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How Effective Is Central Bank Forward Guidance?

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Abstract

This paper investigates the effectiveness of forward guidance for the central banks of four countries: New Zealand, Norway, Sweden, and the United States. We test whether forward guidance improved market participants' ability to forecast future short-term and long-term rates. We find that forward guidance improved market participants' ability to forecast short-term rates over relatively short forecast horizons, but only for Norway and Sweden. Importantly, there is no evidence that forward guidance has increased the efficacy of monetary policy for New Zealand, the country with the longest history of forward guidance.

Keywords: monetary policy; central bank transparency; interest rates; term structure; forecasting

JEL Codes: E52, E43, E47

1. INTRODUCTION

Monetary policy has become increasingly transparent in developed economies since the late 1980s. Initially, transparency was seen as a crucial element of accountability, which was considered essential for central bank independence. Some economists argue that transparency increases the efficacy of monetary policy (e.g., Woodford, 2003, 2005; and Svensson, 2006, 2008). Indeed, Federal Reserve Chairman Ben Bernanke (2007) suggests that increased transparency improves financial and economic performance by anchoring long-term inflation expectations, reducing economic and financial uncertainty, and encouraging financial markets to anticipate policy actions, thereby reinforcing those actions.

The idea that greater transparency necessarily enhances the efficacy of monetary policy is not shared by all. For example, Amato, Morris, and Shin (2002); Morris and Shin (2002); Thornton (2003); Mishkin (2004); Walsh (2007, 2008); Gosselin, Lotz, and Wyplosz (2006); and Kool, Middeldorp, and Rosenkranz (2011) suggest that transparency is not necessarily beneficial for a variety of reasons.

The most recent innovation in monetary policy transparency is the idea that the efficacy of policy can be enhanced if policymakers inform the market of the expected path for the central bank's policy rate. That is, policymakers can increase the effectiveness of their interest policy by providing *forward guidance* about the future path of their policy rate. Forward guidance stems from Woodford's (1999) concept of optimal policy inertia. Specifically, Woodford (1999) argues that monetary policy will have a larger effect on longer-term rates the longer the central bank credibly commits to maintaining its policy rate. This implication is based on the expectation hypothesis of the term structure of interest rates (EH), which asserts that the long-term rate is equal to the expected short-term rate over the holding period of the long-term security plus a constant risk premium. The EH implies that a change in the policy rate will have a larger effect on longer-term yields the longer the central bank commits to keep the policy rate at the new level.

The idea that the central bank's interest rate policy will be more effective the more persistent its interest rate policy (see, e.g., Woodford, 2001; Rosenberg, 2007; and Svensson, 2008) has motivated several central banks to provide forward guidance. As was the case with inflation targeting, the Reserve Bank of New Zealand (RBNZ) took the lead. In 1997 it started to announce a path for the 3-month bank bill rate. The Norges Bank and the Riksbank followed in 2005 and 2007, respectively, and the Czech National Bank adopted forward guidance in 2008. The Federal Reserve began using *implicit* forward guidance in August 2003 but discontinued the practice in December 2005. The Fed began using implicit forward guidance again in December 2008 and began using explicit forward guidance in August 2011.

This paper contributes to the literature by investigating the impact of forward guidance on the predictability of future short- and long-term interest rates for New Zealand, Norway, Sweden, and the United States.[1] Our approach is based on the idea that the predictability of the future short-term rate is a hallmark of the EH (e.g., Guidolin and Thornton, 2010). However, we do not test the EH before and after the adoption of forward guidance as some (e.g., Lange, Sack, and Whitesell, 2003) have done because conventional tests of the EH are known to give misleading results (Bekaert, Hodrick, and Marshall, 1997; Kool and Thornton, 2004; and Thornton, 2005, 2006). Instead, we investigate whether forward guidance has significantly increased the predictability of short-term yields. We further investigate whether the use of

[1] We do not include the Czech Republic for two reasons. First, the number of relevant observations is very small and second, Czech financial markets and institutions are less developed than those in the other countries we study.

forward guidance has significantly increased the predictability of long-term yields because the EH implies that increased predictability of the short-term rate should translate into increased predictability of the long-term yield as well.

We begin by assessing whether the short-term interest rate projections of the central banks of New Zealand, Norway, and Sweden are superior to those from a naïve random walk (RW) benchmark. We then use survey forecasts to evaluate the extent to which forward guidance improves market participants' ability to predict future short-term and long-term interest rates. We compare the improvement in forecast accuracy after adopting forward guidance relative to two benchmark projections: the naïve, RW forecasts and the forecasts of a benchmark country (i.e., a country with similar characteristics that does not provide forward guidance). For New Zealand, the country benchmark is Australia; for Sweden and the United States, the United Kingdom; for Norway, Canada. The survey forecasts for all countries are from Consensus Economics (CE). For the United States we also use Blue Chip Financial's interest rate forecasts. Finally, we investigate whether forward guidance reduced market uncertainty as measured by the cross-sectional dispersion in survey forecasts.

The remainder of the paper is as follows. Section 2 discusses the pros and cons of forward guidance. Previous empirical investigations of the effectiveness of forward guidance are presented in Section 3. Section 4 presents our analysis of the effectiveness of forward guidance and Section 5 concludes.

2. FORWARD GUIDANCE: THE THEORY

Woodford (1999) suggested that policy effectiveness could be enhanced if interest rate policy was more inertial, noting that "aggregate demand depends not upon current short rates alone, but rather upon expected long-term real rates, which in turn depend upon expected future short rates." Similarly, Rudebusch and Williams (2008) use the link between expected future short-term rates and long-term rates in a New Keynesian model to demonstrate that publishing the forecast of the interest rate path makes the private agents' estimate of the central bank's reaction function more precise, which improves welfare.

Not everyone believes that forward guidance necessarily increases the efficacy of monetary policy. Several authors have suggested that forward guidance could disrupt financial markets if economic agents place too much confidence in the announced policy path and disregard other information relevant for the future path of rates. The result could be herding behavior and overreaction to policy announcements. Morris and Shin (2002) demonstrate that under certain conditions higher transparency can drive expectations away from fundamentals. In the same vein, Kool, Middeldorp, and Rosenkranz (2011) use a theoretical model to show that more central bank information under near-risk neutrality of market participants may lead to crowding out of private information acquisition, thereby resulting in a deterioration of forecast precision. Walsh (2007) and Gosselin, Lotz, and Wyplosz (2009) apply a New Keynesian model to demonstrate that the optimal degree of transparency depends on the central bank's ability to forecast demand and supply shocks. Using a similar model, Brzoza-Brzezina and Kot (2008) show that the benefits of publishing interest rate forecasts are marginal once macroeconomic forecasts are provided.

