,t} - \pi_{t+k,t-1}) + \phi(z_{t+k,t} - z_{t+k,t-1}) + e_t - e_{t,t-1}.$$

Thus, the difference between the current policy setting, i_t, and the *expected* policy setting as of the previous period, $i_{t,t-1}$, depends entirely on the revisions in the k-period-ahead expectations of the output gap, inflation, and the unobserved z. Taking the difference relative to the previous period's expectation makes the interest rate smoothing term, ρi_{t-1}, disappear. More importantly, if the central bank's forecasts are rational, then the unobserved revision in the expectation of z should, by the law of iterated projections, be unforecastable—and consequently serially uncorrelated. Similarly, any residual serial correlation in the e_t term will also disappear, leaving a specification free from the usual econometric problems that normally afflict estimated instrument rules.[31]

Access to published central bank forecasts makes it quite easy to implement this approach. Because of the overlapping nature of these forecasts, the

[29] Very similar results are reported in Berg, Jansson, and Vredin (2002), who also find that the forecast of output growth is significant.

[30] Svensson's equation actually contains separate terms involving linear combinations of one- and two-period-ahead forecasts of z, interpreted as a vector of judgment terms. But for our purposes, a single z term suffices.

[31] While this specification resembles that of English, Nelson, and Sack (2002), what distinguishes our approach is its emphasis on forecast revisions.

Table 3

Volatility of Forecast Revisions and Interest Rate Changes

	Standard deviation of		
	Four-quarter-ahead real GDP forecast revision	Four-quarter-ahead inflation forecast revision	Quarterly change in policy rate
New Zealand, 1997:Q4–2003:Q2	0.58	0.30	0.78
Sweden, 1994:Q1–2003:Q2	0.34	0.32	0.48
United Kingdom, 1997:Q4–2003:Q2	0.35	0.31	0.40
United States, 1987:Q1–1996:Q4	0.41	0.28	0.53

NOTE: The forecast revisions represent the difference between the four-quarter-ahead forecast made in quarter t and the five-quarter-ahead forecast made in quarter t–1. The real GDP and inflation forecasts are both for four-quarter growth rates. For New Zealand, the figure reported for the policy rate is the standard deviation of the policy rate forecast error, $i_t - i_{t,t-1}$. The standard deviation of the raw change in the policy rate, Δi_t, is 0.80.

revisions in expectations are calculated quite simply as the difference between the current quarter's k-period-ahead forecast and the previous quarter's $k+1$-period-ahead forecast. This approach also ameliorates the problem with the unobserved output gap. The output gap forecast can be written as the difference between a forecast of real GDP and a forecast for potential output—or, equivalently, the difference between accumulated real GDP *growth* and potential *growth* forecasts. If one is willing to ignore quarterly revisions in potential growth forecasts on the grounds that these are likely to be small relative to the forecast revisions in output growth, then the accumulation of the revisions to real GDP growth forecasts can be substituted for the output gap forecast revisions.

The only remaining issue is what to use for $i_{t,t-1}$, the previous period's forecast of the current interest rate. For the RBNZ, the solution is quite simple, as the interest rate projections underlying the inflation projections are published. In this case, $i_{t,t-1}$ is just data. The solution is also straightforward for the Riksbank and the Bank of England. If these banks' stated policies of maintaining a constant interest rate over the forecast horizon were accurate (and credible), then $i_{t,t-1}$ would simply equal i_{t-1}, leaving

$$(10)\quad \Delta i_t = \beta\,(x_{t+k,t} - x_{t+k,t-1}) + \gamma(\pi_{t+k,t} - \pi_{t+k,t-1}) + \phi\,(z_{t+k,t} - z_{t+k,t-1}) + e_t - e_{t,t-1},$$

i.e., the change in the policy rate as a function of "news" about inflation and the output gap. The resemblance to Hall's (1978) formulation of the permanent income hypothesis is not coincidental. Like a rational consumer, a central bank formulating policy on the basis of efficient forecasts of its target variables should satisfy an analogous set of orthogonality conditions. As a result, the central bank should respond only to the news embodied in its forecast revisions, and not to information that was already known at time t–1.

For the reasons discussed above, however, the assumption of a constant interest rate is not realistic, even for those central banks nominally adhering to a constant interest rate rule. It is nonetheless possible to derive a specification similar to (10) for the case of a time-varying (but unpublished) interest rate path. To do so requires adding $i_{t,t-1} - i_{t-1}$ to both sides of (9), so that Δi_t appears on the left-hand side; assuming $x_{t+k-1,t-1} \approx x_{t+k,t-1}$ (and likewise for π and z), the $i_{t,t-1} - i_{t-1}$ on the right-hand side becomes $\rho\,\Delta i_{t-1} - e_{t-1} + e_{t,t-1}$. With this modification, equation (9) becomes

$$(11)\quad \Delta i_t = \beta\,(x_{t+k,t} - x_{t+k,t-1}) + \gamma(\pi_{t+k,t} - \pi_{t+k,t-1}) + \phi\,(z_{t+k,t} - z_{t+k,t-1}) + \rho\,\Delta i_{t-1} + e_t - e_{t,t-1},$$

the main difference from (10) being the reappearance of the interest rate smoothing term, $\rho\,\Delta i_{t-1}$.

Table 3 reports the standard deviation of the forecast revisions and the change in the policy rate. Inflation forecast revisions are very similar in magnitude across the four central banks. Output growth forecasts are somewhat more volatile for New Zealand, which may explain the relatively high degree of variability in that country's short-term interest rate. The United Kingdom's interest rate, on the other hand, is considerably less volatile, despite

Table 4

Estimates of the "Reaction to News" Specification of the Instrument Rule

Dependent variable = change in policy rate: Δi_t, or $i_t - i_{t,t-1}$ for New Zealand

		Coefficient on				
	N	Output news	Inflation news	Δi_{t-1} or $i_{t-1} - i_{t-1,t-2}$	Adjusted R^2	LM test for 2nd order auto-correlation
New Zealand	21	0.36	1.45***	—	0.39	1.06
1997:Q4–2003:Q2		(0.22)	(0.46)			0.303
	20	0.26	1.61***	0.33*	0.49	7.30
		(0.22)	(0.45)	(0.17)		0.026
Sweden	38	0.27	0.47**	—	0.09	13.00
1994:Q1–2003:Q2		(0.22)	(0.24)			0.002
	38	0.37**	0.51***	0.69***	0.56	10.00
		(0.16)	(0.16)	(0.11)		0.007
United Kingdom	23	0.39	0.73**	—	0.11	7.19
1997:Q4–2003:Q2		(0.26)	(0.35)			0.027
	22	0.58**	0.52	0.47**	0.32	2.22
		(0.24)	(0.32)	(0.19)		0.330
United States	37	0.02	0.55*	—	0.03	13.57
1987:Q1–1996:Q4		(0.21)	(0.31)			0.001
	37	0.02	0.46	0.43***	0.23	7.20
		(0.19)	(0.27)	(0.14)		0.027

NOTE: ***/**/* Indicate significance at the 1/5/10 percent levels, respectively. Estimation is by ordinary least squares. Numbers in parentheses are standard errors. The "news" regressors are the central banks' four-quarter-ahead forecast revisions: e.g., the time-*t* forecast of four-quarter GDP growth four quarters ahead, minus the time-*t*–1 forecast of four-quarter GDP growth five quarters ahead. See also notes to Tables 1 and 2.

having output and inflation forecast revisions comparable to those of Sweden.

The regression results appear in Table 4, with and without the lagged interest rate. As in the conventional forward-looking reaction function estimates above, the horizon k is set to four quarters. This specification works very well for New Zealand, with a highly significant response to inflation news and a positive (but not quite significant) response to GDP news. In addition, the specification eliminates the serial correlation in the residuals, with an LM test statistic for second-order serial correlation of only 1.06. (The lagged interest rate revision is only marginally significant when it is included, although the residuals appear more highly serially correlated in this case.) The specification also works well for Sweden, with a significant, positive response to both output and inflation news; unlike New Zealand, the coefficient on the lagged interest rate term remains quite large, even in this specification. Moving to the "reaction to news" specification greatly improves the U.K. estimates: the coefficients on output and inflation news have the right sign, the magnitudes are plausible, and (depending on the specification) the responses are statistically significant. The coefficient on the lagged interest rate is much smaller (less than 0.5, rather than above 1.0), and there is no evidence of serial correlation in the residuals. The specification works *least* well for the United States, where only the inflation coefficient is even marginally significant and the United States R^2 is low.

One successful aspect of the "reaction to news" specification is the large reduction in the coefficient on the lagged interest rate for the Bank of England, the RBNZ, and the Fed. This result supports Rudebusch's (2002) contention that at least some of the serial correlation in conventionally specified instrument rules represents a response to an omitted variable, rather than interest rate smoothing per se. Indeed, for the United States the estimated lag coefficient of 0.43 is very close to the 0.4 Rudebusch obtains from term structure estimates of funds rate

predictability, and it implies a much more plausible level of interest rate smoothing. It is also not far from the smoothing coefficient of 0.54 reported by English, Nelson, and Sack (2002) for the forward-looking specification with real-time data. The Riksbank is an exception in this regard: The estimated lag coefficient remains a highly significant 0.7 even in the "reaction to news" specification, perhaps suggesting a larger role for interest rate smoothing in that case.[32]

Another attractive feature of this specification is that it allows us to get a much clearer picture of the degree of "judgment" in the setting of policy, relative to a simple instrument rule. An assessment of the role of judgment was difficult to make in the conventional specifications, because it was hard to distinguish between the omitted, serially correlated z and interest rate smoothing. By contrast, the residual from equation (10) or (11) has a clearer interpretation in terms of revisions to the relevant judgment factors.

The interpretation is particularly clean in the case of New Zealand, where the non-constant interest rate assumption and the availability of data on $i_{t,t-1}$ mean the results are not muddled by the implausibility of the constant interest rate assumption. In this case, the respectable but still relatively low R^2 (0.39 without the lagged interest rate, 0.49 with the lagged rate) means no more than one-half of the variance in the interest rate can be traced directly to revisions in the output and inflation forecasts. Thus, even the (arguably) most rule oriented of all the IT central banks apparently still exercises a great deal of judgment in setting policy.

What About Optimal Targeting Rules?

An alternative way to describe central banks' behavior is in terms of a *targeting rule*, as opposed to the instrument rules considered in the preceding section. As stressed by Svensson (2003), this formulation has the advantage of being immune to the inclusion of judgment terms in the central bank's forecast, and in the size of the policy action needed to attain its target. While setting policy to achieve an inflation target at a given horizon might be considered one form of an ad hoc targeting rule, the question taken up in this section is whether inflation targeters' behavior can be characterized in terms of simple optimal targeting rules.

With a backward-looking inflation process in which the inflation rate at time $t+1$ depends on the current output gap, x_t, the specific targeting rule can be written as

$$\pi_{t+\tau,t} - \pi^* = (\lambda/\alpha_x)\,(x_{t+\tau,t} - x_{t+\tau-1,t}), \tag{12}$$

i.e., as a linear relationship between the forecast inflation gap in period $t+\tau$ and the forecast change in the output gap between periods $t+\tau-1$ and $t+\tau$.[33] (Note that here, the period corresponds to the length of time it takes for a change in the output gap to affect inflation, rather than a calendar quarter.) The constant of proportionality is the ratio of λ, the weight on output in the loss function, to α_x, which is effectively the slope of the aggregate supply relation (i.e., $\partial\pi_{t+1}/\partial\pi_t$).

The intuition behind this condition is straightforward and can be put in terms of marginal costs and benefits. Take the case of $\tau = 2$,

$$\pi_{t+2,t} - \pi^* = (\lambda/\alpha_x)\,(x_{t+2,t} - x_{t+1,t}), \tag{13}$$

for example. Suppose inflation in period $t+2$ were forecast to come in above its target, π^*. With a quadratic loss function, the marginal benefit of reducing inflation is simply equal to the gap between inflation and its target. With a backward-looking inflation process and a one-period lag in the response of inflation, reducing inflation in period $t+2$ requires running a negative output gap at time $t+1$, relative to the *future* gap. In terms of output, the cost of reducing inflation is proportional to $1/\alpha_x$; this increases the loss function by an amount λ/α_x. At the optimum, the marginal benefit in terms of inflation reduction is equated to the marginal cost of foregone output.[34]

The bottom line is that under the assumption of a backward-looking inflation process, optimal monetary policy should induce a *positive* correlation between the forecast inflation gap and the forecast change in the output gap. This is not true if the inflation process is assumed to be forward-looking, however. In this case, the relevant targeting rule is

$$\pi_{t+\tau,t} - \pi^* = -(\lambda/\alpha_x)\,(x_{t+\tau,t} - x_{t+\tau-1,t}), \tag{14}$$

and optimal policy induces a *negative* correlation

[32] The estimate of ρ shrinks if the sample is started in 1997, however, suggesting that some of the apparent "smoothing" may be associated with the dramatic decline in interest rates in 1996.

[33] See Svensson (2003, equation 5.13). Note that this reflects the approximation that the discount factor, δ, is close to unity.

[34] This explanation is admittedly somewhat heuristic. See Svensson (2003) for a more precise (but arguably less intuitive) explanation in terms of the relevant marginal rates of substitution and transformation.

between the forecast inflation gap and the forecast change in the output gap.

Indeed, the only difference between this rule and the one for the backward-looking inflation process is the negative sign multiplying the change in the output gap. Although it may seem odd that a simple alteration to the assumed behavior of inflation should change the sign of the relationship describing optimal monetary policy, the intuition is straightforward. In the forward-looking inflation model, inflation in period $t+2$ responds *contemporaneously* to the period-t expectation of the output gap in period $t+2$. Thus, faced with greater-than-desired inflation in period $t+2$, policy will tighten, inducing a negative output gap (relative to the *previous* period) in that period in order to bring inflation down.

This particular specific targeting rule corresponds to one derived under pre-commitment, or a "timeless" perspective. Under discretion, the targeting rule would look like

$$\pi_{t+\tau,t} - \pi^* = -(\lambda/\alpha_x)\, x_{t+\tau,t}, \tag{15}$$

and not exhibit the "history dependence" that is a hallmark of the pre-commitment solution. In this case, optimal policy induces a negative correlation between the forecast inflation gap and the forecast output gap itself, rather than its change.

The lack of a clear implication for even the *sign* of the relationship between inflation and output gap forecasts means it is hard to put any of these targeting rules to the test empirically—after all, *either* a positive or a negative correlation could be interpreted as evidence that the central bank was obeying a specific targeting rule of some sort. By contrast, the signs of the coefficients in the optimal instrument rules do not depend on the assumed nature of the inflation process, although the magnitudes do depend on this assumption. In any case, any Phillips curve fit to the data would likely contain both forward- and backward-looking terms, undoubtedly making the relevant instrument rules more involved than those summarized above.

Further complicating matters is the question of where to put the error term in a regression used to estimate relationships like (12), (14), or (15) and what that error term actually *means*. After all, these targeting rules should hold exactly in terms of the central banks' forecasts, assuming those forecasts embody the assumption that policy behaves optimally; any judgment should already be incorporated into the central banks' forecasts. (In the context of estimating an instrument rule, the vice of judgment terms becomes a virtue, in that it at least suggests a plausible rationale for an error term in the regression.) One potential source of error is mismeasurement of the forecast output gap, which, as described above, can generally only be inferred (imperfectly) from central banks' published GDP forecasts. Another potential source is that central banks behave suboptimally—although in this case it is not clear whether the error term from any less-than-optimal policy should be thought of as orthogonal to the inflation or the output gap forecasts (if either).

Our crude but effective solution to this normalization problem is to report the correlation coefficients, rather than the estimated slope coefficients from regressions. The benefit of this approach is that the correlation coefficient does not depend on the normalization; the cost, of course, is that it says nothing directly about the size of the parameter of interest, λ/α_x. But at least the correlation can say something about the "closeness" of the empirical relationship implied by the targeting rule; and, given that even the *sign* of the relationship is up for grabs, this seems like a reasonable compromise.

Table 5 reports the correlations relevant to the three targeting rules discussed above. The first two are those between the forecast inflation gap and the forecast change in the output gap pertaining to the backward-looking inflation process and the forward-looking inflation process under pre-commitment, for the four- and eight-quarter-ahead horizons. Also reported are those between the forecast inflation and output gaps pertaining to the forward-looking, discretionary case.

In a few cases, there is a significant, negative relationship between forecasts of the inflation gap and forecasts of the change in the output gap, consistent with optimal monetary policy with a forward-looking inflation process. For New Zealand, there is a correlation of –0.46 at the four- to eight-quarter horizon; for the United Kingdom, a negative correlation of a similar magnitude is observed at the shorter zero- to four-quarter horizon. The correlations are relatively weak and insignificant in the case of Sweden.

The correlation is a surprisingly strong –0.69 for the United States at the four- to eight-quarter horizon. Interestingly, this is almost entirely the result of the early 1990s' disinflation, when the Green Book contained forecasts for above-average (but falling) inflation along with a widening output gap—a period typically thought of more in terms of serendipitous "opportunistic disinflation" than as

Table 5

Output-Inflation Correlations Corresponding to Targeting Rules

	Correlations between		
	$(\pi_{t+k,t} - \pi^*)$, $(x_{t+k,t} - x_{t+k-4,t})$		$(\pi_{t+k,t} - \pi^*)$, $(x_{t+k,t})$
	$k = 4$	$k = 8$	$k = 4$
New Zealand	–0.054	–0.455	0.415
1997:Q4–2003:Q2	(0.81)	(0.03)	(0.04)
Sweden	–0.181	–0.144	0.082
1994:Q1–2003:Q2	(0.27)	(0.42)	(0.62)
United Kingdom	–0.419	0.303	0.325
1997:Q4–2003:Q2	(0.05)	(0.16)	(0.12)
United States	–0.383	–0.689	–0.263
1987:Q1–1996:Q4	(0.02)	(0.00)	(0.21)

NOTE: Numbers in parentheses are p values for the hypothesis that the correlation is zero, assuming $\hat{\rho}(N-2)^{1/2}/(1-\hat{\rho}^2)^{1/2}$ follows a t distribution with $N-2$ degrees of freedom, where N is the number of observations. Because the output gap estimates often rely on the assumption that the eight-quarter-ahead gap is zero, the correlation between the inflation and output gap at this horizon is not reported.

an expression of forward-looking optimal monetary policy. In interpreting this result, it is important to keep in mind that the correlation is calculated assuming a constant mean, which implies an unchanged inflation target. Consequently, the negative correlation may reflect the downward shift in the Fed's inflation target that coincided with the 1991-92 recession.

The results are less supportive of the forward-looking, discretionary specification involving the level of the output gap forecasts. The correlation is insignificant for the United Kingdom, Sweden, and the United States. Only for New Zealand is the correlation significant, but in this case it has the "wrong" (i.e., positive) sign.

Overall, the results of this exercise lend lukewarm support for describing inflation targeters' (and the Federal Reserve's) monetary policy in terms of a simple targeting rule, with an underlying forward-looking view of the inflation process. Still, with estimated correlation coefficients generally in the –0.3 to –0.5 range (corresponding to values for the R^2, 0.09 to 0.25), the goodness of fit is mediocre at best and somewhat worse than that of typical estimated instrument rules. It is also important to bear in mind that uncovering a negative correlation between inflation and output forecasts does not necessarily imply that policymakers were behaving optimally. Such a correlation could conceivably arise even with policy governed by a suboptimal or ad hoc rule (or none at all). Furthermore, the simple targeting rules considered here will be misspecified if the underlying inflation process contains both backward- and forward-looking elements. Extending the exercise to more realistic models, along the lines of Giannoni and Woodford (2003c), is clearly worthwhile—although it is also worth noting that, as the targeting rule becomes more complex, it becomes less useful as a means of communicating the policy trade-offs to the public.

5. CONCLUSIONS

The overall goal of this paper has been to bridge the gap between the literature describing the practice of IT and the literature on monetary policy rules. In an effort to dispel some of the terminological confusion that has contributed to this gap, section 2 reviewed some of the alternative definitions of the term "policy rule," while section 3 proposed various ways of interpreting IT within the context of these rules.

Ultimately, the question of how IT shapes monetary policy is an empirical one, however. And here, the empirical results of section 4 suggest a number of important conclusions. The first is that simple instrument rules do provide a reasonable approximation to the conduct of monetary policy, both by inflation targeters and by the Federal Reserve. Second, instrument rules based on *forecasts* of inflation and output perform better than those based

only on *current* output and inflation. Third, while inflation targeters tend to exhibit a somewhat larger response to inflation forecasts than the Federal Reserve, inflation targeters are not "inflation nutters." Although the results depend somewhat on the specification used, forecasts of the output gap or GDP growth do seem to influence interest rate decisions, even controlling for the inflation outlook.

But these conventional instrument rules also leave a great deal unexplained (or at least "explained" only by the lagged interest rate). This observation suggests a fourth conclusion, namely, that central banks exercise a great deal of judgment or discretion relative to these rules. Estimates of an instrument rule from a novel "reaction to news" specification indicate that the Reserve Bank of New Zealand probably comes closest to a pure inflation forecast targeter; but even then, less than half of the variance from the planned interest rate path can be traced to forecast revisions.

A fifth conclusion is that simple optimal targeting rules of the kind advocated by Svensson (2003) do not provide a particularly good description of the conduct of monetary policy for any of the central banks considered. Fitting optimal targeting rules to the data, however, is complicated by the fact that central banks generally do not report output gaps, much less forecasts of those gaps; moreover, theory alone provides no clear guide as to the correct sign of the correlation implied by targeting rules.

At the level of estimated targeting or instrument rules, it is hard to draw sharp distinctions between the behavior of the three bona fide inflation targeters studied and that of the Federal Reserve. But, in general, the connection between changes in the short-term interest rate and forecast revisions is looser for the Fed than for the full-fledged inflation targeters. A sixth conclusion that could be drawn from the results, therefore, is that the FOMC uses even *more* judgment than the (significant) amount exercised by the inflation targeters.

While they may disappoint those who view IT purely in terms of a policy rule, these conclusions will come as no surprise to those familiar with the practice of IT, as described, for example, by Heikensten and Vredin (2002). At the same time, the lack of a sharp, qualitative difference between the Fed's behavior and that of the inflation targeters will probably do little to alter the priors of skeptics, such as Ball and Sheridan (2003), who contend the policy makes little practical difference.[35]

[35] See, for example, the discussion in Posen (2002).

A hypothesis left unexplored in this paper is that the real impact of IT is not so much on central bank policymaking, per se, as it is on the impact of those policy decisions upon inflation expectations in the markets and the broader public; that is, that talk does matter after all. This interpretation of IT suggests that the response of expectations to economic news, or to policy itself, should be more "anchored" for inflation targeters than for less-transparent non-inflation targeters, as suggested in Kuttner and Posen (1999, 2001) and Levin, Natalucci, and Piger (2004). If so, then a better place to look for effects of IT would be in the financial markets, and particularly in the prices of assets that embody inflation expectations. Examining financial markets' response to policy—and, in particular, to "discretionary" policy actions with no apparent connection to the central banks' forecasts—may prove informative as to whether IT can anchor expectations as its proponents claim.

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Appendix

CONSTRUCTING REAL-TIME OUTPUT GAP PROXIES

As described in section 4, the method used to construct estimates of the output gap involves accumulating the difference between the forecast real GDP growth rates and some assumed potential growth rate, imposing a terminal condition on the output gap at the end of the forecast horizon. This recursive technique is adapted to the specifics of each central bank's forecasts, as described here.

The United Kingdom

The Bank of England consistently reports four-quarter real GDP and inflation forecasts at a horizon of one to eight quarters ahead. Because the individual quarterly GDP forecasts are not reported, it is not possible to back-out a quarterly output gap series. But the four-quarter growth figures can be used to construct measures of the current gap and the four-quarter-ahead forecasts. The recursion can be described as follows:

$$x_{t+8} = 0$$
$$x_{t+k} = x_{t+k+4} - (g - \Delta_4 y_{t+k+4}) \text{ for } k = 4 \text{ and } 0,$$

where x_{t+k} is the k-quarter-ahead output gap, g is the growth rate of potential output (assumed to be a constant 2.4 percent per year), and $\Delta_4 y_{t+k}$ is the forecast four-quarter real GDP growth rate (based on the reported mode of the forecast distribution).

Sweden

The Sveriges Riksbank consistently reports a current-year forecast for inflation and output and forecasts for the subsequent two "out" years. Because of this structure, the effective forecast horizon varies between 8 and 11 quarters. The terminal condition on the output gap is imposed only on the longest, the 11-quarter "benchmark" forecast. Letting $x_{s+k,q}$ represent the output gap in the qth quarter of year

$s+k$, the gap for the first quarter of each year is constructed recursively in a manner similar to that of the Bank of England:

$$x_{s+3,1} = 0$$
$$x_{s+k,1} = x_{s+k+1,1} - (g - \Delta y_{s+k}) \text{ for } k = 2 \text{ to } 0,$$

where Δy_{s+k} is real GDP growth in year $s+k$. Subsequent quarters' output gap estimates are constructed by accumulating over the relevant forecast horizon the forecast revisions relative to the previous quarter. Potential growth was assumed to be 2.6 percent throughout, except in 2000 when it was 2.8 percent and 2002 and 2003, when values of 2.5 and 2.4 percent were used, respectively. The end-of-forecast-horizon gap was assumed to be zero, except in 1999, when the March *Inflation Report* referred to underutilized resources at the end of the forecast period and in 2000 when the March *Inflation Report* referred to capacity restrictions. For these years, the end-of-forecast-period gaps are assumed to be –1 and 1 percent, respectively.

New Zealand

For 12 of the quarters in the sample, the Reserve Bank of New Zealand reports quarterly estimates of the output gap. For the remaining 12 quarters, estimates were constructed using a method similar to that used for the United Kingdom, based on reported four-quarter real GDP growth rate forecasts.

The United States

The Federal Reserve is unique in that the Green Book reports forecasts for quarterly GNP and/or GDP growth, which allows the quarterly implied path of the output gap to be extracted. However the forecast horizon varies between four and nine quarters, depending on the date at which the forecast was made. As in Sweden, the terminal condition on the output gap is imposed only for the long-horizon (eight- or nine-quarter-ahead) "benchmark" forecasts, and the estimated gap is constructed as

$$x_{t+T} = 0$$
$$x_{t+k} = x_{t+k+1} - (g - \Delta y_{t+k}) \text{ for } k = T-1 \text{ to } 0.$$

The accumulated revisions in the quarterly GDP growth forecasts are used to update the gap estimates between "benchmarks." Forecast data for the first through fourth quarters are taken from the Green Books dated January or February, May, August, and October or November. Prior to January 1992, output growth is based on real GNP; after this, real GDP is used.

Commentary

Monika Piazzesi

DISCUSSION

Taylor rules, or modifications of Taylor rules such as those proposed by Clarida, Galí, and Gertler (1999), provide useful tools to describe the behavior of central banks. A large literature has estimated these rules and has investigated conditions under which it may be optimal for central banks to use them. The question asked in Kenneth Kuttner's paper is whether these rules are also useful in the context of inflation targeting.

To estimate these rules, the paper uses a new approach. The idea is to measure expected inflation, $E_t\pi_{t+k}$, and the output gap, $E_t x_{t+k}$, with data on the central bank's own projections (where k is the horizon of the projection).[1] Not all central banks publish their own projection numbers. Those who do publish them tend to be inflation-targeters. New Zealand and the United Kingdom started publishing them in 1997, while Sweden started doing it in 1994. The estimations in the paper suggest that projection data really help. While estimated policy rules based on actual inflation and the output gap perform poorly over the 1990s, estimated policy rules based on projection data do a lot better: insignificant coefficient estimates become significant, "wrong signs" turn around, coefficients on inflation get larger than 1, and residuals become less autocorrelated.

Some of the results are hard to interpret in terms of what they mean for the behavior of these central banks. For example, the coefficient on output is significantly different from zero for Sweden and the United Kingdom. With policy rules that are based on actual inflation or some imprecise measure of expected inflation, the coefficient on output may just be due to the fact that output forecasts future inflation. With policy rules based on central bank projections, this argument no longer applies; the projections already contain all relevant conditioning information for predicting inflation. Therefore, the output coefficients seem to suggest that these central banks are reacting to output. But what do we conclude from this?

I am excited about the idea of looking at central bank projections and expect that we will see many papers in the future that use these data to estimate policy rules or to look at other issues. In what follows, I will discuss two reasons to be excited that are not mentioned in the paper (section 2). The first reason is practical and has to do with the usual problems of measuring inflation and the output gap. The second reason is that projections may help us in modeling learning by central banks. I will also mention other issues that could be explored with the data (section 3). At the end of my discussion, I will bring up some disadvantages associated with central bank projections (section 4). These include potential incentives of central banks to manipulate their own projection numbers. So far, the main drawback is that the data sample is short. But the good thing about samples is that they are like trees—they grow.

ADVANTAGES OF PROJECTION DATA

Practical Issues

There are several practical issues associated with estimating forward-looking policy rules. It starts with simple measurement problems. What is the right measure of inflation? John Taylor has used the consumer price index and the gross national product deflator in his papers. At this conference, Andrew Levin, Fabio Natalucci, and Jeremy Piger have focused on core inflation, while Laurence Meyer has advocated the core personal consumption expenditure (PCE) deflator. What is the right measure of the output gap? At this conference, Lars

[1] Orphanides (2003) also takes this approach.

