Further Developments of Inflation Targeting*

Lars E.O. Svensson
Princeton University, CEPR, and NBER

First draft: May 2005

Abstract

The introduction of inflation targeting has led to major progress in practical monetary policy. Nevertheless, inflation-targeting central banks can make substantial additional progress by being more specific, systematic, and transparent about their operational objectives (in the form of using an explicit intertemporal loss function), their forecasts (in the form of deciding on optimal projections of the instrument rate and the target variables), and their communication (in the form of announcing optimal projections of the instrument rate and target variables).

JEL Classification:
Keywords:

*Prepared for "Inflation Targeting: Implementation, Communication and Effectiveness," a workshop at Sveriges Riksbank, Stockholm, June 10–12, 2005. I thank Kathleen Hurley for editorial and secretarial assistance. Expressed views and any remaining errors are my own responsibility.

1 Introduction

Inflation targeting was introduced in New Zealand in 1990 and has since been adopted by more than 20 countries. This period of only 15 years has seen major progress in practical monetary policy. The practice of inflation targeting has led to a more systematic and consistent internal decision process (Brash [13], Sims[40], and Svensson [41]), much more transparent communication with the private sector (Blinder, Goodhart, Hildebrand, Lipton, and Wyplosz [12], Fracasso, Genberg, and Wyplosz [17], and Leeper [30]), and an unprecedented degree of accountability. The actual monetary and real stability achieved is exceptional from a historical perspective (King [27]).

Given all this progress, many might think that much further improvement is hardly possible. Monetary-policy bliss, or something very close to it, might have been reached. I happen to believe that there is still room for further developments and improvements, even though past achievements by inflation-targeting central banks are very impressive. This paper provides a very selective discussion of points on which I believe further improvements are both possible and desirable.

My favorite definition of inflation targeting can be expressed in three points:

1. An explicit monetary-policy objective in the form of a numerical inflation target, these days with an increasingly explicit concern not only about stability of inflation around the inflation target but also about stability of the real economy. Hence, the target variables under inflation targeting include both inflation and a real variable such as the output gap.[1]

2. An internal decision process—"forecast targeting"—where projections of the target variables have a prominent role and the central bank sets the instrument rate such that the forecast of the target variables "looks good" relative to the monetary-policy objective.[2]

3. A very high degree of transparency and accountability, where the central bank typically publishes its internal projections and provides detailed motivations of these and of its instrument-rate decisions, so as to both implement the policy effectively and allow detailed external scrutiny of the bank's performance.

I believe that further improvements are possible and desirable on all three points of the definition. With regard to the *first* point, the monetary-policy objective, the circumstance that the objective includes not only stability of inflation around the inflation target but also stability of

[1] By *target variables*, I mean the variables that are arguments of the central bank's explicit or implicit loss function.
[2] By *instrument rate*, I mean the short nominal interest rate that the central bank is using as an instrument or operating target.

the real economy has been called "flexible" inflation targeting. Inflation-targeting central banks normally acknowledge in different ways that they are flexible inflation targeters.[3] However, they are not very explicit and transparent and probably not very consistent about the relative weight they attach to stability of other variables than inflation. They may not be very consistent about intertemporal substitution between the target variables, either. Some refer to a fixed horizon at which the inflation target shall be met, such as 8 quarters, but a fixed horizon is easily shown not to be appropriate for most circumstances (Faust and Henderson [16]). I believe specifying operational objectives in terms of an explicit intertemporal loss function is an easy way to make substantial progress in this regard.

With regard to the *second* point, the internal decision process, the instrument-rate assumption under which projections of the target variables are made has received considerable attention. Several central banks have used the assumption of a constant instrument rate during the entire forecast horizon. This is very problematic for several reasons (see Archer [3] and [4], Bean [6], Goodhart [18], Heikensten [22], Honkapohja and Mitra [23], Leitemo [32], Lomax [33], Svensson [44], Woodford [57], and others). A few central banks have shifted to the assumption of an instrument-rate path given by market expectations of future instrument rates. This is a considerable improvement but is arguably not the best alternative.

Furthermore, central banks normally make explicit decisions and announcements only about the *current* instrument rate and its level during the period until the next monetary-policy decision. However, the current instrument rate matters very little for the central banks' internal projections. What matters for those projections is the *entire* instrument-rate path assumed. Similarly, the current instrument rate matters very little for private-sector decisions and the economy. What matters is the private-sector expectations about the *entire* future path of instrument rate. These expectations feed into the yield curve and thereby longer interest rates and asset prices, which do affect private-sector decisions. The current central-bank decision and announcement actually matters only through the private-sector expectations of the path of future instrument rates that they give rise to. This means that, when the central bank decides on a particular current instrument-level, implicitly it decides and announces an expected future instrument-rate path, an instrument-rate *plan*. For these reasons, I believe that substantial progress can be made if central banks explicitly think in terms of entire instrument-rate plans and corresponding projections of target variables

[3] Norges Bank (the Bank of Norway) is a model of transparency in this respect (and many others): Each *Inflation Report* contains the statement "Norges Bank operates a flexible inflation targeting regime, so that weight is given to both variability in inflation and variability in output and employment." Norges Bank also puts the inflation forecast and the output-gap forecast in the same graph, so as to emphasize both.

and develop a decision process where the central bank explicitly chooses such an instrument plan. Indeed, the decision process should be designed so as to end with an *optimal* instrument-rate plan and a corresponding optimal projection of the target variables—a projection of the instrument rate and the target variables that minimizes the central bank's loss function.

With regard to the *third* point, the high degree of transparency and accountability, inflation-targeting central banks typically publish their internal projections of their target variables (although some may publish projections of output or output growth rather than the output gap). Since these projections normally are based on an assumed instrument-rate path that differs from the optimal instrument-rate plan (especially if there is no explicit optimal instrument-rate plan), the resulting projections are not the *best* forecasts in the sense of minimizing expected squared forecast errors. The projections are biased one way or another. Hence, they are not the best information for the private sector. Since monetary policy has an impact on the economy via the private-sector expectations of inflation, output, and interest rates that it gives rise to, announcing the optimal projection—including the instrument-rate projection—and the analysis behind it would have the largest impact on private-sector expectations and be the most effective way to implement monetary policy. Since the optimal projection is the best forecast in the sense of minimizing expected squared forecast errors, it also provides the private sector with the best aggregate information for making individual decisions. Announcing the optimal projections also allows the most precise and sophisticated external evaluation of the monetary-policy framework and decisions. Therefore, I believe that substantial progress can be made if inflation-targeting central banks publish and explain optimal projections, including the optimal instrument-rate plan.

In short, I believe that inflation-targeting central banks can make substantial progress by being more *specific, systematic, and transparent* about their operational objectives (in the form of an explicit intertemporal loss function), their forecasts (in the form of deciding on optimal projections of the instrument rate and the target variables), and their communication (in the form of announcing optimal projections of the instrument rate and target variables).

Section 2 discusses how an explicit intertemporal loss function can be introduced and used by a central bank. Section 3 discusses the instrument-rate assumption, section 4 discusses transparency and communication issues, and section 5 discusses some additional issues. Section 6 presents some conclusions. An appendix contains some technical material.