In addition, effective forward guidance may require the central bank to maintain its policy rate at the promised level, even when economic conditions have meanwhile improved enough to warrant an adjustment in the policy rate. That is, a central bank using forward guidance will not adjust its policy rate as rapidly as it otherwise should in response to new information. The delay could be exacerbated by an unwillingness to transmit extra disturbances to the market. Policymakers could also delay adjusting the policy rate for fear of a loss of credibility (e.g., Mishkin, 2004; Blinder and Wyplosz, 2004; and Goodhart, 2005)—the hallmark of effective forward guidance policy (Woodford, 2012). Delaying due to credibility concerns is more likely the less the public understands policymakers' reaction function. Using a New Keynesian framework, Gersbach and Hahn (2008a) show that if forward guidance increases the central bank's commitment to a chosen strategy model, deviating from its own forecast imposes welfare costs. Hence, the announcement of a future interest rate path results in welfare losses. Using an alternative framework, however, Gersbach and Hahn (2008b) conclude that forward guidance improves welfare if costs of reneging on earlier commitments are sufficiently low. In any event, public perception that the central bank is reneging on a forward guidance commitment will significantly impair the effectiveness of future forward guidance.

The desirability of forward guidance also has been questioned for a variety of other reasons. For example, Moessner and Nelson (2008) provide a brief summary of practitioners'—central bankers'—views on the pros and cons of providing interest projections to the market. Quoting, among others, Kohn (2005, 2008), Issing (2005), Rosenberg (2007), Bergo (2006), and Archer (2005), they conclude central bankers generally acknowledge the benefits of reducing uncertainty about the central bank's objectives and being able to better manage market expectations; however, they are concerned about the ability of policymakers to reach a consensus on the interest rate path.[2] Goodhart (2009) raises similar practical concerns about the feasibility and effectiveness of forward guidance.

[2] This concern would appear to be well founded given the range of paths of Federal Open Market Committee participants.

3. FORWARD GUIDANCE: EMPIRICAL EVIDENCE

Empirical investigations of the effects of forward guidance have been relatively limited. Most research has focused on New Zealand because of its relatively long period of providing forward guidance. Andersson and Hofmann (2010) do a comparative event-type analysis of the effectiveness of forward guidance in New Zealand, Norway, and Sweden, dividing monetary policy surprises into target and path surprises. The former is measured as the change in the 1-month interbank rate on the day of the announced target change; the latter is measured as the change in the 12-month-ahead 3-month implied future swap rate that is uncorrelated with the target surprise. They estimate the effect of target and path surprises on 5- and 10-year Treasury yields and the 5-year-forward rate using daily data and an exponential generalized autoregressive conditionally heteroskedastic (EGARCH) model. They also include dummy variables for several macroeconomic announcement dates and find "some mild support for the notion that the publication of an interest rate path forecast may enhance the central bank's leverage over medium term (5-year) interest rates."

Using a similar methodology, Moessner and Nelson (2008) analyze the effects of forward guidance for the RBNZ and the Fed. They conclude that the effect of surprises in monetary policy announcements on expectations of future rates is relatively small and that there is no evidence that deviations from prior forward guidance unsettle the markets.

Ferrero and Secchi (2007) analyze the variability of market interest rates around policy decision dates under forward guidance for the United States, the euro area, Norway, and New Zealand over the period 1999-2006 and find mixed results. Similar to Moessner and Nelson (2008), they find small responses of 3- and 12-month-ahead 3-month futures rates to monetary surprises contained in the revision of the central bank's interest rate projections. In addition, they report that the changes in interest rates between two successive path announcements are similar to the subsequent revision of the path. They take this as evidence that "market operators have well understood the conditionality of the central bank's projections."[3] However, it is possible that policymakers merely revise their projected path based on the observed behavior of rates during the period between successive path announcements (e.g., Andersson and Hofmann, 2010). Finally, they find that when the direction of the official interest rate changes, market expectations move in the opposite direction.

Drew and Karagedikli (2008) provide evidence on the impact of monetary policy surprises on the yield curve in New Zealand using intraday data and an event study methodology. Monetary policy surprises are measured as the change in the Official Cash Rate—New Zealand's policy rate—relative to both survey expectations and expectations derived from futures and swap rates. At the 1-year horizon, there is nearly a one-to-one relation between the surprise and changes in market yields. However, the magnitude of the effect declines and becomes essentially zero after 5 years. In a related study using the same methodology, Karagedikli and Siklos (2008) find significant high-frequency effects of monetary policy surprises on the New Zealand exchange rate.

All of the above research focuses on monetary policy surprises on announcement days and the effect of these surprises on short-term and long-term interest rates. Obviously, any test of the effect of forward guidance then is a joint test, conditional on the appropriateness of the surprise measures. Furthermore, Thornton (2012) has shown that because market rates respond to news every day, the event study methodology can overestimate the response of interest rates to surprise policy actions. Overall, the evidence suggests that, at short horizons, surprise

[3] Ferrero and Secchi (2007), p. 30

announcements have a relatively small impact on market rates. However, none of these studies investigated whether their high-frequency evidence translated into improved predictions of the short-term rates, which the effectiveness of forward guidance requires.

Our analysis is most closely related to that of McCaw and Ranchhod (2002), Turner (2006), and Goodhart and Lim (2011). McCaw and Ranchhod (2002) find evidence that the RBNZ's interest rate projections do not significantly outperform a RW. Turner (2006) compares RBNZ forecasts to CE forecasts and finds no difference in performance at the 3-month horizon but some improvement for the RBNZ at the 12-month horizon. Goodhart and Lim (2011) test the forecasting power of the RBNZ's projected interest path using Mincer-Zarnowitz (Mincer and Zarnowitz, 1969) regressions. They find that the RBNZ forecasts have significant predictive power for the 1-quarter-ahead money market rate and some predictive power for 2 quarters ahead, but none for longer horizons. When the same analysis is performed for the United Kingdom using market forecasts derived from the yield curve, very similar results are found. Goodhart and Lim (2011) also report that forecasts systematically underpredict during periods with rising rates and overpredict during periods with falling rates, suggesting that the forecast improvement may be a consequence of mean-reverting behavior of the macroeconomy.

4. THE EFFECTIVENESS OF CENTRAL BANK FORWARD GUIDANCE

This section provides an analysis of the forecast power of interest rate projections under forward guidance regimes of the central banks of New Zealand, Norway, Sweden, and the United States. We use CE data to measure market expectations for New Zealand, Norway, and Sweden, and CE and Blue Chip survey data for the United States.

4.1 Central Banks' Practice of Forward Guidance

Monetary policy in New Zealand is based on the RBNZ Act of 1989. The RBNZ has had an explicit inflation target in a floating exchange rate regime since February 1990. While the official policy rate set by the RBNZ is its overnight cash rate, the RBNZ began publishing a path for the 90-day bill rate in an attempt to provide forward guidance about future monetary policy (e.g., Detmers and Nautz, 2012) in its quarterly Monetary Policy Statement of December 1997. [4] Projections are for the average daily interest rate in the calendar quarter under consideration, including the current quarter.

Norway's monetary policy is characterized by inflation targeting and a floating exchange rate. Its central bank, the Norges Bank, started to publicly communicate model-based interest rate projections in its Monetary Policy Report of October/November 2005. Consequently, the fourth quarter of 2005 is assumed to be the start of NB's forward guidance. Interest rate projections are for the average daily key policy rate, the sight deposit rate, the rate at which banks can deposit at NB in a calendar quarter. The projections are published in the Monetary Policy Report, which is issued three times a year (March, June, and October). Typically the Monetary Policy Report contains projections for the remainder of the current year plus the three subsequent years.[5]

Sweden's Riksbank used inflation targeting and a flexible exchange rate over the period of analysis. The Riksbank's policy rate is the repo (repurchase) rate. The Riksbank began publishing model-based projections for the repo rate in its Monetary Policy Report in February

[4] Archer (2005, p. 4, footnote 13) states this is due to historical reasons and has only second-order implications that are swamped by the uncertainty surrounding the policy path itself.