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Svensson has recommended the Kalman filter to compute the output trend as opposed to the Hodrick-Prescott filter. But even apart from these problems, it is not clear how we should be computing expected inflation, $E_t\pi_{t+k}$, and the output gap, $E_t x_{t+k}$. To compute these conditional expected values, we need to pick conditioning variables and, more generally, the dynamics of inflation, π, and the output gap, x.

Projection data offer an easy way out of all these practical issues. If a central bank publishes PCE projections, it must be because the board members closely follow the evolution of this particular price index. Similarly, the output-gap projections are based on some kind of trend calculation, and we do not need to find out how this was done exactly. The projections already condition on the relevant variables, and there is no model to chose. If a central bank publishes projections $E_t\pi_{t+k}$ and $E_t x_{t+k}$ for different horizons, k, the only question is what horizon k to pick to estimate the policy rule. But picking k seems easy compared with the host of other problems that we run into otherwise.

Learning by Central Banks

Tom Sargent and others have argued that learning by central banks is important to understand their behavior. In a model with learning, the current belief of the central bank is a state variable. If the data we observe are generated from such a model, we are bound to find parameter instability in policy rules that are written in terms of current inflation, π_t, and the output gap, x_t. Now projection data may just be the right measure of current beliefs. If this is right, we may be able to estimate policy rules that are stable functions of the projection data.

MORE THINGS TO DO WITH PROJECTION DATA

Model Behind the Projections

It would be interesting to know what a model of the economy that gives rise to these projections would look like. In particular, it would be interesting to see whether learning is an important feature of such a model. To set up such a model, answers to the following two questions would be useful. First, what are the empirical properties of the projection data? The paper plots the data in Figures 1 and 2. The paper also computes the variances of changes in the projections in Table 3. But it would be useful to know more about the data: Are these projections unbiased? Are the projection errors autocorrelated? Can they be forecasted with lagged macroeconomic variables? How do the projections compare with forecasts from estimated autoregressive processes? How do they compare with those from estimated vector autoregressions (VARs)?

Second, how do policy rules based on projection data and on VAR forecasts compare? Clarida, Galí, and Gertler (1999) compare their forward-looking policy rule with rules based on π_t and x_t. The paper here compares policy rules based on projection data with rules based on π_t and x_t. Now it would be interesting to know how the policy rules here compare with those estimated by Clarida, Galí, and Gertler.

Financial Data and Private Information

An alternative way to measure expectations is to use financial data. I have looked at this issue in the context of a model of the term structure of interest rates, in which the Federal Reserve targets the short rate (Piazzesi, forthcoming). According to the estimated policy rule from the model, the Fed reacts to information contained in the term structure, which is available right before the Federal Open Market Committee (FOMC) meeting. I document that the rule from the model performs better than Taylor-type rules, at least as a description of Fed behavior.

One reason to estimate policy rules based on yield data is that yields may be a good proxy for the conditioning information available to the central bank at the time of the policy decision. Financial data, however, only reflect public information. If private information of the central bank is important for these policy decisions, projection data may be preferable. To see whether private information matters, one could compare rules based on these two types of data.

Another interesting question would be to analyze the yield-curve implications of a model that is able to explain the projection data. If learning is part of the story, it would be exciting to see how it shows up in yields.

DISADVANTAGES

A disadvantage of projection data is that central banks have started to publish them only recently. The evidence presented in this paper is thus only based on a short sample from the 1990s. But the sample is growing, so that we will have more observations soon.

Moreover, projection numbers may not be the numbers that ultimately influence policy decisions. For example, the Fed's staff presents Green Book forecasts to the FOMC. But, of course, the FOMC has its own views about future economic developments, and its policy decisions are based on these views.

Finally, central banks may have incentives to distort their projection numbers. Such incentives may be particularly strong for inflation-targeting central banks, whose projection numbers are closely watched by the public. For these banks, inflation projections play similar roles to earnings projections by private firms. I do not know whether these incentive problems are severe, but it is certainly something to keep in mind when we interpret the results obtained with these data.

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Is Inflation Targeting Best-Practice Monetary Policy?

Jon Faust and Dale W. Henderson

1. INTRODUCTION

The core requirements of inflation targeting are an explicit long-run inflation goal and a strong commitment to transparency. The framework built around these requirements has much to recommend it. Inflation and output performance in economies using the inflation-targeting framework (ITF) has been good by historical standards, and both governments and central banks claim to be pleased with the framework. Advocates and practitioners of the ITF have been leaders in shaping and exploiting the new consensus that central bank transparency can make policy more effective. Not only are ITF central banks among the most transparent in the world, they have experimented aggressively with ways to make communication with the public more effective. In the process, they have pioneered the use of various tools, such as fan charts, that make conveying essential, but difficult, concepts practical.

Economic performance in some non-ITF economies, such as the United States, has also been good in recent years. However, several ITFers (Mishkin, 1999, and Bernanke et al., 1999) argue that this outcome has resulted in spite of the policymaking frameworks in those countries. Thus, they argue that the United States and others should "fix the roof while the sun is shining."

The recent hurricane in Washington has reminded many of us of the wisdom of this reasoning. It has also reminded us that even attractive new roofs—roofs that have weathered a few spring rains—might bear inspection. In that spirit, we examine whether the ITF constitutes best-practice monetary policy. We use the standard of some mythical best-practice policy to emphasize that we are not simply ranking the ITF relative to some set of ad hoc alternatives, such as the current practices at central banks around the world.

Of course, the ITF community is now large and varied. We focus mainly on the industrialized countries. One might say that we consider the role of the ITF in a low-inflation steady-state and do not address the important question of how it might help in reaching such a steady-state. In much of the paper we seek to highlight some generic issues. In doing so, we do not mean to suggest that there are not important differences among the practices of ITF central banks: Our points will apply in varying degrees to ITF and other central banks.[1]

Our main message can be summarized succinctly. Common wisdom and conventional models suggest that best-practice policy can be summarized in terms of two goals: First, get mean inflation right; second, get the variance of inflation right. The ITF is of great help in achieving the first goal; whether it helps in achieving the second is more problematic. The argument goes as follows. Everyone now agrees that mean inflation should be modest. The ITF may be seen as a constructive attempt to cement the current consensus on this point. Unfortunately, agreement regarding the mean inflation rate has few practical implications at any finite horizon. Many of the most contentious debates over the conduct of policy in the postwar era are not about the mean but about the variance of inflation. That is, under what conditions should the central bank *allow or promote* movements of inflation around the mean in order to promote other goals such as real and

[1] There are excellent taxonomies of the approaches used by different ITF central banks. See, e.g., Bernanke et al. (1999), Debelle (2003), and Truman (2003).

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financial stability? We argue that the ITF does not constitute best-practice in resolving this question. This claim is not new; it has also been made by both critics and supporters of the ITF, including Kohn (forthcoming), Benjamin Friedman (2003), and Svensson (1999).

Of course, the ITF emerged near the end of a period of high inflation in the industrialized economies, when the most important challenge for policy was getting the mean right.[2] As a period of generally low and stable inflation has emerged, more attention has been focused on the potential role of other goals in policy, and greater emphasis both in the academic literature and in ITF practice has been placed on the role of other goals. Our main critical point is not simply that there is more left to do. Rather, we argue that various features of the ITF—for example, the way the preeminence of the inflation goal is stated—obscure rather than facilitate the communication of best-practice policy.

Although we talk a great deal about the second goal of policy, getting the variance right, we emphasize that getting the mean right may be the goal of greatest importance. Arguably, the largest mistakes in the postwar era have been associated with failures to achieve this goal. Further, as a profession we are more certain about our advice regarding the mean of inflation and more confident that central banks can get it right. At a minimum, the best-practice policy framework should stress the goal that we are more clear about and that we are more confident central banks can achieve.

Finally, we raise many issues that are in principle subject to empirical investigation and, therefore, may one day be resolved. We focus on issues not currently amenable to clear empirical resolution. We do raise some questions for future empirical assessment.

In the next two sections we characterize the ITF in more detail and discuss some claims about the economy that underlie the approach. Our characterization, and our thinking more generally, rely heavily on such seminal work as Bernanke and Mishkin (1997) and Bernanke et al. (1999) and several contributions by Svensson including Svensson (1997a). The following three sections deal at a fairly abstract level with macroeconomic and political-economy aspects of the ITF. In the final two sections, we return to reality, discussing some complicating factors missing from the earlier analysis and then making some constructive suggestions.[3]

2. WHAT IS THE INFLATION-TARGETING FRAMEWORK?

2.1 Central Elements

One summary view of the ITF is provided by Bernanke et al. (1999, hereafter BLMP):

> Inflation targeting is a *framework* for monetary policy characterized by the public announcement of official *quantitative targets* (or ranges) for the inflation rate over one or more *horizons*, and by explicit acknowledgment that low and stable inflation is monetary policy's *primary long-term goal*. Among other important features of inflation targeting are *vigorous efforts to communicate* with the public about the plans and objectives of the monetary authorities, and, in many cases, mechanisms that strengthen the central bank's *accountability* for attaining those objectives. (p. 4, italics added)

We have italicized what we believe to be central elements. At the most general level, these elements can be summarized as follows: Set an explicit, long-run inflation goal, give that goal a certain preeminence, and communicate vigorously about the conduct of policy relative to that goal. What may not be clear from the passage above is that ITF advocates also recommend taking into account goals other than inflation—for example, real and financial stability—and call for thorough communication about these goals. All major ITF banks have such goals.

We will regularly refer to two *core* requirements of the ITF: (i) set a long-run inflation goal and (ii) strive vigorously for transparency regarding all goals and aspects of policy.

These requirements might be viewed as innocuous. A long-run inflation target need have few finite-horizon implications. As Keynes (1923, p. 80) famously put it in discussing earlier monetary reforms,

> But this long run is a misleading guide to current affairs. In the long run we are all dead.

[2] Truman (2003) emphasizes the important distinction between actual or potential inflation targeters that have essentially achieved their desired mean inflation rates and those that have not. He provides a thorough analysis of the experience with inflation targeting and argues that mutual understanding among the major central banks would be significantly increased if they all adopted inflation targeting.

[3] Gavin (2004) also makes useful suggestions for improving the ITF framework.

The remaining core requirement is transparency. While how best to achieve transparency is a difficult question, that transparency is important seems uncontroversial; rather, it seems to be the new orthodoxy.

Based on these core requirements alone, it would be difficult to understand why the ITF has generated such strong sentiment for and against.

Going beyond the core requirements, advocates portray the *full-blown* ITF as a framework of "constrained discretion" and claim that it has great advantages over "purely discretionary" policy as practiced, say, at the Federal Reserve. In this paper, we attempt to identify which requirements of the ITF, beyond the core, give rise to such claims and then discuss whether these features should unambiguously be included among the requirements for *best-practice*.

2.2 Rules Versus Discretion

One definitional question that arises immediately is whether the ITF is best viewed as a "rule" or the exercise of "discretion." Proponents such as BLMP and Svensson appear to differ on this matter, so it is important for us to make our view clear at the outset.

BLMP contend that the ITF is "not a rule in the classical sense" (p. 22); that is, it is not a forcing rule—a constraint on behavior that cannot be circumvented. They note that, "an inflation-targeting framework will not *directly* prevent counterproductive attempts of a central bank to apply short-run stimulus. In this respect, inflation targeting is inferior to an iron-clad rule" (p. 24).

In contrast, Svensson (1999) argues that the ITF is a rule. We think that there is no contradiction here: Svensson is simply using a different definition. He mentions the standard definition, but provides an alternative under which advice to the central bank about how to use its discretion is a rule.[4] For purposes of this discussion, the important point is that a Svensson-type rule does not represent even an approximation to a forcing rule. Any consequences of ignoring Svensson-type rules are contingent on the reaction of the public. Thus, in our view the ITF is a typical example of discretion in the classical sense, and we treat it as such in what follows.

[4] In simple models, there is a multitude of formally equivalent ways of recommending that the central bank optimize; an example is "satisfy your first-order conditions." Svensson (1999) examines several interesting exact and approximate ways to recommend optimization in the linear-quadratic framework.

2.3 What the "Discretion" View Implies for Analyzing the ITF

Much standard policy advice comes in the form of concrete suggestions about how to pursue the goals of policy. Such advice often is either codified in the form of a reaction function or can reasonably be so codified for the purposes of study. In these cases, one can take some set of interesting macro models and run horse races among the implied reaction functions. One can also solve for the optimal rule and measure the inefficiency of the proposed rules relative to the optimum. Based on the results from several models, one can make statements about robustness and so on.

Many critics of the ITF have adopted a rules interpretation, but BLMP argue that these exercises completely miss the point (p. 21).[5] BLMP argue along the lines we have been discussing: The ITF does not place any constraints on the central bank that force it to deviate from the social optimum. Thus, it is not sensible to compare ITF outcomes to the optimum—the ITF can attain the optimum.[6]

It may seem like cheating to propose a *framework* and then simply to stipulate that it delivers optimal policy in model-based horse races. What role does this leave for policy research? We can distinguish two strands of the policy literature, which might be called institutional design and day-to-day implementation. If a forcing rule for central bank behavior is feasible and optimal, these two collapse to one: Implement the forcing rule. If judgment must be exercised by the policymaker, these two interact but can be clearly distinguished. Research on institutional design seeks to define the optimal framework within which judgment will be exercised. Research on day-to-day implementation seeks to generate insights that will help policymakers exercise their judgment. The horse-race exercises may shed little direct light on the question of institutional design, but may be of great value in informing the ITF policymaking board regarding how best to use its discretion.

[5] Examples are Friedman and Kuttner (1996), Jensen (2002), and Kim and Henderson (2002).

[6] This statement is correct, so long as the social optimum is consistent with hitting a long-run inflation objective, as it is in virtually all horse-race models. There are many possible optima given by various discretion and commitment solutions. Exactly which one is reached depends on considerations (communication policy, etc.) that are generally left out of horse-race models. As we will explain, it is these considerations that are supposed to ensure that the ITF yields the *right* optimum.

3. CONVENTIONAL MACROECONOMICS AND THE ITF

The reasoning supporting the ITF rests on several features of common ground in the macroeconomics profession and the policy community. Ultimately, some confusion about the ITF seems to arise because there are ITFers on both sides of a familiar dispute. In this section, we survey both the common ground and the disputed ground.

3.1 Macro Common Ground

3.1.1 Best-Practice Monetary Policy Would Deliver Low, Stable Inflation. Inflation should be stationary, perhaps with infrequent, small mean shifts. Its mean should be low, certainly above zero and below 5 percent. Its variability should be sufficiently small that annual inflation is within 1 or 2 percentage points of the mean most of the time. Many technical issues may arise in giving this claim greater precision, but some version of it is now nearly universally accepted. This claim rests on three more basic claims.

First, there is no long-run Phillips-curve trade-off of the traditional variety. Failure to recognize this "fact" was surely behind some mistakes of the past, and Friedman (1968) and Phelps (1968) deserve great credit for pointing this out.[7]

Second, marginal positive expected inflation above some low rate is welfare-reducing. The profession can now list a multitude of channels through which expected inflation can affect welfare by reducing growth or in other ways. Widespread acceptance of the second claim rests neither on an appeal to a particular channel nor on incontrovertible econometric estimates of the costs of inflation. Nonetheless, in this paper we take for granted the common position that, above fairly low levels, raising mean inflation is bad.

Third, marginal decreases in expected inflation below some low, positive level are welfare-reducing. The recent experience of Japan and the return of low inflation in many countries has led economists to explore a number of channels through which deflation could be harmful. We will not focus much on deflation, but it is important to emphasize that inflation costs are two-sided.

3.1.2 There Is a Conventional Short-Run Phillips Curve Trade-off. There may be many short-run trade-offs, but for concreteness we focus on the one that is most familiar to and relevant for many economists: the short-run Phillips-curve relation. We will take it as given that real activity is not always at the most efficient level and define the output gap as actual output minus efficient output. Policy actions that increase the gap are associated with a rise in inflation relative to steady-state inflation. As the next point makes clear, we do not mean to imply that best-practice policy can successfully exploit this trade-off.

3.1.3 The Economy Is Complicated. Economic complications may include policy lags, changing relationships, the potential for self-fulfilling equilibria, and other nonlinearities. Finally, describing the state of the economy may require a high-dimensional state variable.

For a brief period, some leading members of the profession believed we were reaching the point where our understanding of economic dynamics allowed considerable range for beneficial intervention in business cycle dynamics. Friedman argued against this view, claiming that policy acted with long, variable, and unpredictable lags.[8] Building on Friedman, Lucas famously added the Lucas critique to the list of complications.[9] The general view that the economy is very complex is now widely accepted by academics and policymakers, for example, Greenspan (2003).

3.1.4 Due to Political-Economy Problems, Institutional Design Matters. There are various time-consistency, game theoretic, and institutional problems that might cause the government to set policy away from the social optimum.[10] We lump all these under the title of *political-economy problems*. The profession still disagrees about the importance of, for example, time-consistency problems over the postwar era. But even those who feel that time consistency was not a big issue probably agree that institutional design is important. Some version of the claim that governments may have an incentive

[7] This first claim is sometimes stated as the claim that expected inflation does not affect real variables in the long run. When stated this way, the myriad ways that expected inflation leads to welfare losses are presented as exceptions. Recently, considerable attention has been focused on the possibility that expected inflation might affect output because wages and prices are set in staggered contracts that are not fully indexed. See, for example, Wolman (2001).

[8] See Friedman (1948, 1959).

[9] See Lucas (1976).

[10] Kydland and Prescott (1977) and Barro and Gordon (1983) initiated a large literature on time consistency. There are many good treatments of the political-economy issues, e.g., Alesina and Rosenthal (1995) and Persson and Tabellini (2002).

to exploit inflation surprises has been a common belief since the first time a government debased its currency.

3.2 Long-Disputed Ground

Whether monetary policy can beneficially exploit the short-run trade-off between inflation and the output gap is a long-standing dispute that is still at the center of monetary policy discussions.

3.2.1 No Exploitable Trade-offs. Friedman, and later Lucas, forcefully argue that given the inherent complexity of the economy and our regrettably limited knowledge of it, the ambitions of monetary policy should be limited to achieving nominal stability. Their arguments are based on the view that monetary policy has strong short-run real effects but that there is no way monetary policy can beneficially exploit them. They both suggest that a cautious response in the form of a *k*-percent rule for money growth is the best way to achieve nominal stability.

Some ITFers hold the no exploitable trade-offs view (NET) and might well be called neo-Friedmanites. The NETers follow Friedman and Lucas in asserting that any trade-offs that exist cannot be successfully exploited, so that best-practice can only hope to achieve nominal stability. However, they argue that inflation stabilization is the best way to achieve nominal stability.[11] They are at least as pessimistic as Lucas and Friedman about complications in the economy. Nevertheless, they argue that achieving inflation stability requires judgment and looking at a wide range of information variables (a "look at everything" strategy) and may require frequent changes in the instruments of policy.

Orphanides (2003b) provides support for the NET view and discusses its roots in Friedman. Ernst Welteke (2003), president of the Bundesbank and member of the governing council of the European Central Bank, has also clearly stated the NET view. Mishkin (2002) and BLMP both state the case for the NET view clearly, but, as we will explain, they belong in another camp.

What we will call the *singular economy* view is an alternative route to the NET position. In this view the economy is stochastically singular in a helpful way: Stabilizing inflation automatically achieves any other goals of policy. For example, Rotemberg and Woodford (1997), King and Wolman (1999), and Goodfriend and King (2001) produce simple models that exhibit a happy coincidence of the goals of stabilizing inflation and the output gap.[12]

Thus, either a vexing complexity or a fortuitous simplicity of the economy can get one to the view that there are no exploitable trade-offs.

3.2.2 Limited Exploitable Trade-offs. Fine-tuning the real and nominal economy is overly ambitious. In the limited exploitable trade-offs view (LET), there is some beneficially exploitable short-run trade-off between real activity and inflation, and best-practice policy exploits it. LETers, like NETers, contend that best-practice cannot be implemented using a rigid rule or by following a formal model. Studying optimal policy in formal models serves mainly to inform our collective wisdom, and this wisdom should be applied deftly in practice.

Many, if not most, advocates of the ITF are LETers. For example, Svensson and Woodford belong in the LET camp: In numerous papers, such as Svensson (1997a) and Svensson and Woodford (forthcoming), they describe the ITF as involving optimal exploitation of the short-run trade off. BLMP also belong in this camp. Despite the claim of President Welteke of the Bundesbank cited above, we suspect that most central banks are in the LET camp, but this empirical claim need not detain us.

3.2.3 Comments. In both views, no rigid rule is appropriate, and policy must be based on a review of a wide variety of information. Neither camp takes an a priori stance on whether best-practice policy is "activist" in the sense of requiring frequent adjustment of instruments. Only in the LET camp is policy "activist" in the sense of attempting to manage the business cycle.

Because NETers argue that policy should only aim for inflation stability, they are open to the criticism that they are *inflation nutters*—which we take to mean that inflation is the only thing in the loss function. This criticism is misplaced: NETers are not nutters. The NETer argues from standard preferences that achieving nominal stability is the best we can hope for.

[11] One might also imagine a neo-Friedmanite view centered on other notions of nominal stability, such as nominal income stability. Given the topic of the paper, we do not develop this idea.

[12] In these models, only the price of the single composite good is affected by staggered contracts. There are at least two standard modifications that imply trade-offs. The first is adding a cost shock to the price-setting equation for the single good as in, for example, Kiley (1998), McCallum and Nelson (1999), and Clarida, Galí, and Gertler (1999). This modification is incorporated into the simple model we will present here. The second modification is to assume that the wage of composite labor (or the price of a second composite good) is affected by staggered contracts, as in, for example, Erceg, Henderson, and Levin (2000).

While the NET and LET views are distinct, in practice it is sometimes difficult to tell which view various parties take. Several problems emerge. First, some LETers believe that the degree of exploitability is quite low; thus, the views need not be that far apart.

Second, virtually everyone agrees that demand shocks push us toward the *singular economy* perspective. That is, in many standard models, demand shocks temporarily increase the output gap and raise inflation. Thus, smoothing inflation and the gap suggest roughly the same response. While limiting attention to demand shocks does not lead to exact singularity in most models, it certainly reduces the importance of the difference between the NET and LET views.

Supply shocks provide an interesting litmus test for deciding whether one is in the NET or LET camp. Consider a sharp increase in commodity prices. In many standard models, this shock tends to push inflation up and push output below the efficient level.[13] Even if one leaves commodity prices out of the inflation measure, there will be indirect upward pressure on inflation. BLMP conclude that "a supply shock that is great enough or that arises from some unanticipated source may justify missing or changing a previously announced inflation target" (p. 35). In our view, this conclusion puts BLMP squarely in the LET camp. Mishkin (2002) makes similar arguments.

One might hope that empirical evidence would resolve this debate. The problem is that the distinction regards trade-offs along the efficient policy frontier. Informally, the LET view suggests that at the optimum the only way to reduce inflation variance is to raise gap variance. The NET view is that, in the face of our profound ignorance, our best guess is that any deviation from the policy of smoothing inflation will increase both inflation and output variance. That is, policy injects variance into the economy with no expected benefit. Both sides agree that many of the significant policy changes we find in the data are movements toward the efficient frontier. Such moves may result in improvements in all aspects of performance.

In the remainder of the paper, we consider economies that have all the features of macro common ground and that are consistent with the LET view. Thus, much of our analysis will be of limited relevance for NETers.

[13] Included are models with explicit microeconomic foundations, such as the one used by Aoki (2001).

4. DOES THE COMMUNICATION POLICY OF THE ITF MAXIMIZE PUBLIC UNDERSTANDING?

In this section, we begin our assessment of the ITF with the simplest case. We set aside political-economy problems and maintain the view that nothing in the ITF constrains the central bank from implementing the social optimum. Thus, there is no question of whether the ITF delivers good policy. That issue aside, the only remaining question is whether the communication policy of the ITF constitutes a good implementation of transparency. Our core requirements of the ITF give no details about how transparency is to be achieved, so this section also begins our filling in of the details of the ITF. We begin by presenting some arguments in favor of transparency, or as we put it, maximizing public understanding.

4.1 Why Maximize Public Understanding?

In the recent past, few central banks would have placed heavy emphasis on maximizing public understanding. Moreover, there is no general presumption that increasing common knowledge in society improves welfare. The transparency literature is rife with examples where this is not the case, for example, Faust and Svensson (2001). Indeed, much of the transparency literature can be viewed as a study of when it is and is not optimal for the central bank to surprise the public deliberately. This conventional transparency literature does not address three arguments in favor of clear communication that are stressed by ITF advocates and many other commentators.

First, as Greenspan (2002, p. 6) states, "Openness is an obligation of a central bank in a free and democratic society." A great many conservative and liberal economists have supported this view. Deliberately surprising the public, even for its own good, is not the proper role of a central bank, in this view.

The second reason for clarity is that, as Lucas makes clear, what constitutes optimal policy is inextricably linked with public expectations about policy. The effects of a given policy action are not even defined without a treatment of policy expectations. More recently, discussions of the liquidity trap have reminded us of this point. The liquidity trap case drives the point home because, under certain assumptions, expanding the monetary base

in a liquidity trap has no direct effects on the economy.[14] Any effects result from changes in expectations.

Lucas argues that, even away from the liquidity trap, both the agent's problem and the central bank's problem in practice are intractable unless the public understands what the central bank is doing. An assumption about public understanding of the future course of policy is a precondition for coherent analysis of current policy.[15]

Accepting the role of expectations in the economy does not imply that central bank communication is important. Instead, Friedman and Lucas both argued for very simple policies that would largely obviate the need for communication. It is when we accept the view that best-practice cannot at this time be codified in a simply communicable way that continuing central bank explanation of actions becomes essential.

The third argument in favor of clear communication is that it may alter incentives in a beneficial way. Many variations of this idea have been studied in the political-economy literature. We argue that ITF advocates have a new channel in mind. This section focuses mainly on more direct benefits of clear communication; incentive effects are dealt with in section 6.

It is useful to note that none of these three reasons for clear communication has received much emphasis in the transparency literature. These may be the most important reasons for transparency in practice, however.

4.2 Our Approach and Model

Analyzing communication policy is complicated by the interaction between how policy is conducted and how it is communicated. If communication policy actually matters, then there is an interaction between what one should do and what one should say. Here we cut this knot by constructing an example in which we can unambiguously determine what one should do. In particular, we examine a simple model solved under the standard rational-expectations assumption that all agents fully understand the model and policy. We give the central bank the commitment technology to solve any political-economy problems. In this case, the socially optimal policy is unambiguous.

We then assess whether the ITF communication policy provides the most effective way to describe the conduct of policy. If we added an uninformed agent to the economy, would the ITF communication policy be the best approach to bringing that agent up to speed?

The model we employ has many standard features, and models like it have been used by supporters of the ITF, for example, Svensson (1997a). While it is exceedingly simple, it embodies the common ground described above. In our view, adding the complexity of reality would only tend to magnify the importance of the points we emphasize.

The model starts with the policymaker's loss function, which is the standard expected discounted sum of period losses conditional on available information:

$$\mathfrak{L}_t = \frac{1}{2}\mathcal{E}_t\left(\sum_{j=0}^{\infty}\beta^j \ell_{t+j}\right),$$
$$\ell_{t+j} = \left(\pi_{t+j} - \pi^*\right)^2 + \lambda\left(y_{t+j} - y^P - \kappa\right)^2, \tag{1}$$

where $\mathcal{E}_t$ is the operator giving expectations conditional on time t information, ℓ_{t+j} is the period loss at time $t+j$, and $0 < \beta < 1$ is the policymaker's discount factor. The symbols y_{t+j} and π_{t+j} represent the logarithms of output and gross inflation, respectively; π^* is the bliss value for inflation; y^P is flexible-price output, which we refer to as potential output; and $y^* = y^P + \kappa$ is the bliss level of output. We set $\kappa \neq 0$ as in the time-consistency literature to allow for the fact that the central bank may aim for output above potential due to political pressure or for some reason associated with economic distortions. The output gap is defined as actual output minus potential $(y_{t+j} - y^P)$.

The policymaker minimizes the loss function subject to the Phillips curve,[16]

$$\pi_{t+j} - \bar{\pi} = \phi\left(\pi_{t+j-1} - \bar{\pi}\right) + (1-\phi)\beta\left(\pi_{t+j+1|t} - \bar{\pi}\right) + \alpha\left(y_{t+j} - y^P\right) + \varepsilon_{t+j}, \tag{2}$$

where $\bar{\pi}$ is the unconditional mean of inflation. Deviations of inflation from its unconditional mean at time $t+j$ depend positively on both past and

[14] For one discussion of the liquidity trap situation and references to many more, see Clouse et al. (2003).

[15] A recent confirmation that central bank talk matters is provided by Kohn and Sack (2003).

[16] Using Phillips curves that include both lagged and expected future inflation is common practice; the exact specification in equation (2) is used in Clarida, Galí, and Gertler (1999). One way of arriving at this Phillips curve (2) is to assume that inflation rates are set in Calvo-type contracts and that the inflation rates of agents who do not get to reset prices in the current period are indexed to the unconditional mean of inflation.

expected future deviations, the output gap, and an i.i.d. normal cost shock, ε_t. The symbol $x_{t+j|t}$ represents the expected value of x at time $t+j$ conditional on information available at time t.