2 The loss function

All real-world inflation targeting is flexible inflation targeting. Flexible inflation targeting means that monetary-policy objectives include not only stability of inflation around the inflation target but also stability of the real economy, such as stability of the output gap.[4] However, although inflation-targeting central banks normally acknowledge that they are flexible inflation targeters, they are normally not very explicit and transparent and probably not very consistent about the relative weight they attach to stability of other variables than inflation. They may not be very consistent about the intertemporal substitution between the target variables, either. Some refer to a fixed horizon at which the inflation target shall be met, such as 8 quarters, but a fixed horizon is easily shown not to be appropriate for most circumstances (Faust and Henderson [16]). Some state that they have a medium-term objective, without specifying what this means. The most direct way to resolve this ambiguity and lack of transparency is to specify an explicit intertemporal loss function as the operational objective for the central bank. This clarifies what the target variables are and what relative weights they have. This then clarifies both intra- and intertemporal substitution between levels and stability of the target variables and allows unambiguous ranking of alternative projections of the target variables.

Thus, flexible inflation targeting implies that the central bank is not exclusively concerned about stabilizing inflation around the inflation target but is also concerned with the stability of the real economy, as represented by the output gap, the employment gap, or the unemployment gap.[5] This can conveniently be expressed as a conventional quadratic loss function,

$$L_t \equiv (\pi_t - \pi^*)^2 + \lambda x_t^2, \tag{2.1}$$

where L_t denotes the period loss in period t (where the period may be a quarter, for instance), π_t denotes a measure of inflation in period t, π^* denotes the inflation target, x_t denotes a measure of the output gap in period t, and $\lambda > 0$ denotes the relative weight on output-gap stabilization relative to inflation stabilization.[6] The central bank may also be concerned about variability of instrument-rate changes or exchange-rate changes, which would correspond to additional terms $\lambda_{\Delta i}(i_t - i_{t-1})^2$ or $\lambda_{\Delta i}(s_t - s_{t-1})^2$, respectively, where i_t denotes the instrument rate and s_t denotes

[4] "Strict" inflation targeting, when the central bank is concerned exclusively about inflation, is an abstraction that is sometimes used in pedagogical examples.

[5] I will use the *output gap*, the difference between output and potential output, as the generic variable representing the business-cycle status of the economy. The unconditional mean of the output gap is taken to be zero.

[6] The index of inflation, π_t, can be quarterly inflation, 4-quarter inflation, or an average of inflation over a longer period (Nessén and Vredin [37]).

the (log) exchange rate in period t. In that case the interest rate or the exchange rate are also target variables.[7]

The corresponding intertemporal loss function in period t can the be written as the sum of current and expected discounted future losses,

$$\mathrm{E}_t \sum_{\tau=0}^{\infty} \delta^\tau L_{t+\tau}, \tag{2.2}$$

where E_t denotes central-bank expectations conditional on information available in period t and δ is a discount factor that fulfills $0 < \delta \leq 1$.[8] Whereas the period loss function and the weight λ expresses the substitution between inflation and output-gap variability within a given period, the intertemporal loss function and the discount factor δ expresses the substitution between expected losses in different periods.

Let $\pi_{t+\tau,t}$ and $x_{t+\tau,t}$ for $\tau \geq 0$ denote (mean) *projections* in period t of inflation and the output gap τ periods ahead, and let $\pi^t \equiv (\pi_{t,t}, \pi_{t+1,t}, ...)$ and $x^t \equiv (x_{t,t}, x_{t+1,t}, ...)$ denote (mean) inflation and output-gap projections in period t of current and future inflation and output gaps. That is, $\pi_{t+\tau,t}$ and $x_{t+\tau,t}$ denote the projection in period t of inflation and the output gap in the particular period $t+\tau$, whereas π^t and x^t denote the entire projection *paths* of current and future inflation and output gap.

Furthermore, let $L_{t+\tau,t}$ denote the *period loss* associated in period t with the projections $\pi_{t+\tau,t}$ and $x_{t+\tau,t}$ of inflation and the output gap projection for period $t+\tau$,

$$L_{t+\tau,t} \equiv (\pi_{t+\tau,t} - \pi^*)^2 + \lambda x_{t+\tau,t}^2, \tag{2.3}$$

and let $\mathcal{L}(\pi^t, x^t)$ denote the *intertemporal loss* associated in period t with the entire projection paths π^t and x^t of inflation and output gap,

$$\mathcal{L}(\pi^t, x^t) \equiv \sum_{\tau=0}^{\infty} \delta^\tau L_{t+\tau,t}. \tag{2.4}$$

Once the two parameters δ and λ have been determined, the intertemporal loss function $\mathcal{L}(\pi^t, x^t)$ provides a convenient and consistent way to rank different inflation and output-gap projections. Suppose that the central-bank staff presents the Monetary Policy Committee (MPC) with two different instrument-rate plans, which result in two different projections of inflation and the output

[7] Rudebusch [39] provides a survey of recent work on instrument-rate smoothing. Woodford [55] and Svensson [46] provide further discussion of interest rates as target variables.

[8] When $\delta = 1$, the loss function (2.2) should be interpreted as the limit (from below) $\lim_{\delta \to 1-} (1-\delta)\mathrm{E}_t \sum_{\tau=0}^{\infty} \delta^\tau L_{t+\tau}$ in order to ensure convergence (see appendix A).

gap.[9] Suppose that the first instrument-rate plan results in the projection (π^{t1}, x^{t1}) and that the second instrument-rate plan results in the projection (π^{t2}, x^{t2}). Which instrument plan should the MPC choose as its policy? If the parameters δ and λ correspond to the MPC's preferences, the MPC should simply choose the instrument plan that results in the inflation and output-gap projection with the lowest loss. Suppose that $\mathcal{L}(\pi^{t1}, x^{t1}) < \mathcal{L}(\pi^{t2}, x^{t2})$. Then the MPC should choose the first instrument-rate plan and associated inflation and output projections.

How can the MPC determine the parameters δ and λ? A discount factor δ equal to one implies that the loss in future periods has the same weight as current losses. My guess is that most MPC members would agree that a discount factor equal to or close to one is appropriate, given the frequent emphasize of the medium and long run and a desire to avoid myopia. Then only λ remains to be determined. The MPC can determine λ by majority voting. Then, by the Median-Voter Theorem, the resulting λ will be the λ of the median MPC member. This is a convenient and practical way of aggregating the MPC members' preferences. Majority voting has the general advantage that outliers would not affect the median. If MPC members need help in determining their individual λs, revealed-preference experiments will help extract the λs. That is, an MPC member gets to choose the preferred combination of inflation and output-gap projections among a few possibilities. This choice reveals the implicit λ. If the central bank puts weight on interest-rate smoothing or exchange-rate smoothing, the parameters $\lambda_{\Delta i}$ and $\lambda_{\Delta s}$ also need to be determined. If the MPC members do not agree that the discount factor δ is equal to unity, they can vote about the discount factor, too, in which case the resulting discount factor will be the median of the MPC members' individual discount factors.

Using an explicit intertemporal loss function such as (2.4) has several advantages:

- An explicit loss function clarifies what the target variables are and resolves in an unambiguous way the intra- and intertemporal substitution between them. For instance, one projection of inflation and the output gap may have a negative output gap in the near future and lower inflation in the more distant future, whereas another projection may have a less negative output gap in the near future and a higher inflation in the more distant future. The intertemporal loss function provides a consistent ranking of the two projections. The loss function makes clear that the entire projection paths of the target variables matter, not just the projection at some particular horizon. It hence avoids the tendency towards putting weight on a particular

[9] I use *Monetary Policy Committee* (MPC) as the generic term for the monetary-policy decision-making body of a central bank, including when the bank has a single decisionmaker.

horizon, such as 8 quarters, which need neither imply a unique nor a very good policy (see Faust and Henderson [16] and Heikensten [21]).