[5] Due to the timing and frequency of Norway's Monetary Policy Report and interest rate projections, the 1-quarter-ahead October forecast—for next year's first quarter—has a slightly longer horizon than the 1-quarter-ahead March forecast for this year's second quarter and the June forecast for this year's third quarter. The same holds for the other horizons. Preliminary testing shows that this difference does not show up significantly in our results, so we ignore it hereafter.

2007. The repo rate projections are for quarterly horizons three years ahead and are typically released three times a year (February, July, and October).[6] The projections are averages of the daily rate for calendar quarters.

4.2 Forecast Performance of Central Bank Interest Rate Projections

The EH is based on market participant's ability to predict future short-term interest rates. Consequently, our analysis begins by testing whether the central banks' projections are better than the forecasts from the naïve RW model.[7] If the central banks' projections are not significantly better than the no-predictability alternative, it is difficult to see how forward guidance could significantly improve a central bank's ability to influence longer-term yields.

Differences in forecast performance are tested using the Diebold-Mariano (DM) test (Diebold and Mariano, 1995). The DM test statistic is based on the difference in forecast performance for a pair of models indexed as λ_1 and λ_2. Specifically,

$$DM^{\lambda_1,\lambda_2} = \frac{\bar{d}}{\sqrt{\hat{V}(\bar{d})}}, \tag{1}$$

where $\bar{d}$ denotes the mean of a differential loss function of the general form $d_t = L(e_{t,h}^{\lambda_1}) - L(e_{t,h}^{\lambda_2})$, $L(\cdot)$ denotes a generic loss function, $e_{t,h}^{\lambda_j}$ denotes the forecast error for model $j = 1, 2$, made at time t for h quarters ahead, and $\hat{V}(\bar{d})$ denotes the estimate of the variance of $\bar{d}$. $\hat{V}(\bar{d})$ is estimated using a Newey-West procedure. Based on the work of Harvey,

[6] Similar to Norway, the frequency and timing of the projections in Sweden's Monetary Policy Report induce a slight difference in actual horizon across the three projection dates. The *n*-quarter-ahead forecast made in February in fact has a slightly shorter horizon than the corresponding forecasts made in July and October. In the analysis, we abstract from this difference. About halfway between two successive Monetary Policy Report publication dates typically there is a monetary policy update. However, repo rate projections remain virtually unchanged in the update; consequently, we do not consider the updates.

[7] See Guidolin and Thornton (2010) for a discussion of the role of forecast accuracy for the EH.

Leybourne, and Newbold (1997), we used the modified DM test (MDM) to correct for size distortions associated with the original DM test:

$$MDM^{\lambda_1,\lambda_2} = \left[\frac{T+1-2n+\frac{1}{T}n(n-1)}{T}\right]^{1/2} DM^{\lambda_1,\lambda_2}. \qquad (2)$$

The exact date when the central bank's projections are made is unknown, so it is impossible to know exactly what interest rate realizations were available at the time the projections were made. We assume that for projections made in a given month, policymakers would have at least known the interest rate at the end of the previous month. Therefore, for the RW forecasts we used the average rate during the last five market days of the month before the forecast month.

The tests are performed for the period of forward guidance. The results for New Zealand, Norway, and Sweden are presented in Tables 1 through 3, respectively. These tests are not performed for the U.S. because the FOMC did not adopt explicit forward guidance until August 2011. The tables report $\bar{d}$, $\sqrt{\hat{V}(\bar{d})}$, and the MDM statistic for the mean absolute error (MAE) and the mean squared error (MSE) loss functions. A negative value of $\bar{d}$ implies that the central bank's projection outperforms the RW forecast on average. The difference in forecasting performance is tested for up to eight quarters ahead.[8]

The quantitative results vary somewhat across countries; however, the results are qualitatively similar. With a few exceptions, the test statistics are negative, indicating that the central banks' projections are better than those from the naïve model. The differences in performance are quantitatively small for New Zealand, but substantially larger for Norway and

[8] Note that the samples for Norway and Sweden are extremely small, especially at longer horizons. For Norway, only twelve 8-quarter-ahead forecasts are available; for Sweden, only eight quarters are available.

Sweden and of a similar order of magnitude. However, consistent with the findings by Goodhart and Lim (2011) and Middeldorp (2011), the improvements are statistically significant only for horizons of a few quarters. Moreover, with two exceptions, the differences are statistically significant only for the MAE metric.[9]

4.3 Forward Guidance and the Efficacy of Monetary Policy

The fact that the projections of the central banks of New Zealand, Norway, and Sweden are generally superior to those of the naïve model is a necessary condition for the usefulness of forward guidance for these central banks. Stronger evidence would be that forward guidance significantly improves market participants' ability to forecast future short-term interest rates. Specifically, we test whether the conditional expectation of the rate at time t for horizon k, $E_t(i_{t+k})$, improves following the central bank's adoption of forward guidance. We use CE survey forecasts as a proxy for the conditional expectation. CE forecasts are available monthly for horizons of 3 and 12 months ahead.[10] We present the results for the mean 3-month and 12-month forecasts for the 3-month bill rate and the 10-year bond yield. The sample period for each country is determined by the availability of the CE forecasts. The samples begin on December 1994, January 1998, and June 1998 for New Zealand, Norway, and Sweden, respectively. The samples end on August 2011 for the 3-month horizon forecasts and November 2010 for the 12-month horizon forecasts.

We investigate whether the CE forecasts improved significantly after the introduction of forward guidance by estimating the equation

[9] The unusually large forecast errors in the final quarters of 2008 associated with the financial market turmoil after Lehman Brothers' bankruptcy announcement potentially explain the lack of MSE significance as extreme errors impose a relatively large penalty on the MSE loss function.

[10] We cannot match CE forecasts with central bank projections because CE forecasts are forecasts for the end of the month while central banks provide projections for the average rate in future calendar quarters.

$$d_t = \alpha + \beta Dum + \varepsilon_t. \tag{3}$$

The dependent variable, d_t, is the difference in the CE forecast error of the forward guidance central bank and the benchmark forecast error. The benchmark controls for a variety of factors that could affect interest rate predictability. Two benchmarks are used: a simple RW benchmark and the CE forecast error of a benchmark country.[11] Dum is a dummy variable that takes the value 1 during the period of forward guidance and zero otherwise. Hence, the coefficient, β, is the change in the relative forecast error during the forward guidance period. A negative estimate of β indicates an improvement in survey forecast performance relative to the benchmark associated with the adoption of forward guidance.[12] As before, we use the MAE and MSE loss functions.