The Phillips curve, (2), reflects two features of the common ground. First, there is no trade-off between mean inflation and any other mean or variance.[17] This feature implies that the mean inflation rate can be set independent of other considerations in the model. In a more realistic model, there might be a link between, say, the mean and variance of inflation, but so long as the relation is generally positive this does not change the argument that low inflation can be chosen without regard to other goals.[18]

Second, there is a short-run trade-off between inflation and the output gap, and as we shall see, this trade-off is exploitable. The trade-off could be made fuzzier in various ways, but doing so would not alter the implications we emphasize.

4.3 Optimal Policy in a Backward-Looking Version

We use two special cases of the model to illustrate different features of interest.[19] Here, we consider a backward-looking version of the model in which there is no wedge between potential and desired output ($\kappa = 0$) and current inflation depends on lagged inflation but not on expected future inflation ($\phi = 1$). Under these assumptions, the model generates no inflation bias and, under optimal commitment policy, both the output gap and inflation follow autoregressive processes[20]:

$$\pi_{t+j} - \pi^* = \Lambda\left(\pi_{t+j-1} - \pi^*\right) + \Lambda\varepsilon_{t+j},\ 0 < \Lambda < 1 \tag{3}$$

$$y_{t+j} - y^P = \frac{\Lambda - 1}{\alpha}\left(\pi_{t+j-1} - \pi^*\right) - \frac{\Lambda - 1}{\alpha}\varepsilon_{t+j}, \tag{4}$$

where the parameter Λ is defined in the appendix.

These processes have the following implications that we will use in our discussion:

1. Both inflation and the output gap are covariance-stationary, Gaussian time-series processes.
2. The unconditional expectation of inflation is the target value, $\mathcal{E}\pi_{t+j} = \pi^*$.
3. Conditional inflation expectations are described by $\pi_{t+j|t} = \pi^* + \Lambda^j(\pi_t - \pi^*)$.
4. There is an optimal balancing of output gap and inflation variance.

Implications like these are very general given the features of the common ground and the LET view.

4.4 Strengths of the ITF Communication Framework: Transparency and Anchoring

Under the assumption that the central bank implements the socially optimal policy as we have derived it, we can now ask whether several usual features of the ITF represent an effective way to communicate best-practice. As stated in the introduction, the first goal of best-practice is to get mean inflation right. In the model, we have that

$$\lim_{j\to\infty} \pi_{t+j|t} = \pi^*, \tag{5}$$

so it is clearly appropriate to announce a long-run inflation target. Explanation of the behavior of inflation relative to the target is the centerpiece of ITF communication policy. A primary objective of the ITF is to anchor long-run inflation expectations, and the policy leaves little room for misunderstanding this objective. Thus, the ITF communication policy is arguably extremely successful in communicating about the first goal of monetary policy.

4.5 Room for Improvement: The Balance of Multiple Goals

In this section, we argue that the primary shortcoming of the ITF communication policy is that it does not explain clearly the roles and balance of multiple goals. Indeed, we argue that the ITF as implemented often involves elements that are literally inconsistent with best-practice policy and, in any case, obfuscates some basic issues.

To begin discussion, we list some usual features of the framework that we find problematic. It is often a feature of the ITF, as advocated and practiced, that one or more fixed horizons are associated with the inflation target. This practice is literally inconsistent with optimization. For example, the results above imply that

[17] This property can be confirmed by taking the unconditional expectation of the Phillips curve.

[18] Of course, there could be conflict among various low rates, as the bliss points for the mean and variance need not coincide.

[19] Analyzing the general model might be nicer in some respects, but would be unduly complicated given our very limited ambitions. Both Clarida, Galí, and Gertler (1999) and Svensson (2003) consider backward- and forward-looking versions separately.

[20] All derivations are in the appendix.

(6) $$\pi_{t+j|t} \neq \pi^* \qquad j \geq 0$$

with probability 1, and that with certainty we will face times, t, at which,

(7) $$|\pi_{t+j|t} - \pi^*| > \varepsilon > 0 \qquad j \geq 0$$

for any ε. That is, under best-practice, there will be times when the expectation of inflation at any horizon remains far from any target or target range.

Choosing a fixed horizon at which the inflation forecast must be consistent with the target in some sense can be thought of as an approximation to optimization. In particular, under full optimization we can pick a horizon h, a small probability ε, and a margin of error θ such that

(8) $$\text{pr}(|\pi_{t+h|t} - \pi^*| < \theta) = \text{pr}(\pi_{t+h|t} \in \pi^* \pm \theta) = 1 - \varepsilon.$$

That is, at the horizon h, the forecast of inflation is in a small neighborhood of π^* most of the time. Thus, choosing a fixed horizon for meeting the inflation target seems like a sensible approximation. We take up the costs and benefits of approximation in the next section. For now, we note that choosing a fixed horizon is not an accurate description of fully optimal policy.

Some central banks state target ranges for inflation. It is not clear how to interpret these ranges. Does a central bank aim to be inside its announced range all the time? Under best-practice, should it?

In our example, there is an interpretation of the term "target range" that is consistent with best-practice. As is clear from equation (8), the central bank can view the target range as a confidence interval and relate the width of the range to the probability that inflation (or its forecast at the relevant horizon) will be in the range.[21] Under this interpretation, a target range is purely descriptive in that it states that inflation will be within the range $\pi^* \pm \theta$ most of the time. This interpretation of the target range is subtle, and we suspect not the predominant one.

There is a contrasting interpretation that is not consistent with best-practice. Under this interpretation, the central bank wants inflation to be inside the range at all times, but control errors might cause it to wander out at times. This interpretation is not consistent with best-practice in the example. There is no control error in our example—if there were, the θ associated with a given ε would be larger. Under best-practice, the central bank deliberately sets inflation outside any given interval at times. When evaluating policy, no incident of inflation crossing the boundary is evidence of central bank misbehavior; only excessive frequency of being outside the interval constitutes such evidence.

A key test as to whether the range is properly understood as a confidence interval is that under best-practice excessive frequency of being inside the range is also evidence of misbehavior. It should seem equally natural to punish the central bank for being inside the range too often as for being outside the range. In the LET view, no matter how limited one thinks the limited exploitability is, it remains the case that excessive smoothness and excessive volatility of inflation are equally costly at the margin in equilibrium. As BLMP document, some of the problems with target ranges we are pointing to have been observed in practice.

Next we note that the long-run inflation goal is often said to be preeminent in some sense in the ITF framework.[22] While the intention here may seem clear enough, we do not understand what it means formally.

Given the common ground we are accepting, it is true that there is no trade-off between setting the mean of inflation at π^* and any other goal of policy. There is no long-run trade-off; the mean of inflation has no implications for other choices. Thus, the same policy is obtained if inflation is the preeminent long-run goal or if setting the gap equal to zero is the preeminent long-run goal.

Most crucially, we can arbitrarily rank the preeminence of long-run goals only if we are talking strictly about the mean of inflation. Generally, the preeminence statement is linked in some way to *price stability*. To the extent that *stability* is interpreted in a natural way as having something to do with the variability of prices and inflation, any statement of preeminence is the antithesis of the key feature of optimal policy—the notion that optimization implies an optimal marginal rate of exchange between stability of prices and stability of the gap.

[21] The central bank can choose a probability, ε, and derive the width of the range, θ, or pick a width and derive the probability.

[22] For example, the Reserve Bank of New Zealand's 2002 Policy Targets Agreement states that "[i]n pursuing its price stability objective, the Bank shall seek to avoid unnecessary instability in output, interest rates and the exchange rate." The Bank of England Act charges the bank "(a) to maintain price stability, and (b) subject to that, to support the economic policy of Her Majesty's Government, including its objectives for growth and employment." There is similar language for the Swedish National Bank, as confirmed by Heikensten and Vredin (2002).

Here is the essence of our argument so far. Monetary policy in the LET view involves conflicting goals. The mean inflation goal may reside outside this conflict, but any discussion of stability of prices or inflation must inevitably raise issues of other goals. We argue that several aspects of the ITF as practiced do not provide a natural and straightforward framework for communicating this fact. We now consider various ways other goals are accommodated.

One approach to balancing multiple goals is to state a target range for inflation that is assumed to give the central bank wiggle room to consider other goals. In practice, things have arguably worked this way. We return to the primary question of this section: Is *wiggle room* the most effective way to communicate optimization with multiple conflicting goals? In our view, this way of communicating can clearly work, but is not the height of pedagogy.[23]

Escape clauses are another alternative. Every framework will surely need the equivalent of escape clauses. There will be events sufficiently peculiar from the standpoint of what was foreseeable at the time the framework was conceived that briefly abandoning the framework will be necessary. Still, taking account of the role of other goals through escape clauses is surely not fully transparent.

Finally, Svensson (1997a) has argued that in a quadratic optimization framework like the one in our simple example, we can view optimal policy as targeting the forecast of inflation, with consideration of the gap incorporated by allowing it to affect the horizon at which one wants the forecast to hit the target. Mishkin (2002) argues for this approach and some ITF banks use this sort of rhetoric. This approach is consistent with optimization. Formally, it will be true under optimal policy that at each point in time, t, there is a shortest horizon, h, such that

$$|\pi_{t+h|t} - \pi^*| < \theta \tag{9}$$

for a given θ. Thus, in each period an h could be announced.

If we were teaching this optimization process to an undergraduate or to the marginal agent added to the model, is this the most natural way? We have a linear-quadratic optimization with two conflicting goals and one instrument. The two goals of optimization are to get the mean right and to balance variability of inflation against variability of the gap. It seems strained, at best, to describe the optimization process in terms of a target for one variable and adjusting the horizon to take account of the other. This description fundamentally obfuscates the trade-off in question.

In this section, we have tried to make a simple point that many people find obvious. The ITF communication policy is tilted heavily toward emphasis on stabilizing inflation. Several usual features give inflation a role that is literally inconsistent with optimization in the LET perspective. Thus, in our view the communication policy of the ITF is not the best-practice way of maximizing public understanding.

5. SIMPLIFICATION AND APPROXIMATION

We have followed major advocates in interpreting the ITF as allowing the central bank to follow the socially optimal policy. Using this interpretation in a conventional LET-view model, we find that a dissonance arises between policy and the standard communication approach followed by the ITF. Perhaps we are being too literal: It may be that policy, or the communication of policy, is deliberately intended to be some sort of approximation of optimal behavior. These simplifications may be optimal in some broader perspective: Perhaps there is some unmodeled *simplicity* constraint on either communication or policy itself that we have not captured. At some level, there surely are such constraints, so this possibility deserves serious treatment.

5.1 Simplicity-Constrained Policy

Perhaps policy behavior is subject to a simplicity constraint that causes policymakers to follow rule-of-thumb-like policy. From where would such a constraint arise? The standard justification is that it arises from some need for ease of monitoring. Thus, a bank with a severe credibility problem might find that the credibility benefits of a rule that is trivial to monitor outweigh the costs. Fixed exchange rates are often justified in this way both in theory and practice (Atkeson and Kehoe, 2002).[24] The arguments

[23] Faust and Svensson (2001) present an example in which inflation fluctuates narrowly around the optimum value, but due to lack of transparency about the nature of other goals the economy is significantly more volatile than under full transparency.

[24] We are dealing here with the case in which the simplicity constraint binds in the sense that the central bank deviates from the policy that is best on standard macro-stabilization grounds. Thus, we are distinguishing this case from the one in which simple rules are best, even from a pure stabilization standpoint. For example, Friedman argued that a k percent rule is optimal due to our profound ignorance. Others have argued that simple rules may be optimal, or nearly so, from the standpoint of robustness (Levin and Williams, 2003).

for a simplicity constraint in extreme cases are familiar.

Regarding the advanced economies that are the focus here, we make two points. First, if the ITF requires deviating from the optimal policy on economic grounds, then proper evaluation of the ITF requires a clear statement of the deviations required. In this case, we need to go back to the macromodel horse races to evaluate the costs of the deviations and attempt to weigh these costs against the benefits of simplicity. Second, as we argue next, even when banks assert that policy is constrained in this way, it often turns out that only communication is actually constrained.

5.2 Optimal Policy/Simplicity-Constrained Communication

We have generally treated the problematic elements of the ITF as constraining communication, not policy behavior. In practice, public communication requires some simplification, and as economists, we naturally think of simplification in terms of an approximation that is adequate so long as variables stay near some mean or steady-state values. The problems with ITF communication listed above will probably be minor so long as inflation and the gap stay near the steady-state values.

We believe that use of a communication policy simplified in this way is dangerous. As we get further from the steady state, the appropriateness of the simplified framework diminishes. Of course, since these conditions are observed infrequently, uncertainty on the part of the public about the central bank's policy is greatest at these times. Further, the conflict in society over the proper short-run policy becomes more intense as we move away from the steady state.[25] Thus, the simplified communication works best when it is least needed and tends to break down when it is most needed.

If any ITF banks are following this course, they are on a well-trodden path. Central banks have regularly adopted rule-of-thumb communication devices that function well during *normal* times and then scrambled to wean the public from these rules (or adjust and qualify the rules) when times became more challenging.

Intermediate money targeting illustrates this claim. It provided a framework for the conduct and communication of policy. Although it was not necessarily presented this way at the outset, intermediate targeting was a simplifying approach that was viewed as ex ante suboptimal on stabilization grounds.[26] Under such a system, there inevitably comes a time when the best judgments about how to run policy conflict with the direction dictated by the intermediate target.

The central bank must then choose between running policy it believes to be suboptimal or running policy inconsistent with the framework it typically uses in communication. In practice, banks generally chose the latter option. Thus, the Fed regularly redefined the target, redefined the target variable, and simply ignored the deviation of the target variable from target. Similarly, some have argued that the Bundesbank was an implicit inflation targeter and ignored the intermediate money target when it appeared inconsistent with inflation objectives.[27] We are not at all critical of this solution: These banks probably made the right choice in deviating from the communication policy rather than from best policy.

This case illustrates that adopting simplified communication approaches need not actually simplify anything.[28] Such communication works fine in easy times. In challenging times, a dissonance arises between the simple communication framework and the course of policy, generating a certain degree of turmoil and confusion.

5.3 Must the Public Have a Simple Yardstick?

One virtue of the problematic ITF features that we discuss is that they give the public a simple yardstick by which to judge policy. Given lexicographic preferences over inflation and other goals, an inflation target range, and a fixed horizon, inflation targeting becomes very easy to monitor. One simply checks whether the inflation forecast is at the target at the specified horizon.

[25] For example, for the quadratic loss function used in the model, $\partial(\pi_t - \pi^*)^2/\partial\pi_t$ and $\partial(y_t - y^P)^2/\partial\pi_t$ both rise as π_t and y_t move from the steady state.

[26] Intermediate targeting is inherently suboptimal so long as the word intermediate is not superfluous. Svensson (1999) has derived the conditions under which an intermediate target is "ideal," and this, by definition, is when there is no (observable implication of the) distinction between the intermediate and ultimate goal. When intermediate money targeting was adopted, no one claimed that money was "ideal."

[27] See, for example, Svensson (1999) and Romer and Romer (2000).

[28] The Fed's recent experience with the bias in the directive arguably provides another example.

The virtue of this yardstick is ease of use; the problem is that it is the wrong yardstick. From Heikensten and Vredin (2002), it seems that the Swedish National Bank (hereafter Riksbank) may have come closest to explicitly advocating that the public think of policy using such a simple rule of thumb. Recently policy pursued by the bank has deviated from this rule of thumb, perhaps illustrating to some extent the sort of communication problem we raise.[29]

Despite such examples, it is explicit or implicit in many discussions that ease of monitoring demands that the public be given a yardstick for measuring policy that is relatively straightforward to use. We believe that Fed policy over the past 15 years provides a counterexample. Arguably, one of the most notable aspects of Federal Reserve policy in the Greenspan era has been the fact that the Fed has resisted the temptation to characterize policy in terms of some simplified, and thereby inherently suboptimal, framework. The Fed has demonstrated that one can run policy with at least reasonable success without placing constraints on policy or communication that are thought ex ante to be suboptimal on economic grounds.

The Fed's approach in this period is at times viewed with alarm and/or suspicion. Svensson (2003) argues that failure to adopt the ITF is a smokescreen that allows the FOMC freedom to secretly change its goals. Others argue that a concrete goal is essential for accountability.

These arguments may be correct, but they have been selectively applied. The second major goal of policy in the LET view is stabilizing the gap. It has become conventional wisdom that the gap is sufficiently difficult to measure and that communicating a concrete goal for any particular measure of the gap would be problematic. This view is taken as adequate justification for not reporting a concrete goal for a gap measure. Let us set aside for a moment the factual question of whether difficulties in measuring the gap are different in kind or only in degree from those in measuring inflation.

Even acknowledging measurement problems, one must surely echo Svensson in asking whether these problems might be used as a smokescreen, allowing a central bank to shift its preferences about output stabilization.[30] Further, one must ask how the central bank could possibly attain credibility and accountability on the gap goals without a concrete gap goal. These issues are no less pressing in the case of real stability than in the case of inflation stability.

In practice, we suspect that ITF advocates are comfortable with the view that credibility and accountability regarding real stability responsibilities can be attained through vigorous central bank communication. By the same token, we argue that it is, at the very least, an open question whether accountability and credibility regarding inflation necessitate adopting a simple yardstick that is suboptimal in the sense we have been describing.

6. POLITICAL-ECONOMY PROBLEMS AND THE ITF COMMUNICATION POLICY

ITF advocates contend that central bank communication can solve political-economy problems. In our view, this is the least well-analyzed claim of ITF advocates. In this section we describe the communication channel emphasized by ITFers and show how existing tools can be employed to analyze it. We ultimately conclude that use of this channel can play a role in getting the mean of inflation right, but seems as likely to complicate as to facilitate achieving the appropriate balance between inflation and output stability.

6.1 The Communication Channel

The basic idea behind the ITF communication channel is that people dislike exposure of their intentional trickery, honest mistakes, or incompetence. If this is so, then public promises carry their own enforcement mechanism based on policymaker aversion to criticism. The ITF is designed to make better use of this channel by requiring public statement of goals and then public reports about progress on the goals. As BLMP (p. 25) argue,

> To the extent that the central bank governors dislike admitting publicly that they may miss their long-run inflation targets (or, alternatively, to the extent that they dislike having their inflation projections criticized as biased or manipulated), the existence of an inflation-targeting framework provides an incentive for the central bank to limit its short-run opportunism.

[29] For a discussion of the Riksbank's policy during this period, see Sveriges Riksbank (2003).

[30] Faust and Svensson (2001) show that even modest variations in this regard can be costly.

Svensson (1999, p. 663) is more emphatic:

> I believe it fair to say that never before in monetary history has an incentive system been set up with such strong incentives for optimal monetary policy decisions.

In more formal terms, the communication channel invokes terms in the central banker loss function—associated with, say, honesty and aversion to criticism—that have often been ignored.[31]

The ITFers' argument here seems consonant with two alternative views about political-economy problems. Blinder (1998) and McCallum (1997) argue that the time-consistency literature simply misses the point. According to McCallum, knowing about the commitment policy, central bankers would "just do it." The ITF communication policy might be seen as an attempt to increase the probability of this outcome. Friedman has a different take on central bankers' loss functions:

> From revealed preference [as revealed in central bank communication], I suspect that by far and away the two most important variables in their [Federal Reserve policymakers'] loss function are avoiding accountability on the one hand and achieving public prestige on the other. (quoted in Fischer, 1990, footnote 52)

Whether or not one subscribes to such an uncomplimentary view, why not design a framework to constructively exploit motives such as a desire for prestige?

We readily accept the ITF premise that the threat of public criticism affects the incentives of the central bank and thereby the course of policy. We take the view (perhaps following Blinder and McCallum) that, in normal times and with first-rate policymakers, this channel may not be of great importance. These policymakers will "just do" the right thing, as they see it, largely independent of public accolade or criticism. In the spirit of preparing the roof for rainy days, however, we consider the case when a weaker or more *political* board is in place.

6.2 Solving Political-Economy Problems Using Special Loss Functions

The communication channel involves terms in the loss function representing aversion to criticism that are usually neglected. Fortunately, the literature provides tools for studying solutions to political-economy problems using special loss functions. Rogoff (1985) considers simply picking a "conservative" central banker, one with a loss function that embodies greater aversion to inflation than the true social loss function. This approach generates a trade-off: Excess aversion to inflation lowers mean inflation, but it causes inflation to be smoother and the output gap to be more variable than is optimal. Melitz (1988) and Obstfeld (1996) make use of terms in the loss function embodying "political costs" associated with breaking a pledge to keep the exchange rate fixed. They, too, generate a trade-off between reducing inflation bias and achieving stabilization objectives. Calling attention to this possible trade-off is one of the main contributions of the time-consistency literature.[32] Canzoneri, Nolan, and Yates (1997) provide examples in which taking advantage of "political cost" terms generates more complicated trade-offs. These papers all consider intuitively appealing, but ad hoc, loss functions.

In contrast, Walsh (1995) and Persson and Tabellini (1993) show how one can derive a loss function that completely eliminates the inflation bias problem without introducing stabilization costs. They discuss how this structure of loss might be induced using performance contracts for policymakers. More recently, Lockwood, Miller, and Zhang (1995), Svensson (1997b), and Svensson and Woodford (forthcoming) construct loss functions that eliminate both inflation and stabilization biases in models like ours. The basic approach in all these studies is to amend the policymaker loss function in such a way that the implied first-order conditions under discretion give rise to the same policy as under commitment.

[31] The conventional literature has examined several channels through which talk by the central bank could alter equilibrium outcomes. For example, it could lead to the cheap-talk equilibrium of Stein (1989), facilitate coordination on the best of the many equilibria of a monetary policy game as shown by Barro and Gordon (1983), or beneficially expand the set of equilibria as illustrated by Atkeson and Kehoe (2002). ITF advocates have in mind something much simpler—although formalization could involve elements like those discussed above. The communication channel as described here has a family resemblance to what Barro and Gordon called reputational equilibria in which the public might raise its expectation of future inflation in order to "punish" the misdeeds of the central bank. Technically, the important distinctions here are that the disutility from the punishment falls directly on the central bankers, involves no costs to the public, and is automatically attached to failure to deliver on "promises."

[32] Canzoneri (1985) also calls attention to such a trade-off. In his paper, the trade-off arises because of the imposition of an additional constraint on the policymaker, a requirement to achieve an average value for the money supply, not because of a special policymaker loss function.

6.3 A Formal Example

Here we use a forward-looking version of our simple model to illustrate how amending the loss function can eliminate inflation bias and stabilization bias. In this version, we assume that current inflation depends on expected future, but not lagged, inflation ($\phi = 0$) and that target output exceeds potential ($\kappa > 0$). For simplicity, we assume that there is a single random shock in period t ($\varepsilon_t \neq 0$, $\varepsilon_j = 0, j \neq t$). Under commitment, the policymaker can affect inflation at t and expected inflation in all future periods. Therefore, it can smooth adjustment to the shock over multiple periods. In future periods, the policymaker has an incentive to renege but is locked in by commitment. However, under discretion, when the shock hits at t, the policymaker cannot have the desired effect on inflation expectations in future periods because it cannot be relied upon to ratify those expectations. Therefore, inflation returns to its unconditional mean in period $t + 1$ and remains there, so adjustment to the shock is smoothed less effectively. The formal solutions are presented in Table 1.[33] The commitment policy we consider is commonly referred to as the full-commitment policy (or the solution to the Ramsey problem): It is the unconstrained optimum given that the policymaker can commit to the chosen policy.

Our model exhibits the classic *inflation bias* under discretion. Ignoring any shocks, at the optimum inflation rate of π^*, the bank has an incentive to surprise the public by increasing inflation in an attempt to stimulate output. Inflation is increased to the point at which the marginal cost of additional inflation just offsets the marginal benefit of attempting to raise output above potential toward the target. To see the inflation bias in this case, set ε_t equal to zero in the discretion solutions in equations (T1.1) and (T1.2) and assume that $\kappa > 0$. Under discretion, inflation is constant and exceeds π^* by the standard inflation bias, $\lambda\kappa/\alpha$.

In contrast, under commitment, inflation is time varying. It approaches π^* from above and is always less than the positive inflation under discretion. Output is also time varying. It approaches y^P from above and is always below y^*. It is optimal to have inflation above π^* in order to raise output above y^P for all finite j, but optimal inflation and output must decline over time in order to be consistent with the Phillips curve.

[33] As before, all derivations are in the appendix.

The model also exhibits *stabilization bias* under discretion. A useful measure of stabilization bias is the part of the extra loss from discretion relative to commitment that results from the existence of the shock. To consider stabilization bias, set κ equal to zero in all the solutions in Table 1 and assume that there is a positive cost shock in period t ($\varepsilon_t > 0$) and no shock in any other period. As might be expected, under discretion the optimal response to the cost shock in period t involves some increase in inflation and some reduction in output in period t and no response in any later period because there are no shocks then.

Under commitment, the optimal responses of inflation and output in period t are damped relative to those under discretion. There are reductions in both inflation and output in period $t + 1$ and in every period thereafter, with the responses approaching zero from below as j approaches infinity, in order to be consistent with the Phillips curve. The Phillips curve in period t implies that reducing inflation in period $t + 1$ partially offsets the upward pressure on inflation resulting from the shock. Therefore, it is possible to damp the responses of both inflation and output in period t. The benefit in period t more than offsets the losses in all future periods because, with a quadratic loss function, the first small movements away from the optimum in future periods cause negligible increases in loss.

We can attain the full-commitment solution under discretion if the policymaker is given the amended loss function

(10)

$$\mathfrak{L}_t = \varepsilon_t \frac{1}{2}\sum_{j=0}^{\infty}\beta^j \begin{bmatrix} \left(\pi_{t+j} - \pi^*\right)^2 + \lambda\left(y_{t+j} - y^P - \kappa\right)^2 \\ -\left(\alpha^2 + \lambda - \dfrac{\lambda\kappa}{\alpha}\right)\pi_{t+j} \end{bmatrix} - \left(C^{\kappa}_{\pi,t}\frac{\lambda\kappa}{\alpha} + C^{\varepsilon}_{\pi,t}\varepsilon_t\right)\pi_t - \sum_{j=0}^{\infty}\beta^j \; {}^{j}\left(C^{\kappa}_{\pi,t+1}\frac{\lambda\kappa}{\alpha} - C^{\varepsilon}_{\pi,t+1}\right)\varepsilon_t\pi_{t+1+j}.$$

Loosely speaking, one subtracts out terms in the discretion first-order condition that lead to the inflation bias and adds in terms relating to the time-varying and state-contingent optimal policy. In particular, stabilization bias can be eliminated only by subtracting terms that are time varying and depend on the size of the cost shock.

TABLE 1

Discretion Solutions

(T.1) $$\pi_t^D = \pi^* + \frac{\lambda\kappa}{\alpha} + D_{\pi,t}^{\varepsilon}\varepsilon_t, \qquad y_t^D = y^P - D_{y,t}^{\varepsilon}\varepsilon_t,$$

(T.2) $$\pi_{t+j|t}^D = \pi^* + \frac{\lambda\kappa}{\alpha}, \qquad y_{t+j|t}^D = y^P, \qquad j = 1,2,\ldots$$

Commitment Solutions

(T.3) $$\pi_t^C = \pi^* + C_{\pi,t}^{\kappa}\frac{\lambda\kappa}{\alpha} + C_{\pi,t}^{\varepsilon}\varepsilon_t, \qquad 0 < C_{\pi,t}^{\kappa} < 1 = D_{\pi}^{\kappa}, \qquad 0 < C_{\pi,t}^{\varepsilon} < D_{\pi,t}^{\varepsilon}$$

(T.4) $$y_t^C = y^P + C_{y,t}^{\kappa}\kappa - C_{y,t}^{\varepsilon}\varepsilon_t \qquad D_{y,t}^{\kappa} = 0 < C_{y,t}^{\kappa} < 1, \qquad 0 < C_{y,t}^{\varepsilon} < D_{y,t}^{\varepsilon}$$

(T.5) $$\pi_{t+j+1|t}^C = \pi^* + \Lambda^j\left(C_{\pi,t+1}^{\kappa}\frac{\lambda\kappa}{\alpha} - C_{\pi,t+1}^{\varepsilon}\varepsilon_t\right), \qquad j = 0,1,\ldots$$

(T.6) $$0 < C_{\pi,t+1}^{\kappa} < C_{\pi,t}^{\kappa} < D_{\pi}^{\kappa}, \qquad D_{\pi,t+1}^{\varepsilon} = 0 < C_{\pi,t+1}^{\varepsilon} < C_{\pi,t}^{\varepsilon}$$

(T.7) $$y_{t+j+1|t}^C = y^P + \Lambda^j\left(C_{y,t+1}^{\kappa}\frac{\lambda\kappa}{\alpha} - C_{y,t+1}^{\varepsilon}\varepsilon_t\right), \qquad j = 0,1,\ldots$$

(T.8) $$D_{y,t+1}^{\kappa} = 0 < C_{y,t+1}^{\kappa}, \qquad D_{y,t+1}^{\varepsilon} = 0 < C_{y,t+1}^{\varepsilon}$$

6.4 Likely Effectiveness of the Communication Channel

Our example illustrates how political-economy problems can be avoided if only the policymaker's loss function differs from the social loss function in the proper way. It also shows that, even in a stripped down model, the required special terms are somewhat complicated and vary with the state of the economy. In this very simple model, we might, however, imagine writing an incentive contract to achieve optimality. Of course, it is a feature of the common ground that the actual economy is so complicated that it is impossible to codify such a contract.

