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Revealing the Secrets of the Temple: The Value of Publishing Interest Rate Projections*

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Abstract

The modern view of monetary policy stresses its role in shaping the entire yield curve of interest rates in order to achieve various macroeconomic objectives. A crucial element of this process involves guiding financial market expectations of future central bank actions. Recently, a few central banks have started to explicitly signal their future policy intentions to the public, and two of these banks have even begun publishing their internal interest rate projections. We examine the macroeconomic effects of direct revelation of a central bank's expectations about the future path of the policy rate. We show that, in an economy where private agents have imperfect information about the determination of monetary policy, central bank communication of interest rate projections can help shape financial market expectations and improve macroeconomic performance.

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1. Introduction

The modern approach to monetary policy stresses the importance of guiding and influencing the public's expectations about future central bank actions. In this forward-looking view of monetary policy, the current setting of the policy interest rate, which is an overnight or very short-term rate, is on its own of little importance for private agents' decisions about consumption, investment, labor supply, and price setting. Instead, those decisions are more importantly driven by expectations of *future* short rates, especially as embodied in longer-term interest rates and other asset prices (along with the appropriate adjustments for risk). That is, the current policy rate is most relevant to the extent that it conveys information about future policy settings and influences longer-maturity interest rates. Accordingly, at its core, monetary policy can be considered a process of shaping the entire yield curve of interest rates in order to achieve various macroeconomic objectives.

The crucial role that private sector interest rate expectations play in macroeconomic stabilization naturally raises the question: How can central banks best guide private expectations of future monetary policy actions? In the past, central bankers typically assumed that the accumulated record of their past policy actions was the best means of such communication. In this view, actions spoke louder than words. Accordingly, private agents, by examining past policy behavior, could uncover a systematic policy pattern or rule that would be useful in predicting future policy actions. Recently, however, there is a new appreciation of the value of good communication as an accompaniment to good policy actions. One result of this new attitude is that some central banks have started to place more importance on signaling their intentions for future policy settings. In practice, much of the current central bank signaling of future policy intentions is implicit or indirect—essentially, a process of suggesting the future policy path by revealing information other than the future policy path. For example, some inflation-targeting central banks provide descriptions of their macroeconomic models and objectives as well as their current assessments of the state of the economy, but it is left to the public to infer the future policy path that is consistent with this information. A common such communication strategy is to publish an economic projection that is based on the assumption that the policy interest rate will not change in the future from its current setting. Private agents must then compare this constant-interest-rate projection to the announced economic objectives in order to back out the actual expected policy rate path. For example, if, at some future date, the published

constant-interest-rate inflation projection is higher (lower) than the inflation target, then, in general, private agents should infer that the policy rate is likely to increase (decrease). This implicit signaling procedure has been severely criticized as a circuitous, vague, and potentially confusing expression of the central bank's actual views of the likely path of policy.[1] Despite these criticisms, a published constant-interest-rate economic projection remains a key component of many central bank communication strategies.

Implicit signaling remains widespread among central banks because nearly all of them are extremely reluctant to directly reveal their views on likely future policy actions. Indeed, one of the strongest central banking taboos is the prohibition against talking publicly about future interest rates (Faust and Leeper 2005). This taboo largely arises from the belief that financial markets would be prone to interpret any central bank indications about the likely future path of policy as commitments to future action, as opposed to projections based on existing information and subject to considerable change. Thus, many central banks will at best only give indirect hints or use coded language about policy inclinations in order to retain a plausible deniability in case markets are disappointed as the future unfolds.

Although the expected future path of the policy rate remains a closely guarded secret at most central banks, a few central banks have recently provided some explicit signals to the public about their policy intentions. Notably, in 2003, the U.S. Federal Reserve, or more specifically the Federal Open Market Committee (FOMC), started to issue statements directly commenting on the future path of the policy rate. These verbal forward-looking policy inclinations, including, for example, the famous phrase, "policy accommodation can be removed at a pace that is likely to be measured," have been considered in central banking circles relatively bold statements about the future path of policy, even though the phrasing is far from unambiguous. Even more astonishing than the FOMC's direct verbal signaling, the central banks of New Zealand and Norway (the RBNZ and the Norges Bank, respectively) are now publishing numerical forecasts of the future path of the policy interest rate. These public quantitative policy rate projections represent a dramatic change from the past communication practices of central banks. Furthermore, explicit signaling of policy inclinations has been quite controversial, and its future use remains uncertain. In the next section, we describe in more detail such real-world direct signaling of policy inclinations by central banks and outline some of the arguments for and against

[1] For discussion and critiques of this communication strategy, see Rudebusch and Svensson (1999), Goodhart (2001), Leitemo (2003), Svensson (2005b), and Woodford (2005).

such transparency.

The debate among central bankers and researchers worldwide about the explicit signaling of likely future interest rates provides the key motivation for our formal analysis. As a practical matter, Federal Reserve Bank of St. Louis President William Poole (2005a) has stated that "the most important communications issue facing the FOMC currently is whether and how to continue to provide forward guidance on policy decisions." There is also an ongoing debate among researchers about the value of transparency. The political benefits of transparency, in terms of greater accountability and legitimacy, are in little dispute; however, the main argument in favor of directly communicating the central bank's view of the most likely future policy path is an economic one that is based on the benefits of sharing central bank information with private economic agents. As the current Federal Reserve Chairman Ben Bernanke (2004) has suggested, "FOMC communication can help inform the public's expectations of the future course of short-term interest rates, providing the Committee with increased influence over longer-term rates and hence a greater ability to achieve its macroeconomic objectives." This view is supported by research that argues that FOMC statements do affect financial markets and can alter expectations about the future course of policy (e.g., Kohn and Sack 2004, Bernanke, Reinhart, and Sack 2004, and Gürkaynak, Sack, and Swanson 2005a). However, the large research literature on transparency is only a partial buttress for this argument. The theoretical literature has obtained conflicting results on the value of transparency depending on the exact details of the modeling specification.[2] In addition, the literature has not focused on the issue of the effectiveness of explicit future policy signals for enhancing macroeconomic stabilization.[3]

In Sections 3 and 4, we examine the macroeconomic effects of direct revelation of a central bank's expectations about the future path of the policy rate in a small theoretical model in which private agents have imperfect information about the determination of monetary policy. In particular, we focus on an issue that has received relatively little attention in the literature, namely, the desirability of central bank transparency about the expected path of policy when the public is confused about the central bank's medium-run inflation goal and uses signal extraction to discern the central bank's intentions. We show that publication of interest rate projections

[2] The large literature on central bank transparency is summarized in Geraats (2002) and Woodford (2005). As discussed below, a key dissent on the value of transparency is Morris and Shin (2002, 2005) who argue that, in certain circumstances, greater central bank transparency may lead to less private sector infomation gathering and reduced welfare.

[3] An important exception is Faust and Leeper (2005) who examine central bank interest rate projections. More generally, Svensson (1997) and Geraats (2005) discuss the value of central bank inflation and output forecasts.

better aligns the expectations of the public and the central bank in the spirit of the quotes from policymakers cited above. Thus, publishing interest rate projections facilitates the management of expectations and the yield curve. We then show that under reasonable conditions, improving the alignment of expectations also helps the central bank better meet its goals, providing support for full central bank transparency. However, this is not always the case, and we examine conditions under which partial or no transparency may be preferred.

2. The Revelation of Policy Inclinations by Central Banks

Before conducting our formal analysis of explicit central bank signaling, it will be useful to describe briefly some actual instances of direct central bank communication about the likely future path of the policy interest rate and consider some of the arguments made for and against such explicit signals.

2.1. Recent Examples of Direct Policy Signaling by Central Banks

Some of the most intriguing direct signals of future policy inclinations have been in statements issued by the Federal Reserve following FOMC meetings, and it is useful to describe in detail some of this recent history. At times, the FOMC policy statements have provided direct verbal indications of the expected path of policy, which is quite unusual given the Fed's historical secrecy about the setting of the policy rate. Indeed, it was just over a decade ago, in July 1995, that the Fed first even announced the contemporaneous numerical level for the target federal funds rate.[4] Another example of the Fed's reticence involves its semiannual *Monetary Policy Report.* For over two decades, Fed policymakers have been surveyed internally about the economic outlook on a semiannual basis and have been asked to provide macroeconomic forecasts based on their individual views of an optimal future path for the policy interest rate.[5] The ranges and central tendencies of the resulting inflation, output, and unemployment forecasts have been released to the public; however, the underlying conditioning policy paths have not been published and, indeed, have not even been collected from the survey participants. A similar

[4] The first policy announcement following an FOMC meeting occurred in February 1994 and only vaguely noted that "the FOMC decided to increase slightly the degree of pressure on reserve positions." In July 1995, the policy statement noted that the decrease in reserve pressures would also be reflected in "a 25 basis point decline in the federal funds rate." Rudebusch (1995) described some of the difficulties in inferring even the ex post level of the federal funds rate target before 1994. Of course, changes in the discount rate, which is an administered interest rate, have always been announced.

[5] These economic forecasts are summarized in the Fed's semiannual *Monetary Policy Report* to Congress, which was orginally required by the Full Employment and Balanced Growth Act of 1978.

secrecy applies to forecasts prepared by the staff of the Federal Reserve Board, which are distinct from the policymakers' own views. These detailed projections are circulated internally before each FOMC meeting in the so-called Greenbook and are made public with a five-year lag. Still, although over one hundred economic series are projected, the underlying staff forecast for the policy rate (the federal funds rate) is not tabulated.[6]

In general, Fed policymakers' views on the future policy path have been so closely guarded that they were only rarely even discussed. One exception occurred from 1983 to 1999, when the FOMC voted not only on the current setting of the policy interest rate but also on the expected direction of future changes in the stance of policy over the very near term—strictly speaking, over the "intermeeting period," the approximately six-week interval until the next meeting.[7] These future policy inclinations were known as the policy "tilt" or "bias." An "asymmetric bias" meant that the FOMC judged that a policy move in one direction was more likely than in the other, while a "symmetric" judgement meant that the next policy move was equally likely to be up or down. Information about the policy bias was contained in the operational instructions or "domestic policy directive" sent to the trading desk at the New York Fed. Before May 1999, each directive was only released to the public after the next FOMC meeting, so, when released, the directive was, strictly speaking, outdated and of limited use to markets.[8] Following the FOMC meeting in May 1999, as well as after the subsequent five meetings that year, the post-meeting policy statement explicitly announced the expected future direction of policy as contained in the directive. The relevant forward-looking language from these 1999 statements is shown in the first several rows of Table 1. For example, after the October 5, 1999, meeting, the policy statement noted that "the Committee adopted a directive that was biased toward a possible firming of policy going forward."