The results for New Zealand are reported in Table 4. At the 3-month horizon, all of the estimates of β are negative, suggesting forward guidance improved the forecasting performance at this horizon; however, none of the coefficients is statistically significant at the 5 percent significance level. In contrast, there are five instances where the estimate of β is positive at the 12-month horizon; in four of these instances the estimate of β is relatively large; in three instances, statistically significant. Hence, there was a marked and statistically significant deterioration in market participants' ability to forecast bill and bond rates at the 12-month horizon after the adoption of forward guidance. However, all of these instances are relative to the country benchmark. There is no significant change relative to the no-predictability benchmark,

[11] For the RW benchmark, we compare the survey forecasts made in month t for the end of months $t+3$ and $t+12$ with the rate observed on the last working day of month $t–1$.
[12] The estimate of α measures the relative forecast performance against the benchmark in the pre-forward guidance period, where $\alpha > 0$ implies the benchmark performs better.

and most of these estimates of β are negative, suggesting a modest but not statistically significant improvement in forecasting relative to the non-predictability alternative.

The quantitative results in Table 4 are reflected in Figure 1, which shows the MAEs of the 12-month-ahead RW and CE forecasts for the 3-month bill rate. The vertical line denotes the beginning of forward guidance. The figure demonstrates that there was no marked improvement in the CE forecast relative to the RW forecast following the adoption of forward guidance. Indeed, for a period immediately following the adoption of forward guidance, the CE forecasts are somewhat worse than the RW forecasts. However, the CE forecasts have been somewhat better than the RW forecasts since about 2005. Due to the considerable persistence in the difference in forecasting performance, it is difficult to conclude that the recent improvement is due to the RBNZ's forward guidance policy. In any event, the entire period since the adoption of forward guidance reveals no marked difference in the CE forecast errors relative to the RW forecast errors. Indeed, an MDM test of the difference in forecasting performance between the CE and RW forecasts indicates no statistically significant difference in forecasting performance since the RBNZ adopted forward guidance.

The results for Norway, presented in Table 5, indicate an improvement in forecasting ability following the adoption of forward guidance for both the bill and the bond rates at both the 3- and 12-month horizons. However, in most instances the estimates are not statistically significant. There are three instances where the estimate of β is negative, relatively large, and statistically significant, but none of these is robust to either the loss function or benchmark.

Figure 2 shows the absolute average forecast errors for CE and RW at the 12-month horizon for Norway. The figure shows a marked improvement of CE forecasts relative to RW forecasts following the adoption of forward guidance. Indeed, the average difference in MAEs since the adoption of forward guidance is –62 basis points, which is statistically significant. As was the case for New Zealand, there is considerable persistence in the relative forecast performance. Overall, the fact that the RW forecast errors are larger than the CE forecast errors in nearly every month following the adoption of forward guidance provides some modest support for the usefulness of forward guidance.

The improvement in forecasting performance began about a year in advance of the adoption of forward guidance, when the average difference was –55 basis points. This may be taken as evidence in support of the usefulness of forward guidance because the period roughly coincides with a change in the communications strategy of the Norges Bank, focusing more directly on interest rate conditions, including information of a quantitative range for the likely level of the short-term interest rate on a 3- to 4-month horizon (see Ferrero and Secchi, 2007). However, these results are not robust to the country benchmark. Moreover, there is no correspondingly marked improvement in the CE forecast relative to the RW benchmark at the 3-month horizon, where, a priori, one might expect the most improvement.

The results for Sweden, presented in Table 6, are similar to those of Norway: There is a relatively large and statistically significant improvement in forecasting performance relative to the RW benchmark for both loss functions at the 12-month horizon, but not at the 3-month horizon. This improvement is shown in Figure 3, which presents the MAEs for the CE and RW forecasts. The figure shows a marked improvement in survey forecasting performance since the adoption of forward guidance. However, as with Norway, the marked improvement in forecasting performance begins well in advance of the adoption of forward guidance. The average difference in MAE is –77 basis points after the adoption of forward guidance and –87 basis points for the 18 months prior to the adoption of forward guidance. Also, the figure shows that there were extended periods when the CE forecasts were markedly superior to the RW forecasts for the period prior to the adoption of forward guidance. Consequently, it is difficult to know how much of the marked improvement in performance suggested by Figure 3 is due to the Riksbank's adoption of forward guidance.

Overall, the evidence suggests an improvement in CE forecasts of the bill rate relative to RW forecasts following the adoption of forward guidance for Norway and Sweden. The improvement is large and statistically significant at the 12-month horizon, but relatively small and not statistically significant at the 3-month horizon. Moreover, the improvement tends to be smaller and is not statistically significant relative to the country benchmark. The interpretation of these findings is further complicated by the facts that a) the improvement in forecasting performance for both countries occurs well in advance of the central bank's adoption of forward guidance and b) there is marked persistence in relative forecast performance. At best, there appears to be modest evidence that the forward guidance policies of the Norges Bank and Riksbank have been associated with an improvement in the short-term rates at relatively longer-term horizons, but not at short horizons. Moreover, this improvement is not reflected in an improvement in the market's ability to forecast long-term yields.

There is no evidence that the RBNZ's forward guidance has improved market participants' ability to forecast either short-term or long-term rates at any horizon. The RBNZ has had the longest experience with forward guidance. While the intent of the Reserve Bank of New Zealand's forward guidance policy was to increase the predictability of the future course of policy, it is not specifically offering forward guidance with respect to its policy rate. Therefore, the market may not view the RBNZ's path for the 3-month rate to be a commitment to conduct policy in order to deliver the rate at or near the path. Hence, it is not entirely clear whether the evidence present here and elsewhere provides insight into the effectiveness of forward guidance monetary policy per se.

Since the intent of forward guidance is to enable central bank short-term interest rate policy to have a larger effect on longer-term interest rates, we also investigate this possibility directly. Specifically, we test whether the improvement in CE forecast performance for short-term rates following the adoption of forward guidance is reflected in changes in longer-term rates, using the following regression:

$$\Delta R_t^n = \alpha_0 + \alpha_1 \Delta E_t(i_{t+3}^3) + \alpha_2 \Delta E_t(i_{t+12}^3) + u_t, \tag{4}$$

where ΔR_t^n denotes the change in the interest rate on a bond with maturity of *n* years and $\Delta E_t(i_{t+3}^3)$ and $\Delta E_t(i_{t+12}^3)$ denote the change in the CE forecasts for the 3-month bill rate for 3 and 12 months ahead. For New Zealand and Norway $n = 2$ and for Sweden $n = 3$; *u* is a zero-mean, constant variance stochastic error. Equation (4) is estimated for the period before and after forward guidance. If forward guidance increased the central bank's ability to affect interest rates further out on the term structure, we would expect the estimate of R^2 to be higher after forward guidance than before.

Table 7 reports the estimate of R^2 for the pre- and post-forward guidance periods as well as the likelihood ratio statistic for a test of no difference between the two periods. For all countries the estimate of R^2 is larger for the post-forward guidance period; however, the difference is statistically significant only for Sweden.[13] While the results are only suggestive because of the limitations of the CE data, they are qualitatively similar to those reported in Tables 4 through 6. Specifically, there is essentially no evidence of improvement for New

[13] Using the same approach with changes in the 10-year bond yield as dependent variables fails to lead to significant results for all countries.