ITFers argue that we can achieve much of the desired effect by exploiting policymaker aversion to criticism. However, to achieve this effect on the first-order conditions, these aversion-to-criticism terms would have to take a very particular, state-dependent form. We have seen no argument as to why aversion to criticism would work in the intended manner. Indeed, we have difficulty imagining how to form such an argument.

More generally, we know of no literature supporting the view that some combination of public promises, maximal scrutiny, and the threat of public criticism is an uncontroversial recipe for optimal public policy. Suppose we accept that weak policymakers will be swayed by criticism. Given the skewing of communication in the ITF, it strikes us that a weak policymaker may find it safest to excessively smooth inflation. That is, it might literally follow its pronouncements. Both this view and the contrary view, however, are highly speculative given the nature of the mechanism.

Despite our reticence to draw strong conclusions either way, we offer two comments. First, we find it plausible that stating a long-run inflation goal and communicating regularly about it will raise the chance that policy hits the long-run goal for the reasons cited by the ITF. Second, the ITF seems as likely to complicate as to facilitate achieving a proper balance of multiple goals by a weak policymaker.

7. COMPLICATING FACTORS LARGELY MISSING FROM MODELS

Up to now, we have been analyzing the ITF from a relatively abstract perspective. As preparation for making some constructive suggestions based on our analysis, we discuss some real-world complications that are largely missing from our analysis and most other formal work.

7.1 Strategic Skewing and Transparency

Beyond clarity, strategic skewing may be an essential component of effective public communication. One of the most famous principles of strategic skewing in the folk wisdom of central banking is that central banks should "do what they do, but only talk about inflation." Alan Blinder contravened this principle, the story goes, in the famous Jackson Hole imbroglio, perhaps confirming its wisdom.

While most ITF advocates would vigorously dispute it, the ITF might be viewed as an application of this folk wisdom. Without the folk wisdom, it is difficult to imagine why a policy of optimization with multiple conflicting goals would be called "inflation targeting." Calling reports on all aspects of policy "inflation reports" is an analogous misnomer. The folk wisdom would also justify discussing goals other than inflation only as they affect the horizon over which one intends to hit the inflation target.

The folk wisdom might actually be wisdom. If these topics are too sensitive to discuss, then we should stop praising the ITF and other central banks for their commitment to transparency; instead we should lament the fact that central banks cannot publicly discuss the pursuit of their multiple mandates. Further, the practical art of strategic skewing is well-studied, for example, by public relations experts. Economists have no special claim to expertise in optimal skewing.

7.2 Maximal Transparency and Deliberation

Unlimited transparency may be inconsistent with optimal deliberation. As Greenspan (2002, p. 5) puts it

> The undeniable, though regrettable, fact is that the most effective policymaking is done outside the immediate glare of the press.

More generally, transparency could, depending on the social environment, generate inefficient dissension about policy. Goodfriend (1986) lays out various forms of this argument including the following:

> In this view, secrecy could confer a social benefit because it makes consensus politics work more smoothly and with less cost.

The role of concerns like this in determining the current structure of the Federal Reserve is reviewed in Faust (1996).

We think it is almost certainly a grave error to trivialize such concerns. We cannot contribute much to their analysis, however. In our view proper treatment requires bringing in expertise from areas beyond economics. We stick to reviewing the more directly economic merits of transparency.

7.3 Multiple Decisionmakers

In many countries a board is charged with making policy. In much of the theory we have been reviewing, the fact of multiple decisionmakers is inessential. The framers of the Federal Reserve, however, saw the composition of the board as an essential aspect of their response to political-economy problems. For example, Warburg (1930, p. 773) argues that a

> formula had to be found by means of which these two elements [big business and politicians] would be called upon to balance one another.

As is often the case with responses to difficult political design problems, the framers came up with a mish-mash solution.[34] As a bottom line, they decided on a particular weighting of interests on the FOMC. Congressman Henry Steagall (1935, p. 13706) summarized the result:

> [U]nder the bill embodied in the conference report the board [that is, the FOMC] will stand 5 to 7 giving the people of the country, as contradistinguished from private banking interest, control by a vote of 7 to 5 instead of by a vote of 3 to 2 [as proposed in the Senate].

[34] For example, there are 12 votes on the FOMC; five presidents vote; the president of the New York Fed and either the Chicago or Cleveland Fed president always vote. The Reserve Bank presidents are nominated by the boards of their respective banks and confirmed by the Federal Reserve Board. The nominating boards are composed of nine directors, six chosen by district bankers (three representing district bankers and three representing general district interests), and three chosen by the Federal Reserve Board. The seven governors are nominated by the President of the United States with due regard to a fair representation of the financial, agricultural, industrial, and commercial interests.

Multiple heterogeneous policymakers clearly pose a practical problem for transparent communication about the goals of policy, the rationale for policy, and the causes of past policy mistakes and successes. There seems to be disagreement about the magnitude of this problem, however. Some contend that there are not many differences of opinion about either the appropriate loss function for policy or about how the economy works. Others are not so sanguine.

If there are substantial disagreements over the loss function and/or the workings of the economy, one response would be to require multi-stage decisionmaking. First, the board agrees on goals of policy. Next, taking the goals as given, the board agrees on the model of the economy. Finally, the board makes policy taking the goals and model as given.

This approach has the convenient feature of making the policy process, for purposes of analysis, look rather like the simple single-decisionmaker problem. In some discussion, failure to agree first on goals of policy or the model sometimes seems to be taken as prima facia evidence of inefficient behavior by the policymaking board. This view trivializes the analysis of public decisionmaking.

There is no theorem of public decisionmaking stating that the multistage decisionmaking approach is good for society. One can write examples in which multistage decisionmaking is or is not efficient, but theoretical examples probably do not get to the heart of the matter. Imagine a monetary policy board populated by astute, public-spirited, policy-oriented economists—epitomized perhaps by James Tobin and Milton Friedman. The multistage approach would require that they agree first on goals, next on the model, and only then consider policy options, given those goals and model. In an alternative approach, we could simply charge them with agreeing on and implementing policy. One suspects that the multistage approach may not even be feasible in practice. There is at least room to differ regarding which approach would lead to better policy.

7.4 Measurement of Inflation and the Gap

Choosing a measure of inflation and an appropriate long-run inflation goal presents practical problems that may not have been fully appreciated during periods of high inflation. In 1980, any low number seemed like a good thing. Fortunately, gone are days when proponents of low inflation could simply assert, "Zero is a nice round number."

There is now general agreement that most, if not all, price indices exhibit non-negligible quality biases. Further, for various reasons to do with quality bias and composition, different indices often behave quite differently for substantial periods of time. Thus, the issue of which index to focus on may be of some importance.[35]

Many economists inside and outside the ITF camp have also concluded that the inflation goal should be set high enough to limit the probability of hitting the zero lower bound on nominal interest rates. Thus, they argue for allowing a non-negligible stabilization buffer that exceeds proposed allowances for quality bias.[36] Exactly how large a buffer to allow is a technical question involving the costs of moderate inflation, the costs of being mired in a recession, and the responsiveness of the economy to changes in the policy rate. The answer may change over time as the economy changes.[37] In our view, the fact that choosing the appropriate target is a technical question and the possibility that a good initial answer may not be found argue strongly for keeping the choice of the inflation target in the hands of central banks and for revisiting it periodically.

Obviously, ITF banks believe that the benefits of a concrete target outweigh any costs that might be generated by these measurement issues. Some current and past U.S. policymakers agree—for example, Bernanke (BLMP) and Meyer (2002). Gramlich (2003) speculates that announcing a long-run range for inflation might increase transparency without unduly limiting flexibility. In contrast, Greenspan (2002, p. 6) argues that

> For all these conceptual uncertainties and measurement problems, a specific numerical inflation target would represent an unhelpful and false precision.

Greenspan argues, loosely speaking, that the Fed is striving for price stability *properly measured* and that achieving this goal does not correspond reliably to hitting a long-run target for any particular index. We do not attempt to resolve this empirical dispute in this paper, but discuss some of its implications in the final section.

[35] Recent discussion of the issues regarding changing the relevant index in the United Kingdom (HM Treasury, 2003) and of the role of energy prices in Sweden (Sveriges Riksbank, 2003) are a reminder that the choice of price index can have important implications.

[36] For a particularly eloquent statement of the case for a stabilization buffer, see Phelps (1972, p. 210).

[37] Henderson (2004) puts forward views similar to those expressed here.

It is generally believed that the measurement issues regarding the gap are much more serious. Here, in discussing the real world, we are moving beyond our model and using *gap* as a short-hand for the relevant measure of economic slack. In practice, there may be many relevant *gaps*, and none is easy to measure. Indeed, one version of the NET view is that these problems are so overwhelming that the *gap* should not be part of policymaking.[38]

In the LET view, these measurement issues may be immense and, hence, exploitability may be minimal. By definition, however, the LETer believes that we can monitor the economy sufficiently well to attain some beneficial exploitation of the short-run trade-off. If this is so, there is also some way to communicate this information to the public. That is, there should be a heavy presumption against the view caricatured by Karl Brunner that central banking is an inaccessible art, and that the

> esoteric nature of the art is moreover revealed by an inherent impossibility to articulate its insights in explicit and intelligible words and sentences. (as quoted in Goodfriend, 1986)

Arguably, to the extent that there is less controversy regarding the measurement of inflation than the *gap*, careful and thorough communication about the *gap* is more essential. Under this view, the emphasis in the communication strategy of the ITF is misplaced.

8. CONCLUSIONS

In section 2, we state that two core requirements of the ITF are a long-run inflation target, and transparency. The first only constrains central bank policy in the long run; the second constrains talk, not actions. Based on these requirements alone, it would be difficult to understand the passionate debate over the ITF.

In filling out the description of the ITF, we have come to believe that some of the passion comes from the following characterization. Inflation targeting has been portrayed as a *snug-fitting garment* that is a great improvement over *pure discretion*. The latter is caricatured as a *seat of the pants approach*. Less colorfully, inflation targeting is depicted as *constrained discretion*.[39]

From one perspective, this characterization is quite reassuring. Purely discretionary, seat-of-the-pants policymaking sounds a bit risky. Given that monetary policy is made in a complicated world and is subject to conflicting pressures in society over what policy is best, there is rightfully something comforting about the notion of a snug-fitting garment.

From another perspective the characterization is distressing. Central banks have often put on snug-fitting garments—for example, fixed exchange rates and money targeting. Historically, these garments have proven uncomfortable; they have regularly split at the seams.

Which perspective is correct? ITF advocates tell us there is nothing to fear from the snug-fitting garment: The constraints in *constrained discretion* do not constrain the central bank from pursuing optimal behavior. While there is nothing, in principle, wrong with this claim,[40] we remain uncertain about the basis of this claim. Going beyond the core requirements, in practice ITF imposes many requirements—for example, fixed horizons, target ranges, lexicographic preferences regarding price stability. These requirements might be viewed as constraining policy, but they are inconsistent with optimization under conventional views about the economy. We have treated them not as constraints on policy behavior, but merely as features of the ITF communication policy that generate dissonance between how the banks talk and how they act. We have not identified requirements of the ITF that constrain use of policymaking discretion, while remaining consistent with optimization.

We acknowledge that, despite their costs, central banks might find simple yardsticks or rules of thumb useful in guiding the communication of and/or conduct of policy. It is an open question whether such simplifications yield net benefits in any particular context. Until such constraints are better justified, they are not, in our view, clearly part of best-practice monetary policy.

8.1 Constructive Suggestions

Our review of the ITF leads to several constructive suggestions regarding best-practice, whether inside or outside the ITF. In short form, these amount to a guide for implementing the core requirements.

[38] See, for example, Orphanides (2003a).

[39] This characterization can be found in many places, including BLMP.

[40] For example, "attain the social optimum" could be viewed as a constraint that imposes no costs. More generally, of course, constraints on behavior off the desired equilibrium path have no cost of the sort we are discussing and may help in selecting from among equilibria.

Suggestion 1. Central banks should state a clear long-run inflation goal. No range or fixed horizon should be given.[41] If no numeric target is given, clear countervailing interests should be stated, and effort should be made to reduce uncertainty regarding the long-run goal. The value of this goal in meeting all long-run goals of policy should be stressed.

In order to be consistent with this suggestion, ITF central banks would have to modify the characterization of their long-run inflation goals in many cases. The Fed regularly communicates its strong commitment to the principle of price stability but has not stated an explicit target. As justification for not stating an explicit target, various policymakers have cited problems due to measurement issues, political-economy considerations, and the existence of multiple decisionmakers. A key question facing the Fed is whether with careful statement and qualification, it might obtain some of the benefits of a more concrete goal while minimizing the costs.

Suggestion 2. Central banks should communicate in a balanced way about the objectives driving short-run policy. If these objectives are seen as conflicting due to the structure of the economy, this viewpoint should be made clear. To the extent that other goals are more difficult to quantify than the inflation stability goal, the need for clear reporting is heightened and banks should strive to find ways to communicate about these goals effectively.

For ITF central banks, adopting suggestion 2 would involve changing some language that is literally inconsistent with optimization in the LET view. It would also require providing more complete communication about the role of goals other than inflation in policy. It is a matter of perspective whether these are viewed as small or large changes. They may well be minor tweaks on the idealized ITF framework defined by Svensson.

If transparency is truly a goal in central banking, then the area with the greatest room left for improvement at most central banks is communicating the roles of goals other than inflation. For ITF banks and others, it would greatly clarify issues if three questions were answered: Is some notion of real stability an objective of the central bank? Does the bank take the NET or LET view? If it is a LETer, how will the trade-off be managed? At a general level, ITF central banks and others have done quite well in answering the first of these questions but less well in answering the latter two.

Answering the second question—are you a NETer or LETer?—is relatively straightforward. Answering the third question requires successfully characterizing how the trade-off will be managed. This is a complex task that all LET central banks must face. We have no special insights on this topic. We believe, however, that clarity on goals and the NET/LET distinction is an important first step. It brings real stability into the conversation in its proper role. The focus on inflation has led to valuable innovation in communication; putting real stability on the table can promote similar innovation on the real side. The Reserve Bank of New Zealand and the Bank of Norway have begun this experimentation process.[42]

Suggestion 3. If best-practice policy is complicated, the totality of central bank communication should reflect that complexity.

This suggestion is based on the distinction between two dictionary senses of *transparent*. The first, and the one generally applied throughout the central banking literature, is that transparent means "frank, open, candid." However, sometimes the idea surfaces that central bank communication should be transparent in the sense of being, "easily seen through, recognized, [or] understood."[43] If best-practice dictates complicated policy, then communication that is frank, open, and candid will probably not be easily understood.

In practice, central banks probably need to have a multi-layered approach to communication with differing levels of complexity. However, there should be readily available information that makes it possible for a reasonably tenacious and intelligent person to understand policy in its complexity.

A review of the material on the web sites of several ITF banks suggests several useful examples of this multi-layered approach. Setting aside our particular criticisms about overemphasis of inflation, the monetary policy reports of ITF banks represent an extremely valuable aid in understanding the function of policy. These banks generally commission and publish outside reviews of the reports; for this and other reasons, their content is steadily improving.

Assessing the communication of the Fed is more difficult. It is certainly true that there is no one source of information that brings together the information represented in the best of the ITF monetary

[41] Certainly no fixed horizon shorter than a business cycle.

[42] For example, both include a forecast for the gap in their inflation reports.

[43] These definitions come from the *Oxford English Dictionary*, definitions 2a and 2b of *transparent*, respectively.

policy reports. Due to the sheer bulk of reports to Congress, testimony and speeches by FOMC members, and publications by the Board and 12 member banks, it would be a daunting (and unenviable) task to confirm reliably which topics are covered and which are not. A key issue facing the Fed in vigorously pursuing *effective* transparency is whether this material can be more concisely packaged and delivered, while respecting the diverse committee structure of the FOMC.

Suggestion 4. Central banks should strive to communicate clearly the likely course of policy. If forecasts are part of this process, the relationship between the forecasts and the future course of policy should be explained.

If policy cannot be codified in a simple rule, as we have assumed, then helping the public understand the likely course of policy is an essential part of effective policymaking. Central bank forecasts are a central feature of the monetary policy reports of ITF banks. While such forecasts can and do play many roles,[44] determining the proper role of forecasts in shaping policy expectations is more complex than usually recognized.[45] Under standard practice, the forecasts are of unclear value in understanding the course of policy.

For example, it is standard practice to report a forecast for output and inflation conditioned on some *counterfactual* path for policy such as a constant policy rate. These forecasts are generally depicted as judgmental, and the reader cannot know the model in more than general terms. It is very difficult to see how such a forecast has any marginal value in predicting the course of policy, beyond the predictive power of the standard data available to the public. For example, if the central bank optimizes in the LET view, then the public certainly cannot deduce that a conditional forecast of inflation above target means policy will be tightened. Further, releasing a forecast for output growth (which is only tenuously related to the gap or other relevant notions of slack) provides little help. Only if there is a known mapping from the conditional forecast to policy is that forecast of clear use.[46]

In contrast, an unconditional forecast of goal variables and the policy rate would shed a good deal of light on policy. Given that the public already has its own unconditional forecast of the economy and policy, the public can see if the two forecasts differ and, by comparing the policy rate forecasts, make an attempt to deduce whether those differences stem from different views of the future path of policy or from different views of other aspects of the economy.[47]

Of course, central banks have historically been very wary of providing direct information about the future course of policy. The political countervailing interests may be overwhelming. Absent direct information about the future course of policy, a more thorough discussion of the link between the forecast and future policy would be useful.[48]

8.2 Summing Up

Overall, our four suggestions for best-practice reflect the views that central banks should have clear, though possibly conflicting, goals and should aspire to maximize public understanding of policy. Advocates and practitioners of the ITF deserve great credit for their many contributions to clear goal setting and communication by central banks. Our suggested approach differs from the standard ITF approach in that we more strongly reject the folk wisdom of central banking that all communication should be couched in terms of inflation. Further, we do not favor the use of concrete but inherently suboptimal yardsticks for measuring central bank performance. We advocate a more "candid and open" approach to transparency.

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[44] We note that there may be public good benefits from releasing a central bank forecast that are independent of whether the forecast reveals something about central bank intentions. We are setting those aside. Any such benefits may be substantially reduced if the forecast is a conditional one, however.

[45] Anyone who doubts this claim is referred to the excellent work of Svensson and Woodford (2003) on this relationship.

[46] Leeper (2003) makes these and several other points about the use of forecasts.

[47] In addition to its inflation forecast, the Reserve Bank of New Zealand releases forecasts of both the policy rate and the gap. To our knowledge it is the only major ITF central bank that follows this practice. Svensson (2001) has praised this practice and argued that others should follow it.

[48] As discussed in subsection 5.3, the Riksbank has provided a rule of thumb linking their forecast to future policy. This rule, if followed, would make the forecast more useful, but is inconsistent with optimization.

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Appendix

BACKWARD-LOOKING VERSION

In the backward-looking version, $\phi = 1$ and $\kappa = 0$. Therefore, the loss function with the output gap eliminated using the Phillips curve is

$$\text{(A.1)} \quad \begin{aligned} \mathfrak{L}_t^{BL} &= \frac{1}{2}\mathcal{E}_t\left(\sum_{j=0}^{\infty}\beta^j \ell_{t+j}^{BL}\right) \\ \ell_{t+j}^{BL} &= \left(\pi_{t+j}-\pi^*\right)^2 + \frac{\lambda}{\alpha^2}\left[\left(\pi_{t+j}-\bar{\pi}\right)-\beta\left(\pi_{t+j-1}-\bar{\pi}\right)-\varepsilon_{t+j}\right]^2. \end{aligned}$$

The first-order condition for π_{t+j} is

$$\text{(A.2)} \quad \begin{aligned} &\pi_{t+j}-\pi^* + \frac{\lambda}{\alpha^2}\left\{\left[\left(\pi_{t+j}-\bar{\pi}\right)-\left(\pi_{t+j-1}-\bar{\pi}\right)\right]-\varepsilon_{t+j}\right\} \\ &\quad -\frac{\lambda\beta}{\alpha^2}\left\{\left[\left(\pi_{t+j+1|t+j}-\bar{\pi}\right)-\left(\pi_{t+j}-\bar{\pi}\right)\right]\right\} = 0. \end{aligned}$$

Taking the unconditional expectation of equation (A.2) yields the result that $\bar{\pi} = \pi^*$. Using this result, collecting terms, and multiplying through by $-\alpha^2$ yields

$$\text{(A.3)} \quad \begin{aligned} &\beta\mathcal{X}_{t+j+1|t+j} - \frac{1}{\lambda}A\mathcal{X}_{t+j} + \mathcal{X}_{t+j-1} = -\varepsilon_{t+j}, \qquad j = 0,1,\ldots \\ &\mathcal{X}_{t+j} = \pi_{t+j}-\pi^*, \qquad A = \alpha^2 + (1+\beta)\lambda. \end{aligned}$$

The roots represented by Λ and Ψ are

$$\text{(A.4)} \quad \begin{aligned} &0 < \Lambda = \mathcal{A} - \sqrt{\mathcal{A}^2 - \frac{1}{\beta}} < 1, \qquad 1 < \Psi = \mathcal{A} + \sqrt{\mathcal{A}^2 - \frac{1}{\beta}}, \\ &\mathcal{A} = \frac{1}{2\beta\lambda}A, \qquad \mathcal{A}^2 - \frac{1}{\beta} > 0 \qquad \lim_{\lambda\to 0}\Lambda = 0, \qquad \lim_{\lambda\to\infty}\Lambda = 1. \end{aligned}$$

Using standard methods we obtain the solutions:

$$\text{(A.5)} \quad \begin{aligned} &\mathcal{X}_{t+j} = \Lambda\mathcal{X}_{t+j-1} + \Lambda\varepsilon_{t+j} + \Lambda^2\sum_{i=0}^{\infty}(\beta\Lambda)^i\mathcal{E}_{t+j}\varepsilon_{t+j+1+i}, \qquad j = 0,1,\ldots \\ &\mathcal{Y}_{t+j} = \frac{\Lambda-1}{\alpha}\mathcal{X}_{t+j-1} - \frac{\Lambda-1}{\alpha}\varepsilon_{t+j}, \qquad j = 0,1,\ldots \end{aligned}$$

where $\tilde{y}_{t+j} = y_{t+j} - y^P$. A positive cost shock increases inflation and reduces output. Taking expectations conditioned on information at time t yields the forecasts

$$\text{(A.6)} \quad \begin{aligned} &\mathcal{X}_t = \Lambda\mathcal{X}_{t-1} + \Lambda\varepsilon_t, \qquad \mathcal{Y}_t = \frac{\Lambda-1}{\alpha}\mathcal{X}_{t-1} - \frac{\Lambda-1}{\alpha}\varepsilon_t \\ &\mathcal{X}_{t+j+1|t} = \Lambda\mathcal{X}_{t+j|t}, \qquad \mathcal{Y}_{t+j+1|t} = \frac{\Lambda-1}{\alpha}\mathcal{X}_{t+j|t}, \qquad j = 0,1,\ldots \end{aligned}$$

as stated in the text. By repeated substitution

$$\text{(A.7)} \quad \begin{aligned} \pi_{t+j|t} &= \pi^* + (\Lambda)^{j+1}\pi^* + (\Lambda)^{j+1}(\pi_{t-1}+\varepsilon_t), \quad j = 0,1,\ldots \\ y_{t+j|t} &= y^P + \frac{\Lambda-1}{\alpha}(\Lambda)^j\pi^* + (\Lambda)^j\left[\frac{\Lambda-1}{\alpha}\pi_{t-1} - \frac{\Lambda-1}{\alpha}\varepsilon_t\right] \quad j = 0,1,\ldots \end{aligned}$$

Now we derive the unconditional efficient policy frontier implied by the optimal commitment rule. We begin by finding the unconditional variances of $\tilde{\pi}_{t+j}$ and $\tilde{y}$:

(A.8)
$$\sigma_{\tilde{\pi}}^2 = \frac{\Lambda^2}{1-\Lambda^2}, \quad \sigma_{\tilde{y}}^2 = \frac{(\Lambda-1)^2}{\alpha^2}\frac{\Lambda^2}{1-\Lambda^2} + \frac{(\Lambda-1)^2}{\alpha^2} = \frac{1-\Lambda}{\alpha^2(1+\Lambda)},$$

where σ_ε^2 has been set equal to one for simplicity. To complete the derivation, we invert the expression for $\sigma_{\tilde{\pi}}^2$ to obtain an expression for Λ in terms of $\sigma_{\tilde{\pi}}^2$ and substitute that expression into the expression for $\sigma_{\tilde{y}}^2$:

(A.9)
$$\sigma_{\tilde{y}}^2 = \frac{\sigma_{\tilde{\pi}}^2 + 1 -}{\alpha^2\left(\sigma_{\tilde{\pi}}^2 + 1 + \quad\right)} > 0, \qquad = \sqrt{\left(\left(\sigma_{\tilde{\pi}}^2 + 1\right)\sigma_{\tilde{\pi}}^2\right)}$$

The policy frontier has a negative slope and is convex to the origin since

(A.10)
$$\frac{d\sigma_{\tilde{y}}^2}{d\sigma_{\tilde{\pi}}^2} = -\frac{\sigma_{\tilde{\pi}}^2 + 1}{\alpha^2 \quad \left(\sigma_{\tilde{\pi}}^2 + 1 + \quad\right)^2} < 0$$

(A.11)
$$\frac{d^2\left(\sigma_{\tilde{y}}^2\right)}{d\left(\sigma_{\tilde{\pi}}^2\right)^2} = \frac{1}{2}\left[\frac{2\sigma_{\tilde{\pi}}^2 + 1 + 2}{\alpha^2\sigma_{\tilde{\pi}}^2 \quad \left(\sigma_{\tilde{\pi}}^2 + 1 + \quad\right)^2}\right] > 0.$$

An increase in $\sigma_{\tilde{\pi}}^2$ is achieved through an increase in Λ (generated by an increase in λ), which lowers $\sigma_{\tilde{y}}^2$.

FORWARD-LOOKING VERSION

In the forward-looking version, $\phi = 0$ and $\kappa > 0$. The loss function with the output gap eliminated using the Phillips curve is

(A.12)
$$\mathfrak{L}_t^{FL} = \frac{1}{2}\mathcal{E}_t\left(\sum_{j=0}^{\infty}\beta^j \ell_{t+j}^{FL}\right)$$
$$\ell_{t+j}^{FL} = \left(\pi_{t+j} - \pi^*\right)^2 + \frac{\lambda}{\alpha^2}\left[\left(\pi_{t+j} - \bar{\pi}\right) - \beta\left(\pi_{t+j-1} - \bar{\pi}\right) - \varepsilon_{t+j} - \alpha\kappa\right]^2.$$

To simplify the analysis, we assume that the only shock occurs in period t.