- A loss function clarifies the unnecessary and unhelpful distinction between a "dual" and a "hierarchical" mandate (see Meyer [34] and Svensson [47]), removes any ambiguity about the degree of flexibility in inflation targeting (for instance, in the debate on inflation targeting for the Fed; Kohn [28]), and clarifies the appropriate role of asset prices and concerns about bubbles in inflation targeting (Bean [5]).

- The MPC has to make choices between different projection combinations in any case; using an intertemporal loss function avoids other inconsistent and ad hoc ways to make such choices.

- The loss function can be seen as a necessary operational interpretation of a legislative mandate or government instruction, which usually is too vague to provide precise guidance to consistent policy in particular policy situations. Such an operational interpretation is already needed for the inflation target in some countries, where the institutional arrangement for monetary policy leaves the central bank with deciding on the number and index for the inflation target (as in Sweden and the euro area).

- The parameters of the loss function have clear intuitive meaning. The discount factor δ represents the substitution between period losses in different periods; the weight of a period loss in one period relative to the period loss one period earlier. The weight λ can be interpreted as the weight on variability of the output gap relative to variability of inflation, so $\lambda = 1$ implies that the MPC is equally concerned with the variability of the output gap as with the variability of inflation (see appendix A).

- The MPC can add any target variables and weights it is concerned about, for instance, interest-rate and/or exchange-rate smoothing and/or stability, separate weight to an unemployment gap or an output-growth gap (this does not imply that I endorse such additions).

- The MPC may use another form of loss function than the quadratic, if it believes another loss function better represents its objectives.[10] (However, the quadratic loss function has many advantages. For instance, it can be seen as second-order approximation to a more general

[10] Other functional forms are discussed in Bray and Goodhart [14] and Svensson [45]. [References for asymmetric loss functions to be added.]

loss function, its symmetry seems natural in an era where both inflation and deflation are undesirable, and it is easy to use in optimization exercises.)

- If the MPC for some time would prefer not to specify a loss function, the staff can still provide the MPC with optimal projections for a reasonable set of alternative parameters of the loss function. This set of optimal projections for different parameters then forms the set of efficient feasible projections from which the MPC should choose its preferred alternative.

- The MPC can experiment with internal uses of alternative loss functions and go public about any loss function at a later stage, when it has decided which loss function to use and the approach has proved useful.

- Eventually going public on the loss function will bring improved transparency of monetary policy, allow increased precision and consistency in the evaluation of MP, and thereby imply increased accountability. It may also bring better public understanding of the substitutions and tradeoffs involved.

- An intertemporal loss function does not require that the projections are made with a model; it can be used to rank purely judgmental projections.

Consequently, I believe that specifying operational objectives in terms of an explicit intertemporal loss function is an easy way to achieve a substantial improvement in inflation targeting.[11]

[11] Arguments against central banks' announcing a loss function (and implicitly also against central banks' *using* a loss function) were recently reiterated and summarized by Mishkin [35]: (1) It might be quite hard for members of an MPC to specify a loss function. (2) It would be difficult for an MPC to agree on its loss function. (3) It is far from clear who should decide on the loss function. (4) It may be difficult to communicate a loss function to the public. (5) Announcing a positive weight on output-gap stabilization may lead to more aggressive private-sector price and wage increases. (6) Announcing a positive weight on output-gap stabilization will require the central bank to publish estimates of the output gap and potential output and estimation of a conceptually correct potential output is difficult. Regarding (1) and (2), I have already mentioned simple procedures to specify and agree on a loss function. Regarding (3), the loss function can always be seen as a necessary operationalization of the central bank's mandate. Regarding (4), even a very precise statement such as "a weight on output-gap stabilization equal to a half of that on inflation stabilization" would not seem impossible to understand for an educated general public. Regarding (5), there is no evidence of more aggressive price or wage increases after Norges Bank became more explicit about output-gap stability (and Norway does have powerful trade unions). Regarding (6), I agree that estimation of a conceptually correct measure of potential output is difficult, but I believe that such estimation is necessary for good policy. I extend on this in section 5.4. That something is difficult is not a good argument in this context. It is difficult to provide inflation forecasts. This is no longer—and may never have been— a valid argument against publishing them. Before the introduction of inflation targeting in New Zealand, I am sure almost every central banker would have thought that the current standard of transparency would be (1) more or less impossible to achieve and (2) very harmful if it could be achieved.

3 The instrument-rate projection

Because of lags in the transmission mechanism between monetary-policy actions and effects on the economy and the target variables, good monetary policy must be forward-looking and rely on projections of the target variables. Before the instrument-rate decision, the MPC is normally presented with a number of alternative projections of the target variables, conditional on alternative assumptions about the state of the economy, the development of various exogenous variables, the transmission mechanism, and so forth. In particular, those projections are conditional on some assumption about the instrument-rate path, the instrument-rate projection.

The decision process results in a decision about the level of the instrument rate for the immediate future. Implicitly or explicitly, however, the decision is actually about an instrument-rate plan. The optimal instrument-rate plan is the instrument-rate plan that results in an optimal projection of the target variables, the projection that minimizes the intertemporal loss function. This projection is also the best forecast, in the sense of minimizing expected squared forecast errors.[12]

3.1 The instrument-rate assumption underlying projections of the target variables

Traditionally, several inflation-targeting central banks have used projections based on an assumption of a constant instrument rate (CIR) over the forecast horizon. If then, everything else equal, the inflation projection is higher (lower) than the inflation target at some given horizon, usually about 8 quarters, this has been interpreted as indicating that sooner or later the instrument rate needs to be raised (lowered).

However, there are numerous problems with the CIR assumption.[13] These problems include:

- A CIR is often unrealistic. This implies that the resulting projection of inflation and the output gap is unrealistic and not the best forecast of future inflation and the output gap. This in

[12] I use the following terminology: *Feasible* projections (or the set of feasible projections) are the (mean) projections of the instrument rate and the target variables that are consistent with the central bank's information, more specifically, its estimate of the state of the economy, view of the transmission mechanism, and forecast of exogenous variables. The *optimal* projection is the central bank's preferred feasible projection of the instrument rate and the target variables, that is, the feasible projection that best achieves the central bank's objective. More specifically, the optimal projection is the feasible projection that minimizes the central bank's intertemporal loss function. The *best forecast* is the projection that best predicts the actual future path of the variables in question, more precisely, the projection that minimizes expected squared forecast errors. A *conditional forecast* is a projection that minimizes expected squared forecast errors subject to some particular assumption, such as a particular path of the instrument rate. The *unconditional forecast* is the best projection given available information, including information about monetary policy. Therefore, the unconditional forecast is the best forecast.

[13] These problems are detailed in Archer [3] and [4], Bean [6], Goodhart [18], Heikensten [22], Honkapohja and Mitra [23], Leitemo [32], Lomax [33], Svensson [44], and Woodford [57].

turn makes it difficult and misleading to compare these projections to those of other forecasters, since those forecasters normally would assume more realistic underlying instrument-rate paths. It also makes it difficult and misleading to compare the projections to actual outcomes and in this way assess the forecast performance of the central bank.

- A CIR often differs from market expectations of future interest rates (ME). Current asset prices such as exchange rates, stock-market prices, bond prices, house prices, and so forth, depend on these market expectations. Typically, the current market prices of these assets are used as inputs in central-bank projections rather than the hypothetical asset prices that would result if market participants actually expected a CIR. Hence, the central-bank projections end up using many inputs which are inconsistent with the CIR, making the projections themselves inherently inconsistent and misleading. Put differently, they are not consistent CIR projections but a mixture of projections based partly on the CIR, partly on ME.