Zealand; somewhat stronger, but not statistically significant, evidence for Norway; and the strongest evidence for Sweden.[14]

4.4 The Effectiveness of Forward Guidance: The United States

The FOMC did not announce an explicit path for it policy rate until August 2011, but provided implicit forward guidance during two periods before August 2011. Beginning with its August 2003 meeting (the FOMC reduced its funds rate target to the then-historically low level of 1.0 percent at its June meeting), the Committee announced that it believed "that policy accommodation can be maintained for a considerable period." The *considerable period* language was meant to signal the FOMC's intention to keep the funds rate near 1 percent for a longer period than might otherwise have been expected in the hope of having a larger effect on longer-term yields.[15] The FOMC repeated the statement at each of its next three meetings. The statement was modified slightly at the January and March 2004 meetings to "the Committee believes that it can be patient in removing its policy accommodation." The FOMC signaled its intention to start slowly increasing the target at its May 2004 meeting by stating "the Committee believes that policy accommodation can be removed at a pace that is likely to be measured." The target was increased by 25 basis points at each of the next 16 meetings, but the forward guidance language was dropped at the December 2005 meeting when the target had reached 4.0 percent.

The FOMC returned to forward guidance again in December 2008 when, following its decision to reduce the funds rate target to between zero and 0.25 percent, the Committee announced that "economic conditions are likely to warrant exceptionally low levels of the federal

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[14] A caveat applies: In contrast to our earlier analyses, we do not control for other factors that may have changed the predictability of interest rates. This may be particularly important for the Swedish results as the Riksbank started its forward guidance almost simultaneously with the start of the global financial crisis.

[15] Woodford (2005, p. 2) referred to this as the Fed's "bold recent experiment in greater explicitness about the future outlook for interest rates."

funds rate for some time." Identical or very similar language appeared in the FOMC's statement until August 2011, when the FOMC noted that economic conditions "are likely to warrant exceptionally low levels for the federal funds rate at least through mid-2013." At its January 2012 meeting, the FOMC extended forward guidance until "late 2014" and to "at least through mid-2015" at its September 2012 meeting.

This section investigates the extent to which the Fed's forward guidance enhanced the ability of private market participants to forecast future interest rates by estimating the equation

$$d_t = \alpha + \beta_1 Dum_1 + \beta_2 Dum_2 + \varepsilon_t, \tag{5}$$

where Dum_1 is a dummy variable that takes the value 1.0 from August 2003 through December 2005 and zero elsewhere and Dum_2 is a dummy variable that is 1.0 since December 2007. For the United States we have survey forecasts from both CE and Blue Chip Financial. The Blue Chip forecasts differ from the CE forecasts in that they the average rate for the forecasted calendar quarter.[16]

Table 8 presents the results using CE forecasts.[17] The top panel shows the results for the RW benchmark, and the bottom panels show the results for the country benchmark. For the first period of forward guidance, there is a statistically significant improvement in forecasts of the 3-month rate with either loss function and at both the 3-month and 12-month horizons relative to RW forecasts. The gains are relatively small at the 3-month horizon but large at the 12-month horizon: 125 to 300 basis points. The FOMC increased its target for the funds rate 325 basis points between June 2004 and December 2005, so it hardly surprising that the RW forecasts did

[16] Note that this implies that the January 1-quarter-ahead forecast, the February 1-quarter-ahead forecast, and the March 1-quarter-ahead forecast are for the same second calendar quarter. As a result, we may expect January forecasts to be worse than February forecasts and so on; checking the data confirms this. However, since all our results are for the Blue Chip forecast error relative to a benchmark with the same characteristics, the heterogeneity in forecast ability across months plays no role.

[17] The sample starts in January 1990.

poorly during the period and that the RW forecast errors increased with the forecast horizon. Consequently, the country benchmark constitutes a better test of the efficacy of the FOMC's forward guidance policy. There is no statistical support for forward guidance when the country benchmark is used. While the estimates of β_1 and β_2 are most often negative, they are relatively small and not statistically significant. Moreover, there is no improvement for the 10-year bond yield regardless of loss function, forecast horizon, or benchmark.

The results are even less encouraging for the second period of forward guidance: For the bill rate, all four coefficients are positive, three significantly so compared with the RW forecast. They are negative and insignificant for the U.K. benchmark. For the bond yield, all coefficients are positive, significantly so for the MSE loss function using either the RW or country benchmark.

Table 9 shows the results using the Blue Chip forecasts with the RW benchmark.[18] Only RW benchmark results are presented because corresponding survey forecasts are unavailable for other countries. The results are quantitatively and qualitatively the same as those based on the CE forecasts. The similarity in the parameter estimates is a consequence of the fact that the two sets of survey forecasts are very similar.

4.5 Forward Guidance and Forecast Consensus

This section investigates the efficacy of these central banks' forward guidance policy in a different yet complementary way. Because all forecasters have access to the same central bank forward guidance, there should be a marked reduction in cross-sectional forecast variance following the adoption of forward guidance, i.e., forward guidance should increase the

[18] We choose the RW benchmark for the BC forecasts as the average interest rate in the last five working days of the month before the forecast.

predictability for all forecasters and, hence, reduce the cross-sectional variance of the forecasters in the surveys. Specifically, we evaluate the efficacy of forward guidance by testing whether there was convergence in market participants' forecasts following the adoption of forward guidance. To do this, we define the cross-sectional standard deviation of h-period-ahead forecasts of rate *x* at time *t* as[19]

$$cs_t^{x^h} = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}[f_{i,t}^{x^h} - E(f_{i,t}^{x^h})]^2} = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}[(f_{i,t}^{x^h} - \bar{f}_t^{x^h}]^2}, \tag{6}$$

where *i* is the survey participant index, *N* is the number of individual survey forecasts, and $\bar{f}$ is the average forecast, i.e.,

$$\bar{f}_t^{x^h} = \frac{1}{N}\sum_{i=1}^{N} f_{i,t}^{x^h}. \tag{7}$$

The standard deviation, *cs*, is not scale invariant—the higher the current interest rate the larger the variance. To account for this fact, we normalize *cs* relative to level of the interest rate being forecast. Our normalized measure of variation is

$$csn_t^{x^h} = cs_t^{x^h} / x_t, \tag{8}$$

where x_t is the level of the forecasted rate at the time the forecast was made.

We test whether forward guidance decreased the heterogeneity of forecasts using regression equations identical to (3) and (5) except that the dependent variable is $csn_t^{x^h}$. To

[19] It is straightforward to show that the cross-sectional standard deviation of survey forecasts equals the cross-sectional standard deviation of survey forecast errors, independent of the realization of the forecasted variable.

control for other factors that may have influenced the degree of forecast convergence, we benchmark against non-forward-guidance countries as before.

The results are summarized in Table 10. For New Zealand, all four coefficients are negative, three significantly so. Hence, it appears that forward guidance produced a convergence of expectations among survey participants. This may be seen as a mixed blessing because the consensus forecasts of short-term and long-term rates deteriorated during the period. Worse forecasts that are held more unanimously provide some support for Morris and Shin’s (2002) and Kool et al.’s (2011) position that central bank transparency can actually hurt rather than help the market.