The Fed's first attempt at directly signaling the direction of future policy in 1999 was, in some sense, a straightforward and logical extension of the earlier transparency about the contemporaneous policy setting that was initiated in July 1995. Essentially, since the FOMC had been voting on both the current policy setting and a future policy inclination, it made some

[6] Similarly, the research staff of the Federal Reserve Bank of San Francisco frequently publish their forecasts for various economic series but never for the federal funds rate.

[7] Especially in the 1990s, the relevant horizon was often interpreted as a longer period, which, as noted below, led to some confusion. Thornton and Wheelock (2000) provide a fascinating history of the policy bias and its interpretation.

[8] The secrecy of the directive was the subject of a famous Freedom of Information complaint that came before the U.S. Supreme Court in 1979. As described by Goodfriend (1986, p. 71), one of the reasons given defending the need for the secrecy of the directive was, "The FOMC does not wish to precommit its future policy actions and current disclosure of the directive would tend to precommit the FOMC."

sense to communicate both pieces of information to the public. At the FOMC meeting on July 1, 1998 (based on now-public transcripts), Don Kohn, who was then a Fed research director, noted that an important rationale for releasing the directive stemmed "from a desire at times to warn markets that a change might be forthcoming in order to reduce the odds on an overreaction because of the surprise when policy tightening or easing actually occurred." Any such ability to shape market expectations of future policy by using the policy statement would seem to be quite attractive.

After the fact, however, the FOMC was not pleased with the market reactions to the policy statements in 1999, and there was some anguished FOMC discussion that year about the apparent confused reactions in financial markets to the release of the forward-looking language. At the start of 2000, given the FOMC's unhappiness with market responses, the direct signals of policy inclinations were replaced by implicit ones, specifically statements about the "balance of risks" to achieving the Fed's economic objectives. The formulaic balance of risks language in the policy statement went as follows, with only one of the three sets of alternative bracketed words to be used depending on the circumstances: "Against the background of its long-run goals of price stability and sustainable economic growth and of the information currently available, the Committee believes that the risks are [balanced with respect to prospects for both goals][weighted mainly toward conditions that may generate heightened inflation pressures][weighted mainly toward conditions that may generate economic weakness] in the foreseeable future." Of course, the three alternative balance of risks options could be roughly mapped into the three earlier policy bias options of higher, unchanged, or lower future rates; however, the looser linkage obtained by avoiding any references to future policy actions appeared important. As Fed Governor Larry Meyer described the motivation for the balance of risks language at the December 21, 1999, FOMC meeting: "The majority [in the FOMC] also wants to change the language to focus on the balance of risks in the forecast in order to detach it from an explicit reference to policy." Indeed, at that meeting, there was a general agreement among the participants at the FOMC meeting to re-establish the taboo against any direct forward-looking signals about policy.

In the event, the implicit balance of risks language was also an imperfect and short-lived substitute. Its tight formulaic corset with a choice between "heightened inflation pressures" and "economic weakness" was not able to capture the Committee's worries in 2003 about inflation falling too low and deflation. Instead, the FOMC again decided that a direct statement about

its future policy inclinations could be a useful means to guide market expectations. Therefore, as shown in Table 1, in August 2003, the FOMC introduced the following language into its public statement: "the Committee believes that policy accommodation can be maintained for a considerable period." This was a direct, though not unambiguous, indication that the FOMC anticipated that the policy interest rate could be kept low for some time. The balance of risks language also remained in the statement in various forms, but it was essentially trumped by the direct forward-looking language. The initial direct signal was followed by "the Committee believes that it can be patient in removing its policy accommodation" in January 2004, and by "policy accommodation can be removed at a pace that is likely to be measured" in May 2004, and by "some further policy firming is likely to be needed" in December 2005, and by "further policy firming may be needed" in January 2006. Don Kohn (2005), as a member of the FOMC, described the underlying reasoning behind this return to an explicit signal of future policy:

> The unusual situation at that time [in 2003] shifted our assessment of the balance of costs and benefits in favor of a public statement about our expectations for the near-term path of policy. Markets appeared to be anticipating that inflation would pick up soon after the expansion gained traction, and therefore that interest rates would rise fairly steeply. This expectation was contrary to our own outlook. We saw economic slack and rapid productivity growth keeping inflation down for some time. Our expectations about policy also took account of the fact that the level of inflation was already low—lower than it had been for several decades. We thought that our reaction to a strengthening economy would be somewhat different this time than it had been in many past economic expansions and unlike what the markets seemed to anticipate.

Furthermore, unlike in 1999, the direct verbal policy signaling begun by the Fed in 2003 was viewed by many to have been useful in guiding financial markets (as discussed below), though, as noted in the introduction, its continued use in the future remains open to debate.

A few other central banks have also provided direct verbal signals about their future policy inclinations.[9] For example, in 1999, the Bank of Japan lowered its policy interest rate to zero and announced its intention to maintain the zero rate "until deflationary concerns are dispelled." This verbal signal to the public that the Bank of Japan would maintain a zero policy rate into the future—conditional on continued price deflation—was a key element of what was known as the "zero interest rate policy" and later as "quantitative easing." This signal, which tried to

[9] In 2006, the Bank of Canada telegraphed its intentions in policy statements that noted "some modest further increase in the policy interest rate may be required to keep aggregate supply and demand in balance and inflation on target over the medium term."

persuade financial market participants to lower their expectations of future short rates and hence lower long rates, was part of an attempt to stimulate the economy and escape from deflation. Even more so than in the U.S., however, the continued future use of such direct signals appears in doubt. (See Bernanke, Reinhart, and Sack 2004 and Oda and Ueda 2005.)

In contrast to the signals given in the U.S. and Japan, which were verbal and appeared to be potentially transitory responses to special circumstances, two central banks—the RBNZ and the Norges Bank—have been providing quantitative and ongoing guidance on the future policy rate path. Indeed, the RBNZ has provided numerical policy interest rate projections that reflect the policymaker's views to the public since 1997 (Archer 2005). For example, Figure 1, which is from the March 2006 RBNZ *Monetary Policy Statement*, contrasts the RBNZ's expected path for future policy over the next two years with the path expected by financial markets.[10] In the *Statement*, the Governor of the RBNZ describes the expected policy path as follows: "As long as these inflation risks remain under control, we do not expect to raise interest rates again in this cycle. However given the time that it will take to bring inflation back towards the mid-point of the [inflation] target band, we do not expect to be in a position to ease policy this year. Any earlier easing would require a more rapid reduction in domestic inflation pressures than the substantial slowing already assumed in our projections." All in all, the RBNZ *Monetary Policy Statement* provides a remarkably clear judgement on the most likely future path of policy.

While the RBNZ has been a pioneer in the publication of quantitative projections of the policy interest rate (and other economic variables), the Norges Bank has recently gone even further, as described in Qvigstad (2005) and Svensson (2006b). Since 2005, the Norges Bank has been providing not only the numerical expected future path of the policy interest rate, but also the confidence intervals around this projection as well as state-contingent alternative scenarios. As shown in Figure 2, which is from the November 2005 Norges Bank *Inflation Report*, the baseline policy interest rate path rises steadily over the next three years. As described in the report, the projections "indicate that the interest rate will increase by about 1 percentage point in the course of next year, which is in line with expectations in the money and foreign exchange market. At the two to three year horizon, we expect a further, gradual rise in the interest rate. Our interest rate projections further out are somewhat higher than forward rates in the financial market." The Norges Bank also provides a probability distribution or fan chart

[10] The policy rate of the RBNZ is actually an overnight Official Cash Rate, but that is closely linked to the 90-day interest rate, which is displayed.

around its baseline interest rate projection, as denoted by the shaded regions in Figure 2. By outlining the range of possible monetary policy responses to unexpected macroeconomic disturbances, these confidence intervals reinforce the conditional nature of the baseline projection. The conditionality of the interest rate projection is further reinforced by two specific alternatives that are also displayed and discussed at length in the report. In one, labeled "Stronger trade shifts," the greater pass-through of low import prices lowers inflation and the policy rate, while in the other, a shock boosts inflation and the policy rate.

2.2. Assessments of Direct Signaling of Policy Inclinations

The above descriptions of various instances of direct policy rate signaling convey some of the variety of the recent historical experience. The range of practice—from complete silence to explicit quarter-by-quarter numerical guidance—is breathtakingly wide. Such signaling has elicited strong reactions, both pro and con, from central bankers and academic researchers. We will consider two common objections to direct signals and then survey some of the research on the effects of transparency.