- When ME differ from the CIR, central banks typically would not like ME to adjust towards the CIR. If that would happen, it might result in drastic and unwelcome changes in asset prices. Hence, central banks using CIR projections would normally not like the private sector to take the CIR assumption seriously.

- For a CIR, most projection models are unstable and with increased horizon the inflation and the output-gap projection tends to increase or decrease at an increasing rate, making longer-term projections more or less useless. This has induced central banks to avoid plotting such projections for longer horizons, so as not to display the problems with CIR projections too openly. Projection models with forward-looking variables are normally not even determinate for a CIR. Determinacy is then restored by the assumed shift to some endogenous instrument setting in the form of an ad hoc reaction function beyond the forecast horizon. That shift is then often associated with a drastic and awkward jump in the instrument rate, and the projection for shorter horizons depends on the assumed future endogenous policy. Alternatively, the projection model assumes that the instrument rate follows some determinacy-inducing ad hoc reaction function, but unanticipated shocks to the instrument rate make it constant for many quarters (see Leeper and Zha [31] for a formalization of this idea with an estimated reaction function; the shocks are in practice assumed to be unanticipated and not affect market expectations, although they will be conspicuously serially correlated for many quarters).

For these reasons, the CIR assumption for projections is inherently problematic and confusing.

Since there are better alternatives, it should be abandoned sooner rather than later. Several central banks have indeed abandoned the CIR assumption (Norges Bank and the Bank of England, for instance). The Reserve Bank of New Zealand has used projections based on a time-varying instrument-rate path for many years.

A first alternative to a CIR for the instrument-rate assumption is using the market expectations of future interest rates (ME), where these are normally identified with forward interest rates implied by the yield curve. Norges Bank and the Bank of England use ME for their projections, and the Riksbank seems to give increasing weight to projections based on ME (see Heikensten [22]). ME have several advantages:

- ME are usually more realistic than the CIR, depending on the market's understanding and prediction of future instrument-rate decisions. This makes projections based on ME better forecasts of future instrument-rate decisions than CIR projections.
- Since current asset prices are conditional on ME, using current asset prices as inputs in the projections does not cause any apparent inconsistency, in contrast to what is the case for CIR projections.

Thus, ME projections are much better than CIR projections. However, using ME may be problematic, if the ME are strange in some way or deviate substantially from the central bank's preferred instrument plan—a situation which would indicate either a credibility problem or differences between the private sector and the central bank in their view of the state of the economy or the transmission mechanism. In such situations, the central bank may want to use ad hoc adjustments of the instrument-rate projection implied by ME. Furthermore, ME would normally not be identical to the central bank's explicit or implicit instrument plan, and the projections based on ME therefore would normally not be the best forecast, the forecast that minimizes expected squared forecast errors.[14] Woodford [57] provides more detailed criticism of ME.

A second alternative for the instrument-rate assumption is an ad hoc reaction function for the instrument rate, such as a Taylor-type rule. Such an assumption results in projections where inflation eventually approaches the inflation target and the output gap eventually approaches zero. The resulting instrument-rate projections will generally differ from ME. (To the extent that the

[14] Although private-sector expectations are a natural and important input in central-bank projections, it is important that they only are one set of inputs among many, and that the central-bank does not respond mechanically to private-sector expectations that in turn depend on the central bank's response. As Woodford [54] and Bernanke and Woodford [9] show, a mindless mechanical response to private-sector expectations may lead to indeterminacy and a loss of the nominal anchor.

projections are published and interpreted by the private sector as good forecasts of future instrument rates, they may bring ME closer to that instrument-rate projection.) The resulting projections of the target variables will generally not be minimizing an intertemporal loss function, and there is no reason the instrument-rate projections will be good forecasts of the central bank's actual instrument-rate setting. The resulting projections are to some extent arbitrary.[15] However, if the reaction function used is an estimate of previous policy by the central bank, the resulting projection can be interpreted as those resulting from "policy as usual" (Berg, Jansson, and Vredin [7] and Jansson and Vredin [24]). Essentially, the projections would be analogous to VAR forecasts. The Reserve Bank of New Zealand uses an ad hoc reaction function in its Forecast and Policy System (discussed in Archer [3] and [4] and Svensson [41]). However, the resulting instrument-rate path is subject to considerable adjustment reflecting judgment and policy preferences making it for practical purposes similar to an optimal instrument-rate plan (Archer [4]).[16]

A third alternative is to use optimal instrument-rate projections, that is, instrument-rate projections for which the resulting projections of the target variables minimize an intertemporal loss function. The staff can present optimal projections of target variables and the instrument rate for alternative parameter values of the loss function and alternative scenarios. This can be done in several different ways, incorporating judgment as discussed in Svensson [48] and more concretely demonstrated by Svensson and Tetlow [51], who describe the method of Optimal Policy Projections, a variant of which is being used by the Federal Reserve Board.[17] If the MPC agrees on an intertemporal loss function, the staff can present the MPC with optimal projections for that loss function for different scenarios (different assumptions about the state of the economy, forecasts of exogenous variables, and the transmission mechanism, for instance). If the MPC does not agree on a loss function or does not use a particular loss function, the staff can still present the relevant tradeoffs for different policy choices—the set of efficient feasible projections—by presenting projections for a range of parameters of the loss function. If the MPC chooses policy in line with this, the resulting projection will be the best forecast in the sense of minimizing expected squared forecast errors. This brings me to a discussion of the actual instrument-rate decision.

[15] See Svensson [46] for a more general critique of simple instrument rules such as Taylor rules.

[16] The particular reaction function used before any judgmental and policy adjustments, a variant of a so-called forecast-based Taylor rule originating with Bank of Canada's Quarterly Projection Model, has some particular problems that are discussed in Svensson [43].

[17] By central-bank *judgment*, I mean information, knowledge, and views beyond the scope of a particular model.

3.2 The instrument-rate decision

The assumption about the current instrument rate, the instrument rate for the next month or two, matters very little for the central bank's projections. What matters for the projections is the assumption about the entire future instrument-rate path. Similarly, the current instrument rate matters very little for private-sector economic decisions. Instead, what matters is the private-sector expectations about future instrument rates. These expectations feed into the yield curve and affect longer interest rates and asset prices that do matter for private-sector decisions. The current instrument rate and central-bank announcement matter and have an effect on the economy essentially only through the private-sector expectations about future instrument rates and about aggregate future inflation and output that they give rise to. Indeed, it is paradoxical that so much attention and discussion is focused about current instrument-rate settings and levels, when what matters is the related plans and expectations about future interest rates. As is becoming increasingly well known, and as Woodford [56] and Svensson and Woodford [53] have emphasized, modern monetary policy is essentially the management of private-sector expectations.