The results for Norway and Sweden also suggest that forward guidance increased forecast convergence in the bill market, but had no effect in the bond market. However, these countries experienced no improvement in the ability of market participants to forecast short-term or long-term rates relative their respective country benchmarks. Consequently, the benefits form increased convergence of expectations is unclear.

There is no evidence of increased convergence for the United States during the first period of forward guidance; there is a small and statistically significant increase in the convergence of forecasts of the short-term rate during the second. Overall, the evidence suggests that there was a statistically significant increase in convergence of forecasts following the adoption of forward guidance by the RBNZ, the Norges Bank, and the Riksbank; however, the benefit from this convergence, if any, is unclear.

SUMMARY AND CONCLUSIONS

This paper investigates the impact of forward guidance on the predictability of future short- and long-term interest rates in New Zealand, Norway, Sweden, and the United States. New

Zealand began providing forward guidance in 1997, Norway in 2005, and Sweden in 2007. The United States used implicit forward guidance during two periods: 2003-2005 and 2008-2011.

We have three main findings. First, central bank interest rate projections were superior to naïve random walk forecasts at horizons up to three quarters, but the improvement was only statistically significant for Norway and Sweden, where the gain was as large as 30 to 50 basis points. In contrast, there was essentially no evidence that the RBNZ's projections were superior to RW forecasts.

Second, using 3-month-ahead and 12-month-ahead monthly survey forecasts of the 3-month bill rate and the 10-year bond yield, we find some evidence that forward guidance improves market participants' ability to predict future short-term rates relative to the predictions from the RW model. However, the evidence is significantly weaker when the post-forward-guidance forecasts are evaluated relative to a non-forward-guidance country benchmark. Also, surprisingly the evidence is strongest for longer-horizon forecasts. Moreover, the evidence is statistically significant only for Norwary, Sweden, and the United States and only relative to the no-predictability benchmark. In addition, we find no evidence of increased predictability of long-term yields for any of the forward-guidance countries using either benchmark.

Third, we found evidence of a statistically significant reduction in the cross-sectional variance of survey participants forecast following the adoption of forward guidance by the RBNZ, the Norges Bank, and the Riksbank, but not for the Federal Reserve. Given the relatively weak evidence of improvement in market participants' ability to forecast the short-term rate, the benefit associated with the increased convergence is unclear.

Overall, the statistical analysis provides weak evidence that forward guidance increased the ability of market participants to forecast future short-term yields and no evidence of increased predictability of long-term yields. Given the generally modest improvement in forecasting ability relative to the non-forward-guidance country benchmark, it is difficult to see how forward guidance could significantly increase these central banks' ability to control long-term yields as Woodford (1999, 2001, 2005, 2012), Svensson (2008) and others have suggested it would.

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Table 1
Difference between central bank and RW forecasts: New Zealand

	MAE			**MSE**		
Quarters ahead	**Mean**	**SE**	**MDM**	**Mean**	**SE**	**MDM**
1	–0.045	0.025	–1.79	–0.053	0.061	–0.85
2	–0.107	0.044	**–2.37***	–0.316	0.167	–1.84
3	–0.107	0.072	–1.43	–0.514	0.300	–1.63
4	–0.096	0.102	–0.88	–0.679	0.471	–1.34
5	–0.044	0.132	–0.30	–0.711	0.605	–1.07
6	–0.012	0.130	–0.08	–0.789	0.651	–1.08
7	–0.004	0.135	–0.02	–0.812	0.687	–1.03
8	–0.058	0.142	–0.34	–1.009	0.782	–1.09

Note: *Significant at 5 percent level. Significant coefficients are printed in bold.

Table 2
Difference between central bank and RW forecasts: Norway

	MAE			**MSE**		
Quarters ahead	**Mean**	**SE**	**MDM**	**Mean**	**SE**	**MDM**
1	–0.332	0.095	**–3.40****	–0.488	0.344	–1.38
2	–0.505	0.124	**–3.73****	–0.959	0.581	–1.50
3	–0.528	0.196	**–2.24***	–1.346	0.776	–1.44
4	–0.517	0.254	–1.56	–1.440	0.856	–1.29
5	–0.660	0.293	–1.53	–1.838	0.981	–1.27
6	–0.697	0.286	–1.40	–2.340	1.088	–1.24
7	–0.663	0.358	–0.85	–2.415	1.550	–0.71
8	–0.492	0.446	–0.41	–1.716	2.191	–0.29

Note: *Significant at 5 percent level; **significant at 1 percent level. Significant coefficients are printed in bold.

Table 3
Difference between central bank and RW forecasts: Sweden

	MAE			**MSE**		
Quarters ahead	**Mean**	**SE**	**MDM**	**Mean**	**SE**	**MDM**
1	–0.378	0.124	**–2.92****	–0.696	0.510	–1.31
2	–0.529	0.148	**–3.15****	–0.961	0.687	–1.24
3	–0.559	0.192	**–2.31***	–1.183	0.828	–1.13
4	–0.449	0.248	–1.23	–1.163	1.016	–0.78
5	–0.281	0.300	–0.51	–0.699	1.320	–0.29
6	–0.380	0.364	–0.47	–0.442	1.580	–0.13
7	–0.307	0.376	–0.22	0.150	1.788	0.02
8	–0.031	0.374	0.00	0.956	1.906	0.00

Note: *Significant at 5 percent level; **significant at 1 percent level. Significant coefficients are printed in bold.

Table 4
Changes in survey (CE) forecast performance (β): New Zealand

	MAE		MSE	
	$\hat{\beta}$	SE	$\hat{\beta}$	SE
Australian benchmark				
Bill				
3-mo-ahead	–0.294	0.202	–0.466	0.385
12-mo-ahead	**0.949***	0.467	2.364	1.485
Bond				
3-mo-ahead	–0.062	0.12	–0.18	0.225
12-mo-ahead	**0.644****	0.19	**1.864****	0.579
Random walk benchmark				
Bill				
3-mo-ahead	–0.104	0.114	–0.367	0.313
12 mo-ahead	0.226	0.322	–0.493	1.09
Bond				
3-mo-ahead	0	0.056	–0.079	0.077
12-mo-ahead	–0.071	0.141	–0.194	0.318

Note: *Significant at 5 percent level; **significant at 1 percent level. Significant coefficients are printed in bold.

Table 5
Changes in survey (CE) forecast performance (β): Norway

	MAE		MSE	
	$\hat{\beta}$	SE	$\hat{\beta}$	SE
Canada benchmark				
Bill				
3-mo-ahead	–0.121	0.142	–0.236	0.332
12-mo-ahead	–0.275	0.383	–1.319	1.461
Bond				
3-mo-ahead	–0.005	0.062	–0.029	0.056
12-mo-ahead	–0.146	0.087	**–0.341***	0.157
Random walk benchmark				
Bill				
3-mo-ahead	–0.161	0.096	–0.39	0.371
12-mo-ahead	**–0.600****	0.210	**–2.479***	0.974
Bond				
3-mo-ahead	0	0.051	0.02	0.053
12-mo-ahead	0.01	0.129	–0.059	0.21

Note: *Significant at 5 percent level; **significant at 1 percent level. Significant coefficients are printed in bold.