The first objection is an institutional one. Many have argued that forward-looking policy signals are very difficult, if not impossible, for monetary policymakers to produce; that is, a committee of monetary policymakers may be unable to agree on a likely future path. This is the view of Goodhart (2001), a former member of the Monetary Policy Committee (MPC) of the Bank of England, who notes, "it is hard to see how a committee could ever reach a majority for any particular time path. A great advantage of restricting the choice to what to do now, this month, is that it makes the decision relatively simple, even stark. Given the difficulties involved already in achieving majority agreement in the MPC on this simple decision, the idea of trying to choose a complete time path by discretionary choice seems entirely fanciful and counterproductive." Blinder (2004) and Mishkin (2004) essentially concur with Goodhart's pessimistic assessment. Of course, as Blinder (1998) earlier bemoaned, it seems quite unsatisfactory to ignore the fact that optimal policy in an economy with forward-looking agents will require at least an implicit time profile for future policy. Indeed, Svensson (2005b) has argued that understanding the likely future path of policy is a crucial element of policy, and he suggests obtaining consensus on a quantitative path with a fairly straightforward voting mechanism. In this respect, the successful practical example of the Norges Bank, in which a seven-person Ex-

ecutive Board has been able to agree on and publish a quantitative future policy path, should alleviate many of the concerns about impracticality of obtaining agreement on future policy rate signals.[11] Below, in our formal modelling, we do not address the institution dynamics of policy committees but simply assume that the monetary authority can formulate a likely future path for the policy rate.

A second, more serious objection to direct signaling is that financial market participants will inevitably misinterpret the central bank's signals. Policymakers often express the fear that financial markets will misconstrue statements of policy inclinations and, in particular, that the markets will interpret them as essentially guarantees of future policy action. At the FOMC meeting on July 1, 1998, Don Kohn noted that a forward-looking policy announcement "could lock in market expectations and reduce flexibility because it would set up situations in which the market expected some action and the Committee would then have to worry about disappointing those expectations." In the event, of course, such misunderstandings did occur. As described in The *Wall Street Journal* (Schlesinger 2000), "When the Fed started revealing its 'bias' statements in May, financial markets tended to treat the directives as a virtual guarantee of the outcome of subsequent meetings—assuming a 'bias' toward tightening likely meant a rate rise, and that a neutral bias likely meant no rate rise. That wasn't what the Fed intended. With markets ascribing greater clarity to Fed statements than the Fed did, officials at times felt boxed in by extreme market reactions." A similar view of the confusion resulting from the direct signals was expressed in the official postmortem assessment of the 1999 policy statements, titled "Modifications to the FOMC's Disclosure Procedures," (released on January 19, 2000) which noted that the direct forward-looking policy language "caused some unanticipated confusion. It became apparent that the public was uncertain about the interpretation of the language used to characterize possible future developments, about the time period to which it applied, and the extent to which the announced changes in that language represented major shifts in the Committee's assessment. Perhaps partly as a result, the announcement of a directive biased toward tightening seemed to exaggerate the responses of financial markets to subsequent information bearing on the likely course of interest rates and monetary policy."

Of course, part of the confusion in 1999 stemmed from the particular language that was

[11] Alternatively, the diversity of opinion about the future on a policy committee could be informative, and Archer (2005) suggested publishing the "braid" of separate interest rate paths of individual committee members. As noted by Archer (2005), the New Zealand experience is not informative on this issue, as the RBNZ has a single monetary policymaker.

used in the statement. In contrast, the direct verbal policy signals provided by the Fed in 2003 and thereafter have been generally viewed as successful. Kohn (2005), Bernanke (2004), and Woodford (2005), for example, all argue that the language was properly interpreted and that market rates were influenced in the right direction. This interpretation has garnered some support from empirical studies as well. Overall, for example, the incremental steps toward greater openness and transparency that the Fed took throughout the 1990s and early 2000s appear to have had important effects on financial markets. Indeed, as documented by Lange, Sack, and Whitesell (2003) and Swanson (2006), financial markets became much better at forecasting the future path of monetary policy than they were in the 1980s and early 1990s and more certain of their forecast ex ante, as measured by implied volatilities from options.[12] Other studies that have been more narrowly focused on the specific effect of recent forward-looking Fed policy statements, notably Bernanke, Reinhart, and Sack (2004) and Gürkaynak, Sack, and Swanson (2005a), have also supported the notion that these statements have been useful in suggesting to the public a particular course of future action. Furthermore, the experience of the RBNZ, which has given specific numerical policy guidance for over a decade, is instructive. As discussed by Archer (2005), financial markets in New Zealand have reacted favorably to the central bank's interest rate forecasts, and understood their conditionality. Although the Norges Bank has a scant track record, the explicit confidence bands should reinforce forecast conditionality, and its experience thus far has been favorable.

Of course, the counterfactuals in these cases cannot be observed, so it is difficult to judge definitely the effectiveness of the recent specific communication. Indeed, some have judged the episode far less favorably. As noted in *Business Week* (Miller 2005): "But what started out as a well-meaning attempt to give investors a clear sense of where monetary policy was headed has degenerated into a muddled message that has sown confusion in financial markets and helped fan fears of higher inflation among investors. That has raised questions inside and outside the Fed about whether the central bank's extraordinary strategy of mollycoddling the markets has done more harm than good." And the president of the European Central Bank (ECB), Jean-Claude Trichet (2006), made it clear that the ECB would not be sending similar direct signals about the likely path of its policy interest rate.[13]

[12] Of course, this greater certainty about future rates may be precisely the worry of those opposing explicit guidance on interest rates. Namely, that providing information about the first moment of future interest rates—the expected path—will distort the second moment of future rates, reducing the implied volatility or dispersion of expected future rates in an unwarranted fashion.

[13] Trichet noted that "the ECB does not embark on a particular multi-monthly pre-commitment on interest

Even among those who judged the Fed's direct signaling to have been useful, many considered it a one-time solution for a transitory deflationary risk. Notably, the signaling could be considered a particular example of the strategy of stimulating the economy discussed by Reifschneider and Williams (2000) and Eggertsson and Woodford (2003), which provides assurances that, with the current policy rate close to or at its lower bound, future rates will also be kept low. It is not clear, as noted above, that the Fed (or for that matter the Bank of Japan), will employ an ongoing strategy of direct signaling. For example, in the U.S., the minutes of the FOMC meeting of November 10, 2004, stated, "A few members felt that, because of greater uncertainties, it might become appropriate eventually to move away from the recent practice of providing guidance about the likely future path of policy, while others emphasized the desirability of continuing to be as informative as possible about the Committee's perceived outlook." That is, the future of direct signals is uncertain.[14]

For some, given the sophistication of the financial system, it is perhaps easy to dismiss at an abstract level concerns about the inevitable breakdown of the communication between central banks and markets. However, there is still much unknown about the precise relationship between the revelation of information and market pricing, and this black box has long worried central bankers (Goodfriend 1986). Perhaps the most subtle rendering by a policymaker of the difficulties inherent in communicating with financial markets is provided by Kohn (2005):

> In fact, economists do not fully understand how markets incorporate information. Herding behavior, information cascades, multiple equilibria, and the amount of investment in financial research all pose puzzles about markets and information. The situation is complicated still more when an important participant is seen as having superior information owing to its investment in research or its understanding of its own behavior. In such circumstances, certain types of central bank talk might actually impinge on welfare-enhancing market pricing by being misunderstood and receiving too much weight relative to private judgements.

Some of the research underlying this apprehension about transparency is by Morris and Shin

rates or on the path of future policy interest rates. As the Governing Council has decided to regularly consider the most up-to-date information, such an unconditional commitment would limit the ability of the Governing Council to react to changes in the economic situation and therefore hamper our credibility and our capacity to preserve the solid anchoring of inflation expectations. This is, in particular, the reason why we refused to promise to maintain interest rates at 2 percent for a 'considerable period of time.'"

[14] Poole (2005b) appears to express the view of at least a few FOMC members when he notes that "most of the time the FOMC cannot provide accurate information to the market as to the probable course of the target fed funds rate, in terms of a specific path measured in basis points. The future path will be conditional on future information that cannot itself be predicted. Attempts to provide specific forward-looking guidance will prove inaccurate and even misleading to the market. Moreover, the Fed could create a credibility problem for itself if forward guidance is too specific. If the market acts on the guidance, and the Fed subsequently responds to new information in a way that departs from the guidance, then the market will naturally feel that it has been misled. But if the Fed fails to respond to new information that seems to demand a response, in the interest of doing what it said it was going to do, then failure to respond may also damage credibility."

(2002), who provide a simple theoretical model in which the public revelation of policy information can be bad for social welfare. This work has been widely cited and followed by a vigorous debate introducing new theoretical models and modifications. However, as is apparent in surveys by Geraats (2002) and Woodford (2005), many conclusions about the value of transparency appear to hinge on the exact specification of the theoretical models. Various authors, including Roca (2005), and Hellwig (2005) show that transparency is welfare-increasing in more general models. Furthermore, Svensson (2006a) argues that the Morris and Shin result has been widely misinterpreted and that, even in their own model, the anti-transparency result is only obtained for a small set of unlikely parameter values.

Again, with just a few exceptions, the literature has not actually examined the effects of the release of the forward-looking policy information for macroeconomic dynamics and stabilization. It is this is line of reasoning that we pursue in the next two sections.

3. A Framework for Analyzing Central Bank Interest Rate Projections

In this section and the next, we analyze how publishing central bank interest rate projections can affect bond yields and macroeconomic performance in a simple model of the economy. In this section, we describe our framework, which is a standard New Keynesian structure modified to allow for asymmetric information sets for private agents and the central bank. In particular, in our model, the central bank may have an informational advantage over the public that reflects its better information regarding its policy intentions. At the outset, note that we abstract from two issues that have been widely discussed in the past literature on central bank transparency. First, we assume that the central bank is able to commit to future policy actions and therefore does not face a Barro-Gordon time inconsistency problem. Second, we assume that the central bank's provision of information does not affect a private agent's collection or use of idiosyncratic information; thus, we ignore the strategic complementarity highlighted in Morris and Shin (2002).