Since the current instrument rate has very little importance and it is the entire future instrument-rate path that matters, explicitly or implicitly, the central-bank instrument decision is really a decision about the future path of the instrument rate, about an instrument-rate *plan*. To some extent this is becoming increasingly recognized. A good example is the increased attention paid to some key words in FOMC statements indicating future instrument-rate setting: "policy accommodation can be maintained for a *considerable period*, " "[the Committee] can be *patient* in removing its policy accommodation," and "policy accommodation can be removed at a *pace that is likely to be measured*" (italics added).[18]

My conclusion from this is that central banks should be more specific, systematic, and transparent about instrument-rate paths and plans. Since the decision about the instrument rate is in effect a decision about the instrument-rate path, it is better that this is explicitly acknowledged. Maintaining that the decision is one about the current instrument-rate levels alone is both misdirected and misleading. Indeed, throughout the decision process, it should be natural to think in terms of alternative instrument-rate paths and plans, not about the instrument rate during the next month or two. Similarly, it should be natural to think in terms of entire projection paths of future target variables, not just the current level or the target variables or the projection at some

[18] Imagine if the FOMC instead had got their act together and plotted an instrument-rate projection, as the RBNZ and Norges Bank are doing!

particular horizon, such as 8 quarters. Furthermore, the above discussion of the intertemporal loss function in section 2 has (hopefully) made clear that the loss function induces a ranking about entire projection paths, not projections at particular horizons. Indeed, the monetary-policy transmission mechanism should be seen as a mapping from an instrument-rate path to target-variable paths, not as a mapping from an instrument-rate level to a level of the target variables at some particular horizon.

Goodhart [18] and [20] and Mishkin [35]) have argued that it is too difficult for an MPC to agree on a path (a sequence of numbers) rather than a current instrument-rate decision (one single number). I argue that it is necessary and not too difficult. In particular, it is already being done. MPCs all over the globe decide on projections of inflation and output all the time. Projections are paths, sequences of numbers. What is the big difference between agreeing on an instrument-rate path and an inflation path? And some MPCs are already explicitly deciding on instrument-rate paths—the Reserve Bank of New Zealand and Norges Bank, for instance.[19]

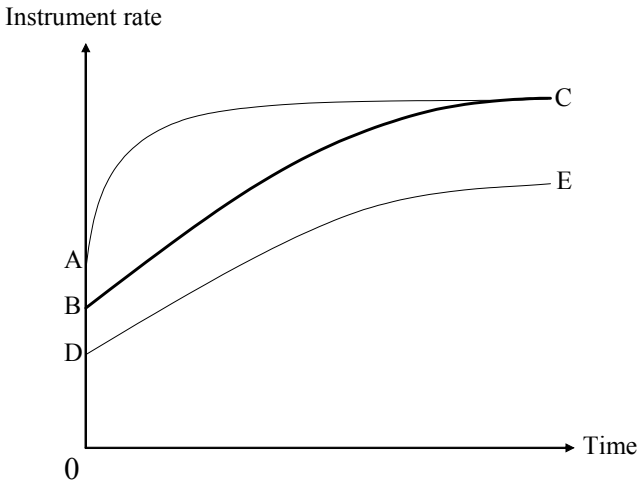
In particular, majority voting about paths is completely feasible. I have suggested a procedure in Svensson [44]: Suppose that each MPC member has a preferred instrument-rate plan for the current and future instrument rate in the form of a path. Plot all those paths in a graph with time on the horizontal axis and the instrument rate on the vertical axis. Then, for each future date on the horizontal axis, pick the median instrument-rate level. Recall the Median-Voter Theorem: The outcome of majority voting about a single variable is the level preferred by the median voter. This is the Median-Voter Theorem applied to a path, as if the MPC members were simultaneously voting about the instrument rate at the current and future dates. The procedure results in the median instrument-rate plan. Let this median instrument-rate plan be the starting point for a new round of voting. Let each MPC member suggest some modification of the median instrument-rate plan, and take the median of those suggestions, corresponding to majority voting about the modifications. I would be very surprised if this procedure does not converge to a reasonably consistent compromise within a couple of rounds.[20]

Figure 3.1 illustrates a situation with three MPC members. One member prefers the instrument-rate plan AC, where A corresponds to the preferred current instrument-rate setting. A second

[19] At the RBNZ, the governor is the single decisionmaker and is advised by an internal MPC. The single decisionmaker is sometimes said to simplify the decision about the interest-rate path (Goodhart [18] and [20]). My information about MPC meetings gained especially during the review of monetary policy in New Zealand (Svensson [41], admittedly a few years old) nevertheless indicates that the decisions normally were very collegial and similar to a majority-voting MPC. Archer [4] provides more specific information supporting this impression.

[20] Relying on the median instrument-rate plan also has the attractive property that outliers are disregarded: extreme MPC members will have little or no influence on the resulting instrument-rate plan.

Figure 3.1: Voting about instrument-rate plans



member prefers the instrument-rate plan BC. These members agree on the instrument-rate far into the future, but disagree on the time to get to that level and on the current instrument-rate level. A third member prefers the instrument-rate plan DE, with a lower current level and a lower future level than the other two. The median instrument rate for each date results in the median instrument-rate BC. For this simple configuration of individual instrument-rate plans, the procedure converges in one step.[21]

4 Transparency and communication issues

The internal forecast/decision process and the bank's announcement and communication process are distinct, although the appropriate announcement and communication is an important part of managing private-sector expectations and thereby implementing monetary policy. From a transparency and accountability point of view, it is desirable that the central bank's reporting is a correct representation of the internal forecast/decision process and its results. However, I see no problem with the bank trying out different internal procedures for some time and announcing them later, when the bank has decided which procedures to follow.

Since monetary policy has an impact on the economy via the private-sector expectations of

[21] For an MPC member with an even number of voters, the median curve can be defined as the average of the two middle curves. If one member (the Governor) has the decisive vote in case of a tie, the Governor's vote would decide which of the two middle curves is the median.
If the MPC members' individual instrument-rate plans intersect, the median curve may consist of segments of different members' plans. Then a few rounds may be required for a reasonably smooth and consistent median plan.

inflation, output, and interest rates that it gives rise to, announcing the optimal projection—including the instrument-rate projection—and the analysis behind it would have the largest impact on private-sector expectations and be the most effective way to implement monetary policy. Since the optimal projection is the best projection in the sense of minimizing expected squared forecast errors, it also provides the private sector with the best aggregate information for making individual decisions. Announcing the optimal projections also allows the most precise and sophisticated external evaluation of the monetary-policy framework and decisions.

Morris and Shin [36] have presented a result indicating that more public information may reduce welfare. This result has received considerable attention and been interpreted as an anti-transparency result (Amato, Morris, and Shin [1], Amato and Shin [2], and Economist [15]). However, Svensson [49] shows that some scrutiny of the result reveals that it has been misinterpreted and is actually *pro* transparency: except in very special circumstances, more public information is good. Furthermore, for a conservative benchmark of equal precision in public and private information, social welfare is higher than in a situation without public information.

The announcement of the optimal instrument-rate projection could include fan charts to emphasize that the projection is a probability distribution conditional on current information and judgment, and that only with probability zero would future decisions be exactly equal to the central projection. Goodhart [20] and Mishkin [35] have warned that the instrument-rate projection might be interpreted as an unconditional commitment. Some special explanation may indeed be required to emphasize that the instrument-rate projection is not a commitment but only the best forecast, the best plan, conditional on current information and judgment, and that future decisions and future projections would normally change due to new information and judgment. Experience from New Zealand indicates that the market and private sector have no problems understanding that projections are conditioned on current information and will change with new information (Archer [3] and [4], Svensson [41]). Furthermore, educating the market and the general public about monetary policy is a natural part of successful inflation targeting.