DISCRETION

Under discretion, the first-order condition for π_{t+j} holding π_{t+j+1} constant is

(A.13)
$$\pi_{t+j} - \pi^* + \frac{\lambda}{\alpha^2}\left[\left(\pi_{t+j} - \bar{\pi}\right) - \beta\left(\pi_{t+j+1} - \bar{\pi}\right) - \varepsilon_{t+j} - \alpha\kappa\right] = 0.$$

Taking the unconditional expectation yields the familiar inflation bias result

(A.14)
$$\bar{\pi} = \pi^* + \frac{\lambda\kappa}{\alpha}$$

so that the first-order condition for deviations from the unconditional mean is

(A.15)
$$\pi_{t+j} + \lambda\left(\frac{1}{\alpha}\pi_{t+j} - \frac{\beta}{\alpha}\pi_{t+j+1} - \frac{1}{\alpha}\varepsilon_{t+j}\right)\frac{1}{\alpha} = 0$$
$$\pi_{t+j} = \pi_{t+j} - \bar{\pi}, \qquad \pi^* = \pi^* - \bar{\pi}.$$

It will be optimal to have no deviations from period $t+1$ on because there are no shocks then. Therefore the solution for the deviation in period t is

(A.16) $$\pi_t = \frac{\lambda}{\alpha^2+\lambda}\varepsilon_t$$

and the full solutions for inflation in period t and all other periods are

(A.17) $$\pi_{t+j} = \pi^* + \frac{\lambda\kappa}{\alpha} + \frac{\lambda}{\alpha^2+\lambda}\varepsilon_t, \qquad j = 0,1,\ldots$$

COMMITMENT

Under commitment, the first-order condition for any period except period t is

(A.18) $$\begin{aligned} &-\frac{\lambda\beta}{\alpha^2}\left[\left(\pi_{t+j}-\bar{\pi}\right)-\beta\left(\pi_{t+j+1}-\bar{\pi}\right)-\varepsilon_{t+j}-\alpha\kappa\right]+\beta\left(\pi_{t+j+1}-\pi^*\right) \\ &+\frac{\lambda\beta}{\alpha^2}\left[\left(\pi_{t+j+1}-\bar{\pi}\right)-\beta\left(\pi_{t+j+2}-\bar{\pi}\right)-\varepsilon_{t+j+1}-\alpha\kappa\right]=0. \end{aligned}$$

Taking unconditional expectations yields the familiar commitment result that

(A.19) $$\bar{\pi} = \pi^*.$$

Multiplying through by $-\frac{\alpha^2}{\lambda\beta}$ and collecting terms, the first-order conditions can be rewritten in deviation form as

(A.20) $$\beta\mathring{\pi}_{t+2} - \frac{1}{\lambda}A\mathring{\pi}_{t+1} + \mathring{\pi}_t = \varepsilon$$

(A.21) $$\beta\mathring{\pi}_{t+j+2} - \frac{1}{\lambda}A\mathring{\pi}_{t+j+1} + \mathring{\pi}_{t+j} = 0, \qquad j = 1,2,\ldots$$

(A.22) $$\mathring{\pi}_{t+j} = \pi_{t+j} - \pi^*,$$

where the condition (A.20) for π_{t+1} is the only one with a shock term. Note that the distortion term does not enter these conditions. Solving the difference equation (A.21) yields

(A.23) $$\mathring{\pi}_{t+j+1} = \Lambda\mathring{\pi}_{t+j}, \qquad j = 1,2,\ldots$$

The first-order condition for period t in deviation form is

(A.24) $$\mathring{\pi}_t + \frac{\lambda}{\alpha^2}\left(\mathring{\pi}_t - \beta\mathring{\pi}_{t+1} - \varepsilon_t - \alpha\kappa\right) = 0.$$

Multiplying through by α^2, collecting terms, and rearranging yields

(A.25) $$-\lambda\beta\mathring{\pi}_{t+1} + \left(\alpha^2+\lambda\right)\mathring{\pi}_t = \lambda\kappa\alpha + \lambda\varepsilon_t.$$

The first-order conditions for π_t and π_{t+1} can now be written as

(A.26) $$\left(\alpha^2+\lambda\right)\mathring{\pi}_t - \lambda\beta\mathring{\pi}_{t+1} = \lambda\kappa\alpha + \lambda\varepsilon_t$$

(A.27) $$\mathring{\pi}_t - \frac{1}{\lambda}\left(A - \lambda\beta\Lambda\right)\mathring{\pi}_{t+1} = \varepsilon_t,$$

where π_{t+2} has been eliminated from equation (A.20) using equation (A.23) for $j = 1$ and A and Λ are defined in equations (A.3) and (A.4), respectively.
The solutions are

(A.28) $$\mathring{\pi}_t = C^{\kappa}_{\pi,t}\frac{\lambda\kappa}{\alpha} + C^{\varepsilon}_{\pi,t}\varepsilon_t$$

(A.29) $$\mathring{\pi}_{t+j+1} = \Lambda^j\left(C^{\kappa}_{\pi,t+1}\frac{\lambda\kappa}{\alpha} - C^{\varepsilon}_{\pi,t+1}\varepsilon_t\right), \qquad j = 0,1,\ldots$$

(A.30) $$C^{\kappa}_{\pi,t} = \frac{\alpha^2(A-\lambda\beta\Lambda)}{\lambda\Delta}, \qquad C^{\varepsilon}_{\pi,t} = \frac{A-\lambda\beta\Lambda-\lambda\beta}{\Delta}$$

(A.31) $$C^{\kappa}_{\pi,t+1} = \frac{\alpha^2}{\Delta}, \qquad C^{\varepsilon}_{\pi,t+1} = \frac{\alpha^2}{\Delta}$$

(A.32) $$\Delta = \left(\frac{\alpha^2}{\lambda}+1\right)C - \lambda\beta > 0, \quad C = A - \lambda\beta\Lambda > 0, \quad A - \lambda\beta\Lambda - \lambda\beta > 0$$

where all of the C's are positive and the C's for period t differ from those for period $t + 1$ and all other periods. First suppose that target output is above potential ($\kappa > 0$) but that there is no shock ($\varepsilon_t = 0$). It can be shown that the inflation rate starts out above π^* by less than under discretion and approaches π^* asymptotically and that output starts above y^P and approaches y^P asymptotically. Now suppose that $\kappa = 0$ and $\varepsilon_t > 0$. It can be shown that inflation is above π^* in period t, below π^* from period $t + 1$ on, and approaches π^* asymptotically.

Commentary

Benjamin M. Friedman

Macaulay—not Frederick Macaulay, who did economic research on interest rates, but the great historian of the British empire, Thomas Babington Macaulay—wrote that the benefactors of mankind are customarily attacked by "the dunces of their own generation" for going too far, as well as by "the dunces of a future generation" for not going far enough.[1] The consensus on display at today's conference, and perhaps more broadly in the economics profession as well, is that inflation targeting where it is already in practice is, and wherever it is adopted in the future will be, a significant benefactor of, if not mankind, then at least monetary policy. Compared with that apparent consensus, and with today's paper by Jon Faust and Dale Henderson, my view is that of Macaulay's dunces both of the present and of the future: I will argue that inflation targeting goes too far—or, what in this context amounts to the same thing, takes us in a direction we should not want to go. And I will also argue that while Faust and Henderson's paper contains many valid and important criticisms of inflation targeting, they do not go nearly far enough in following the logical implications of the criticisms they offer.

Whether inflation targeting has led to superior outcomes for monetary policy in countries whose central banks have already adopted this practice is, of course, an empirical matter.[2] The paper presented at this conference by Andrew Levin, Fabio Natalucci, and Jeremy Piger (2004, p. 75) concludes that "inflation targeting (IT) has played a role in anchoring inflation expectations and in reducing the intrinsic persistence of inflation." But there is also plenty of conflicting evidence. The recent paper by Laurence Ball and Niamh Sheridan, for example, offers a quite different interpretation of the same experience that Levin et al. study: "This paper asks whether inflation targeting improves economic performance, as measured by the behavior of inflation, output, and interest rates...Once one controls for regression to the mean, there is no evidence that inflation targeting improves performance".[3]

The main issues in Faust and Henderson's paper, however, are conceptual. In particular, they continually—and rightly—highlight the role of inflation targeting as a way for the central bank to communicate with the public. They approvingly quote Bernanke, Laubach, Mishkin, and Posen to the effect that among the "important features of inflation targeting are *vigorous efforts to communicate* with the public about the plans and objectives of the monetary authorities..." (p. 118, emphasis added by Faust and Henderson).[4] They begin their own paper by saying, "The core requirements of inflation targeting are an explicit long-run inflation goal and *a strong commitment to transparency*" (my emphasis). And they go on to say, "Not only are ITF [inflation targeting framework] central banks among the most transparent in the world, they have experimented aggressively with ways to make communication with the public more effective" (p. 117).

I disagree. As typically practiced today, inflation targeting is a framework not for communicating the central bank's goals and policies but for obscuring them. In crucial ways it is not a window but a screen. It promotes not transparency—at least not in the dictionary sense of the word—but opaqueness.

The key issue here, as Faust and Henderson clearly understand, is multiple goals. Monetary policy has one instrument: typically today some short-term

[1] Cited by Clive (1973, p. 481).

[2] Faust and Henderson opened the version of their paper that they presented at the conference by flatly declaring, "The inflation targeting framework (ITF) has been a great success around the world." In this version they have abandoned that claim.

[3] Ball and Sheridan (2003, abstract).

[4] Bernanke et al. (1999).

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interest rate, but alternatively the quantitative change in the central bank's liabilities. As Tinbergen showed decades ago, in the absence of degeneracy or other pathologies, the solution to a problem with one instrument and multiple targets can always be expressed in terms of the intended trajectory for any one arbitrarily chosen target. So far, so good. But the question Tinbergen did not address is whether that way of describing the solution promotes or subverts public understanding of what the policymaker is doing, and why.

Faust and Henderson's way of putting this matter—which I like very much—is to think in terms of the mean inflation rate and the variability of inflation. Inflation targeting communicates well about mean inflation. As they point out, however, "agreement regarding the mean inflation rate has very few practical consequences at any finite horizon" (p. 117). By contrast, inflation targeting does not communicate at all well about how much inflation should vary, or why.

There are at least two reasons why policymakers should expect, indeed want, inflation to vary. One, of course, is the unpleasant fact of technical errors. More central to this entire line of argument is the policymaker's concern for other goals of monetary policy. (Within the literature of inflation targeting this issue is made most explicit in Lars Svensson's formulation, in which the key decision is how rapidly to bring inflation back to the desired rate after some departure from it.[5]) The failure of most inflation targeting schemes, as implemented by actual central banks, to say anything about how much inflation variability the central bank will tolerate, or why, is also a failure to say anything about any goals of monetary policy other than inflation, or about the relationship between those goals and the inflation goal.

Moreover, as I have argued elsewhere, I believe this failure is intentional on the part of the central banks that adopt this framework.[6] As Faust and Henderson put it, "One of the most famous principles of strategic skewing in the folk wisdom of central banking is that central banks should 'do what they do, but only talk about inflation'." They go on to say that "the ITF might be viewed as an application of this folk wisdom. Without the folk wisdom, it is difficult to imagine why a policy of optimization with multiple conflicting goals would be called 'inflation targeting.' Calling reports on all aspects of policy 'inflation reports' is an analogous misnomer. The folk wisdom would also justify discussing goals other than inflation only as they affect the horizon over which one intends to hit the inflation target" (p. 132).

They obviously have in mind, for example, the Bank of England. The Bank of England, however, is by no means the only central bank to exhibit this form of anti-transparency. For example, the Bank of Canada's one-page public explanation of its policymaking framework, entitled "Canada's Inflation-Control Strategy" and prominently printed on the inside front cover of the Bank's regular *Monetary Policy Report*, has only three sentences bearing on the strategy's underlying rationale: "Inflation control is not an end to itself; it is the means whereby monetary policy contributes to solid economic performance. Low inflation allows the economy to function more effectively. This contributes to better economic growth over time and works to moderate cyclical fluctuation in output and employment."[7] There is no mention of any tension, at any horizon, between the Bank's inflation goal and output, employment, or any other matter of potential concern to monetary policy. (The remainder of the statement, devoted to operational considerations, also gives no hint of any reason, beyond technical errors, for inflation ever to depart from the desired rate.)

What is the import of all this? As Faust and Henderson write, "the primary shortcoming of the ITF communication policy is in making clear the roles and balance of multiple goals...[T]he ITF as implemented often involves elements that are literally inconsistent with best-practice policy and, in any case, obfuscates some basic issues" (p. 124). Further, "any discussion of stability of prices or inflation must inevitably raise issues of other goals... [S]everal aspects of the ITF as practiced do not provide a natural and straightforward framework for communicating this fact" (p. 126).

Given this assessment—which I believe is correct—two questions follow: Is this aspect of inflation targeting, as actually practiced, incidental or deliberate? And, in the end, is it only about how central banks *talk*—although that too is clearly important—or does it also have implications for what central banks *do*?

[5] Svensson (1997).

[6] See Friedman (2003).

[7] Bank of Canada, *Monetary Policy Report*, April 2003, inside front cover page.

Faust and Henderson imply—and elsewhere I have argued more directly—that the connection is deliberate.[8] As they note, inflation targeting appeared on the policymaking scene at a time when the pressing need, throughout the industrialized world, was to reduce the ongoing rate of inflation. As I have also argued, the intellectual background against which inflation targeting emerged consisted of the time-inconsistency discussion and the forward-looking Phillips curve; and both of these lines of thought naturally lend themselves to the kind of obfuscation that inflation targeting embodies. The crucial implication of time inconsistency, not just for monetary policy but for a broad class of problems (lender-of-last-resort policy, for example), is that misleading people about the policymaker's likely actions—if it is possible to do so—can induce beneficial behavior. But the same implication is also inherent in any model based on the standard forward-looking Phillips curve: The lower is the public's expectation of future inflation, the more favorable is the trade-off between inflation and output that the policymaker faces in the present—in other words, less inflation for given output, or more output for given inflation.

Given the central role in macroeconomics now played by the forward-looking Phillips curve, this logic, in both simple and sophisticated forms, is pervasive. It is no surprise, for example, that in section 1 of Michael Woodford's paper for this conference (on "Advantages of an Explicit Target for Monetary Policy"), section 1.1 is titled "Central Banking as the *Management* of Expectations" (emphasis added). This is not the place to go over yet again the concerns I have expressed elsewhere about this way of thinking about monetary policy.[9] The question to pose, however, is whether, when the central bank in fact has multiple goals but quantifies only one—indeed, when it refuses to talk explicitly about any of the others, except in terms of how they bear on the achievement of that one—we should call this kind of communications policy the *management* of expectations or the *manipulation* of expectations.

As Woodford and many others have ably shown, the public's expectations matter for economic behavior, including the efficacy of monetary policy, and so even if all that the obfuscation inherent in inflation targeting did were to affect expectations, that in itself would be important. But there is also ground to believe that inflation targeting may distort not just what the central bank says but what it does.

One reason for thinking so, which Faust and Henderson note, is "the ITF premise that the threat of public criticism affects the incentives of the central bank and thereby the course of policy" (p. 129). But as they also rightly point out, "The ITF communication policy is tilted heavily toward emphasis on stabilizing inflation" (p. 126). As a result, "Given the skewing of communication in the ITF...a weak policymaker may find it safest to excessively smooth inflation." Hence, "the ITF seems as likely to complicate as to facilitate achieving a proper balance of multiple goals by a weak policymaker" (p. 131).

I have little to add to this important (and, I believe, correct) line of argument, other than to say that it probably applies to strong policymakers as well as weak ones—what Faust and Henderson call "policymaker aversion to criticism" is pervasive—and to suggest that it calls back into question an often-made claim that they dismiss out of hand at the outset of their paper: namely, that in many contexts the debate over inflation targeting is really a debate over what properly belongs in the central bank's preference function. Faust and Henderson are at pains to distinguish what Mervyn King has colorfully called "inflation nutters" from what they here label "NETers."[10] For practical purposes, however, these two positions are isomorphic. Their respective implications for monetary policy are observationally equivalent.

There is also a second reason for thinking that the inflation-targeting framework affects not just what the central bank says but also what it does. Put simply, the point is that language matters. David Hume, who importantly influenced the shaping of our discipline in its formative years, both directly and even more so through his influence on Adam Smith, had this to say about how skewed language affected the central political issue in the Britain of his day (monarchy versus republic): "The Tories have been obliged for so long to talk in the republican stile that they...have at length embraced the sentiments as well as the language of their adversaries."[11]

We are all familiar with instances in our own day of the same phenomenon. For example, how might research on monetary policy (and macroeconomics more generally) have evolved differently if the particular assumption about expectations

[8] See, again, Friedman (2003).

[9] Interested readers can refer to my discussion of Eggertsson and Woodford (2003).

[10] See King (1997).

[11] Hume (1741, p. 72).

introduced by Muth and Lucas had been labeled "super-smart-agents expectations," or, perhaps more even-handedly, "model-consistent expectations," rather than the far more compelling "rational expectations"? Might the work now exploring the implications of "bounded rationality" have developed earlier, or differently, under a less biased label?

To return to the case at hand, it is not too great a leap to conjecture that one consequence of constraining the discussion of monetary policy to be carried out entirely in terms of an optimal inflation trajectory will be that concern for real outcomes will atrophy, or even disappear from policymakers' consideration altogether. Nor is it unreasonable to suppose that the hope that this eventuality will ensue is, for some advocates, a motivation for favoring inflation targeting in the first place.

I shall turn in closing to three narrower and more specific comments on Faust and Henderson's paper. First, they write that, "as a profession we are more certain about our advice regarding the mean of inflation" (p. 118) than about what we say regarding the variance (in other words, economic stabilization). This may well be true. But even so, a reader of the relevant theoretical and empirical literature is entitled to ask just how confident we are on this score. At the conceptual level, there are at least five reasons for choosing a mean inflation rate different from zero: (i) measurement bias; (ii) the "stabilization buffer" argument that Michael Woodford and Gauti Eggertsson have recently analyzed at length[12]; (iii) the role of inflation as "grease to the labor market," as famously argued in James Tobin's AEA presidential address and more recently highlighted by Akerlof, Dickens, and Perry[13]; (iv) the distortionary tax argument, to which Stephanie Schmitt-Grohé has already referred in her comments on Michael Woodford's paper at this conference; and (v) the fact that in the United States today the principal asset bearing a permanently fixed nominal interest rate (zero) is currency, together with the apparent facts that much of the outstanding U.S. currency is held outside the country and that much of the rest is used by drug dealers and other criminals on whom we should *want* to impose distortionary taxes. At the empirical level, there is no evidence that mean inflation even quite far above zero by the standards of today's industrialized world retards economic growth; Robert Barro's work on this question has shown no effect on growth associated with mean inflation up to 15 percent per annum, and Michael Sarel's work has shown no effect up to 8 percent.[14]

Second, while Faust and Henderson are certainly correct that a belief in "long and variable lags" is nowadays part of the common ground of monetary economics, the familiar attempt to appeal to this argument as a rationale for inflation targeting is at best out of place and, more likely, misleading. Milton Friedman's classic argument applied not merely to the attempt to vary the policy instrument in order to control output, but also to control inflation. Nothing is lost, or even changed, by rewriting the notation in Friedman's 1953 paper to make the left-hand-side variable π and the key right-hand-side variable either r or M. The force of the long-and-variable-lags argument is the implied optimality of a constant instrument rule (most famously, a constant money growth rule). Long and variable lags do not constitute an argument for inflation targeting.

Third, Faust and Henderson's point about the symmetry of costs applying not just to the mean of inflation but also to the variability of inflation is both interesting and important. Referring to the target range that the central bank announces for inflation, they rightly point out that "excessive frequency of being *inside* the range is also evidence of misbehavior." An appropriate analytical framework recognizes that "*excessive smoothness* and excessive volatility of inflation are equally costly at the margin in equilibrium" (p. 125, emphasis added).

In conclusion, I disagree, sharply, with what increasingly looks like an emerging consensus that inflation targeting is, if not the optimal framework for monetary policy, then a close enough approximation to be about as good a framework as any real-world central bank can practically hope to have. More specifically, I do not believe that inflation targeting is a framework that the Federal Reserve System should adopt for the United States. For the many reasons I have explained in the course of discussing Faust and Henderson's paper, my view of inflation targeting is that of Macaulay's dunce of the present: I think inflation targeting would take U.S. monetary policy too far, in a direction in which we should not want to go. And in regard to their paper, I am content to be a dunce of the future. Faust and Henderson have all the right insights. They fall short only in not following the implications of these insights far enough.

[12] Eggertsson and Woodford (2003).

[13] Tobin (1972); Akerlof et al. (2000).

[14] Barro (1995); Sarel (1996).

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Practical Problems and Obstacles to Inflation Targeting

Laurence H. Meyer

The number of conferences, papers, and speeches on inflation targeting suggests a growing interest in exploring whether and in what way the Federal Open Market Committee (FOMC) should consider adopting an explicit numerical objective for inflation. Because the devil is often in the details, it is important to go beyond the general interest in this direction and to explore obstacles to moving in the direction and, at the same time, to begin to think about some practical problems that would have to be resolved if such an approach were to be implemented.

My point of departure is the conviction that, if the FOMC were to adopt an explicit numerical inflation target, the vision of the resulting regime would have to fit both the political realities and the basic approach to monetary policymaking in the United States over the past decade. Indeed, the case for adopting an explicit inflation target in the United States is typically rationalized in terms of continuity rather than change. That is, it is an attempt to ensure continuity in the conduct of monetary policy, especially after the departure of Alan Greenspan, not to be an instrument for changing the way in which monetary policy has been conducted over the past decade or two.

The key distinction essential for understanding the regime that would be a good fit for the United States is between *inflation targets* and *inflation targeting*. After explaining that distinction, I will offer my view of the vision of the Greenspan FOMC and consider the consistency of that vision with a regime with an explicit numerical inflation target. Next I consider the political climate for adopting an inflation target and other potential obstacles. I will conclude with a consideration of implementation details, as the choice is not ultimately between an explicit and implicit target in principle, but between the current practice and a specific alternative.

INFLATION TARGETS AND INFLATION TARGETING

This distinction between inflation targets and inflation targeting, first made in a speech in July 2001 while I was a member of the Board of Governors, can perhaps be best understood in terms of a two-by-two matrix (Table 1). Across the top, I identify two types of inflation targets, one implicit (like the United States today) and the other explicit (as in so-called "inflation targeting" countries today). Down the side I identify two forms of mandate that central banks around the world operate under. These mandates are typically set by the legislatures. The United States and Australia operate under a dual mandate, according to which monetary policy is directed at promoting both full employment and price stability, with no priority expressed, and with the central bank responsible for balancing these objectives in the short run. Inflation-targeting countries generally operate under hierarchical mandates, one in which price stability is identified as the principal objective, and central banks are restricted in pursuing other objectives unless price stability has been achieved.

The United States has an implicit inflation target and a dual mandate, the upper left. The United Kingdom, Canada, and other so-called inflation-targeting countries have an explicit inflation target and a hierarchical mandate. They are in the lower right. Australia has a dual mandate along with an explicit inflation target. That is the combination I am suggesting for the United States.

Lars Svensson always responds to my proposal by telling me that my distinction between dual and hierarchical mandates is too strict. In particular it misses the evolution in practice around the world. In general, inflation-targeting countries today have moved away from the initially austere implementation, more in line with the spirit of a hierarchical mandate, and have become flexible inflation targeters, close cousins of dual mandate central banks.

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Table 1

Monetary Policy Regimes

	Inflation target	
Mandate	Implicit	Explicit
Dual	U.S.	Australia
Hierarchical		U.K., Canada

There are two possibilities in connection with that evolution. First, the language in the mandates was intended to impose restrictions on the central banks, restrictions that went beyond simply identifying an explicit numerical inflation objective. So, whatever you want to call inflation targeters, from nutters to flexible inflation targeters, central banks under a hierarchical mandate are going to behave differently, specifically with less flexibility than in the case of dual mandate central banks. It is of course a topic for research, as to whether or not such differences can be identified in practice.

Second, what about the assessment that there is no practical difference between flexible inflation targeters operating under a hierarchical mandate and dual mandate central banks? If this were the case, the only difference between dual and hierarchical mandate central banks is one of transparency. Dual mandate central banks are transparent about their objectives and flexible inflation targeters are not. To allow for this possibility, I have shown a second two-by-two matrix, what I call my Lars Svensson model.

The transparency with respect to the stabilization objective for monetary policy is itself a fascinating subject. Historically, central bankers, unlike members of the Congress, have been embarrassed to admit they care about anything other than price stability or conduct monetary policy for any other purpose. Bob McTeer has perhaps said it best when he reminded the Committee that "only hawks go to central bank heaven." Even in the United States, it is much easier to find quotes from FOMC members about the importance of price stability than about the responsibility of monetary policymakers for damping fluctuations in output around full employment. You all, I expect, recall the pillorying Alan Blinder received when he noted at the Jackson Hole conference in August 1994 that monetary policymakers should keep an eye on the unemployment rate as well as on inflation.

This also reminds me of an incident at my very first Jackson Hole conference as a member of the Board in August 1996. Two of the leading central bankers in the world took me aside to help educate me about how to conduct myself so I would be viewed as an upstanding central bank citizen. They offered me the very same advice. Good central bankers never admit they pursue stabilization policy. Such an admission would reduce the confidence of the public in your commitment to price stability and therefore undermine your credibility and effectiveness as a monetary policymaker. I responded that I appreciated the advice, especially from such distinguished central bankers, but that it left me a bit confused. They seemed to be telling me that the way to build credibility was to lie, specifically about how I understood the objectives and how I intended to conduct monetary policy. I never followed their advice and indeed tried to educate the public about the importance of the dual mandate.

This distinction between dual and hierarchical mandates is central to the issue of the obstacles to moving to an explicit numerical inflation target in the United States and to the goal of designing a regime that provides for continuity with the vision of monetary policy as practiced in the United States for at least the past decade or two. Indeed, many of those who vigorously oppose inflation targets do so because they identify that practice with the hierarchical mandates and a down-weighting of responsibility of the central bank for promoting full employment.

One caveat is in order here. There *are* important differences between the full employment and price stability objectives, and I do not want to minimize or disregard these differences, because they are central to good practice for central banks. These differences may indeed be the origin for hierarchical mandates, though I expect the origin has more to do with the disappointing experience with monetary policy and inflation before the inflation-targeting regimes were adopted.

First, a central bank, over some appropriate intermediate term, can achieve an inflation target, with a significant degree of precision. It has a choice as to whether that target should be 2 percent or 3 percent or some other number. In a word, with respect to inflation, the buck literally does stop at the central bank. Central banks have less influence over the short-run path of output and employment, but, nevertheless, at the margin, can damp movements in output around its potential level.

Second, with respect to an inflation target, central banks know where they want to go. Notwithstanding biases and measurement issues, the central bank can pick a target and get there. Unfortunately, the same cannot be said for the full employment objective. We do not know exactly where it is at a given moment or where it may be in the future. It is, of course, not really as murky as that characterization suggests, but we have only an estimate of the non-accelerating inflation rate of unemployment (NAIRU) and of potential output, and we have to update that estimate over time, in part using information based on the experience with inflation. This measurement uncertainty does not mean that a central bank should not pursue its estimate of full employment, but it does imply that that pursuit has to be different in some subtle ways from the way it pursues its inflation objective. In particular, central banks cannot simply aim for a particular unemployment rate and decide after the fact if it is really sustainable. Rather, monetary policymakers have to be prepared to move aggressively into the range of the estimate of full employment and then perhaps move more gingerly toward the estimate, watching each step along the way for feedback as to whether it has gone far enough or has overshot.

THE VISION OF GREENSPAN

My premise is that the goal of any change with respect to the inflation target is one designed to preserve and even ensure continuity in the way monetary policy has been conducted under the Greenspan FOMC. I therefore set out my vision of that approach, identifying the three principles that, in my view, have guided practice.

1. **Build a reputation for a commitment to price stability in order to anchor inflation expectations.** While an inflation target can in principle contribute to this end, inflation expectations, in practice, are based more on performance than promise. Hence, outcomes are more important than rhetoric. Therefore, the first principle is that monetary policy should be conducted to move the inflation rate over time to a low, stable rate (the FOMC's implicit inflation target) and then to maintain it close to that rate, with allowances for normal cyclical variation. I thus identify the FOMC under Greenspan as an implicit inflation targeter.
2. **Monetary policymakers should aggressively respond to demand shocks that would otherwise move output and employment from their full employment levels, with appropriate consideration for prevailing and prospective inflation rates.** Well-anchored inflation expectations provide monetary policymakers increased freedom to adjust policy in the shorter run to damp movements in output relative to potential, without concern that such aggressive use of stabilization policy could destabilize inflation expectations. There is a corollary to the second principle. The anchoring of inflation expectations itself makes the economy more stable, reducing the effect on overall inflation of adverse supply shocks and reducing the instability that arises when the economy is allowed to overheat and inflation rises above the implicit inflation target, to be reversed later on.
3. **Monetary policymakers should be flexible and pragmatic in the conduct of monetary policy.** Policy rules can provide useful guidance to monetary policymakers, but policymakers' judgment will be essential in responding to unique shocks or circumstances and to making policy when the uncertainty about the model, parameters, or the measurement of key variables becomes especially large.

The Chairman, in my view, also believes that low, stable inflation contributes to strong productivity growth and hence to a higher maximum sustainable rate of economic growth. This provides still another reason why maintaining low stable inflation has significant payoffs for economic performance. I expect that the other members of the FOMC have less faith in this principle than the Chairman.

What is unique about the Greenspan vision are the synergies presumed between the two objectives for monetary policy—price stability and damping fluctuations around full employment—as well as between price stability and achieving maximum sustainable growth. What is also unique is that the Chairman, based on this vision, is generally viewed as being a hawk when it comes to containing inflation and a dove when it comes to quickly providing support for a weakening economy. That is a remarkable combination, politically as well as economically, and one that the FOMC presumably would not want to lose as it considers adopting an explicit numerical target for inflation.

THE POLITICS OF INFLATION TARGETS

The Congress sets the objectives for monetary policy, just as legislatures typically do in the case of other central banks around the world. The Greenspan vision, if not rhetoric, is, in my view, very much in sync with the Congressional mandate.

There is, in my opinion, no chance that the Congress would accept a regime with a hierarchical mandate that raised the profile of price stability and diminished the responsibility of the FOMC for stabilization policy. It is true that there have been specific bills introduced in the Congress that would have moved the Fed in this direction. But those bills reflected a minority position, indeed a very small minority position, and the overwhelming majority of the Congress would have rejected such an approach. The only exception would be if there was a period in which monetary policy in the United States was not appropriately disciplined and inflation rose to very high levels. The Congress might then impose a more restrictive mandate. And that is the historical experience that preceded the implementation of many of the inflation-targeting regimes around the world.

Nevertheless, there could be an obstacle in achieving a consensus with the Congress about any change in the conduct of monetary policy. The greater danger is that the Congress would want to balance an explicit target for inflation with an explicit target for full employment. And, for the reasons developed above—specifically, we do not know precisely the level of the NAIRU or potential output, and our estimates of these indicators of full employment change over time—the FOMC could not accept an explicit numerical target for inflation if it were bundled with an explicit target for full employment. This is perhaps the most important reason why consultations with the Congress are so important as a part of any interest of the FOMC in moving in this direction. My belief is that the Congress would accept an explicit numerical target for inflation in the context of a reaffirmation of the Federal Reserve's responsibility for promoting full employment.