3.1. A Model of Interest Rates, Output, and Inflation

For our analysis, we use a standard log-linearized New Keynesian model (see Woodford 2003 for further discussion). The output gap, y_t, is determined by a forward-looking "IS curve" given by

the intertemporal saving decision:

$$y_t = -(i_t - \mathrm{E}_t \pi_{t+1} - g_t) + \mathrm{E}_t y_{t+1},$$

where i_t is the nominal interest rate, π_t is the inflation rate, g_t is a distortionary output shock described by a stationary stochastic process, and E_t denotes mathematical expectations conditional on the available time t information set. (Throughout our analysis, we abstract from intercepts.) We have implicitly assumed log preferences so that the coefficient on the interest rate is unity. Solving this equation forward, we can express the output gap in terms of future expected short-term real interest rates:

$$y_t = -\mathrm{E}_t \sum_{j=0}^{\infty} (i_{t+j} - \pi_{t+j+1} - g_{t+j}).$$

This version of the IS curve illustrates a basic insight of modern macroeconomic theory: monetary policy affects output through the expected future path of real interest rates. Generalizations of this model that incorporate a richer description of consumption, investment, and other components of output leave this basic insight intact (see Woodford 2003 and Fuhrer and Rudebusch 2004 for discussion).

It is useful to reformulate this condition in terms of bond yields. Denote the ex ante real perpetuity bond rate by R_t:

$$R_t \equiv -\mathrm{E}_t \sum_{j=0}^{\infty} (i_{t+j} - \pi_{t+1+j}),$$

where we abstract from a term premium. Let R_t^* denote the expected sum of future shocks to output:

$$R_t^* \equiv \mathrm{E}_t \sum_{j=0}^{\infty} g_{t+j}.$$

Given these definitions, the IS curve can be represented by the following simple equation relating the output gap to the real bond rate gap, which is the difference between the real bond rate and R_t^*:

$$y_t = -(R_t - R_t^*).$$

Thus, R_t^* is the "equilibrium" level of the real bond rate needed to offset all future output shocks and set the current output gap to zero. This formulation makes evident the central role of long-term real interest rates for the conduct of monetary policy (see McGough, Rudebusch, and Williams 2005).

The inflation rate, π_t, is given by the New Keynesian Phillips curve of the form:

$$\pi_t = \beta \, \mathrm{E}_t \pi_{t+1} + \kappa(y_t + u_t),$$

where u_t is a distortionary stationary shock to marginal cost, β is the rate of time preference, and κ measures the sensitivity of inflation to the output gap.[15] Solving this equation forward yields the following equation for inflation in terms of expected real bond rates:

$$\pi_t = -\kappa \, \mathrm{E}_t \sum_{j=0}^{\infty} \beta^j (R_{t+j} - R^*_{t+j} - u_{t+j}).$$

As in the case of the output gap equation, this reformulation of the Phillips curve highlights the central role of expected real bond rate gaps in determining current inflation. It is clear from this representation that private agents, and by implication monetary policymakers who strive to ensure macroeconomic stabilization, are interested in the whole future path of the short-term policy interest rate.

3.2. Monetary Policy

As is standard in the literature, we assume that the central bank's objective is to minimize the weighted sum of the unconditional variance of the inflation gap, which is the difference between the inflation rate and a target inflation rate π^*_t, and the unconditional variance of the output gap. Specifically, the central bank loss, $\mathcal{L}$, is given by:

$$\mathcal{L} = \mathrm{VAR}\,(\pi_t - \pi^*_t) + \lambda \mathrm{VAR}\,(y_t),$$

where $\mathrm{VAR}(x)$ denotes the unconditional variance of a variable x and λ is the relative weight on output gap variability, which we set to unity.

Of course, a crucial aspect of our analysis is the structure of information: what the central bank knows and what the public does not. In our framework, there are central bank actions and intentions that the public may be able to understand and predict only imperfectly. Specifically, there are two different policy shocks in the system that only the central bank knows. The first shock affects the inflation target. This is an analytically convenient and fairly standard way in the literature to add uncertainty about the central bank's intentions.[16] Specifically, we assume

[15] For our analysis below, we use typical parameter values of $\beta = 1$ and $\kappa = 0.1545$. The value of κ is consistent with Calvo price setting with one-quarter of all prices reoptimized each quarter, log utility from consumption, and a 0.8 elasticity of disutility from work. Our results are not qualitatively sensitive to these assumptions.

[16] For a discussion of target shocks, see Faust and Svensson (2001) and Geraats (2005).

that the inflation target is an autoregressive process, subject to stochastic shocks:

$$\pi_t^* = \delta \pi_{t-1}^* + v_t, \quad \delta \in [0,1], \quad v_t \sim N(0, \sigma_v^2),$$

where the inflation target innovation, v_t, is assumed to be an i.i.d. normally-distributed random variable. In our baseline analysis, we assume that the inflation target is highly persistent, with $\delta = 0.95$, but that its conditional variance is quite small, with $\sigma_v^2 = 0.01$. Therefore, the implied unconditional standard deviation of the inflation target is about 0.3 percentage point, which is plausibly modest. Indeed, the resulting unconditional variation fits inside the explicit inflation target ranges that have been announced by many central banks which are typically a percentage point in width. In addition, target shocks also can be justified by time variation in the factors that influence the optimal choice of the inflation target, including distortions to the economy, bias in inflation measures, and structural changes that affect the magnitude of the problems associated with the zero lower bound on interest rates. For example, one could interpret the recent heightened concerns about the possibility of deflationary stagnation in the United States as an episode of implicitly targeting a higher rate of inflation than usual owing to concerns about the zero lower bound on interest rates. Furthermore, in the United States, and in many other countries, there is considerable empirical evidence that persistent shocks to the inflation target have occurred, as exemplified by the disinflations of the early 1980s and again in the early 1990s, which suggest a gradual ratcheting down of the inflation target over time.[17] Finally, much related recent macro-finance research finds that the inflation target embedded in bond yields does move significantly and persistently over time (e.g., Kozicki and Tinsley 2001, Rudebusch and Wu 2004, Gürkaynak, Sack, and Swanson 2005b, and Hördahl, Tristani, and Vestin 2006).

The second shock that affects the current interest rate is a generic policy shock that is also known only to the central bank. This second stochastic element, denoted w_t, is assumed to be i.i.d. normally-distributed random variables with variance $\sigma_w^2 = 1$ (also measured in units of the inflation target), and it enters the first-order condition for policy directly. In particular, as discussed in Woodford (2003), in the above model, optimal policy under commitment with complete information is implicitly described by the condition:

$$\pi_t - (\pi_t^* + w_t) = -\phi(y_t - y_{t-1}),$$

where the single optimal policy parameter, ϕ, depends on the model and loss function para-

[17] See, for example, Bomfim and Rudebusch (2000), Erceg and Levin (2003), and Cogley and Sbordone (2005).

meters.[18] The policy shock w_t represents deviations from this optimal rule. We view these deviations as representing the central bank's response to transitory factors outside the model. Indeed, as stressed by Svensson (2005a, b), good monetary policy in practice involves a vast amount of subtle knowledge and judgement. For example, this information may reflect assessments about asymmetric risks to the outlook not directly connected to the mean forecast for inflation and output. These risks may reflect fears about fallout from financial instability, and the Fed has responded a number of times to threats to the financial system: in 1987, following the stock market crash, in 1998, when international financial markets threatened to freeze up, and in 2001, following the terrorist attacks on September 11. Finally, it should be stressed that, in real time, the policymaker does not have a clear read on the data and does not know the best way to minimize the loss function.

The nature of the policy shocks can be illuminated by examining the optimal policy instrument rule that is an equivalent reformulation of the optimal policy condition above.[19].This optimal instrument rule shows the dependence of the short-term interest rate on inflation, the current and lagged output gap, and the inflation target:

$$i_t = \alpha(\pi_t^* + w_t) + \psi\pi_t + \eta(y_t - y_{t-1}).$$

The coefficients of this policy rule depend on the model parameters. Together, the time-varying inflation target, π_t^*, and the policy shock, w_t, represent deviations by the central bank from its policy reaction function, similar to the residuals of an estimated policy rule (as in Svensson 2003 and Rudebusch 2002, 2006).

3.3. Incomplete Information and Public Expectations

The public and the central bank are both assumed to know the structure and parameters of the output and inflation equations, the optimal policy reaction function, and the inflation target dynamics. Furthermore, the shocks to output and marginal cost (g_t and u_t) are also observed. However, we assume that at the beginning of period t, the central bank, but not the public, knows the realized values of the two policy-related innovations, v_t and w_t. The public observes

[18] This assumes that the central bank can precommit to future policy actions.

[19] The only state variables of the structural model are the inflation target and the transitory shocks. The optimal rule under comitment adds the first lag of the output gap to the state space (through the first difference of the gap). The instrument rule thus can be written in terms of inflation, the difference of the output gap, and the inflation target.

the current interest rate, from which it can infer the sum $\pi_t^* + w_t$, but it cannot disentangle the current level of the inflation target and the realization of the policy shock w_t.

We view the central bank knowledge of π_t^* and w_t, which in large part are the judgemental aspects of policy, as far too complex and inchoate ever to be explicitly expressed to the public or even written down within the halls of the central bank. However, we do assume that the central bank can potentially provide a useful signal to the private sector of its plans for the future setting of the policy rate. Specifically, at time t, the central bank provides a signal, denoted $i^P_{t+1|t}$, of its own internal projection of the next period's interest rate setting, denoted $\mathrm{E}_t[i_{t+1}|CB]$, where the conditioning information set is clearly denoted as the central bank's. (In the literature, these are often termed "unconditional" forecasts.)[20] We also consider various degrees of central bank transparency with regard to this projection by adding a *transmission noise*, z_t, to the projection:[21]

$$i^P_{t+1|t} = E_t[i_{t+1}|CB] + z_t, \qquad z_t \sim N(0, \sigma_z^2).$$

The transmission noise, an i.i.d. random variable with variance σ_z^2, reflects the fact that the central bank may not be able to, or choose not to, send a perfectly clear signal of its expectation of future policy. The limiting case of $\sigma_z = \infty$ corresponds to the central bank providing no information to the public regarding the future course of policy. The opposite limiting case of $\sigma_z = 0$ corresponds to the central bank perfectly communicating to the public its expectation of the interest rate path. For intermediate cases, we interpret a highly noisy signal, say $\sigma_z = 1$ (again in interest rate percentage points), as corresponding to a central bank providing only qualitative hints about the possible direction of future policy. A modestly noisy signal, say, $\sigma_z = 0.1$ (or 10 basis points), suggests a central bank providing fairly detailed, numerical information about its expectations of the future path of policy.