Table 6
Changes in survey (CE) forecast performance (β): Sweden

	MAE		MSE	
	$\hat{\beta}$	**SE**	$\hat{\beta}$	**SE**
U.K. benchmark				
Bill				
3-mo-ahead	–0.003	0.087	–0.034	0.105
12-mo-ahead	–0.343	0.204	–1.12	0.679
Bond				
3-mo-ahead	–0.02	0.079	0.048	0.133
12-mo-ahead	–0.189	0.119	–0.539	0.293
Random walk benchmark				
Bill				
3-mo-ahead	–0.107	0.095	–0.384	0.362
12-mo-ahead	**–0.837****	0.168	**–2.684****	0.846
Bond				
3-mo-ahead	0.08	0.061	0.157	0.107
12-mo-ahead	0.236	0.129	0.285	0.260

Note: **Significant at 1 percent level. Significant coefficients are printed in bold.

Table 7
Explanatory power of survey forecasts for longer-term yields

	New Zealand	Norway	Sweden
R^2 Pre-forward guidance	0.7	11.1	6.6
R^2 Post-forward guidance	8.0	23.1	27.9
Likelihood ratio test statistic	1.45	1.23	6.14**

Note: ** Significant at 1 percent level.

Table 8
Changes in survey (CE) forecast performance: United States

	MAE				MSE			
	$\hat{\beta}_1$	**SE**	$\hat{\beta}_2$	**SE**	$\hat{\beta}_1$	**SE**	$\hat{\beta}_2$	**SE**
Random walk benchmark								
Bill								
3-mo	**–0.297****	0.086	**0.081****	0.027	**–0.221****	0.076	**0.070***	0.034
12-mo	**–1.268****	0.134	**0.426****	0.124	**–3.014****	0.470	0.224	0.270
Bond								
3-mo	0.019	0.074	0.032	0.059	0.015	0.055	0.090	0.098
12-mo	0.131	0.187	0.422	0.226	0.095	0.243	**0.759***	0.372
U.K. benchmark								
Bill								
3-mo	–0.017	0.083	–0.073	0.091	0.033	0.171	–0.013	0.175
12-mo	–0.047	0.210	–0.279	0.199	–0.647	0.690	–0.842	0.692
Bond								
3-mo	0.045	0.062	0.101	0.064	0.085	0.095	0.216	0.116
12-mo	0.060	0.116	0.210	0.114	0.026	0.215	**0.498***	0.252

Note: *Significant at 5 percent level; **significant at 1 percent level; Significant coefficients are printed in bold.

Table 9 Changes in survey Blue Chip forecast performance: United States (RW Benchmark)

	MAE				MSE			
	$\hat{\beta}_1$	**SE**	$\hat{\beta}_2$	**SE**	$\hat{\beta}_1$	**SE**	$\hat{\beta}_2$	**SE**
Bill								
3-mo	**–0.307****	0.078	**0.066***	0.028	**–0.218****	0.068	0.034	0.033
12-mo	**–1.329****	0.144	**0.588****	0.133	**–3.005****	0.463	0.426	0.312
Bond								
3-mo	0.033	0.082	0.031	0.060	0.016	0.062	0.079	0.093
12-mo	0.204	0.226	0.376	0.223	0.231	0.278	0.690	0.372

Note: *Significant at 5 percent level; **significant at 1 percent level. Significant coefficients are printed in bold.

Table 10
Changes in survey (CE) forecast convergence

	New Zealand (benchmark Australia)		**Norway (benchmark Canada)**		**Sweden (benchmark UK)**	
	$\hat{\beta}_1$	SE	$\hat{\beta}_1$	SE	$\hat{\beta}_1$	SE
Bill						
3-mo	**–0.015****	**0.005**	**-0.144****	**0.044**	**–0.064****	**0.019**
12-mo	–0.002	0.005	**-0.527***	**0.233**	**-0.135***	**0.056**
Bond						
3-mo	**-0.011***	**0.005**	0.005	0.005	-0.002	0.005
12-mo	**-0.014***	**0.007**	0.002	0.008	-0.013	0.009
	United States (benchmark UK)					
	$\hat{\beta}_1$	**SE**	$\hat{\beta}_2$	**SE**		
Bill						
3-mo	–1.002	0.977	-0.539	0.986		
12-mo	–2.085	2.095	–0.795	2.344		
Bond						
3-mo	0.001	0.005	**-0.016***	**0.007**		
12-mo	0.004	0.008	0.010	0.012		

Note: *Significant at 5 percent level; **significant at 1 percent level; significant coefficients are printed in bold.