So both the political realities and the focus on continuity require that an explicit numerical target for inflation be implemented as part of a dual mandate and be done in a way that does not undermine the flexibility of monetary policy to respond to various shocks or unusual circumstances. This is both the only choice and the best direction.

WHY BOTHER?

The FOMC is already an implicit inflation targeter; and policy has been successful in achieving a low rate of inflation, while preserving flexibility to pursue stabilization policy. As a result, there is some understandable skepticism about the payoff in terms of better policy or improved outcomes from making the inflation target explicit.

First, at the margin, an explicit inflation target should contribute to anchoring inflation expectations, both by identifying the point at which the public should put down the anchor and by establishing a consensus on the Committee about where the anchor should be. I personally believe that an explicit inflation target is more effective in anchoring inflation expectations once the target has already been achieved, rather than in lowering the cost of initially achieving the target.

Second, an explicit inflation target would also ensure a consensus on the Committee about the inflation rate members should be aiming at, ensuring that everyone is pushing in the same direction with respect to the inflation objective. This could, at the margin, improve the coherence of the deliberations and the policy outcomes. It should be noted, however, that the payoff from more coherent internal deliberations could be achieved by having an internally acknowledged target and does not require that the target be made public. However, in my view, it would be difficult to sustain and inappropriate politically for the Committee to agree on a target internally and not announce it publicly.

Third, the added transparency about monetary policy might further enhance the ability of bond market participants to anticipate the future course of monetary policy, shortening the lags from policy to outcomes, and thereby improving the effectiveness of policy. There is, I believe, a synergy between transparency and policy effectiveness; and, if so, the adoption of an explicit numerical inflation target will be a step toward a more effective monetary policy, improving the partnering between monetary policy and the bond market.

PROCESS

Part of the successful navigation through the political process is to set up a well-structured process of inside deliberation, outside consultation, and Congressional oversight about both the general direction and the details of the implementation. The degree of acceptance of the direction will ultimately

depend importantly on the details, including the reaffirmation of the commitment to the dual mandate, the precise level of the target, whether there is a range or just a point, the timeframe over which the FOMC would be judged about its compliance with the target, and any reporting requirements that accompanied the new regime.

Below, I set out a possible process for moving toward an explicit numerical inflation target in the United States.

1. The process should begin with internal discussion. There has to be, at the outset, sufficient support within the FOMC to justify a renewed and intensified focus on the topic. The FOMC then has to direct the staff to develop options and implementation details.
2. The staff should then revisit some of the topics they have previously considered, update some of the previous relevant studies, including the work presented at the July 1996 and July 1997 FOMC meetings, and set out options for implementation details.
3. The FOMC should then make a decision as to whether they want to adopt an explicit inflation target and set out a preliminary proposal for implementation details.
4. At this point, the Chairman should brief Congressional leaders about the desire of the FOMC to move in this direction and set up a mutually agreed consultation process, including hearings. An agreement would be reached as to whether the inflation target was to be adopted by the FOMC, in pursuance of the existing Congressional mandate for price stability, or whether the target was subject to consideration and approval by the Congress.
5. The preliminary proposal should be released to the public for comments.
6. After comments, a final proposal would be released and, after further Congressional consultations and perhaps hearings, would be implemented.

OBSTACLES

The most obvious obstacle to establishing an explicit numerical target for inflation is, of course, Alan Greenspan. He has made it clear that he is opposed to moving in this direction, though the argument he made at a conference at this Bank—specifically that he opposed an explicit target for inflation because we could not measure inflation precisely enough—was singularly disappointing and uncompelling. No matter. The Chairman clearly prefers the status quo for the remainder of his term, and no one on the Committee, including myself when I was there, would push to adopt an explicit inflation target while he was at the helm. But when the Chairman's term is over in early 2006, the topic will likely resurface and become an active one inside and outside the FOMC.

The second obstacle could be the new chairman. The new chairman should presumably be given some time to develop his own views on the topic and will undoubtedly have a considerable influence on whether the Committee moves in this direction. On the other hand, I expect the Committee will be looking to assert greater influence on policy outcomes and directions for policy strategy, and the momentum inside the Committee to at least give this careful consideration is likely to be impossible to contain.

The third obstacle is the politics of inflation targeting. The irony is that it might take a chairman with the clout and political savvy of Alan Greenspan to navigate such a change through the political process. I believe that the current legislative mandate provides a legal basis for the Fed to adopt a numerical inflation target, as long as the FOMC continues to accept the dual mandate. Nevertheless, adopting an inflation target would be viewed as an important change in the monetary policy regime and, as such, would need to be vetted with the oversight committees in the Congress. While I do not believe that new legislation is needed, the Fed would have to ensure that the Congress was comfortable with this direction.

The fourth is inertia. Members of the FOMC undoubtedly believe, as I do, that the Committee has conducted policy in a flexible yet disciplined and effective manner over the past decade. There is no perceived imperative to change the policy regime. It could be argued that adopting a numerical inflation target is not fundamentally a change in the regime, but the point is still "if it ain't broke, why fix it."

The fifth obstacle is the challenge of building a consensus for the change inside the FOMC and then for the details of the change. To do so, it will be necessary to meet head on the legitimate concerns of some who have staked out positions against such a direction. By the way, my basic procedural proposal is to lock Governors Ben Bernanke and Don Kohn in a room and not let them out until they have

reached an agreement. That agreement is one I am sure I and the overwhelming majority of the Committee likely could accept.

What is the core of the case against an inflation target? Don Kohn, in my view, has presented the most thoughtful argument against moving in this direction. There may be a trade-off between becoming more transparent and accountable by adopting an explicit numerical inflation target and losing some of the flexibility that the Committee has had in the conduct of monetary policy.

My proposal—adopting an explicit numerical inflation target in the context of a reaffirmation of the Committee's commitment to the dual mandate—is designed to meet that concern by making clear that the intention of the change was not to alter the way in which monetary policy has been conducted, but only to make that conduct more transparent and accountable.

Still, that concern lingers. It can perhaps be appreciated in terms of the Taylor rule, viewed as a simple summary of the way in which the FOMC conducts monetary policy. The question then is whether the FOMC can make explicit the numerical target for the inflation objective—one of the key terms on the Taylor rule—without, at the same time, also altering the response coefficient on the output gap relative to the response coefficient on the gap between inflation and the inflation target. That is, can the Committee more precisely identify one target without changing the way it balances its two objectives and the aggressiveness, in particular, with which it responds to deviations in inflation from its target?

Perhaps even more to the point, does adopting an explicit and numerical inflation target force monetary policymakers to be more mechanical in their conduct of monetary policy, as in following more closely a Taylor rule, as opposed to having the flexibility to deviate from the rule when circumstances encourage the Committee to do so?

I would not argue that this is a trivial question and one without merit. Indeed, many who favor an inflation target or a full-fledged inflation-targeting regime do so precisely because such an approach constrains discretion. It is noteworthy that in their discussions of the policy framework, Governor Bernanke's highest praise goes to one which involves "constrained discretion," while Governor Kohn reserves his highest praise for a policy that is flexible and pragmatic. Of course, they both undoubtedly see the merit in the attempt to achieve a balance among these properties of a policy regime.

I do not believe that, under my proposal, there would be much risk that monetary policy would lose its current flexibility—but that would depend on how the change was understood by the Committee, the Congress, and the public. My recent experience reinforces this point. I have recently talked to economists who often say that they oppose moving to an inflation-targeting regime; when they heard my proposal, however, they not only indicated that they could support it but seemed at least modestly enthusiastic about going in that direction. That suggests that much of the opposition to an explicit numerical inflation target is really opposition to the hierarchical mandates and perceived practices of so-called inflation-targeting regimes.

In any case, I believe that the Committee would have to become comfortable that they could conduct policy with the degree of flexibility they have in recent years, while still adopting an explicit numerical inflation target.

The last obstacle to adopting an inflation target is agreeing upon the details. As it is often said, the devil is in the details. Even those who might support some version of an inflation target might not be able to agree on the details of such a regime. That provides a good bridge to my last section, practical problems with implementing an inflation target.

PRACTICAL CONSIDERATIONS

I presume that the staff would be asked to come up with some recommendations and perhaps options for the various implementation details required to develop a proposal for the adoption of an explicit numerical inflation target. I will offer my own views on how the various issues might be resolved, identifying some potential deal busters, but I would quite likely change my mind about some of the details after reading the staff's recommendations and hearing the comments both from members of the Committee and outsiders who have been focused on this topic.

What Price Index Should the Inflation Target Be Based Upon?

I do not believe there is a definitive answer to this question, but I also do not believe that the answer is very important, assuming the choice is between a broad production-based index, such as the chain-weighted price index for gross domestic product, or a broad-based consumption measure, such as the consumer price index (CPI) or the personal consumption expenditures (PCE).

I do not believe that economic theory establishes whether a production- or a consumption-based measure of inflation is better as a target. Empirical analysis might reveal interesting differences in the way that monetary policy would respond to shocks under production- and consumption-based measures, and that analysis might help to make the decision. For example, the response of monetary policy to changes in the price of oil would be more aggressive under a consumption-based measure, although that conclusion would be reversed if the target was expressed in terms of a core measure of consumer price inflation.

Still, I expect, as with all other countries that have an inflation target, the choice will be a consumption-based measure, as these appear more widely understood by the public. This is also the direction of the discussion of this topic at FOMC meetings, specifically in July 1996.

This would leave us with a choice between the CPI and PCE measures. I viewed this as a close call up until the release of the chain version of the CPI. The chain CPI inflation rate lined up much closer to, and indeed very close to, the PCE measure. I would therefore opt for the PCE measure. But I wouldn't be a fanatic about this choice. There are times when I might, were I a member of the FOMC, indicate that the Committee was putting somewhat more attention on the CPI measure, as a result of distortions believed to be affecting the PCE relative to the CPI.

Should the Target Be Defined as Applying Over a Specified Time Horizon?

The Congress and the public, as well as the FOMC itself, are going to want to monitor the success of the FOMC in achieving the target established for inflation.

First, the Committee should always refer to inflation in terms of the 12-month inflation rate for the measure it selects, and specifically not talk about monthly or even quarterly inflation rates. All monitoring of FOMC performance relative to the target should be focused on the 12-month rate.

Second, the Committee should emphasize that it is focused on achieving the target over an intermediate term and will move only gradually to return inflation to the target if a shock pushes inflation away from the target, especially if it is pushed outside its monitoring range.

Many inflation-targeting countries explicitly interpret their inflation target as applying to the intermediate term, typically out $1^1/_2$ to 2 years. This is sometimes referred to as inflation-forecast targeting. Central banks often report their inflation forecast over this horizon, and it is expected that such forecasts will be lined up on the inflation target.

This approach creates a potential tension with a dual mandate. Under such a regime, it is not appropriate to always be at the inflation target, just as it would not be appropriate to always be at the point of maximum sustainable employment. An example would be that it would make sense for inflation to be above the inflation target late in the expansion. If inflation just rose to the target during expansions and fell below the target in recessions, the average inflation rate will be below the target. In addition, the overall target might have to be set higher in this case, to reduce the prospect of occasionally hitting the zero nominal bound.

In my view, a good way to set the target would be as an average over the business cycle. Of course, taken literally, that would be an average inflation target, with properties like a price level target, in that past deviations from the inflation target would not be forgiven, but might at least implicitly be expected to be offset by deviations in the other direction later.

Should the Target Be the Overall Measure of Inflation or a Core Measure of Inflation?

If the objective is viewed as the forecast for inflation over the intermediate term, say $1^1/_2$ to 2 years out, then it does not matter very much, if at all, whether the target is specified as overall or core inflation. That is because any shock will have dissipated by then, so the policy that would be consistent with achieved overall and core inflation rates 2 years out would be very close, if not identical.

Still, the public and the Committee are going to want to monitor inflation outcomes along the way to determine whether the inflation performance is broadly consistent with the target. In my judgment, the core measure, by providing the best guidance about expectations for overall and core inflation in the future, is the better measure for monitoring how the FOMC is doing relative to its inflation target. I would prefer to use a core measure as the inflation target itself because I believe that would reduce possible confusion about how the Committee views departures from the inflation target induced by temporary supply shocks.

Still, the choice between core and overall meas-

ures of inflation would make a difference in the conduct of monetary policy, at least if policymakers were responding to recent changes in inflation in their decisions about the setting of the funds rate target. As a result, the optimal response to price shocks remains an important consideration in the choice between core and overall inflation rates as targets. If it is optimal to "look through" the direct effects of a price shock, and only respond to the extent that there are indirect effects that later raise the core inflation rate, this might suggest a preference for the core measure. On the other hand, the presumption that some portion of a price shock would likely pass-through to the core may suggest the desirability of some initial response to the direct effect.

Should the Target Be Set as a Point or a Range, and, if a Range, Should There Be a Special Focus on the Midpoint?

I prefer either a point target or a range with a focus in the midpoint as the explicit target. This would likely provide a better anchor for inflation expectations and reduce the indecision in the markets when the central bank was at one end of the range about whether or not the central bank would look for an opportunity to move back to the middle.

That does leave the question of what the purpose of a range is and how wide the range should be. One purpose is to identify a range of variation that is typical cyclically and would not be as strongly resisted as when inflation moves outside the range. That suggests a kind of nonlinear policy response that could, in turn, be effective in limiting the variation of inflation expectations. The range might also identify, for example, the upper limit to where the Committee would be comfortable pursuing an opportunistic disinflation strategy, and the lower limit could identify the level below which policy would be more focused on erring on the side of ease, because of concerns about the possibility of deflation or hitting the zero nominal bound.

Many inflation-targeting countries have chosen a range of 1 percentage point, typically from 1 percent to 3 percent. Governor Bernanke has indicated that he would like to see inflation within a 1-percentage-point range, 1 percent to 2 percent.

Should the Inflation Target Be Set Once and for All or Be Subject to Adjustment?

The spirit of an inflation target is that it should be set and remain in place for long periods, so as to ensure economic agents that they can make longer-run decisions with confidence about the average inflation rate over such horizons.

But, while the target should not be changed often, there should be a willingness to revisit the target, on occasion, as evidence about the inflation bias evolves and as research provides new information about the appropriate size of the cushion relative to zero true inflation.

Should the Target Be a Price Level or Inflation Target?

There has been considerable discussion about the benefits of a price level rule for an economy facing the danger of deflation. Similar benefits accrue to a target for the average inflation rate over some period, as long as there is a commitment to compensating for periods when inflation is below the target with periods where inflation is above the target. However, as I have suggested, the case for moving to an explicit numerical inflation target is generally perceived to be an attempt to preserve continuity in U.S. monetary policy, not to provide an opportunity for a significant change in the way in which that policy is conducted. So I would not anticipate that an option of a price level target would be seriously considered.

Should the Inflation Target Be Set for True Price Stability or Price Stability Plus a Cushion, and, if There Should Be a Cushion, How Large Should It Be?

The FOMC considered this topic in considerable detail at the first FOMC meeting I participated in, in July 1996. Janet Yellen made the case for an inflation target set high enough to both take into account measurement error and also allow a cushion that took into account the potential deterioration in economic performance if inflation were too low.

She called for an inflation target of 2 percent and everyone on the Committee lined up to state their preference. The Chairman tried to get away with his vague definition of price stability: "Price stability is that state in which expected changes in the general price level do not effectively alter business or household decisions." But Yellen pressed him and asked if he could put a number on that. Remarkably, the Chairman agreed, and said he preferred zero inflation, correctly measured. Janet asked if he could settle for 2 percent incorrectly measured.

By the way, this is the only time during my $5^1/_2$ years on the Board and the FOMC that anyone was able to extract from the Chairman a number related

to his forecast, his estimate of productivity growth or anything else—of course, other than his recommendation each meeting for the federal funds rate target.

During a go-around on the topic, only a few Committee members preferred a target of zero, and the consensus was very strong for a 2 percent inflation target. The Chairman ended up summarizing the discussion as "an agreement for 2%," but then cautioned Committee members not to reveal that such a discussion even took place.

Interestingly, the Chairman asked toward the end of the discussion to what measure of inflation the 2 percent target should apply. Yellen indicated she did not have a specific measure in mind, but most of the Committee appeared to be thinking in terms of the CPI, specifically the core CPI. Greenspan argued that the PCE was the better measure of consumer price inflation and that the target should be set in terms of the best measure. He then pointed out that while the core CPI was 2 1/2 percent, the core PCE was already 2 percent, so that the Committee could apparently declare victory.

Bob McTeer noted, however, that the specific target depends on the specific measure. If the Committee preferred 2 percent for the core CPI, the consistent target for the core PCE would be 1 1/2 percent, given the recent differentials among the measures. Interestingly, the Chairman's apparent acquiescence to a 2 percent target for the core PCE would have left him with a higher target for inflation than preferred by the rest of the Committee.

What if that discussion were opened up today? Governor Bernanke has indicated his preference for a target of 1 to 2 percent, presumably for the PCE measure, in line with the spirit of the July 1996 meeting. But a lot has happened since then, particularly experience in Japan with deflation and in the United States with low inflation.

The lessons drawn from these experiences have reinforced the wisdom of Yellen's remarks in July 1996, specifically that inflation can be too low as well as too high, and that monetary policymakers need to raise inflation to its target when inflation falls below the target, just as they need to lower inflation when it rises above the target.

Indeed, the lessons from recent experience suggest that policy should be asymmetric, in light of the asymmetric risks associated with deflation and the zero nominal bound. That is, policymakers should be more aggressive raising inflation to its target when it is initially too low than lowering it to its target when it is initially too high.

An interesting question is whether the inflation target should be set high enough so that policymakers could respond symmetrically to movements in inflation above and below the target, except perhaps in a small percentage of cases.

That suggests that consideration might be given, for example, to a 1 1/2 percent or 2 percent target for the core PCE.

Should Additional Reporting Requirements Accompany the Introduction of an Explicit Numerical Inflation Target?

A feature of inflation-targeting regimes, in additional to an explicit numerical inflation target and a hierarchical mandate, is greater transparency about the forecast and a greater focus on explaining any departures from the target.

First, the FOMC should not issue a separate "inflation report"—because that would be inconsistent with the spirit of the dual mandate. The only change relative to the Monetary Policy Report and semi-annual testimony would be some explicit commentary on the outcome for inflation relative to the target, and, when inflation is outside the monitoring range, why that occurred and how the Committee viewed the process and timetable for a return to an inflation rate inside the range.

Second, the FOMC forecast should explicitly include whatever inflation measure the target is based upon. Today, the FOMC provides its forecast of the overall inflation rate for the PCE, while many, including myself, believe that the Committee makes its decisions based more on the core measure. If the target is stated in terms of the core measure, it should be included in the FOMC forecast.

Third, since the FOMC controls inflation over the intermediate term, it would be useful if the FOMC forecasts always went out at least 1 1/2 to 2 years. The current practice is that the FOMC forecast in late January or early February only extends through the remainder of that year. This should be extended for another year.

Fourth, it might be useful to increase the frequency of FOMC forecasts from twice per year to four times. Just as a picture is worth a thousand words, a forecast can be more revealing than speeches and testimonies.

Fifth, if there is more attention on the forecast, the Committee should fine-tune the process by which they are prepared by the individual Committee members. The forecasts are supposed to be based on "appropriate" monetary policy, but the

forecasts the staff provides the Committee are often based on a constant nominal funds rate. The staff should help the Committee members in the forecast process by always providing them a forecast based on a policy rule or an "optimal policy" simulation.

AN EXAMPLE OF AN EXPLICIT NUMERICAL INFLATION TARGET

The FOMC will conduct policy in an effort to achieve maximum sustainable employment and price stability, where the latter is defined as an inflation rate of *1½ percent*, measured by the *core PCE inflation rate*. Given that the economy is subject to shocks and business cycles, it will be impossible for the Committee to achieve simultaneously both objectives at each moment in time. The objective for employment is to minimize the variance of employment relative to its maximum sustainable level. The objective for price stability is to achieve an average for the rate of inflation as close as possible to the inflation target *over the business cycle*.

The inflation target is *symmetric*, as the Committee recognizes that inflation can be too low as well as too high. Therefore, monetary policy would be directed to raising inflation if it fell below the target and lowering inflation if it rose above the target.

The Committee has intentionally set the target so as to provide some *cushion* to reduce the likelihood that the economy could encounter deflation or that the federal funds rate could reach the zero nominal bound.

The Committee, in conducting its policy, finds it useful to establish a *monitoring range* around the inflation target of *1 to 2 percent*. Movements within the band represent cyclical variation in the inflation rate that is acceptable to the Committee. Movements outside this range would be of more concern and would be more vigorously countered by monetary policy, with appropriate consideration as to whether the divergences were likely to be temporary or more permanent, without the intervention of policy.

Commentary

Lars E.O. Svensson

Larry Meyer has presented us with a fine paper on practical problems and obstacles to inflation targeting in the United States—a very suitable paper for this great conference at the St. Louis Fed. I find it a very thoughtful paper with many good points. I agree with most of the points Larry makes; I hope many people will read the paper and, in particular, take seriously his proposal for inflation targeting in the United States.

However, one issue that I believe Larry puts too much weight on is his pet idea, the distinction between a dual and hierarchical mandate. I do not believe this distinction is very useful. We are all flexible inflation targeters now. More precisely, we are all talking about an intertemporal loss function for monetary policy consisting of the expected discounted sum of present and future period losses, that is, of the form

$$E_t \sum_{\tau=0}^{\infty} (1-\delta)\delta^{\tau} L_{t+\tau},$$

where the period loss function is typically given by

$$L_t = \frac{1}{2}\left[\left(\pi_t - \pi^*\right)^2 + \lambda_y\left(y_t - \bar{y}_t\right)^2\right].$$

Here, E_t denotes expectations conditional on information available in period t (typically a quarter), δ is a discount factor and fulfills $0 < \delta < 1$, π_t denotes an inflation measure in period t (typically four-quarter inflation for a specified price index), π^* denotes the inflation target, y_t denotes log output, $\bar{y}_t$ denotes log potential output, $y_t - \bar{y}_t$ is the output gap, and $\lambda_y > 0$ is the relative weight on output-gap stabilization relative to inflation-gap stabilization. Alternatively, the period loss function can be expressed in terms of employment,

$$L_t = \frac{1}{2}\left[\left(\pi_t - \pi^*\right)^2 + \lambda_l\left(l_t - \bar{l}_t\right)^2\right],$$

where l_t and $\bar{l}_t$ denote log employment and log equilibrium employment, respectively, $l_t - \bar{l}_t$ is the employment gap, and $\lambda_l > 0$ is the relative weight on employment-gap stabilization.[1]

Let us look at the loss function in terms of the output gap. There are three parameters there: δ, π^*, and λ_y. The δ, the discount factor, is very close to 1 and not a big issue. The π^* is the inflation target, announced explicitly by an inflation targeter. There remains only one parameter, the λ_y, the relative weight on output-gap stabilization. The adjective "flexible" in "flexible inflation targeting" has to do with the value of λ_y.

The issue is really how to describe a loss function of this type in words rather than a formula. I do not believe the dual-hierarchical distinction helps in this respect. But, if we must use it, we can think of this loss function as saying something about the *first* moments, the long-run means, of the target variables, inflation and output; and the *second* moments, the variability of the target variables around those means.

Regarding the first moments, there is a target for long-run mean inflation, π^*. This target is subject to choice by the central bank or by its principal, the government or the parliament, depending on the institutional setup in the country. But the target for output is *not* subject to choice. It is a "fact." It is given by the economy, by its potential output. Since potential output is an unobserved variable, it requires estimation. We can say that the output target is subject to *estimation*, but it is certainly not subject to *choice*. Alternatively, we can say that the *output-gap* target is given at zero, and also not subject to choice. Since there is a meaningful choice of the target for long-run inflation but not of the target for long-run

[1] The period loss function could also be expressed in terms of the unemployment gap, $u_t - \bar{u}_t$, instead of the employment gap, where u_t denotes unemployment and $\bar{u}_t$ denotes equilibrium unemployment.

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output or the output gap, and therefore an asymmetry between the two targets, we can, if we like, talk about a *hierarchical* mandate for long-run inflation.

Regarding the second moments, the parameter λ_y expresses the weight on the loss from output-gap variability relative to the loss from inflation variability. Whenever λ_y is positive, output-gap stability, as well as inflation stability, is an objective. There is a symmetry between the two variability objectives, and we can, if we like, talk about a *dual* mandate for inflation-gap variability and output-gap variability. Since all inflation targeters are flexible inflation targeters, in the sense that they are concerned about stability of the real economy in addition to stability of inflation, we can, if we like, talk about inflation targeters as having a dual mandate. But, as long as we know that we are talking about different verbal descriptions of monetary policy loss functions of the kind stated above, I do not find the dual/hierarchical mandate distinction helpful. In particular, it is misleading to say that inflation targeters have a hierarchical mandate but the Fed has not.

Let us compare the mandates for the Fed and for the Reserve Bank of New Zealand (RBNZ). The mandate for the Fed, as expressed in the Federal Reserve Act, is: "[The Fed shall] promote effectively the goals of maximum employment, stable prices, and moderate long-term interest rates." The mandate for the RBNZ, as expressed in the 2002 Policy Target Agreement (PTA), is: "[The RBNZ's policy target] shall be to keep future CPI inflation outcomes between 1 per cent and 3 per cent on average over the medium term." But the PTA also states that, "[i]n pursuing its price stability objective, the Bank...shall seek to avoid unnecessary instability in output, interest rates and the exchange rate."

First, I do not find the formulation of words in the mandate for the Fed to be particularly well-chosen. These words need careful interpretation to be a meaningful mandate for monetary policy. The expression "maximum employment" does not make sense from the point of view of modern monetary macroeconomics. Taken literally, it leads directly down the inflation-bias lane of Kydland, Prescott, Barro, and Gordon. Instead, the Fed prefers to deviate from the words of the Federal Reserve Act by inserting the word "sustainable" before "employment." This insertion allows the interpretation of "maximum employment" as "equilibrium," "natural," or "potential" employment, which is required to make sense of the mandate. This way, the mandate can be said to describe a loss function like the ones above, although without saying anything about the parameters, except that λ_l is positive.

Second, I do not see that the New Zealand PTA says anything substantially different about the form of the loss function than the (reinterpreted) U.S. Federal Reserve Act. "Avoiding unnecessary instability in output" can certainly be interpreted as "avoiding unnecessary instability in the output *gap*" and be seen as a verbal description of the loss function above. Thus, the PTA says that the λ_y is positive, in addition to specifying the parameter π^* (the latter we can interpret as the midpoint of the target range, that is, 2 percent).[2]

In conclusion, I do not see that these two mandates are different in a way that makes it meaningful to say that one is dual and the other is hierarchical.

To continue with Larry's paper, his goals for a change in the Fed framework are to improve transparency and accountability and to enhance the effectiveness of monetary policy, without fundamentally altering the basic approach to the conduct of monetary policy under the Greenspan Federal Open Market Committee (FOMC). He goes on to discuss the vision of the Greenspan FOMC and summarizes it in three principles. I believe one could add a fourth principle to these, namely, "Avoid commitment, transparency, and accountability." It seems to me that the vision of the Greenspan FOMC includes maintaining maximum discretion, including maximum discretion about interpreting and reinterpreting the mandate. This is "flexibility," but in a very different—and rather undesirable—sense from the flexibility in flexible targeting.

I believe the world has voted many times on the Greenspan Fed versus inflation targeting. As far as I know, no country has copied the vision of the Greenspan Fed, but many countries have copied the inflation-targeting framework of the RBNZ, the Bank of England, and Sweden's Riksbank. Furthermore, Michael Woodford's (2004) paper for this conference explains clearly and convincingly how commitment and transparency are essential in making more effective the management of expectations, which is at the core of modern monetary policy, and, in particular, how this provides a strong argument for inflation targeting. In my own work, for instance, in Svensson (1999), I have emphasized

[2] In my review of NZ monetary policy, Svensson (2001), a major issue was whether the RBNZ had conducted monetary policy with the appropriate degree of flexibility, that is, whether it had successfully avoided unnecessary variability of output, interest rates, and the exchange rate. My conclusion was that it had.

that inflation targeting is fundamentally a commitment to sensible monetary policy objectives and to transparency about those objectives. This puts inflation targeting in stark contrast to this fourth principle of the vision of the Greenspan FOMC.

Some have noted that the Fed has become more transparent in recent years. This is true, but most of it seems to consist of somewhat reluctant concessions to outside pressure and the example set by the inflation targeters rather than enthusiastic reforms from within. I suggest that this fourth principle be abandoned.

Larry goes on to discuss the politics of inflation targeting, why to bother about a change in the framework at all, why to do it now, and what the obstacles are. He also discusses the case against inflation targeting.