Given the central bank signal and the central bank action, private agents face a standard signal extraction problem in order to try to disentangle the realizations of the inflation target and the policy shock. One way to interpret the solution to this problem is to consider what

[20] Note that in the simple model that we consider, the central bank could provide "unconditional" projections of inflation or the output gap, meaning projections consistent with the projected future path of interest rates, and the analysis and results would be the same as in the case of interest rate projections. This equivalency obtains because all of these projections are linear combinations of the same state variables. This contrasts with the case of central bank publication of forecasts of inflation and output conditional on an arbitrary assumed path of policy with no explicit guidance on policy, as is typically done in many central banks. These conditional forecasts yield no useful information regarding the nature of the shocks to the public in our model.

[21] Note the central bank's signal is assumed to be unbiased, but any bias, if it existed, would be detected and eliminated through agents' filtering of the projection.

private agents will determine as the most likely value of the true inflation target from realized policy actions and published central bank interest rate projections. Given the assumptions of independent Gaussian disturbances, the resulting optimal filter estimate of the inflation target at time t, based on information available in period t, denoted by $\hat{\pi}_t^*$, is given by

$$\hat{\pi}_t^* = \delta\hat{\pi}_{t-1}^* + \gamma(\pi_t^* + w_t - \delta\hat{\pi}_{t-1}^*) + \frac{\theta}{\alpha}(i_{t+1|t}^P - \mathrm{E}_t[i_{t+1}|\hat{\pi}_{t-1}^*]),$$

where $\mathrm{E}_t[i_{t+1}|\hat{\pi}_{t-1}^*]$ denotes private agents' projection of the interest rate in the next period conditional on the previous period's estimate of the inflation target and time t information regarding the shocks to output and marginal cost.[22] The parameter $\gamma \in [0, 1]$ is the optimal gain associated with the revelation of the policy action. It is a function of the variances of the various innovations in the model. It multiplies the "policy surprise" measured by the difference between the realized policy and the expected policy based on the discounted private estimate of the inflation target. The parameter $\theta \in [0, 1]$ is the optimal gain associated with the central bank's announcement of its projection of the interest rate in the next period. It is likewise a function of model variances. It multiplies the "policy surprise" measured by the difference between the central bank's communicated projection of the nominal interest rate, $i_{t+1|t}^P$, and private agents' projection of the same before the estimate of the inflation target is updated. Private agents form expectations of future variables based on their estimate of the inflation target, and output, inflation, and interest rates are determined as described above.

Note that in this simplified model, the public is attempting to parse the policy action into only two component signals. If the central bank perfectly communicated its expectation of the interest rate in the next period ($\sigma_z = 0$), this information would be sufficient for the public to completely ascertain the target shock and the policy shock. Additional information from the central bank about its projection of interest rates two, three, or more periods in the future would be superfluous. In the more general case of n distinct policy shocks, however, perfectly transparent policy projections for n different periods in the future are needed to convey the true nature of the policy shock perfectly to the public. In addition, the noise associated with the policy projection is likely to be less for multiple period projections than for a single-period projection. For these reasons, we interpret our analysis in terms of providing signals on the projected path of interest rates over a few years.

[22] The central bank's projection is based on its expectation of interest rates taking into account the signal extraction problem faced by agents.

4. The Macroeconomic Effects of Publishing Interest Rate Projections

In this section, we use the theoretical framework outlined above to analyze the effects of publishing central bank interest rate projections on macroeconomic behavior and the central bank calculation of loss. We start by considering the two polar extreme cases regarding central bank transparency: no published information, and full communication of all central bank information. We then analyze the more relevant intermediate case of noisy central bank communication of future policy intentions.

4.1. The Beneficial Effects of Transparency

When shocks to the inflation target are persistent, imperfect public information about the target creates persistent discrepancies between the public's estimate of the target and the target's true value. Figure 3 illustrates this by showing the impulse response of the public's estimate of the inflation target following an increase in the true target, assuming that central bank does *not* publish its interest rate projections ($1/\sigma_z^2 = 0$). In a loose sense, given the relative variances of the target shock and the policy shock, the persistent shifts in the inflation target are less "important" than transitory policy shocks, so in the optimal filter, the public's view of the inflation target is not very sensitive to a surprising policy action. Indeed, the optimal gain parameter γ equals 0.062, indicating that the public's estimate of the inflation target initially would rise only by 0.062 percentage point in the period of a one percentage point shock to the actual target. The public's misperception of the inflation target gradually shrinks over time, both because the target itself is returning to baseline and the public's estimate is becoming more accurate.

Imperfect information about the inflation target unequivocally worsens the outcomes in response to a shock to the inflation target. Figures 4 and 5 show the responses of the output gap and the inflation rate to the same inflation target shock given in Figure 3. For the basis of comparison, we also compute the responses for the case of perfect central bank communication ($1/\sigma_z^2 = \infty$), in which private agents effectively observe the individual shocks. In the case of no communication, the public wrongly ascribes too much central bank behavior to the transitory policy shock, so output rises more and inflation rises less than if the public knew about the shift in the inflation target. The excessive rise in the output gap continues throughout the simulation and eventually causes the inflation rate to persistently overshoot the true target. As a result,

the loss associated with a shock to the inflation target is greater when central bank does not communicate.

We now consider a range of intermediate cases of noisy interest rate intention signals. Introducing communication noise, z_t, modifies our analysis in two ways. First, the updating equation for the public's estimate of the inflation target incorporates information gleaned from the publication of the central bank interest rate projections, as described above. Second, the noise in the interest rate signal distorts the public's expectations of future policy and is thus a source of aggregate variability that was not present in the two polar cases (i.e., no projections and completely transparent communication) that we considered above. An increase in transparency achieves a better alignment of public expectations of future policy with those of the central bank. The improved management of expectations of future rates and thereby long-term bond rates pushes the economy's responses to the inflation target and policy shocks closer to the complete transparency benchmark.

This improvement in performance contributes to a reduction in the central bank's loss. Indeed, as shown in Figure 6, loss monotonically decreases as the quality of the signal about the central bank's interest rate projection improves as it ranges from no published information, $1/\sigma_z^2 = 0$, to full communication, $1/\sigma_z^2 = \infty$. This relationship, which is our key result, is also plotted for robustness for three different parameterizations of the persistence of the inflation target shock, with δ equal to .8, .95, or 1.0. In each of these three cases, the loss monotonically decreases as the quality of the signal about the central bank's interest rate projection improves; however, the benefits of transparency are larger when the inflation target shocks are more persistent. The smaller benefit of communication when the inflation target is not very persistent reflects the fact that in this situation the responses of the economy to an inflation target shock and a transitory policy shock are quite similar. Thus, the public's parsing of the sources of the shock is not as important.

Finally, Figure 7 displays the two optimal filter gains associated with the policy action and with the interest rate projection (i.e., γ and θ), which can illuminate how the private sector behavior changes as the transparency of the central bank changes. Not surprisingly, as the clarity of the central bank projections increases, the public places more weight on those projections and less weight on the current policy setting. As the signal noise goes to zero, the public places all weight on the projections and none on the policy actions, which is the natural outcome of

optimal gains in a signal extraction problem.

4.2. Misperceptions About Central Bank Projections

In the examples considered above, transparency improves performance, but one often-cited concern about central bank provision of interest rate projections is that private agents may overestimate the accuracy of these projections projections. In this case, private agents and, in particular, financial markets may overreact to the statements of central bank intentions, which could add deleterious noise to the economy. Alternatively, private agents might underestimate the value and accuracy of the central banks statements, which would limit the effects of publishing interest rate projections implied by the analysis given above. Such misperceptions of the quality of the central bank projections cannot be part of a long-run equilibrium because agents will eventually deduce the true value of central bank information. Nonetheless, it is possible that misperceptions of the noise in the central bank published projections could persist for a significant period of time.

If the public moderately underestimates the degree of noise in the central bank interest rate projections, the central bank loss actually declines; however, if the central bank signal is drastically more noisy than believed, the loss can rise significantly. Figure 8 shows the central bank losses for different degrees of noise in the central bank projections, but where the public filters the data based on the indicated assumption regarding the degree of noise. (As before, $\delta = 0.95$.) The solid line plots the benchmark case where agents always use the optimal filter. The dashed line shows the outcomes when the public assumes erroneously that the central bank signal is entirely without noise and therefore and therefore responds fully to projections and ignores actually policy actions. Interestingly, for values of σ_z greater than about 0.3, the loss actually is slightly lower when the public overestimates the accuracy of the central bank projections. However, if the central bank projections are highly noisy, then the loss rises significantly, and exceeds that which would occur with no projections. The dashed-dotted line shows the more reasonable case where the public assumes the projections are accurate but not perfect, corresponding to $\sigma_z = 0.25$. In this case, the loss is lower than implied by optimal filtering for σ_z between 0.25 and 1, and is rises sharply as σ_z rises above 1. Finally, the dotted line shows the case where the public assumes that the central bank signals are noisy, corresponding to the assumption that $\sigma_z = 1$. Under this assumption, the benefits of central bank projections

are curtailed and the loss is nearly invariant to the true accuracy of the projections.

The potential for misperceptions of the accuracy of the interest rate projections suggests that an important part of such communication emphasize their conditionality on future events and uncertainty. Such communication should reduce the risk that private agents vastly misestimate the accuracy of such projections. Indeed, that is exactly what the Reserve Bank of New Zealand and the Norges Bank already do in their reports. As noted above, the Norges Bank goes so far as showing interest rate projection fan charts and implied paths under alternative simulations to highlight the conditionality and uncertainty regarding future rates. Such an approach also reduces the chance that private agents may give up completely on analyzing and forecasting policy instead relying on the central bank projections. Such an outcome would eliminate a source of outside information for the central bank that they could otherwise use as a check on their analysis. This has not happened in New Zealand, as evidenced by the difference in central bank projections and market expectations.