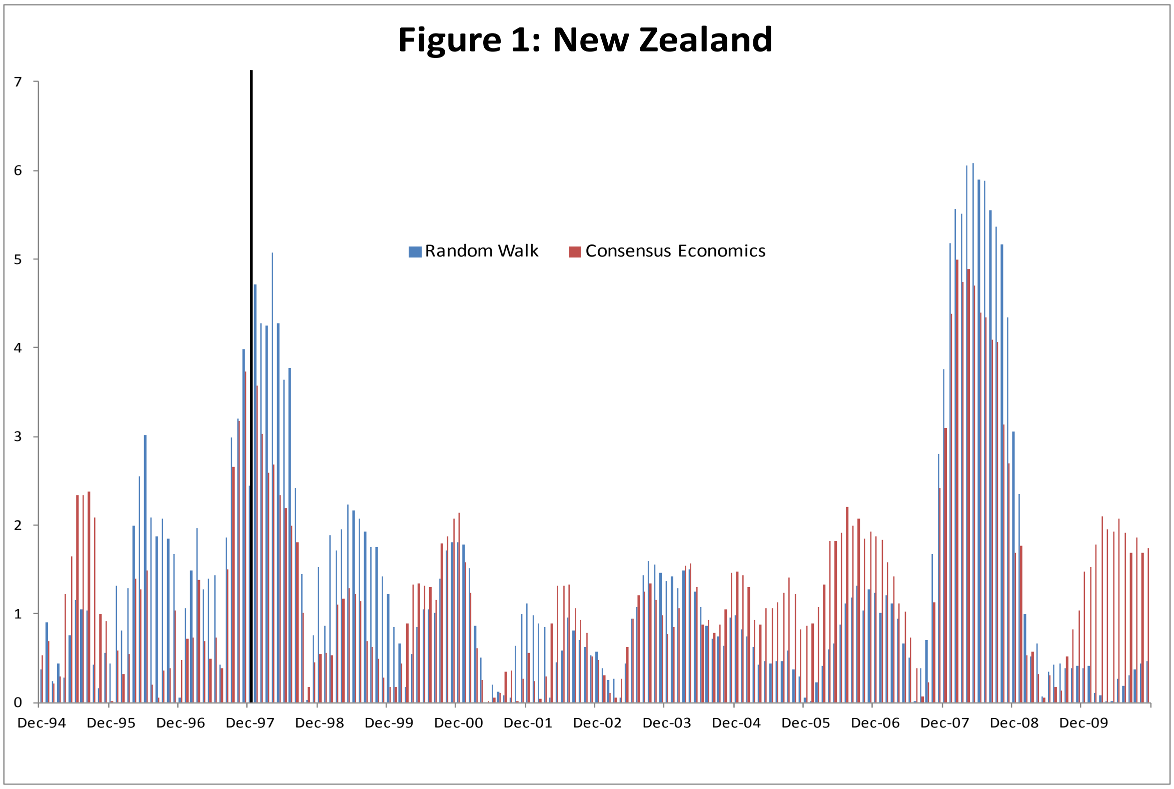

Figure 1: 12-Month-Ahead Absolute Forecast Errors of the 3-Month Bill Rate

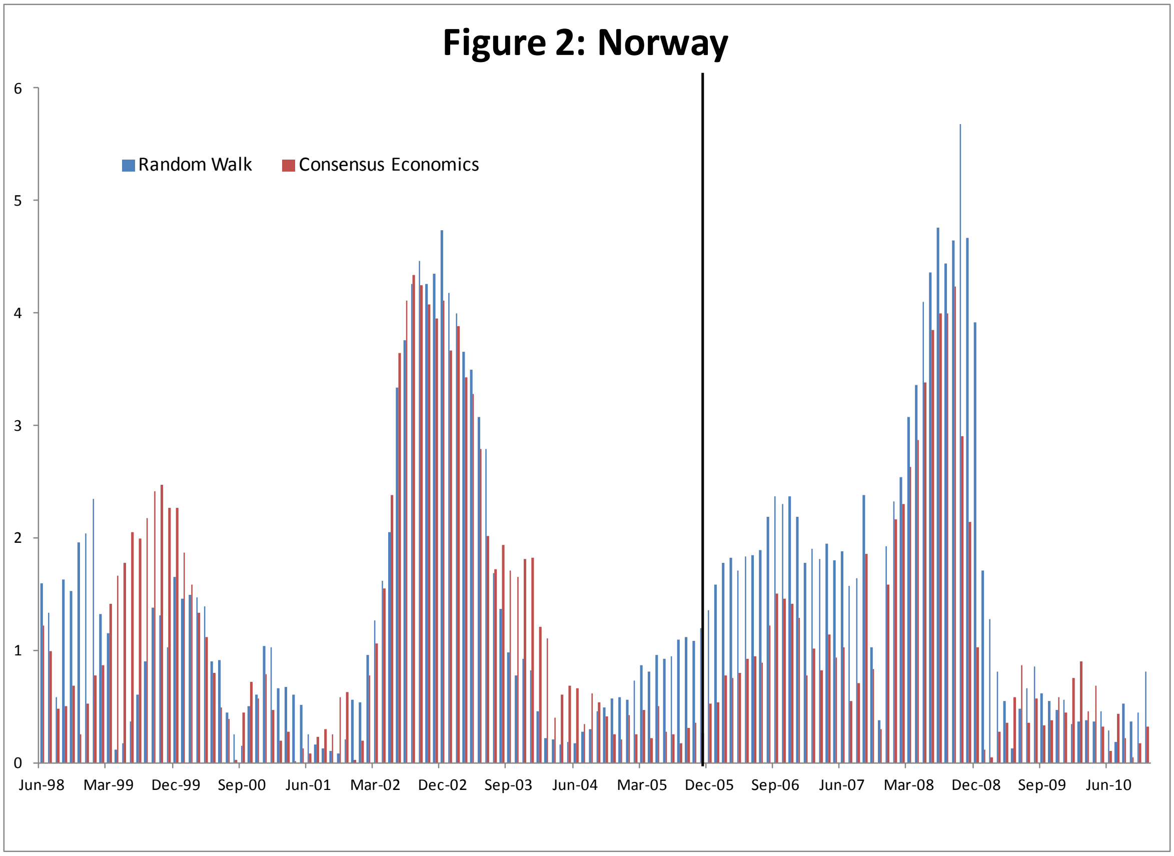

Figure 2: 12-Month-Ahead Absolute Forecast Errors of the 3-Month Bill Rate

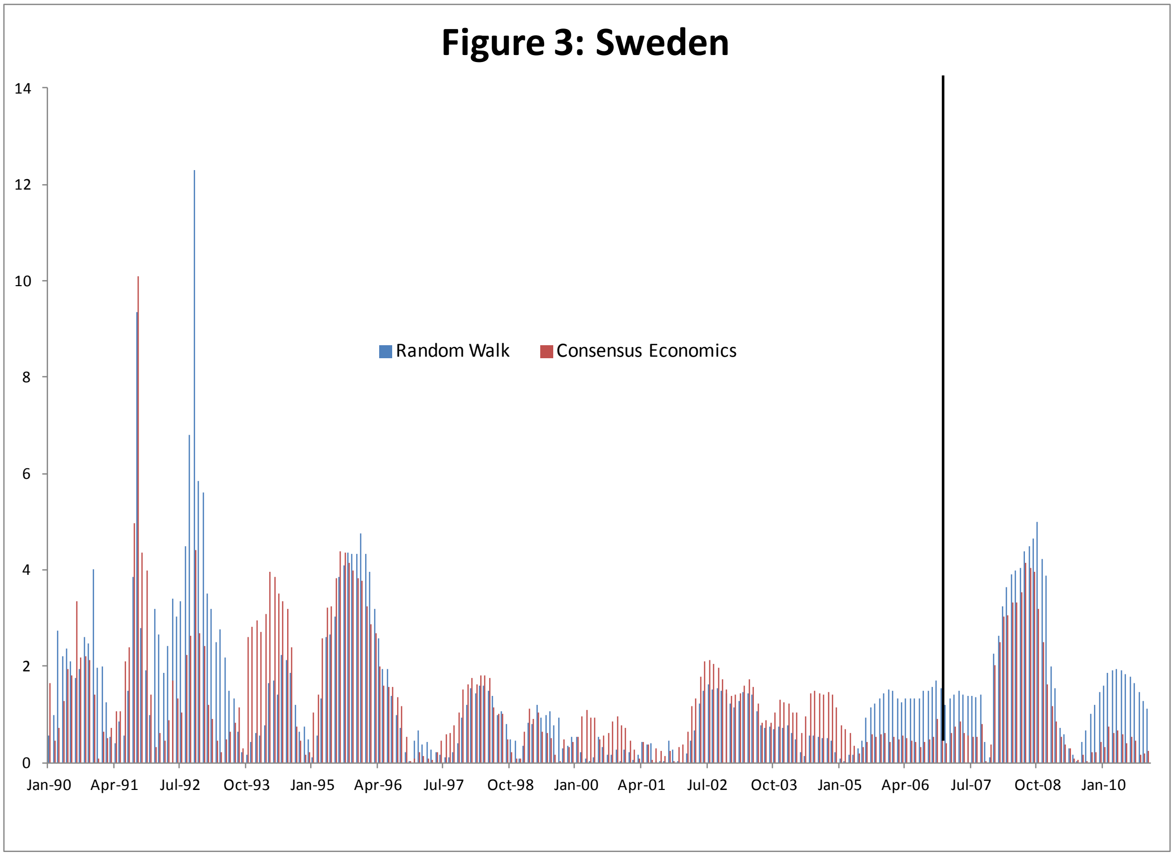

Figure 3: 12-Month-Ahead Absolute Forecast Errors of the 3-Month Bill Rate