The case against has most explicitly been laid out by Kohn (2003), with worries about the possible loss of flexibility: "[T]he success of U.S. monetary policy has in large part derived from its ability to adapt to changing conditions—a flexibility that likely has benefited from the absence of an inflation target."[3] As far as I can see, the flexibility referred to here is the flexibility to reinterpret the mandate and change the monetary policy objectives. I believe such flexibility is flexibility of the wrong kind. Instead, I believe that all the flexibility we need is the flexibility summarized in the λ above, the weight on stabilization other than that of the inflation gap. I do not see what prevents the Fed from announcing an inflation target and becoming an explicit inflation targeter and, in particular, introducing its own variant of inflation targeting, a high-λ, high-flexibility one. Indeed, nothing prevents the Fed from being an explicit super-flexible inflation targeter, if that is what it wants to be. It may even call itself an "inflation-and-output-gap targeter," or an "inflation-and-real-economy stabilizer," or whatever. The Fed might indeed want to set an example for the world, by being the most flexible inflation targeter in history. What I do not get is what the social benefit is from the Fed being fuzzy about its objectives.[4]

In sum, there is simply no case against inflation targeting for the United States. There is no downside to inflation targeting for advanced countries. This is furthermore demonstrated by the fact that no country has, to my knowledge, had any regrets about adopting inflation targeting. In contrast, the view in these countries seems to be that it is the best monetary policy regime they have ever had.

Larry goes on to discuss a number of practical considerations, with many good and concrete suggestions. He suggests not calling the monetary policy report "Inflation Report," but calling it "Monetary Policy Report" instead. I have no quarrel with this. Indeed, many inflation-targeting central banks call their report something other than "Inflation Report"; the RBNZ calls it "Monetary Policy Statement." The important thing is not the name but that it provides the appropriate information.

In particular, I believe that the report should ideally include forecasts of inflation, output, potential output, and the interest rate, with the appropriate fan charts to indicate the uncertainty in these forecasts. The forecasts should be the best unconditional forecasts; that is, they should be for the optimal interest-rate path, the most likely future interest-rate path. Only then do the forecasts provide the best guide for private-sector expectations, and only then does it make sense to compare the forecasts with ex post outcomes. Furthermore, I believe the forecasts should extend to three years rather than the standard two (the RBNZ and Bank of Norway already have three-year forecasts). It is awkward when the forecasts end at two years, since there is often quite a bit of discussion of the two-year horizon. In most cases, there would not be much specific information about the third year, which implies that in most cases the forecasts for the third year would be flat on target; but it will be reassuring to the general public that there is nothing dramatic lurking beyond the two-year horizon that the central bank is aware of but does not mention. Three-year forecasts would also be more in line with the increasingly frequent reference to "the mid term." In the interest of increased transparency, I would humbly suggest that this term be replaced by "1.5–3 years" or similar, whenever possible.

A recent innovation of the Bank of Norway—an enthusiastic newcomer to the inflation-targeting camp that has moved straight into the group of best-practice inflation targeters (see Svensson et al., 2002)—is to plot the inflation forecast and the output-gap forecast in the same graph (see chart 1 in Norges Bank, 2003). This clearly serves to emphasize that the Bank is concerned with the stability of the real economy as well as with inflation, emphasizing the flexibility in its inflation targeting.

Finally, Larry provides a concrete example of

[3] See McCallum (2003) for a strong rebuttal of Kohn's arguments.

[4] Debelle (2003) provides an interesting description and discussion of the flexible inflation targeting of the Reserve Bank of Australia.

an inflation-targeting proposal for the Fed, with an inflation target of 1.5 percent for the core PCE price index, in line with the proposal of Goodfriend (2003). I hope that a proposal similar to these is adopted soon.

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Panel Discussion

Inflation Targeting

Ben S. Bernanke

Should the Federal Reserve announce a quantitative inflation objective? Those opposed to the idea have noted, correctly, that the Fed has built strong credibility as an inflation-fighter without taking that step and that this credibility has allowed the Fed to be relatively flexible in responding to short-run disturbances to output and employment without destabilizing inflation expectations. So, the opponents argue, why reduce this flexibility unnecessarily by announcing an explicit target for inflation?

It would be foolish to deny that the Fed has been quite successful on the whole over the past two decades. Whether the U.S. central bank would have been even more successful, had it announced an explicit objective for inflation at some point, is impossible to say. We just don't know. We can't rerun history; and although empirical cross-country comparisons can be useful, they are far from being controlled experiments.

However, the relevant question at this point is not the unknowable outcome of the historical counterfactual but whether, given the initial conditions we face today, the adoption of an explicit inflation objective might not improve U.S. monetary policy in the future. The Fed's environment today is different from that of the 1980s and 1990s in at least one important respect: Price stability is no longer just over the horizon, but has been achieved—core inflation rates are currently not much above 1 percent. Thus, in contrast to the experience of the past 35 years or so, in which there could be little doubt about the Fed's desired direction for inflation, today the risks to inflation are more nearly symmetrical; that is, inflation can be too low as well as too high.

A case can be made, I believe, that when the economy is operating in the region of price stability, public expectations and beliefs about the central bank's plans and objectives, always important, become even more so. First, because the public can no longer safely assume that the central bank prefers lower to higher inflation, expectations about future policy actions and future inflation may become highly sensitive to what the public perceives to be the Fed's "just right" level of inflation. Uncertainty about this "just right" level of inflation thus may translate, in turn, into broader economic and financial uncertainty. Second, at very low inflation rates, the zero lower bound on the policy interest rate is more likely to become relevant, which increases the potential importance of effective expectations management by monetary policymakers. For example, when interest rates are very low, the best way to ease policy may be to explain to the public that the current low interest rate will be maintained for a longer period, rather than simply lowering the current rate. It seems to me that the enhanced importance of public beliefs and expectations about monetary policy in the region of price stability argues for greater attention by the central bank to its methods of communication when inflation is low.

On the premise that effective communication is even more crucial near price stability, I will focus today on how an incremental move toward inflation targeting, in the form of the announcement of a long-run inflation objective, might help the Fed communicate better and perhaps improve policy decisions as well, *without* the costs feared by those concerned about a potential loss of flexibility. As usual, my views are not to be attributed to my colleagues on the Board of Governors of the Federal Reserve System or the Federal Open Market Committee.

As a preliminary, I need to introduce the idea of the optimal long-run inflation rate, or OLIR for short. (Suggestions for a catchier name are welcome.)

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The OLIR is the long-run (or steady-state) inflation rate that achieves the best average economic performance over time with respect to *both* the inflation and output objectives.

Note that the OLIR is the relevant concept for dual-mandate central banks, like the Federal Reserve. Thus, it is not necessarily equivalent to literal price stability or zero inflation adjusted for the usual measurement error bias. Rather, under a dual mandate, a strong case can be made that, below a certain inflation rate, the benefits of reduced microeconomic distortions gained from price stability are outweighed by the costs of too-frequent encounters of the funds rate with the zero-lower-bound on nominal interest rates. (This argument underlies the common view that there should be a "buffer zone" against deflation.) Hence, in general, the OLIR will be greater than zero inflation, correctly measured. Note also that the OLIR is an average long-run rate; variation of actual inflation around the OLIR over the business cycle would be expected and acceptable (Meyer, 2004).

What is the OLIR for the U.S. economy? A fairly extensive recent literature has attempted to quantify the OLIR. (See, e.g., Coenen, Orphanides, and Wieland, 2003, and references therein.) Because direct measures of the benefits of low inflation are not available, papers in this literature, in practice, estimate the OLIR to be the lowest inflation rate for which the risk of the funds rate hitting the lower bound appears to be "acceptably small." Interestingly, the results using this approach seem fairly consistent across models and specifications, with several papers (including work using FRBUS, the Federal Reserve's large econometric model of the U.S. economy; see Reifschneider and Williams, 2000) having concluded that the risk of hitting the zero bound seems to decline sharply once the long-run average inflation rate rises to about 2 percent. In addition, other studies of the costs of very low inflation (such as the supposed effects of downward nominal wage rigidity on the allocation of labor) have found that these costs are also largely eliminated at inflation rates of about 2 percent (Akerlof, Dickens, and Perry, 1996; see also Altig, 2003).

Fortuitously, then, it may be the case that something in the vicinity of 2 percent is the optimal long-run average inflation rate for a variety of assumptions about the costs of inflation, the structure of the economy, the distribution of shocks, etc. However, before we embrace that number, many details remain to be filled in. For example, in practice, much might depend on the specification of the inflation index, on assumptions made about the steady-state value of the real interest rate, and on other factors. Also important would be getting a better sense of the range of uncertainty around this number. More research on this issue would be highly worthwhile. As the economy seems currently to be moving toward a sustainable expansion path, with a stabilizing rate of inflation, having an estimate of the OLIR likewise seems crucial to making good policy in the next few years. The issue is one that, in my view, the FOMC and the staff should be looking at carefully.

Suppose, as I believe would be feasible, that the FOMC were able to agree on a value or central tendency for the OLIR, based on the results of staff research and discussion among Committee members. Of course, the value of the OLIR would only be a rough approximation to the "truth," but one cannot avoid making such approximations in policymaking, whether implicitly or explicitly. Should the FOMC then take the next step and announce this number to the public? Some have argued that such an announcement would be unnecessary because the Fed's implicit inflation objective is already well understood by the market. I am skeptical. Publicly expressed preferences by FOMC members for long-run inflation have ranged considerably, from less than 1 percent to 2.5 percent or more. Long-run inflation expectations implicit in the pricing of inflation-indexed securities vary significantly over time, and the apparently high sensitivity of long-term nominal interest rates to Fed actions suggests some uncertainty about the Fed's long-run inflation target (Gurkaynak, Sack, and Swanson, 2003). Gavin (2004) points out that the range of private-sector forecasts for inflation is typically higher for the United States than for inflation-targeting countries.

If announcing the OLIR does not constrain short-run policy unduly, I really cannot see any argument against it. To reassure those worried about possible loss of short-run flexibility, my proposal is that the FOMC announce its value for the OLIR to the public *with the following provisos* (not necessarily in these exact words):

(i) The FOMC believes that the stated inflation rate is the one that best promotes its output, employment, and price stability goals in the long run. Hence, in the long run, the FOMC will try to guide the inflation rate toward the stated value and maintain it near that value on average over the business cycle.

(ii) However, the FOMC regards this inflation rate as a long-run objective only and sets no fixed time frame for reaching it. In particular, in deciding how quickly to move toward the long-run inflation objective, the FOMC will always take into account the implications for near-term economic and financial stability.

As you can see, stating the OLIR with these provisos places no unwanted constraints on short-run monetary policy, leaving the Committee free to deal with current financial and cyclical conditions as the Committee sees fit. In this respect, the proposal is very similar to one recently advanced by Governor Gramlich (2003).

To be clear, because neither the horizon at which the inflation objective is to be attained nor the expected path of inflation and output is specified under this proposal, what I am suggesting is not equivalent to inflation targeting as commonly understood. Instead, what is being proposed is an incremental step that I believe would provide important benefits in itself and which would leave the door open for further steps later if that seemed appropriate. In the language of Faust and Henderson (2004) at this conference, my objective is to get the mean of inflation right while leaving the determination of the variance open for future discussion and debate.

Without any fixed time frames for reaching the optimal long-run inflation rate, would an announced value for the OLIR carry any credibility? I think it would, for the important reason that the OLIR is not an arbitrarily selected value. In particular, because this inflation rate would have been judged by the Committee to be the one under which the economy operates best in the long run, the FOMC would have an incentive to try to reach it eventually, *even if it were not an announced long-run objective of policy*. Thus, despite the lack of a time frame, the OLIR should have long-run credibility; that is, it should be the best (lowest-forecast-error) answer to the question, What do you expect the average inflation rate in the United States to be over the ten-year period that begins (say) three years from now?

Additional reasons that the announcement would carry weight are the accumulated credibility of the Fed and the fact that we are presumably starting from a point near the optimal inflation rate, so that a period of costly disinflation will not be needed to reach the OLIR. In other words, this relatively unconstrained approach might not work for other central banks, and it might not have worked for the Fed at other times (e.g., when we were at early stages of the disinflation process); but given the current configuration of circumstances, it should work now.

I have argued that announcing the OLIR would not have significant costs. What are the benefits? In my view, the announcement of the OLIR should serve as a useful clarification of the long-run objective of the Fed and would thereby provide a long-run "anchor" to monetary policy. Among other benefits, the announcement of the OLIR should help participants in financial markets price long-term bonds and other financial assets more efficiently; help to lower inflation risk in financial markets and in other forms of contracting; and tend to stabilize long-term inflation expectations more broadly, which in turn would make short-run stabilization policy more effective (Orphanides and Williams, 2003). Although the announcement of the OLIR would not constrain short-run policymaking in undesirable ways, it would nevertheless also help the market make inferences about the likely timing and extent of tightening and easing cycles, since, all else equal, the FOMC would want the inflation rate to move "asymptotically" toward the long-run desired level. For example, if the current inflation rate were known to be below the OLIR, that fact would convey some information about how long it will likely be before the Fed begins its tightening cycle.

Because some of the principal benefits of announcing the OLIR would arise from the reduction of uncertainty in financial markets and in the economy more broadly, I prefer the announcement of a single number for the OLIR, or at least a number with a surrounding tolerance range that is as narrow as the Committee can live with. I acknowledge that the OLIR cannot be determined precisely. Nevertheless, to the extent that the FOMC is fairly indifferent over a modest range of long-run inflation rates, there would be a positive benefit to choosing a single number within that range and trying to coordinate public expectations on that number.

Agreeing on and announcing a value for the OLIR might improve policymaking more directly, at least on the margin. In particular, the stated inflation objective would help guide policy during periods, like now, in which the economy is (we hope) returning to a sustainable growth path; at all times, it would also serve as a reminder to policymakers to keep one eye on the long run at the same time that they are reacting to current developments in the economy. But, to reiterate, it seems likely that the biggest gains would be in the area of communica-

tions. Sharing the OLIR with the public would address the most important information asymmetry in the system: namely, the public's imperfect knowledge of the FOMC's objectives. I believe this step would help to reduce the reliance of the Fed on complex and easily misinterpreted qualitative language in its communications with the public.

I conclude with a word on the politics of this proposal. One concern frequently expressed about announcing an inflation objective is that the Congress would interpret the introduction of an inflation target as a repudiation of the dual mandate. This would be a misinterpretation, but I understand why some legislators might draw the wrong conclusion.

However, it seems to me that the recent attention to the risk of deflation changes the political calculus. There now exists a broad awareness that an inflation rate that is too low, by raising the probability of deflation and a binding zero bound on the nominal interest rate, poses a threat to output and employment stability. Therefore the connection between the announced OLIR and the real side of the economy will be much more apparent to non-economists. Indeed, the entire rationale for the OLIR can be expressed in terms of jobs and growth. The FOMC might say to Congress: "We don't want long-run inflation to be too high, because low inflation promotes growth and productivity. On the other hand, inflation shouldn't be too low, because we want to have all the room we need to respond to the dangers that deflation poses for output and employment. We pose the objective in terms of inflation only because that is what the Fed can control in the long run." It does not seem to me to be such a difficult case to make in terms of the existing dual mandate. In addition we would have the explicit proviso that important short-run economic and financial goals will not be sacrificed to reach the long-term inflation objective more quickly. Although it would be important to vet these ideas thoroughly with the relevant Congressional committees before proceeding, I am hopeful that a change of the type I am proposing would be acceptable to Congress as being within the spirit of existing legislation.

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Inflation Targeting: A View from the ECB

Otmar Issing

1. INTRODUCTION

What is the ultimate objective of monetary policy? What is the appropriate framework for conducting monetary policy? Central bankers and academics have been asking these critical questions for decades. This conference, in which I was honored to take part, was a milestone in this long-standing debate.

It is a fact that never before in the history of *fiat* money has there been so much consensus on the benefits of a low-inflation environment, and many central banks have achieved results consistent with this conviction. This is a tremendous achievement and one that could easily lead us to think that at last this long-standing debate has been settled once and for all.

However, I do sometimes wonder whether we are not too complacent in believing that the regime of low inflation will be with us "from here to eternity." There is always a risk that even great achievements, after a while, are taken as given and that their value is only rediscovered when they are in danger of becoming lost. In addition, recent history should tell us that the structure of the economy changes over time in a way that is difficult to anticipate and perceive in real time. This continuous mutation makes the task of monetary policy and its implementation even more challenging. It is the intrinsic nature of the economy that makes the debate on the aims of monetary policy and its appropriate framework so difficult to settle, and I believe that this debate will continue for some time to come.

In the course of the 1990s the inflation-targeting framework for the conduct of monetary policy has become popular among central banks and academics. In this paper I will highlight some of what I think are the distinguishing features and possible pitfalls of this approach. I will then draw comparisons with the European Central Bank's (ECB) monetary policy strategy, also in the light of the ECB's clarification of its strategy in May 2003.

Thus, in section 2, I would like to put the current debates on monetary policy into a historical perspective. In section 3, I will discuss what I see as the critical aspects of the inflation-targeting approach. Section 4 outlines the ECB's monetary policy approach and the ways in which it resembles and differs from the inflation-targeting framework.

2. A HISTORICAL PERSPECTIVE

Following the philosophy of "rules above authorities"—to paraphrase slightly the title of Henry Simons' famous article (1936)—one strand of research wanted the behavior of central bankers to be strictly constrained by a rule for conducting monetary policy. The most prominent advocate of this was Milton Friedman and his famous *k*-percent rule. The key argument in favor of the adoption of a simple strict rule was the acknowledgment of the economists' and central bankers' ignorance of the exact functioning of the economy and the long and variable time lags of monetary policy. It maintains that the actors of monetary policy know too little of the actual functioning of the economy to be able to perform activist policy and their discretionary actions would only exacerbate economic fluctuations instead of smoothing them. Strict rules prevent such problems, eliminating judgmental elements in monetary policy action and avoiding activist policy.

However, during the 1960s, few central bankers were in favor of rules, mostly because the performance of discretionary monetary policy at that time had been quite satisfactory, at least in the United States, and policymakers were increasingly confident of their ability to properly steer the performance of the economy. The 1970s marked the end of that overconfidence. In the period between the first oil shock and the early 1980s, the world's major economies experienced two recessions while inflation rose to double-digit levels. Although these events were not fully under the control of the monetary authorities, it is clear that the discretionary approach to monetary policy did make a negative contribution by not properly anchoring inflation expectations and instead allowing them to drift.[1]

[1] Among others, Orphanides and Williams (2003) show how the interaction of policy errors and endogenous expectation formation contributed to stagflation in the 1970s.

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One of the lessons that economists learned from their experience of the 1970s was that economic agents' expectations cannot be taken as given by policymakers when choosing their policy action. The underlying idea is simple but path-breaking and goes back to at least Marschak (1947), although the strongest case was made by Lucas (1976). In forming their expectations and taking their actions, economic agents will always try to anticipate future policy moves. This makes expectations of future policy relevant for today's consumption and investment decisions and creates the room for strategic interaction among economic agents, a cornerstone of which is the credibility of the policymaker to commit to a given set of actions. In the context of monetary policy, Kydland and Prescott (1977) and Barro and Gordon (1983) proposed models where the desire of the central bank to attain an unemployment rate below the natural rate generates surprise inflation in the economy: This is the "time consistency" problem. Economic agents properly understanding the incentives of the monetary authority and its actions would thus anticipate future inflation. In equilibrium, this would end up generating the well-known "inflation bias." A superior outcome could be achieved if monetary policy authorities took into account the effect their behavior could have on economic agents' action and properly commit not to inflate. The advantage of commitment relative to discretion crucially hinges on the credibility of the monetary authority actually sticking to its promises.

From those original contributions a large strand of literature tried to devise incentive-compatible institutional schemes capable of enforcing a rule-type behavior and thus dealing with the time inconsistency problem. General consensus has emerged that a necessary prerequisite for solving the time inconsistency problem is the establishment of an independent central bank to which the management of monetary policy is then delegated. The institutional arrangement mostly adopted to enforce the commitment accepts that monetary policy should treat the natural rate of unemployment as a given, and not try to push unemployment below its natural rate.[2]

These results square with another finding of the 1970s, namely, the absence of any long-run trade-off between unemployment and inflation. This point was stressed by Friedman in his 1977 Nobel lecture, among others. Friedman's argument was that, while it is possible to stimulate the economy in the short run by some form of monetary illusion, workers would see through the illusion in the longer run, demanding higher wages and so bringing employment back to its natural level. Every effort to permanently push employment above its natural level is therefore self-defeating.

These arguments reinforced the original criticism of discretionary monetary policy and were the final nails in the coffin of the theory of an activist monetary policy (and the idea of a monetary policy seeking to push economic activity above its natural level). The focus of monetary policy action had to be price stability.

The awareness of the limitations of monetary policy was also coupled with a better understanding of the possible costs of inflation and the recognition that a low-inflation environment is a necessary precondition for long-run growth and an efficient allocation of resources.[3]

Taken together, the awareness of the cost of inflation, of the absence of a long-run trade-off between inflation and real activity, and of the relevance of the credibility problem of the monetary authority are some of the motivations underlying the widespread adoption of a culture of price stability among the central banks of the industrialized countries during the 1980s and 1990s. I have no doubt that this new culture has made an important contribution to the disinflation process that we have observed in many countries over the past two decades.[4]

The inflation experience of the 1970s and developments in the theory of monetary policy analysis over the past 20 years have made clear the importance of the monetary authority making a firm commitment. However, contrary to the debate of the 1960s, it is a commitment on an objective rather than on a simple rule. Once an agreement on the objective had been reached, another critical question remained: Which is the best strategy for achieving this final objective? Over the years central bankers and academics around the world have

[2] See Walsh (1998) for a survey.

[3] For references on the theoretical and empirical literature on the cost of inflation, see Issing (2001) and Rodriguez-Palenzuela, Camba-Mendez, and Garcia (2003).

[4] Citing the words of another member of the discussion panel of this conference: "A number of factors have contributed to the reestablishment of price stability, but surely an essential ingredient has been the attention that the Federal Reserve has paid to long-run trends in inflation and inflation expectations since 1979" (Kohn, forthcoming).

proposed a variety of strategies. Different central banks have adopted strategies that place different emphasis on the various pieces of information, or elements of their decisionmaking process, or different aspects of their communication policies.

Inflation targeting is one of those strategies. Following the pioneering approach of the Reserve Bank of New Zealand in the early 1990s, a large number of central banks have formally adopted an "inflation targeting framework"; and today we can count around 20 central banks that refer to this approach. At the same time the inflation-targeting framework has triggered a large amount of interesting and stimulating theoretical work, as indeed this conference testifies.[5] Looking back at the experience of those central banks, there is no doubt that it has been a success. This is particularly evident in the case of countries starting from high levels of inflation. These countries needed to implement a disinflationary process, where inflation targeting served to guide inflation expectations and provide an explicit framework and direction to monetary policy. The approach has also turned out to be successful in countries with lower inflation, as, for example, the positive experience of the United Kingdom, Sweden, and Canada shows. In the few cases—limited to some emerging economies—where the experience has been somewhat less successful, it is quite evident that problems originated in other areas—notably, often stemming from misguided fiscal policies.[6]

At the same time, while not adopting an inflation-targeting approach, some major central banks have also achieved and maintained price stability, proving that visible success in the management of monetary policy is not confined to inflation-targeting central banks.

In the rest of this paper I will try to substantiate this claim.

3. INFLATION TARGETING

There is a vast amount of literature on inflation targeting, and the first challenge to some readers' eyes is to decide upon a proper definition. Different authors have proposed different, and in some cases conflicting, definitions.[7]

The first and broadest definition of inflation targeting is simply a monetary policy framework that accords overriding importance to the maintenance of price stability, typically defined as a low and stable rate of consumer price inflation.[8] As pointed out in the previous section, given the broad consensus that price stability is the appropriate goal of monetary policy, the strategies pursued by most central banks, including the ECB, would fall under this loose definition. However, this definition suffers from two interrelated weaknesses. First, from the policymaking perspective, it offers no practical guidance for the conduct of monetary policy beyond identifying the primary objective. As such, its practical relevance is rather limited. Second, from a scientific perspective, the definition imposes few empirically testable restrictions on the implementation of monetary policy. As such, it does not allow inflation-targeting strategies to be distinguished from other stability-oriented strategies and their relative merits to be evaluated. Central banks that have pursued strategies other than inflation targeting cannot be meaningfully distinguished on the basis of this definition. For example, Deutsche Bundesbank has been classified as an inflation-targeting central bank by some, despite its long adherence to an intermediate monetary targeting strategy. To put it more provocatively, by this definition all "successful" central banks are inflation targeters, while all "unsuccessful" central banks are not.

Given the problems associated with this broad definition, in the remainder of this paper I will focus on alternative, more restrictive definitions of inflation targeting. Consistent with the existing academic literature on monetary policy, such narrower definitions are typically expressed in terms of a monetary policy framework based on the adoption of a monetary policy rule in which forecasts of future inflation play a central role, either in the form of the so-called instrument rules or of target rules.

An instrument rule expresses the monetary policy instrument—usually a short-term nominal interest rate—as a simple and usually linear function of deviation of a few key macroeconomic variables, generally inflation and the output gap, from their target levels. Usually the literature distinguishes between an outcome-based rule (if the instrument is a function of currently observable variables, as

[5] For references on inflation targeting, see, among the others, Bernanke et al. (1999) and Svensson (1997, 1999, 2000, 2003).

[6] See Sims (forthcoming) for an example that a sound fiscal policy is a prerequisite for the performance of an inflation-targeting framework.

[7] See, for example, the two definitions proposed by Amato and Gerlach (2002) and Svensson (2002) in the same volume of the *European Economic Review*.

[8] Bernanke and Mishkin (1997, p. 97) write: "[Inflation targeting] is characterized, as the name suggests, by the announcement of official target ranges for the inflation rate…and by explicit acknowledgement that low and stable inflation is the overriding goal of monetary policy."

in Taylor, 1993) and a forecast-based rule (if the instrument is an explicit function of the current forecast for key variables in the future).

Under a target rule, the appropriate setting for the monetary policy instrument is defined implicitly as the solution to an optimization problem facing the central bank. This optimization problem is defined by two elements: first, an explicit loss function describing the costs associated with deviations of specific goal variable(s) from their target levels; and, second, a structural model of the economy. Minimization of the loss function subject to the constraints imposed by the economy's structure (as captured by the model) implicitly defines a model-specific optimal interest rate reaction function, which determines the interest rate as a function of all relevant state variables. In this context, an inflation-targeting framework is characterized by the adoption of a loss function that focuses on the deviations of forecast inflation from a target level.[9]

There is a natural complementarity between instrument and target rule characterizations of inflation targeting. A target rule implicitly defines an instrument rule—albeit typically one that is complex and therefore difficult to use in presenting policy decisions to the public. Similarly, it is usually possible to derive a loss function and an economic model that would broadly support a specific instrument rule as the solution to an optimization problem facing the central bank.

Here, I do not want to enter the vast debate on the different definitions of and the choice between instrument and target rules.[10] Nor will I address many of the problematic issues identified by the literature and associated with the adoption of those rules, such as the indeterminacy of equilibria, the issue of commitment to the rules, and the important aspect concerning the measurement of key variables, for example, the output gap.[11] Instead what I wish to discuss here are two more practical pitfalls associated with the narrower definition of inflation targeting, namely, the central role of macroeconomic forecasts in inflation targeting, on the one hand, and the robustness of the rules in view of the possible presence of model misspecifications, on the other.

Information Content and Forecasts

As pointed out above, simple outcome-based instrument rules constrain the central bank to respond only to developments in observed inflation and the output gap, and thus not to make use of other available evidence about the state of the economy. However, it is widely recognized that an efficient monetary policy should exploit all relevant information. By imposing an arbitrary partition on the data, simple instrument rules do not adopt such a full-information approach. This raises the issue of whether those rules can be incentive-compatible. If a central bank is aware of information suggesting that the interest rate implied by the rule might be inappropriate (e.g., because of weakness in the financial system), it would have an incentive to deviate from the rule. Given the incentive for such deviations, it is questionable whether central banks would follow such a rule and thus whether the ex ante commitment to this rule can be credible. However, if the rule lacked credibility, it is unlikely to help stabilize private inflation and interest rate expectations.

Forecast-based rules partially overcome the information restrictions imposed by outcome-based Taylor-like rules, making the instrument respond to expectations of future inflation and the output gap. To quote Haldane and Batini (1998): "expected inflation ought to embody all information contained within the myriad indicators that affect the future path of inflation." Along the same lines, Clarida, Galí, and Gertler (2000) characterize forecast-based rules as making use of "a broad array of information (beyond lagged inflation and output) to form beliefs about the future condition of the economy, a feature that we find highly realistic."

However, this opens the door to the problem of the complexity of the construction and nature of the forecast. For example, which is the proper model to forecast? What is the proper way of treating the central bank's monetary policy responses in the future projection or of using market participants' forecasts?[12] Instead of tackling these issues, let me

[9] This definition corresponds to what is now usually labeled as "strict inflation targeting." In "flexible inflation targeting," on the other hand, the loss function of the monetary authority focuses on both deviations of inflation and output from their targets.

[10] McCallum (2001b) adds the following disclaimer: "In fact, I believe that my terminology is more consistent with actual practice, in part because actual central banks have thus far not adopted explicit loss functions. In any event, the issue is of little importance, especially since it is always possible to write instrument rules that approximate as closely as desired the instrument settings of a policy regime involving targeting in Svensson's sense."

[11] See Benhabib, Schmitt-Grohé, and Uribe (2001), Svensson (2003), and Svensson and Woodford (2003).

[12] See Bernanke and Woodford (1997) for an exposition of the circularity problem induced by monetary policy mechanically responding to private inflation forecasts.

focus on another main critique by challenging the view that forecasts, particularly inflation forecasts, are sufficient statistics on the state of the economy and for monetary policy.