Note that the above discussion concerns conveying the bank's optimal *projection* of inflation, the output gap, and the instrument rate to the private sector. It does not attempt to convey the bank's *reaction function*, that is, how the current instrument-setting depends on current information and judgment. This reaction function is, in my view, too complex to ever be explicitly expressed, not even within the bank. The current information and judgment is too complex and evolving to allow this. The optimal instrument-rate decision depends in a complex way on all the information and

judgment used in the forecasting process. I argue this case in more detail in Svensson [46] and [48]. The reaction function is, in my view, best left implicit. Fortunately, the decision process proposed above does not require the central bank's reaction function to be explicit.[22]

5 Additional issues

In short, I believe that the best instrument-rate decisions, the most effective implementation of monetary policy, and the most satisfactory degree of transparency and accountability can be achieved with the moderately formal framework discussed above. Let me discuss a few additional points.

5.1 Models versus judgment

The above framework allows the combination of model projections and judgmental projections. It can be used with projections that are largely judgmental or with projections that are largely model-based, or any combination in between. Svensson [48] discusses in greater detail how central-bank judgment—information, knowledge, and views beyond the scope of a particular model—can be incorporated into optimal projections in a consistent way. Svensson and Tetlow [51] describe a practical such way, the method of Optimal Policy Projections, which is in actual use at the Federal Reserve Board. My own view is that models are very useful in practical monetary policy, but a substantial amount of judgment always needs to be applied. I doubt that good monetary policy can ever be conducted without a substantial amount of judgment. Any model is always a drastic simplification of a complex economy, and judgment in the form of information, knowledge, and views outside the scope of a particular model will always be necessary. The challenge is to apply good judgment in a disciplined and systematic way rather than in a completely discretionary and ad hoc way.

5.2 Uncertainty, "mean" forecast targeting, and "distribution" forecast targeting

Monetary policy is always conducted under substantial amounts of uncertainty. The projections discussed above can be interpreted as *mean* projections of future random variables, and the procedures discussed above can be called mean forecast targeting. Strictly, mean projections are sufficient

[22] Although it is in principle true that inflation targeting, as stated by King [25], can be described as (1) an ex ante inflation target and (2) an optimal instrument-rate response to observable shocks, in practice the number of different potential shocks is so large that the optimal response to all possible observable shocks cannot be made explicit.

for optimal policy only under *certainty equivalence*, which strictly requires a known linear model and a quadratic loss function and only additive uncertain shocks. Clearly, there exists a substantial amount of uncertainty that does not fall into that category.

When certainty equivalence is violated, for instance, because the uncertainty is multiplicative and not just additive, mean projections are not sufficient for optimal policy. Then the entire distribution of future random target variables matters. Svensson and Williams [52] develop a flexible and powerful but still tractable framework for optimal monetary policy under model uncertainty. This framework extends so-called Markov jump-linear-quadratic systems to include forward-looking variables. In principle, the procedure of forecast targeting that I have discussed in this paper can be done with projections being probability distributions—distribution projections—instead of mean projections. Then the procedures discussed above can be called *distribution* forecast targeting. It is too early to tell whether in most situations for monetary policy the difference between mean forecast targeting and distribution forecast targeting is so large as to matter for practical policy.[23]

In both mean and distribution forecast targeting, the uncertainty in the projections can conveniently be illustrated with fan charts. The methods of Svensson and Williams [52] allow the convenient construction and plotting of consistent fan charts under both certainty equivalence and certainty non-equivalence.

5.3 Optimization under commitment, the timeless perspective, and discretion

When forward-looking private-sector expectations are important, optimization under commitment differs from optimization under discretion. From a descriptive point of view, the behavior of some central banks is probably better described as optimization under discretion, where each new decision is done from scratch, regardless of previous promises and statements. Indeed, some debaters who are opposed to the idea of publishing instrument-rate projections have referred to the undesirability of such projections since they might be interpreted by the private sector as commitments and thereby restricte the bank's freedom to act (Mishkin [35]).

However, from a normative point of view, and when policy advice is given, optimization under commitment is the obvious standard, since policy under commitment, when commitment is possible, results in better outcomes. Furthermore, the issue of consistent reoptimization under commitment can be handled with optimization under commitment in the timeless perspective (Woodford [55]

[23] The terms "mean forecast targeting" and "distribution forecast targeting" were, to my knowledge, introduced in Svensson [42].

and Svensson and Woodford [53]). Svensson [48] and Svensson and Williams [52] provide details when there is certainty equivalence and non-certainty equivalence, respectively.

5.4 The output gap, potential output, the interest-rate gap, and the neutral interest rate

Above the output gap, the difference between output and potential output, has been used as a generic variable indication the state the business cycle. However, in modern views of the transmission mechanism, the output gap is an import variable and far from arbitrary. In this regard, the theoretically most satisfactory concept of potential output is the hypothetical output level that would result in the economy if all prices and wages were completely flexible. This means that potential output is time-varying, shock-dependent, and is not a simple trend. Because the output gap and potential output gap is a crucial variable in the transmission mechanism, it makes sense that central banks should use a fair amount of resources to estimate potential output and construct projections of potential output and the output gap and also publish those estimates and projections, especially if the output gap is an implicit or explicit target variable. The fact that estimates and projections of potential output and the output gap are quite uncertain does not diminish their importance and is not a reason not to publish them (contrary to what Mishkin [35] argues). Generally, a simple principle for transparency is that the central bank shall publish projections of all its target variables. If a central bank has the employment gap or the unemployment gap, defined as the difference between employment (unemployment) and "potential" employment (unemployment), as a target variable, it should publish estimates and projections of that as well. (Here, the theoretically most satisfactory definition of "potential" is again the hypothetical level in an economy with completely flexible prices and wages.)

In modern views of the transmission mechanism, the most appropriate measure of monetary-policy stance is the projection of the current and future *interest-rate gap*, the difference between the real instrument rate and the neutral real interest rate. The neutral real interest rate (the Wicksellian natural real interest rate) is, in analogue with potential output, the hypothetical short real interest rate that would result in the economy if prices and wages were completely flexible. As for potential output, this means that the neutral real interest rate is time-varying, shock-dependent, and is not a simple average of past real interest rates. The neutral real interest rate and potential output are related. In the simplest case, the neutral real interest rate is the sum of the rate of time preference and a term equal to expected growth of potential output divided by the intertemporal

elasticity of consumption. The most appropriate measure of monetary-policy stance is then given by the projection of the current and future interest-rate gap. Given the importance of this concept in the modern views of the transmission mechanism, it makes sense that central banks estimate, use, and publish estimates of it. (Appendix B provides some details on the interest-rate gap.)

[To be extended.]

6 Conclusions

In short, I believe that inflation-targeting central banks can make substantial progress by being more specific, systematic, and transparent about their operational objectives (in the form of an explicit intertemporal loss function), their forecasts (in the form of deciding on optimal projections of the instrument rate and the target variables), and their communication (in the form of announcing optimal projections of the instrument rate and target variables).

[To be extended.]

Appendix

A The loss function

Let the period loss function be (2.1). Note that,

$$\begin{aligned}\lim_{\delta\to 1-}(1-\delta)\mathrm{E}_t\sum_{\tau=0}^{\infty}\delta^{\tau}L_{t+\tau} &= (\mathrm{E}[\pi_t]-\pi^*)^2+\mathrm{Var}[\pi_t]+\lambda(\mathrm{E}[x_t]^2+\mathrm{Var}[x_t])\\ &= (\mathrm{E}[\pi_t]-\pi^*)^2+\mathrm{Var}[\pi_t]+\lambda\mathrm{Var}[x_t],\end{aligned}$$

under the assumption that $\mathrm{E}[x_t]=0$.

[To be extended.]