4.3. A Perverse Transparency Result

Although the examples discussed above show that publishing central bank interest rate projections can improve macroeconomic performance, this need not always be the case. If, for example, one allows for a transitory shock to the true inflation target that has a significantly higher variance than either of the other two policy shocks, then either partial transparency or no transparency can be optimal. This occurs because the public puts some probability that any realized shock is highly persistent, which causes inflation to rise more and the output gap to move less than for a transitory shock, both desirable responses if the source of the shock is a transitory disturbance to the inflation target. Figure 9 illustrates this finding. For these experiments, we have set the standard deviation of the transitory shock to the inflation target equal to χ and reduced the standard deviation of the transitory policy shock so that the variance of the two transitory shocks together equals one. In each case, we normalized the losses so that they equaled zero in the case where interest rate projections are not published. As long as the standard deviation of the transitory shock is less than or equal 5 times that of the persistent inflation target shock, full transparency is optimal. In the case that the transitory shock is 7.5 times as volatile as the persistent shock, $\sigma = 0.25$, and if the transitory shocks are 10 times as volatile, no transparency is optimal. So, in general, transparency can be a double-edged sword:

for certain shocks it improves the responses, but for others it worsens them. But these results suggest that on net transparency is preferred except when transitory shocks to the inflation target are the dominant source of unpredictable part of policy. Thus, our analysis indicates that although one cannot draw blanket conclusions regarding the effects of publishing central bank interest rate projections, under reasonable assumptions, publishing projections improves macroeconomic performance and reduces the central bank loss.

5. Conclusion

The indirect signaling of future policy intentions has been the overwhelming choice of central banks in the past. The Federal Reserve, for example, has typically been unwilling to describe a numerical definition of its price stability goal or a quantitative assessment of the tradeoffs involved in the operation of the economy. Recently, however, some central banks, including the Fed, have started to reveal to the public some information about there future policy intentions. However, only two central banks, the RBNZ and the Norges Bank, have gone so far as provide explicit quantitative forecasts of the policy expectations. The existing theoretical literature has not focused on transparency with regard to interest rate projections; however, in general, the literature has not reached firm conclusions regarding the optimal degree of central bank transparency. In our analysis, we find that central bank communication of interest rate projections can indeed improve macroeconomic performance.

Table 1
Forward-Looking Language in Statements Issued after FOMC Meetings
(All FOMC meetings from May 1999 to March 2006)

Date of meeting	Funds rate	Forward-looking language in FOMC policy statement
05/18/1999	4.75	". . . the Committee was concerned about the potential for a buildup of inflationary imbalances that could undermine the favorable performance of the economy and therefore adopted a directive that is tilted toward the possibility of a firming in the stance of monetary policy."
06/30/1999	5.00	". . . the FOMC has chosen to adopt a directive that includes no predilection about near-term policy action."
08/24/1999	5.25	". . . the directive the Federal Open Market Committee adopted is symmetrical with regard to the outlook for policy over the near term."
10/05/1999	5.25	". . . the Committee adopted a directive that was biased toward a possible firming of policy going forward. Committee members emphasized that such a directive did not signify a commitment to near-term action."
11/16/1999	5.50	". . . the directive the Federal Open Market Committee adopted is symmetrical with regard to the outlook for policy over the near term."
12/21/1999	5.50	". . . the Committee decided to adopt a symmetric directive in order to indicate that the focus of policy in the intermeeting period must be ensuring a smooth transition into the Year 2000."
02/02/2000	5.75	". . . the Committee believes the risks are weighted mainly toward conditions that may generate heightened inflation pressures in the foreseeable future."
03/31/2000	6.00	Same as 02/02/2000.
05/16/2000	6.50	Same as 02/02/2000.
06/28/2000	6.50	Same as 02/02/2000.
10/03/2000	6.50	Same as 02/02/2000.
11/15/2000	6.50	Same as 02/02/2000.
12/19/2000	6.50	". . . the Committee consequently believes the risks are weighted mainly toward conditions that may generate economic weakness in the foreseeable future."
01/03/2001	6.50	Same as 12/19/2000.
01/31/2001	5.50	Same as 12/19/2000.
03/20/2001	5.00	Same as 12/19/2000.
04/18/2001	4.50	Same as 12/19/2000.
05/15/2001	4.00	Same as 12/19/2000.

06/27/2001	3.75	Same as 12/19/2000.
08/21/2001	3.50	Same as 12/19/2000.
09/17/2001	3.00	Same as 12/19/2000.
10/02/2001	2.50	Same as 12/19/2000.
11/06/2001	2.00	Same as 12/19/2000.
12/11/2001	1.75	Same as 12/19/2000.
01/30/2002	1.75	Same as 12/19/2000.
03/19/2002	1.75	". . . the Committee believes that, for the foreseeable future, . . . the risks are balanced with respect to the prospects for both goals."
05/07/2002	1.75	Same as 03/19/2002.
06/26/2002	1.75	Same as 03/19/2002.
08/13/2002	1.75	". . . the Committee believes that, for the foreseeable future, . . . the risks are weighted mainly toward conditions that may generate economic weakness."
09/24/2002	1.75	Same as 08/13/2002.
11/06/2002	1.25	". . . the Committee believes that . . . the risks are balanced with respect to the prospects for both goals for the foreseeable future."
12/10/2002	1.25	Same as 11/06/2002.
01/29/2003	1.25	Same as 11/06/2002.
03/18/2003	1.25	"In light of the unusually large uncertainties clouding the geopolitical situation . . . the Committee does not believe it can usefully characterize the current balance of risks . . . "
05/06/2003	1.25	". . . the Committee perceives that over the next few quarters the upside and downside risks to the attainment of sustainable growth are roughly equal. In contrast, over the same period, the probability of an unwelcome substantial fall in inflation, though minor, exceeds that of a pickup in inflation from its already low level. The Committee believes that, taken together, the balance of risks to achieving its goals is weighted toward weakness over the foreseeable future."
06/25/2003	1.00	Similar to 05/06/2003.
08/12/2003	1.00	". . . the Committee believes that policy accommodation can be maintained for a considerable period."
09/16/2003	1.00	Same as 08/12/2003.
10/28/2003	1.00	Same as 08/12/2003.
12/09/2003	1.00	Same as 08/12/2003.
01/28/2004	1.00	"With inflation quite low and resource use slack, the Committee believes that it can be patient in removing its policy accommodation."

03/16/2004	1.00	Same as 01/28/2004.
05/04/2004	1.00	". . . the Committee believes that policy accommodation can be removed at a pace that is likely to be measured."
06/30/2004	1.25	Same as 05/04/2004.
08/10/2004	1.50	Same as 05/04/2004.
09/21/2004	1.75	Same as 05/04/2004.
11/10/2004	2.00	Same as 05/04/2004.
12/14/2004	2.25	Same as 05/04/2004.
02/02/2005	2.50	Same as 05/04/2004.
03/22/2005	2.75	Same as 05/04/2004.
05/03/2005	3.00	Same as 05/04/2004.
06/30/2005	3.25	Same as 05/04/2004.
08/09/2005	3.50	Same as 05/04/2004.
09/20/2005	3.75	Same as 05/04/2004.
11/02/2005	4.00	Same as 05/04/2004.
12/13/2005	4.25	"The Committee judges that some further policy firming is likely to be needed to keep the risks to the attainment of both sustainable economic growth and price stability roughly in balance."
01/31/2006	4.50	"The Committee judges that some further policy firming may be needed to keep the risks to the attainment of both sustainable economic growth and price stability roughly in balance."
03/28/2006	4.75	Same as 01/31/2006.

Note: The date of each FOMC meeting or conference call is given along with the intended target level of the federal funds rate prevailing after the meeting and the salient forward-looking language in the post-meeting statement about the future policy inclination or the balance of economic risks.

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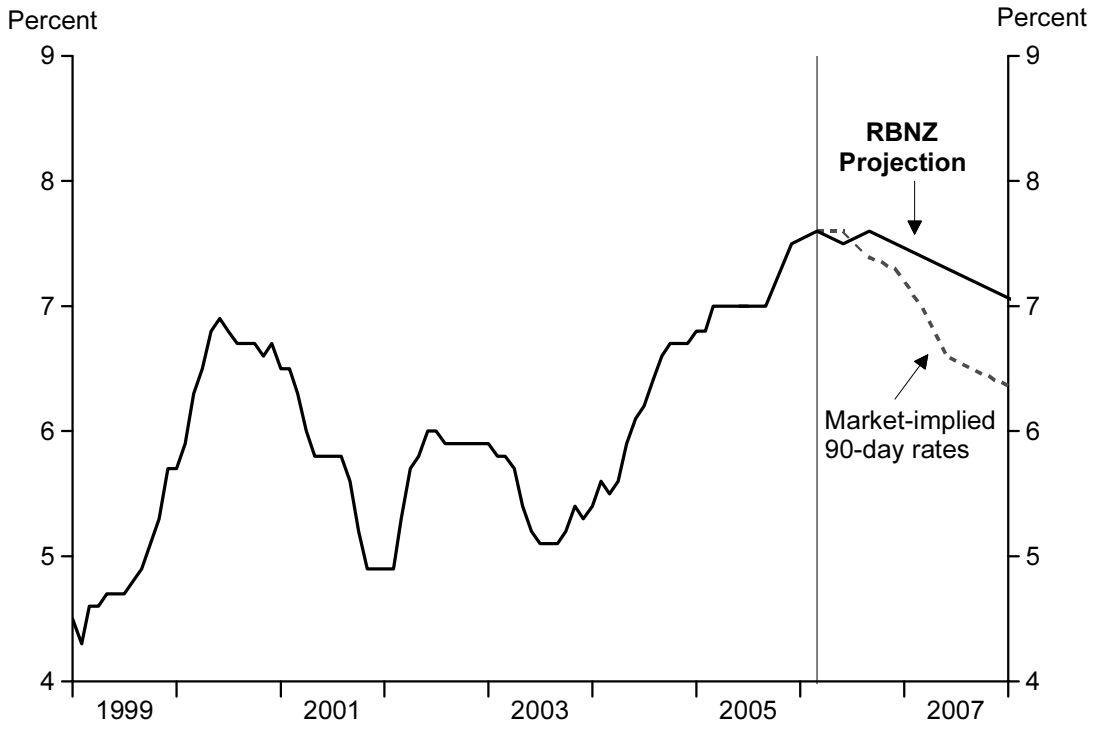

Fig. 1 RBNZ projection of short-term interest rate

Note: The solid line shows the historical data and the RBNZ's March 2006 baseline projection for the 90-day interest rate (which is closely linked to the official policy interest rate). The dashed line shows expected rates in financial markets. Source: RBNZ March 2006 *Monetary Policy Statement*, Figure 2.6.