To exemplify, let us begin by assuming that the only objective of policy is to maintain price stability. If prices move in tandem with the existing tension on employable resources, the policy goal of price stability dictates keeping the economy continuously close to its potential. Under these circumstances, reacting to a pure inflation forecast figure, with no reference to any additional indicator of macroeconomic performance, would be a recipe for policy mismanagement any time the economy is hit by a transitory (say, favorable) supply shock. This type of shock would entail both a downward blip in forecast inflation and an upward movement of output away from its sustainable level. Hence, restricting the central bank's information set solely to the inflation forecast figure—to the exclusion of a broader suite of other indicators, which help discriminate between supply and demand shocks—would, in this situation, call for a policy easing today, which could destabilize the economy by laying the ground for the build-up of inflationary pressures tomorrow.

This is an elementary example of the general proposition that inflation forecasts alone are not sufficient to reveal the nature of the threat to price stability and that it would therefore be misleading to follow a rule that requires setting the policy instrument simply as the function of a forecast. Even in an ideal world in which the models producing the forecast are properly specified, the policymakers are not interested in the result of the forecast per se but instead aim at a consistent economic picture—or, to put it differently, they aim at identifying the relevant shocks underlying the forecasts and how different types of disturbances to the economy imply different kinds of policy responses. The relation between forecasts and underlying shocks is clearly one-to-one in many simple stylized models used in the monetary policy literature, but this relation clearly breaks down once we depart from that simple set-up. So, once again, forecasts of a few macrovariables cannot be sufficient statistics to determine monetary policy action.

Target rules are somehow immune from the above problem, given that they are routinely implemented by producing forecasts of future inflation and output conditional on the path of the policy instrument and searching for the path, which minimizes a proper loss function. Consequently, when evaluating inflation targeting in the context of target rules, the discussion should primarily focus on the structural model used to define the central bank's constrained optimization problem. In other words, an evaluation of the target rule characterization of inflation targeting is largely equivalent to an evaluation of the economic model employed to derive that rule.[13] One criticism of the models underlying most target rule characterizations of inflation targeting is that they neglect any role that might be played by the monetary aggregate or financial frictions in the determination of price developments. This opens the way to a second set of remarks on the issue of model misspecification and the robustness of the rules.

Robustness and Model Misspecification

The possible presence of model misspecification is something that economists and econometricians have some difficulty in acknowledging. However, every model we write down and estimate contains some form of shortcut and approximation. This uncertainty is worsened since economists have not yet agreed upon a proper, commonly accepted approximating model. This implies that the appropriateness of a monetary policy strategy cannot be evaluated only within a particular class of model—rather a good strategy has to perform well across a variety of empirically plausible models.

However, most advocates of inflation targeting—at least those referring to simple rules for monetary policy decisions—ultimately rely on a view of the economy whose essence can be captured by no more than three equations. The defining characteristics of these equations are (i) staggered pricing, (ii) the centrality of the output gap (or Phillips curve), and (iii) the notion that monetary impulses propagate primarily via a price (interest rate) channel, with monetary quantities playing no role.

The presence of only a market for goods and the absence of a fully formalized market for assets whose supply is inelastic in the short run implies that money has no role other than to facilitate the exchange of goods. Decisions about money holdings are not seen as part of a wider portfolio decision that—at times—may lead households to prefer liquidity over risky assets. For example, a positive change in money demand has no counterpart in

[13] While Svensson (2003, p. 450) says "[forecast targeting] does not imply that forecasts must be exclusively model-based," I would not tackle the slippery issue of the use of judgmental information in the forecasting process.

an excess supply of some other asset. On the contrary, if truly alternative assets were to exist whose issuance was related to their private issuers' investment decisions and capital formation, then generating a higher (or lower) supply of money—at any given interest rate—could become all but inconsequential.

Quoting McCallum (2001a), there is "nothing fundamentally misguided" about the model used by advocates of inflation targeting. Such a model is internally consistent and elegant. It can also mimic the observed behavior of modern economies in "normal" circumstances. Yet it rests upon what can certainly be regarded as extreme assumptions about the role of money in the economy. A central bank can legitimately question the usefulness of a model for monetary policy-setting in which money has been deprived of its basic liquidity—or, equivalently, its "store-of-value"—function that generations of scholars have recognized and discussed for decades (cf. Hahn, 1990, inter alia).

Levin, Wieland, and Williams (1999, 2001) demonstrate that Taylor-like instrument rules perform quite robustly in a particular set of macroeconomic models. However, this robustness does not survive a broadening of the suite of candidate models beyond those considered in these papers. Suitably parameterized Taylor-like rules appear to work well in stabilizing the economy within the confines of the mainstream New Keynesian paradigm, in which money market equilibrium conditions are redundant. This last assumption, in particular, proves to be absolutely crucial. If financial markets are not free of frictions, then Taylor-like rules often do not prove to be robust and yield suboptimal outcomes.

Examples of financial market frictions are prominent in transmission mechanism literature, e.g., in so-called limited participation models (Christiano and Eichenbaum, 1992) or segmented markets models (Alvarez, Lucas, and Weber 2001). Within the class of limited participation models, Christiano and Gust (1999) show that the set of parameters under which a Taylor-like inflation-targeting rule becomes a source of instability is much broader than for mainstream New Keynesian models.

More recently, Alvarez, Lucas, and Weber (2001) presented some experiments on the stabilization properties of simple Taylor rules within a segmented financial markets model. They conclude that central banks pursuing a Taylor-like interest rate instrument rule—by systematically ignoring money market (velocity) shocks—censor the information set available to policymakers and thereby reduce the effectiveness of their responses to economic shocks by arbitrarily excluding relevant monetary information from the policy decision. In a similar vein, but in a different class of model, Christiano and Rostagno (2001) show that a Taylor-like interest rate instrument rule can generate equilibria with undesirable properties; this outcome could be avoided by a policy rule that takes into account the information provided by monetary aggregates.

It should be clear that, from the view point of a central bank, a serious attempt should be made to construct a model where shocks to velocity are treated appropriately within the context of broader portfolio shifts, possibly in the presence of (changing) risk assessments. Unless disturbances in money holdings are formalized in such a way as to reflect financial decisions, then nothing can be said about the role of money in the business cycle and insufficient policy advice can be drawn from analyses of models that do not properly tackle these problems.

4. THE ECB'S MONETARY POLICY STRATEGY

Let me now turn to the ECB's monetary policy strategy. The ECB started to conduct policy in 1999 with the inception of the euro. While taking stock of the experience of the central banks of the Eurosystem, the ECB was at the time facing a major institutional change. Eleven national economies[14] merged into a unified market almost overnight; in this context, past experience and data might turn out not to be particularly informative with regard to the new economic structure.

In the presence of such Knightian uncertainty, in October 1998 the Governing Council of the ECB announced its monetary policy strategy. The designed strategy was a novel one, suited to the special and still partially unknown characteristics of the euro area, and different in a number of respects from other current and past strategies.

Three aspects of the ECB strategy are critical. First, its focus on the price stability objective: Price stability is enshrined in the Treaty on European Union as being the primary objective of the ECB. The ECB Governing Council therefore provided a quantitative definition of price stability as a year-on-year increase of the Harmonized Index of Consumer Prices (HICP) below 2 percent.[15] A second, closely

[14] Twelve from January 2001, when Greece also adopted the euro.

[15] See Issing et al. (2001) and ECB (2001a) for a detailed description of the ECB's monetary policy strategy.

related element, is the medium-term orientation of our policy. Central banks can only affect the price level with "long and uncertain lags"; consequently they cannot be overambitious and try to steer price developments in the short run, nor should they seek to precisely define the horizon of their action. Moreover they need to respond gradually to economic shocks, taking output fluctuations into account. A third element of the strategy relates to the analyses and economic perspectives that ultimately guide policy decisions. The strategy recognizes the need for a comprehensive analysis of economic and financial shocks and dynamics but, at the same time, it attaches a privileged role to indicators based on monetary aggregates. This organization of the information has been labeled the "two-pillar" strategy of the ECB. The ECB's monetary policy strategy was meant to provide a transparent and consistent conceptual framework: structuring the internal analysis of the economic situation and risks to price stability, facilitating the decisionmaking process in the Governing Council, and communicating policy decisions to the public at large.

In almost five years of experience with the ECB monetary policy, the strategy has served all these functions to a high level of satisfaction. The ECB has pursued its mandate of maintaining price stability with vigor and determination, gaining a high level of credibility from the outset. This achievement is all the more remarkable given that the ECB started without a track record and in an uncertain environment. Testifying to this success, inflation expectations, as measured by survey data and by financial market indicators, have remained consistent with our definition of price stability.[16]

In December 2002 the ECB announced the decision to conduct a comprehensive review of its strategy. This decision was sometimes wrongly interpreted by observers as an implicit indication of dissatisfaction with the strategy. In fact, the opposite was true. To ensure the continued satisfactory development of the strategy in a complex and changing environment, it was only natural that, after more than four years of experience, the ECB Governing Council would want to look back and reflect in a systematic way on past experience. The outcome of the strategy review was made public on May 8, 2003, and it aimed primarily at addressing certain misunderstandings that have emerged in our communication with the public.[17]

Regarding the definition of price stability, the Governing Council confirmed the explicit quantitative definition announced back in October 1998. However, in continuing with the past conduct of monetary policy, the Governing Council clarified that in the pursuit of price stability it will aim to maintain inflation rates below but close to 2 percent over the medium term. This clarification emphasizes the need for a sufficient safety margin against the risk of deflation and at the same time is also sufficient to cover the potential presence of a measurement bias in the HICP and the implications of inflation differentials of a structural nature within the euro area.

Regarding the role of money in the strategy framework, the Governing Council confirmed that the strategy's two-pillar framework is an effective tool for organizing the information used to assess the risks to price stability. As discussed in the previous section, the economic literature confirms that integrating the analysis of monetary aggregates with the analysis of conditions on the goods and labor markets in a unified model remains an elusive challenge. Different types of analysis provide information relevant for price developments at different time horizons. What we labeled as economic analysis focuses on the most proximate causes of inflation, such as cost developments and demand-supply imbalances, and primarily contributes to the assessment of short- to medium-term economic dynamics and the risks to price stability at that horizon. Monetary analysis, on the other hand, focuses instead on the ultimate monetary determinants of inflation, and primarily contains information for assessing price trends at medium- to long-term horizons. The Governing Council clarified that the monetary analysis mainly serves as a means of cross-checking, from a medium- to long-term perspective, the short- to medium-term indications coming from the economic analysis.

Let me emphasize the role of the cross-checking. All the information coming from different sources, such as short-term conjunctural indicators, quarterly macroeconomic forecasts, the analysis of asset prices and monetary aggregates, have to be compared and properly evaluated to come to an overall assessment of the monetary policy stance. This ensures that,

[16] See the evidence provided in Castelnuovo, Nicoletti-Altimari, and Rodriguez-Palenzuela (2003).

[17] The outcome of the strategy review and the background documents can be found at www.ecb.int.

while responding to economic shocks as they manifest themselves, we do not lose sight of the fact that, in the longer term, developments in money need to be consistent with our objective. This helps, in my view, to give a sense of direction and impart a steady course to the conduct of monetary policy.

The Eurosystem staff macroeconomic projections[18] are one important input into the monetary policy decision as a way of organizing a large amount of information and helping to create a consistent picture of possible future developments, but without making them the sole input for the conduct of monetary policy. As discussed in the previous section, forecasts cannot be, per se, a sufficient statistic for policy, nor can they contain all relevant information, not least because the models underlying the forecast are inevitably misspecified to some extent.

There are instances that standard macroeconomic models, which, by definition, are constructed to replicate normal conditions and regularities in the economy, are unable to capture and incorporate. This is particularly the case when large shocks or special circumstances arise, such as episodes of financial instability or asset price bubbles. I am merely recalling the developments over the past two to three years, when we faced exceptional uncertainties and major stock market movements followed by large portfolio adjustment. How those past events can be squared with forecasts of inflation and output, based on models in which financial assets do not play any active role, is still an open issue both for central bankers and academics. In such occasions the need of careful judgment, of a broadening of the horizon for the conduct of policy, and of the consideration of non-standard indicators and different interpretations of the evidence become especially relevant.[19]

Of course this does not mean that the ECB does not make full use of models. On the contrary, the ECB devotes a lot of time and resources to improving the set of economic models that are used in-house to gain a better understanding of the euro area economy and provide better guidance for monetary policy decisionmaking. Like many other central banks, we do use quite a large menu of models ranging from simple time-series models, useful in short-term forecasting, up to medium-size structural macroeconometric models in both area-wide and multi-country specifications.[20] Compared with purely time-series or reduced-form models, structural models have the advantage of having a well-specified conceptual framework (or a set of identification assumptions) that help to provide some better economic interpretation of the results, i.e., "the story behind the numbers." Moreover, considerable effort has recently been devoted to the development of "state of the art" medium-sized stochastic dynamic general equilibrium models (SDGE), where the estimated specification is fully micro-funded and consistent with the solution of the optimization problem of economic agents. Those models have proved to combine a solid theoretical grounding with a good ability to replicate many relevant features of the euro area data. Smets and Wouters (2003) proposed an extended version of the standard New Keynesian SDGE closed-economy model with sticky prices and wages. Christiano, Motto, and Rostagno (2003) substantially extended a stylized real-sector SDGE model to include a fully formalized financial sector, where the issuance of assets is related to firms' need to finance entrepreneurial activity, although there are frictions in the activity of the intermediaries related to the cost paid to monitor firms.

As a central banker but also as an academic, I am looking forward to the results of this line of research given that it provides macro models with both a solid micro-foundation and good empirical properties, and with the potential to bring into the picture phenomena of a monetary and financial nature that are often left out of the more commonly used macro models.

5. CONCLUSION

Let me end by saying that, in practice, probably no central bank follows the strict characterization of inflation targeting and that differences in the practices of central banks oriented to price stability should not be exaggerated. Most of the central banks oriented to price stability share a number of key elements that guide the conduct of their monetary policy, namely, a clear, quantitative definition of the overriding objective, a forward-looking orientation

[18] See ECB (2001b) for a description of the Eurosystem staff macroeconomic projection exercise. Within our framework, we clearly separate the production of projections, as carried out under the responsibility of the staff, from the monetary policy decisions taken under the responsibility of the Governing Council in order to avoid any ambiguity between the assumptions of the projections and the policy implications.

[19] See Issing (2002) for a discussion on the usefulness of information stemming from monetary aggregates in revisiting some historical episodes of financial instability.

[20] See Fagan, Henry, and Mestre (2001) for a description of the area-wide model of the euro area.

of their policy, and the awareness of the need to take a broad range of information into account and to communicate with the public in a clear and transparent manner.

There is no clear-cut evidence to suggest that generally, and according to some well-specified criteria, one specific framework should be preferred to all others.[21] Take, for example, one crucial measure of our success as central bankers: the ability to firmly anchor long-term inflation expectations. These appear to be well anchored, in terms of the very low volatility of expectations as well as the very low correlation with actual inflation developments, in most industrialized countries or currency areas, including those where central banks do not usually consider themselves to be "inflation targeters," such as the United States and the euro area. This to me is just a confirmation of something that I always believed: that there is no "single" or "best" way to conduct monetary policymaking and that different approaches or frameworks can lead to successful policies and/or be better adapted to different institutional, economic, and social environments.

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[21] See Ball and Sheridan (2003) for a comparative analysis of the macroeconomic performance of countries adopting an inflation-targeting framework.

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Inflation Targeting

Donald L. Kohn

I should start with two declarations. First, the usual disclaimer holds with particular force today—the views I am about to express are my own and not necessarily those of any other policymaker at the Federal Reserve. Second, this conference has been most interesting and informative, but I remain an inflation targeting (IT) skeptic. I will briefly lay out the reasons for my attitude, then address some topics, such as communication, that frequently arise in the discussion, and conclude by trying to stress-test my skepticism by speculating on whether IT would have been helpful in some recent episodes related to monetary policy.

INFLATION TARGETING FOR THE UNITED STATES

I agree with advocates of IT in several critical areas. Price stability—or its approximation at very low inflation—is the appropriate primary long-term objective of monetary policy, and achieving this objective is the way that policy can best contribute to the long-term welfare of the country. Moreover, in some countries, adopting IT, together with the central bank independence that often accompanies the initiation of IT regimes, has been a major step toward attaining price stability.

The question I would like to address is whether IT would improve economic performance in the United States. That is, would IT be likely to lead to actions by policymakers and private agents that increase the odds on keeping the economy producing at its maximum sustainable level and inflation low and stable. In my view, the verdict on IT for the United States is at least "not proven" and possibly negative—that is, IT might detract from economic performance over time.

I start from the premise that the United States has had a very successful monetary policy over the past two decades. We have achieved price stability, inflation expectations are low and stable, and we have done this with two relatively shallow recessions in 20 years. Many factors have contributed to this economic performance, but monetary policy has been an important element. So, for me, the default option is to keep doing what we have been doing—however hard it might be to model or explain. And that is not inflation targeting. I believe that adopting IT, even in its softer versions, would be a slight shift along the continuum of constrained discretion in the direction of constraint, and the benefits of such a shift are unlikely to outweigh its costs. Consequently, I would stick with the status quo.

On the cost side, I believe that under some circumstances central banks do face short-term trade-offs between economic stability and inflation stability, and I am concerned that IT would result in less-than-optimal attention being paid to stabilizing the economy and financial markets. In its actions,

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the Federal Reserve has put considerable weight on achieving and maintaining price stability, but it has not been "inflation targeting"—not even implicitly. IT implies putting a higher priority on hitting a particular inflation objective over the intermediate run than the Federal Reserve has done.

This point is most obvious from 1983 to 1997, in the so-called opportunistic disinflation period. During this time, the Federal Reserve was well aware that inflation was running above levels consistent with price stability but concentrated on keeping inflation from rising, not on reducing it further.

I believe the Federal Reserve also paid more attention to non-inflation factors than IT would have suggested in the 1997 to 2003 period, even though inflation outcomes were low and stable. Its broader focus was especially evident in the reaction to the threat to financial stability in the fall of 1998 and in the very aggressive easing in early 2001. In the latter case, easing continued through the spring even though inflation expectations looked as though they might be increasing, which would have been very difficult for an IT central bank to ignore. I recognize that such responses would in theory be available under flexible IT, but I wonder what would happen in practice. Most IT frameworks put a priority on inflation control and base their communication and accountability structures on inflation forecasts and outcomes. Under circumstances in which short-run conflicts among various objectives are possible, I ask myself where IT policymakers are likely to take their chances.

Moreover, with its concentration on mean inflation, IT seems to be ill-adapted to the risk-management paradigm that Chairman Greenspan (2003) laid out in Jackson Hole. That mode of operation, which I believe has been an important factor in the Federal Reserve's success, weighs the skews in the outlook, as well as the central tendencies, and also takes account of the cost of missing on one side or the other—and for more than one objective.

I think that the U.S. economy has benefited from the flexibility that the Federal Reserve has derived by eschewing a formal inflation target. By flexibility I mean not frequent changes in long-term objectives but rather the freedom to deviate from long-term price stability, perhaps for a while. I recognize that such deviations are also possible in models of flexible IT, but I question whether they can occur in practice.

Against these potential costs, I believe that the benefits of IT in the United States relative to the current regime are questionable.

We do not see evidence in IT economies that inflation is lower or more stable or that output is more stable around potential. On the surface, then, IT appears to produce little or no gain in hitting goals. To be sure, the evidence on how well inflation expectations are anchored is more mixed. Levin, Natalucci, and Piger (2004) at this conference, provided some backing for the idea that long-term expectations in IT economies respond less to incoming information on inflation. But I am also aware that the bulk of the studies show that interest rates and inflation are no more predictable in IT economies than in non-IT economies. The IT economies examined in the studies may have been subject to larger shocks than the non-IT economies studied, but the burden of proof should be on the advocates of IT to show that it would improve economic performance in non-IT economies—by providing either greater cyclical stability or better resource allocation.

A frequently used argument for IT in the United States is that it will help to extend the good performance of monetary policy as leadership changes—that is, it will protect against persistent increases or decreases in inflation under a new chairman. In my view, however, considerable safeguards against these outcomes are already in place. The law mandates price stability. Without exception, everyone now on the Federal Open Market Committee (FOMC) agrees with this mandate, and it enjoys wide acceptance in the public and in the Congress as well as in the academic community. Moreover, FOMC members have diverse views and the Committee has been operating in an environment in which members are free to express those views—in sharp contrast to some earlier eras. Any chairman gets deference, but a new chairman would not have the clout of Alan Greenspan, at least initially. A further safeguard is provided by the greater amount of public discussion and media attention to monetary policy currently than in the 1960s and 1970s.

Of course there is a risk, however small, that incompetence or political motivations in a new leader might foster new trends or greater variability in inflation, and IT might help counter any such tendencies. The question is whether insuring against this remote outcome is worth paying the cost. IT prevents some bad results, but it tends to foreclose very good results as well.

SPECIAL TOPICS

Communications and Transparency

IT does provide a clear framework for communicating with the public if communication is framed mostly around the behavior of inflation relative to the target. But does it help produce better policy and economic outcomes? For flexible inflation targeters who are paying attention to other objectives as well as inflation, communication tends to be clear but not especially transparent. Other goals are downgraded. In practice, IT communication does not even mention varying time periods for achieving price stability, much less the reason for those periods to vary. Those other goals are the tough messy stuff that does not fit into the IT framework very well. That they get so little attention is not surprising because accountability is usually framed in terms of inflation and the reports are elements in the accountability framework. But if, in fact, the goals of economic and financial stability are factored into policy decisions, they are often poorly acknowledged in IT communication. There is also a risk that communication will drive policy, and so those goals end up with less-than-optimal attention. For the most part, the manifestations of better transparency—reduced variability and greater predictability of inflation and interest rates—are not readily apparent in IT economies.

I am not arguing that the Federal Reserve cannot communicate better. But I am saying that IT is not a cure-all for communication problems; that it might not even help much in the markets where it really counts; and that, if simplicity of communications drives policy, IT might lead to inferior economic outcomes.

Political Legitimacy

In his paper at this conference, Larry Meyer (2004) was right to emphasize the importance of the Federal Reserve's interactions with the political system. One of the major values of IT is its role in forcing the people and their representatives to think through carefully what they can and cannot expect or demand from a central bank. This benefit would be lost through unilateral adoption of IT by the Federal Reserve.

The Federal Reserve is in a more complex position within the government relative to the central banks of many other countries, and this position both complicates any consultative process and elevates its importance. The checks and balances of our system mean that, unlike most other central banks, which operate in a parliamentary system, we do not have a "government" to interact with. The paradigm of goal dependence/instrument independence so common in IT regimes is effectively blocked for us. If we moved toward setting a goal for ourselves, perhaps even if we just defined price stability, we would need to consult carefully with both houses of the Congress and the Administration and would need to judge what, short of legislation, constituted a veto by any of the people with whom we were consulting. This process would be subtle and difficult—but absolutely essential to protect our independence and preserve our democratic legitimacy.

Defining Price Stability

By "defining price stability," I mean publishing a number or a reference range that makes more concrete our long-term inflation objective, without making a commitment to achieve that objective in any given time frame. Individual FOMC members are increasingly stating their numerical definition of price stability, but the Federal Open Market Committee has not done it. In some respects, such a specification is an appealing idea. In concept, it might allow the United States to realize some of the benefits of inflation targeting without some of the costs. The theory would be that putting a numerical value on long-term price stability could reduce uncertainty about longer-run price tendencies without constraining our actions to stabilize the economy or financial markets over shorter periods.

I am still trying to make up my mind on the balance of costs and benefits of taking this step. As I have already noted, most evidence does not suggest a lot of private uncertainty about longer-term price trends in the United States, and so the benefits, if any, would be limited. Spreads between nominal and indexed 10-year bonds have fluctuated narrowly around 2 percent since 1999, and survey measures of long-term inflation expectations have barely moved in recent years. Nonetheless, further evidence supporting the inference of Levin, Natalucci, and Piger that IT would result in even more firmly anchored expectations would be important in this equation.

The costs, given my views on IT, would arise from any tendency for this definition to morph into a target that unnecessarily constrained actions—that did not effectively permit outcomes outside the range or away from the target under some circum-

stances. Resisting such a tendency would be difficult, I think, once the number was given. And the pressure to elevate price stability over economic stability, even in the short-term, would be accentuated because the latter goal would not have a numerical value. However, ways of mitigating this tendency might be found—for example, by giving a fairly wide range and making it clear that the midpoint had no special meaning and that the edges were soft. Critical to maintaining useful flexibility would be the understanding, believability, and sustainability of the "provisos" that the Federal Reserve would give outlining the circumstances under which it would not seek to achieve its price stability objective.

STRESS-TESTING MY SKEPTICISM—WOULD INFLATION TARGETING HAVE IMPROVED ECONOMIC PERFORMANCE IN RECENT YEARS?

1. Would IT have contributed in any way to damping the boom and bust since the mid-1990s? I have already voiced my opinion that it would not have helped and might even have hurt in the reaction to emerging weakness in 2001. But another part of the question is, Would IT have constrained the previous upswing in a way that also would have lessened the subsequent weakening?

A number of observers believe that a little more policy tightening a little earlier might have damped the fluctuations in financial markets and the economy. Personally, I doubt that, given the strong forces at work. But I also do not think an IT framework would have helped, even if such an outcome were possible. Inflation was edging lower through much of this period. To be sure, forecasts were consistently missing on the high side, so a forecast-based IT framework might have run a slightly tighter policy—but I do not think you want to rest a case for changing policy regimes on persistent forecast misses.

The arguments usually given for tighter Federal Reserve policy in the mid-to-late 1990s reference developments in asset prices—specifically in the equity market—and the judgment that too-low interest rates fostered an intertemporal misallocation of resources in the form of an excessive buildup of capital and, hence, raised the amplitude of longer-term economic fluctuations. IT is especially poorly adapted to deal with these sorts of issues, however, since it tends to emphasize the performance of inflation in consumer goods and services over the succeeding few years. For those, like me, who are skeptical about the ability of central banks to deal with swings in asset prices or with longer-term resource allocation issues, this aspect of IT is not negative. Nonetheless, it is also evident in speeches and commentary that policymakers in IT countries right now are wrestling with the tension between IT frameworks and the suspicion that economic imbalances and disequilibriums in house or other asset prices are developing that could disrupt the economy at some point down the road.

2. Would ongoing IT or even a numerical definition of price stability have damped the bond market volatility of this spring and summer?

Long-term interest rates fell steeply in May and early June and rebounded even more sharply in late June and July. The decline got under way in earnest after the FOMC statement of May 6. What was the news that day? First, the FOMC thought that inflation could be below a level consistent with satisfactory economic performance over time and that the current rate of inflation was close to that excessively low level. Second, the FOMC was worried that the lower limit would be breached—it thought inflation was more likely headed down than headed up from the already low level. In response, 10-year Treasury rates fell 8 basis points the day of the announcement and another 12 basis points the next day as the import of the announcement sank in.

In my view, most of this immediate 20-basis-point decline in longer-term rates came not in response to the clarification of the inflation objective but rather to the revelation that the FOMC was worried about the trend of inflation. Moreover, much of the information on the latter point was quite recent, reflecting what seemed to be a lack of a rebound in the economy after the Iraq war and a steep decline in recent inflation readings. In these circumstances, had we had an inflation target for a while, rates might have been lower before the announcement, but most of that decline would have filtered into the markets only over the preceding few weeks and rates would have been just as low a few days after the meeting.

The next 70 basis points of rate decline occurred by mid-June in response to further indications of weakness in activity and prices and to statements by Federal Reserve officials that they were thinking about how to conduct policy in the remote contingency that a deflation threatened to take hold. I do not see how this response would have been different in an IT framework. My judgment in this regard is reinforced by the fact that rates in many IT coun-

tries over this same period of May and June fell by a similar magnitude. Weakness in the world's most important economy and declines in its exchange rate should lead rates overseas to decline, but the extent and similarity of the decline is surprising. This occurrence has led me to conclude that the rate drop in the United States was caused by the downward shocks to expected prices and activity, not by the policy framework.

The IT countries did experience somewhat smaller rate increases relative to the United States in July and August. They did not have some of the special factors pushing U.S. rates up—revised expectations about bond purchases and mortgage hedging activity. Perhaps more importantly, their economies, though strengthening, did not demonstrate the surprising degree of rebound that seems to be occurring in the United States.

In sum, this is a striking episode in which misunderstandings between the central bank and the markets probably contributed to an extraordinary volatility in financial markets. But these misunderstandings did not stem from the absence of inflation targets in the United States; volatility would have been damped only a little, if at all, under IT.

CONCLUSION

I recognize that I am at risk of being interpreted as saying that something good—the policy regime of the past 20 years—cannot be made better or that there are not downside risks to highly judgmental, flexible policy with an imprecise price stability objective. That is not what I think. I am open to alternatives that promise improvements or that raise the odds on good policy continuing in the future without incurring much in the way of current costs. But I do believe that those who propose changes from a good system have a high burden of proof. The marginal benefits from improving a good regime, by definition, are not likely to be high. And any change must deal with the uncertainties created by the law of unintended consequences. I have yet to be convinced that for the United States inflation targeting has jumped those hurdles.

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