B The interest-rate gap

That the projection of the current and future interest-rate gap is an appropriate indicator of the monetary-policy stance can be demonstrated in a simple New Keynesian model of aggregate demand. Let aggregate demand be given by

$$y_t = y_{t+1|t} - \sigma(r_t-\rho_t), \tag{B.1}$$

where y_t denotes (log) output in period t, $z_{t+\tau|t}$ denotes $\mathrm{E}_t z_{t+\tau}$ (the rational expectation in period t of the realization of variable $z_{t+\tau}$ in period $t+\tau$), $\sigma>0$ denotes the intertemporal elasticity of substitution, r_t denotes a short (one-period) real interest rate, and ρ_t denotes the rate of time preference between period t and period $t+1$ and is an exogenous stochastic process. The short real interest rate is defined by

$$r_t \equiv i_t - \pi_{t+1|t}, \tag{B.2}$$

where i_t is a short (one-period) nominal interest rate and $\pi_{t+1|t}$ denotes the rational expectation in period t of inflation between period t and period $t+1$, π_{t+1}. Equation (B.1) follows from a first-order condition for optimal intertemporal consumption choice with an additively separable utility function for a representative consumer with constant elasticity of intertemporal substitution σ and a stochastic subjective discount factor whose logarithm is ρ_t.

Let $\bar{y}_t$ denote (log) potential output and assume that it is an exogenous stochastic process. Define the neutral real interest rate, $\bar{r}_t$, as the real interest rate for which output in (B.1) equals potential output. This gives

$$\bar{r}_t \equiv \rho_t + \frac{1}{\sigma}(\bar{y}_{t+1|t}-\bar{y}_t), \tag{B.3}$$

so the neutral interest rate equals the sum of the rate of time preference and expected potential output growth divided by the intertemporal elasticity of substitution.

Define the output gap as the difference between (log) output and (log) potential output,

$$x_t \equiv y_t - \bar{y}_t. \tag{B.4}$$

Using (B.3) and (B.4) in (B.1) results in

$$x_t = x_{t+1|t} - \sigma(r_t - \bar{r}_t). \tag{B.5}$$

The output gap in period t depends on the expected output gap in period $t+1$ and the current interest-rate gap, $r_t - \bar{r}_t$. (The nominal and the real interest rate gaps are the same, if we identify $\bar{r}_t + \pi_{t+1|t}$ with the nominal neutral interest rate, since $r_t - \bar{r}_t = r_t + \pi_{t+1|t} - \bar{r}_t - \pi_{t+1|t} = i_t - (\bar{r}_t + \pi_{t+1|t})$.)

Solving (B.5) forward T periods gives

$$x_t = x_{t+T|t} - \sigma \sum\nolimits_{\tau=0}^{T-1} (r_{t+\tau|t} - \bar{r}_{t+\tau|t}). \tag{B.6}$$

Assume that the expected output gap far into the future approaches zero ($x_{t+T|t} \to 0$ when $T \to \infty$) and assume that the sum in (B.6) converges when $T \to \infty$ (that is, that $r_{t+T|t} - \bar{r}_{t+T|t} \to 0$ sufficiently fast when $T \to \infty$). Then we can let $T \to \infty$ in (B.6) and we get

$$x_t = -\sigma \sum\nolimits_{\tau=0}^{\infty} (r_{t+\tau|t} - \bar{r}_{t+\tau|t}).$$

The output gap depends on the accumulated projected current and future interest-rate gaps, $\sum_{\tau=0}^{T-1}(r_{t+\tau|t} - \bar{r}_{t+\tau|t})$. The projection of the current and future interest-rate gap, $r^t - \bar{r}^t = (r_t - \bar{r}_t, r_{t+1|t} - \bar{r}_{t+1|t}, ...)$ contains all information about the monetary-policy stance.

References

[1] Amato, Jefferey D., Stephen Morris, and Hyun Song Shin (2002), "Communication and Monetary Policy," *Oxford Review of Economic Policy* 18, 495–503.

[2] Amato, Jefferey D., and Hyun Song Shin (2003), "Public and Private Information in Monetary Policy Models," BIS Working Paper No. 138, www.bis.org.

[3] Archer, David (2004), "Communication with the Public," paper presented at the Czech National Bank Conference on Practical Experience with Inflation Targeting, Prague, May 13–14.

[4] Archer, David (2005), "Central Bank Communication and the Publication of Interest Rate Projections," paper prepared for "Inflation Targeting: Implementation, Communication and Effectiveness," a workshop at Sveriges Riksbank, Stockholm, June 10–12.

[5] Bean, Charles (2003), "Asset prices, financial imbalances and monetary policy: are inflation targets enough?" BIS Working Paper No. 140, www.bis.org.

[6] Bean, Charles (2004), "Some Current Issues in UK Monetary Policy," speech in London, July 28, www.bankofengland.co.uk.

[7] Berg, Claes, Per Jansson, and Anders Vredin (2004), "How Useful are Simple Rules for Monetary Policy? The Swedish Experience," Sveriges Riksbank Working Paper No. 169, www.riksbank.se.

[8] Batini, Nicoletta and Tony Yates (2003), "Hybrid Inflation and Price Level Targeting," *Journal of Money, Credit, and Banking* 35, 283–300.

[9] Bernanke, Ben S., and Michael Woodford (1997), "Inflation Forecasts and Monetary Policy," *Journal of Money, Credit, and Banking* 29(4), 653–684.

[10] Blinder, Alan S. (1998), *Central Banking in Theory and Practice*, MIT Press, Cambridge, MA.

[11] Blinder, Alan S. (2004), *The Quiet Revolution*: *Central Banking Goes Modern*, Yale University Press, New Haven, CT.

[12] Blinder, Alan S., Charles A.E. Goodhart, Philipp M. Hildebrand, David Lipton, and Charles Wyplosz (2001), *How Do Central Banks Talk?* Geneva Reports on the World Economy No. 3, CEPR, London.

[13] Brash, Donald T. (2000), "Making Monetary Policy: A Look Behind the Curtains," speech in Christchurch, January 26, www.rbnz.govt.nz.

[14] Bray, Margaret, and Charles A.E. Goodhart (2002), "'You Might as Well Be Hung for a Sheep as a Lamb': The Loss Function of an Agent," LSE Financial Markets Group Discussion Paper No. 418.

[15] *Economist* (2004), "It's Not Always Good to Talk," July 22, 71.

[16] Faust, Jon, and Dale W. Henderson (2004), "Is Inflation Targeting Best Practice Monetary Policy?" *Federal Reserve Bank of St. Louis Review* 86:4, 117–144, www.stlouisfed.org.

[17] Fracasso, Andrea, Hans Genberg, and Charles Wyplosz (2003), *How Do Central Banks Write? An Evaluation of Inflation Targeting Central Banks*, Geneva Reports on the World Economy Special Report 2, CEPR, London.

[18] Goodhart, Charles A.E. (2001), "Monetary Transmission Lags and the Formulation of the Policy Decision on Interest Rates," *Federal Reserve Bank of St. Louis Review* July/August 2001, 165–181, www.stlouisfed.org.

[19] Goodhart, Charles A.E. (2003), "Some Concluding Comments," in Paul Mizen, ed., *Central Banking, Monetary Theory and Practice: Essays in Honour of Charles Goodhart*, Volume II, Edward Elgar, 275–278.

[20] Goodhart, Charles A.E. (2005), "The Interest Rate Conditioning Assumption," working paper.