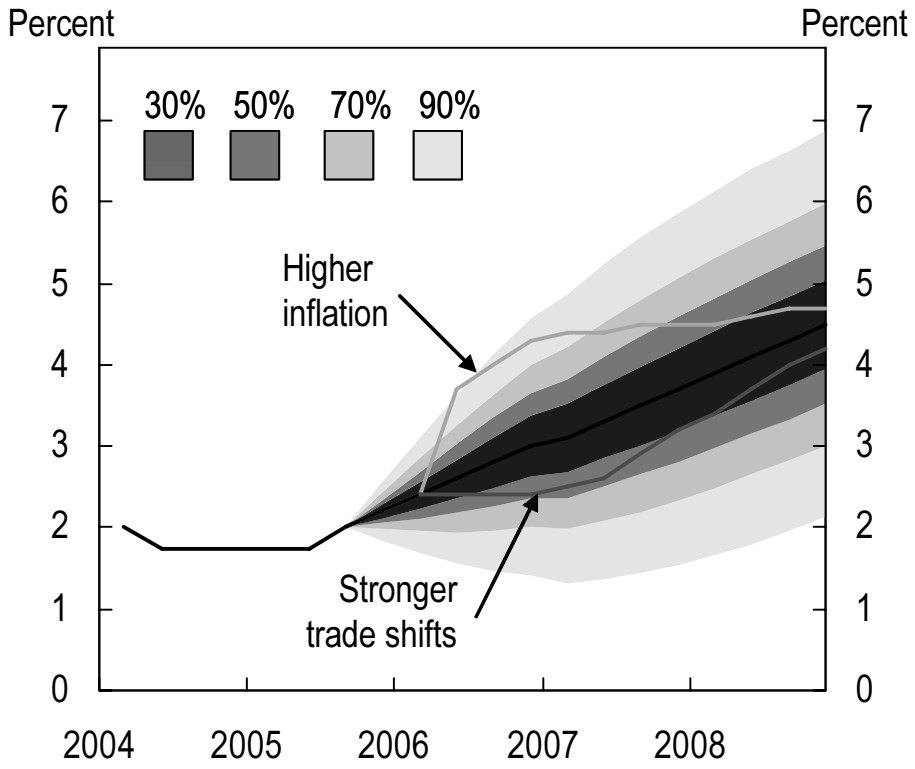

Fig. 2 Norges Bank projection of its policy interest rate

Note: The dark central line is the recent past and the Norges Bank's November 2005 baseline projection of the policy interest rate ("sight deposit rate") over the next three years. The shaded regions represent 30, 50, 70, and 90 percent confidence intervals around the baseline projection. Projected policy rate paths under two alternate scenarios are also shown. Source: Norges Bank November 2005 *Inflation Report*, Chart 1.9a.

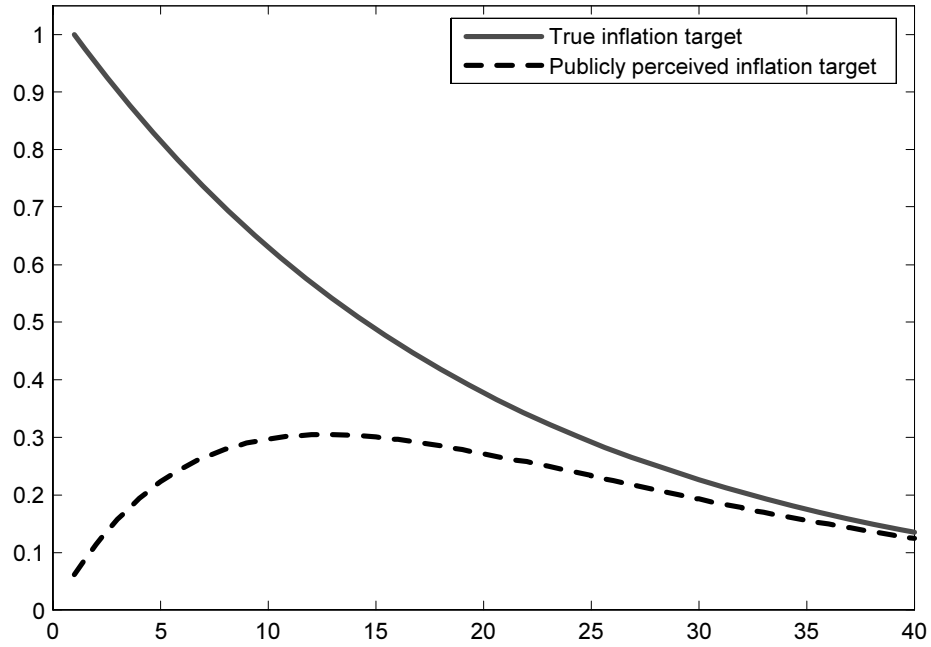

Fig. 3 Inflation response to target shock with no transparency

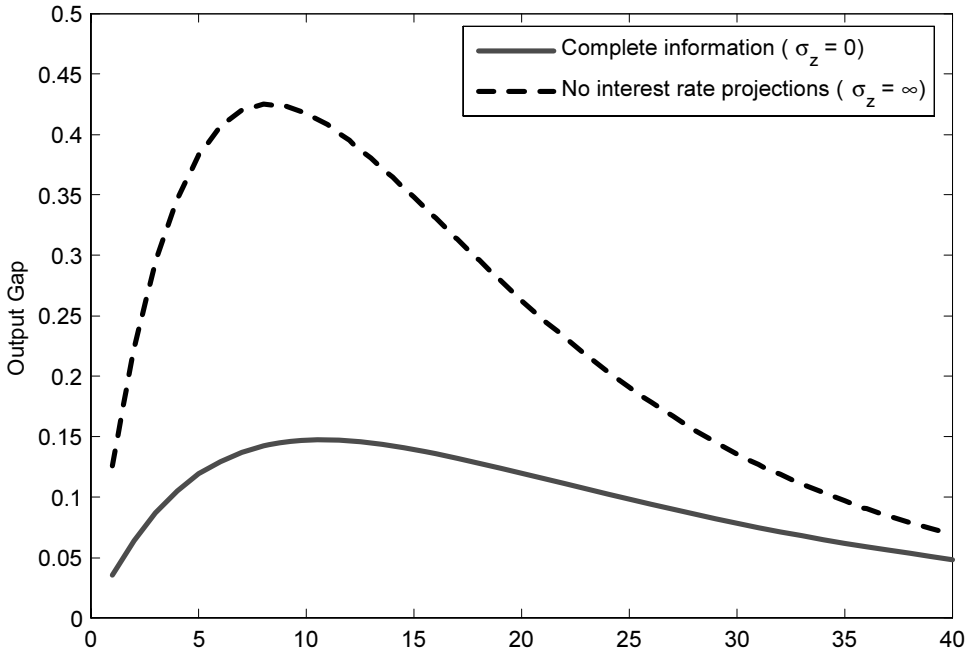

Fig. 4 Output gap response to inflation target shock

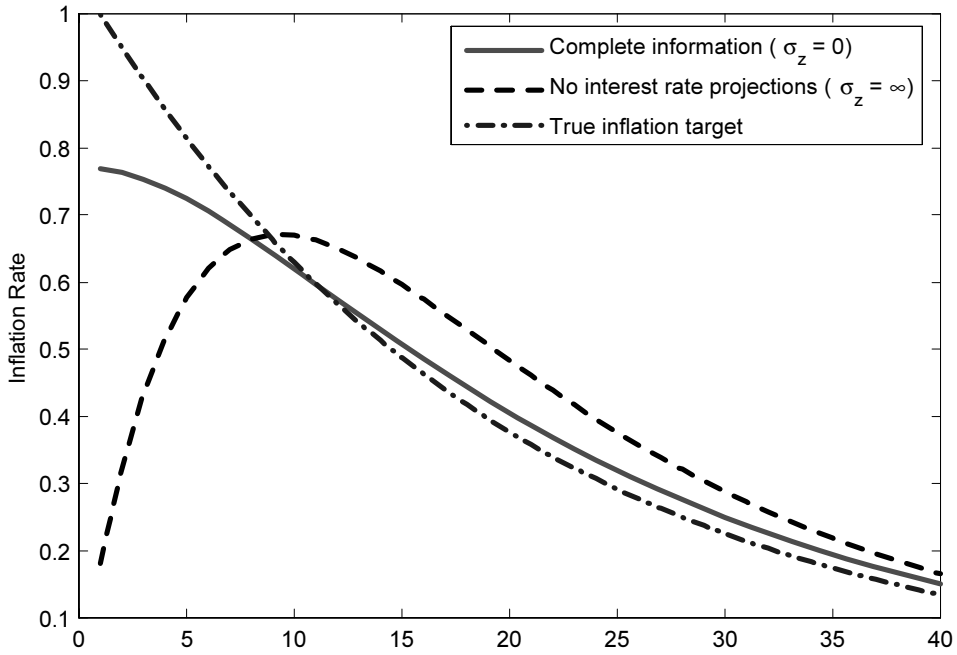

Fig. 5 Inflation response to inflation target shock

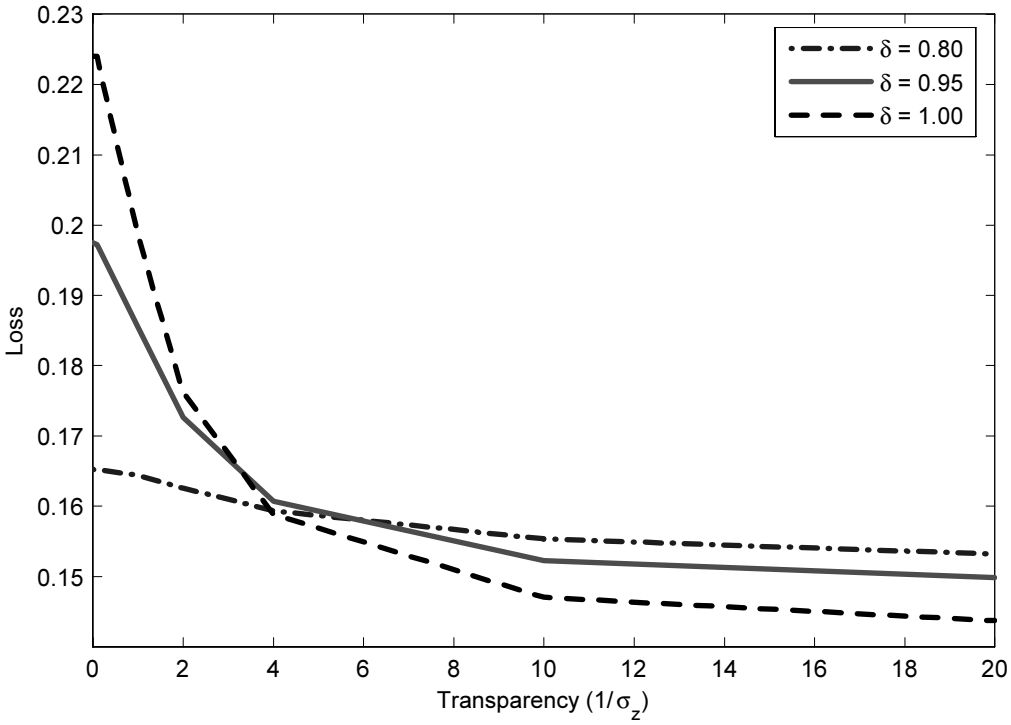

Fig. 6 Effect of transparency on loss

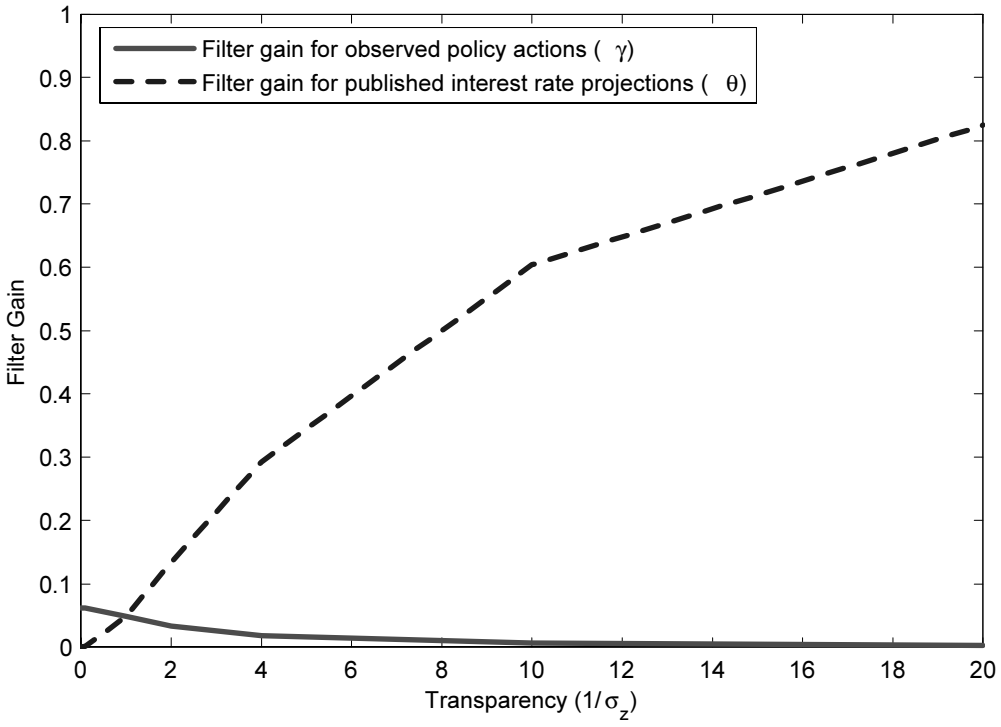

Fig. 7 Effect of transparency on policy statement and policy action gains

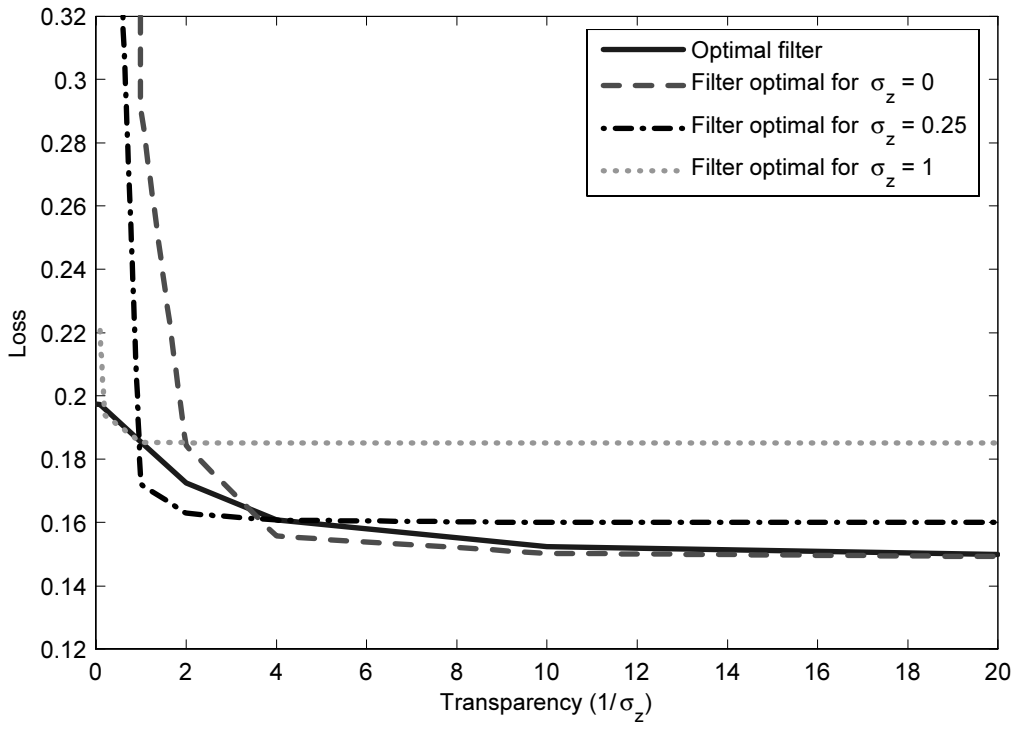

Fig. 8 Central bank loss with suboptimal filtering

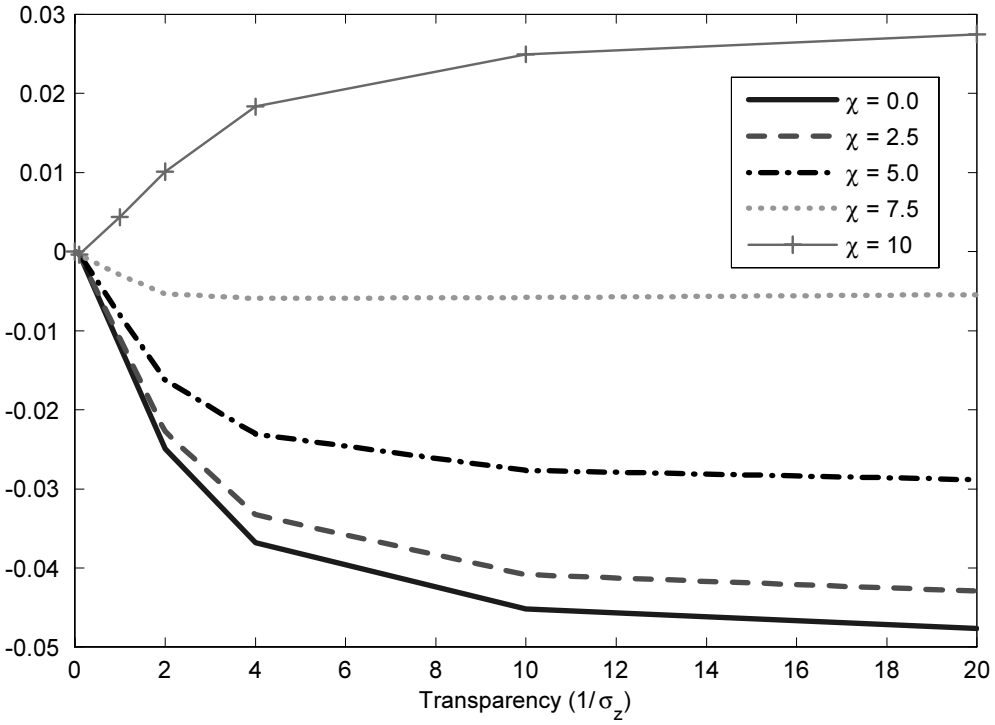

Fig. 9 Relative central bank loss with transitory π^* shocks