[21] Heikensten, Lars (1999), "The Riksbank's Inflation Target—Clarifications and Evaluation," *Sveriges Riksbank Quarterly Review* 1999:1, 5–17, www.riksbank.se.

[22] Heikensten, Lars (2005), "Thoughts on How to Develop the Riksbank's Monetary Policy Work," speech in Stockholm, February 22, www.riksbank.se.

[23] Honkapohja, Seppo, and Kaushik Mitra (2003), "Problems in Inflation Targeting Based on Constant Interest Rates," working paper.

[24] Jansson, Per, and Anders Vredin (2003), "Forecast-Based Monetary Policy: The Case of Sweden," *International Finance* 6, 349–380.

[25] King, Mervyn A. (1996), "How Should Central Banks Reduce Inflation?—Conceptual Issues" in *Achieving Price Stability*, Federal Reserve Bank of Kansas City, 53–91, www.kc.frb.org.

[26] King, Mervyn A. (1999), "Challenges for Monetary Policy: New and Old?" in *New Challenges for Monetary Policy*, Federal Reserve Bank of Kansas City, 11–57, www.kc.frb.org.

[27] King, Mervyn A. (2002), "The Inflation Target Ten Years On," speech in London, November 19, www.bankofengland.co.uk.

[28] Kohn, Donald L. (2003), "Comments on Marvin Goodfriend's 'Inflation Targeting in the United States?' " speech in Miami, January 25, www.federalreserve.gov.

[29] Kuttner, Kenneth N. (2004), "A Snapshot of Inflation Targeting in its Adolescence," in *The Future of Inflation Targeting*, Reserve Bank of Australia, 6–42, www.rba.gov.au.

[30] Leeper, Eric M. (2003), "An *Inflation Reports* Report," *Sveriges Riksbank Economic Review* 2003:3, 94–118, www.riksbank.se.

[31] Leeper, Eric M., and Tao Zha (2002), "Modest Policy Interventions," *Journal of Monetary Economics*, forthcoming, php.indiana.edu/~eleeper/.

[32] Leitemo, Kai (2003), "Targeting Inflation by Constant-Interest-Rate Forecasts," *Journal of Money, Credit and Banking* 35, 609–626.

[33] Lomax, Rachel (2005), "Inflation Targeting in Practice: Models, Forecasts and Hunches," speech in London, March 12, www.bankofengland.co.uk.

[34] Meyer, Laurence H. (2004), "Practical Problems and Obstacles to Inflation Targeting," *Federal Reserve Bank of Saint Louis Review* 86:4, 151–160, www.stlouisfed.org.

[35] Miskin, Frederic S. (2004), "Can Central Bank Transparency Go Too Far," in *The Future of Inflation Targeting*, Reserve Bank of Australia, 48–66, www.rba.gov.au.

[36] Morris, Stephen, and Hyun Song Shin (2002), "The Social Value of Public Information," *American Economic Review* 92, 1521–1534.

[37] Nessén, Marianne, and David Vestin (2003), "Average Inflation Targeting," *Journal of Money, Credit and Banking*, forthcoming, www.davidvestin.com.

[38] Pagan, Adrian (2003), *Report on Modelling and Forecasting at the Bank of England*, Bank of England, www.bankofengland.co.uk.

[39] Rudebusch, Glenn (2005), "Monetary Policy Inertia: Fact or Fiction?" paper prepared for "Inflation Targeting: Implementation, Communication and Effectiveness," a workshop at Sveriges Riksbank, Stockholm, June 10–12.

[40] Sims, Christopher A. (2002), "The Role of Models and Probabilites in the Monetary Policy Process," *Brookings Papers on Economic Activity* 2:2002, 1–62.

[41] Svensson, Lars E.O. (2001a), *Independent Review of the Operation of Monetary Policy in New Zealand: Report to the Minister of Finance*, www.princeton.edu/∼svensson/.

[42] Svensson, Lars E.O. (2001b), "Price Stability as a Target for Monetary Policy: Defining and Maintaining Price Stability," in Deutsche Bundesbank, ed., *The Monetary Transmission Process: Recent Developments and Lessons for Europe,* Palgrave, New York, 60–102, www.stlouisfed.org.

[43] Svensson, Lars E.O. (2001c), "Requiem for Forecast-Based Instrument Rules," working paper, www.princeton.edu/∼svensson/.

[44] Svensson, Lars E.O. (2003a), "The Inflation Forecast and the Loss Function," in Paul Mizen, ed. (2003), *Central Banking, Monetary Theory and Practice: Essays in Honour of Charles Goodhart*, Volume I, Edward Elgar, 135–152.

[45] Svensson, Lars E.O. (2003b), "Optimal Policy with Low-Probability Extreme Events," in *Macroeconomics, Monetary Policy, and Financial Stability - A Festschrift for Charles Freedman*, Proceedings of a conference held by the Bank of Canada, Ottawa, June 2003, 79–104. Also at www.princeton.edu/∼svensson/.

[46] Svensson, Lars E.O. (2003c), "What Is Wrong with Taylor Rules? Using Judgment in Monetary Policy through Targeting Rules," *Journal of Economic Literature* 41 (2003) 426-477, www.princeton.edu/∼svensson/.

[47] Svensson, Lars E.O. (2004), "Commentary" (on Laurence H. Meyer, "Practical Problems and Obstacles to Inflation Targeting"), *Federal Reserve Bank of St. Louis Review* 84:4, 161-164, www.stlouisfed.org.

[48] Svensson, Lars E.O. (2005a), "Monetary Policy with Judgment: Forecast Targeting," *International Journal of Central Banking*, www.ijcb.org.

[49] Svensson, Lars E.O. (2005b), "Social Value of Public Information: Morris and Shin (2002) Is Actually Pro Transparency, Not Con," working paper, www.princeton.edu.

[50] Svensson, Lars E.O., Kjetil Houg, Haakon Solheim, and Erling Steigum (2002), "An Independent Review of Monetary Policy and Institutions in Norway," *Norges Bank Watch 2002*, Centre for Monetary Economics, Norwegian School of Management BI, www.princeton.edu/∼svensson/.

[51] Svensson, Lars E.O., and Robert J. Tetlow (2005), "Optimal Policy Projections," working paper, www.princeton.edu/∼svensson/.

[52] Svensson, Lars E.O., and Noah Williams (2005), "Monetary Policy with Model Uncertainty: Distribution Forecast Targeting," working paper, www.princeton.edu/∼svensson/.

[53] Svensson, Lars E.O, and Michael Woodford (2005), "Implementing Optimal Policy through Inflation-Forecast Targeting," in Bernanke, Ben S., and Michael Woodford, eds., *Inflation Targeting*, University of Chicago Press, 19-83, www.princeton.edu/∼svensson/.

[54] Woodford, Michael (1994), "Nonstandard Indicators for Monetary Policy: Can Their Usefulness Be Judged from Forecasting Regressions?" in Gregory N. Mankiw, ed., *Monetary Policy*, University of Chicago Press, 96–115.

[55] Woodford, Michael (2003), *Interest and Prices*: *Foundations of a Theory of Monetary Policy*, Princeton University Press.

[56] Woodford, Michael (2004), "Inflation Targeting and Optimal Monetary Policy," *Federal Reserve Bank of Saint Louis Review* 86:4, 15–41, www.stlouisfed.org.

[57] Woodford, Micahel (2005), "Central-Bank Communication and Policy Effectiveness," paper prepared for "Inflation Targeting: Implementation, Communication and Effectiveness," a workshop at Sveriges Riksbank, Stockholm, June 10–12.