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Central Bank Forecasts of Policy Interest Rates:
An Evaluation of the First Years

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National Institute of Economic Research

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Abstract

In recent years the central banks of Norway and Sweden have published their endogenous policy interest-rate forecasts. In this paper, we evaluate those forecasts alongside policy-rate expectations inferred from market pricing. We find that for both economies there are only small differences in relative forecasting precision between the central bank and market-implied measures. However, both types of forecast fail tests for unbiasedness and efficiency at longer horizons.

JEL Classification: E52

Keywords: Monetary policy, Market expectations, Norges Bank, Sveriges Riksbank

Summary in Swedish

På senare år har centralbankerna i Norge och Sverige publicerat sina endogena styrräntepronoser. I denna studie utvärderar vi dessa prognoser tillsammans med styrränteförväntningar beräknade utifrån marknadsprissättningen. Vi finner att det är små skillnader i prognosprecision mellan centralbanken och marknadsbaserade mått i såväl Norge som Sverige. Resultaten visar även att såväl centralbankernas prognoser som styrränteförväntningar beräknade utifrån marknadsprissättningen är behäftade med frånvaro av förväntningsriktighet och ineffektivitet på längre horisonter.

Contents

1. Introduction

Central bank transparency has increased dramatically over the last two decades as inflation targeting has become a standard framework for monetary policy. The benefits of an open and transparent monetary-policy process are widely agreed upon by policymakers and academics and have led to explicit numerical targets for inflation, publication of minutes from policy-decision meetings and comprehensive monetary policy reports containing forecasts of a large number of variables and detailed descriptions of the analysis behind them.

One of the more recent aspects of the increasing transparency is central banks publishing their own forecasts of the policy interest rate. This is by no means uncontroversial and a lively discussion has arisen about the associated costs and benefits and ultimately the limits to transparency; see, for example, Morris and Shin (2002), Mishkin (2004), Svensson (2006), Blinder *et al.* (2008), Rudebusch (2008), van der Cruijsen *et al.* (2010) and Ehrmann *et al.* (2012). Proponents argue that publishing the policy-rate path helps economic agents better understand monetary policy and lends the central bank more influence over longer-term interest rates, thereby improving the central bank's ability to achieve its macroeconomic objectives. Opponents argue that the policy rate path is too uncertain to be worth communicating and point to a risk that the path might be misinterpreted as commitment. While there is no consensus, some academic research suggests that it might be beneficial to publish the path. For example, Rudebusch and Williams (2008) show – using a small theoretical model with private sector imperfect information – that it generally generates better aligned expectations and helps the central bank to achieve its goals.

With the benefits uncertain, few central banks have so far chosen to publish a forecast for the policy rates. There is accordingly yet little data to analyse regarding questions relating to this issue. However, Norges Bank and Sveriges Riksbank took the step early; the former started publishing its own policy rate forecast in October 2005 and the latter followed in February 2007.[1]

The purpose of this paper is to evaluate the forecasting properties of policy interest-rate forecasts of the central banks of Norway and Sweden, alongside policy-rate expectations inferred from financial market pricing. We evaluate unbiasedness, efficiency and precision using a standard framework. This analysis provides relevant information on a number of issues. Central banks' forecasts and market expectations diverge at times, creating a tension between outlooks.[2] The divergence can owe to measurement problems when extracting market expectations from interest rates on finan-

[1] It should be noted that the Reserve Bank of New Zealand was the true pioneer when it comes to endogenous interest-rate forecasts but it provides a forecast of the 90-day bank bill rate, not its own policy rate (the OCR rate).

[2] For example, Figure A1 in the appendix shows the Riksbank's repo rate forecasts and market expectations in Sweden in October 2010 as presented in the *Monetary Policy Report* October 2010.

cial-market instruments but may also reflect different outlooks about the economy and policy rate. That is, at times the central bank's policy-rate path may not be fully credible. When the forecast paths do diverge, one can ask which will prove to be the better forecast and on which path economic agents would do best to rely. At any given time, the answer to those questions will depend on a range of factors but this paper aims to present some facts from the realised sample so far. Our results show that neither the central banks' forecasts nor market expectations pass simple tests for unbiasedness and efficiency but that there are generally very small differences in forecasting precision between central banks and market expectations.

The rest of this paper is organised as follows. In Section 2, we describe the data used. Section 3 presents the empirical analysis and, finally, Section 4 concludes.

2. Data

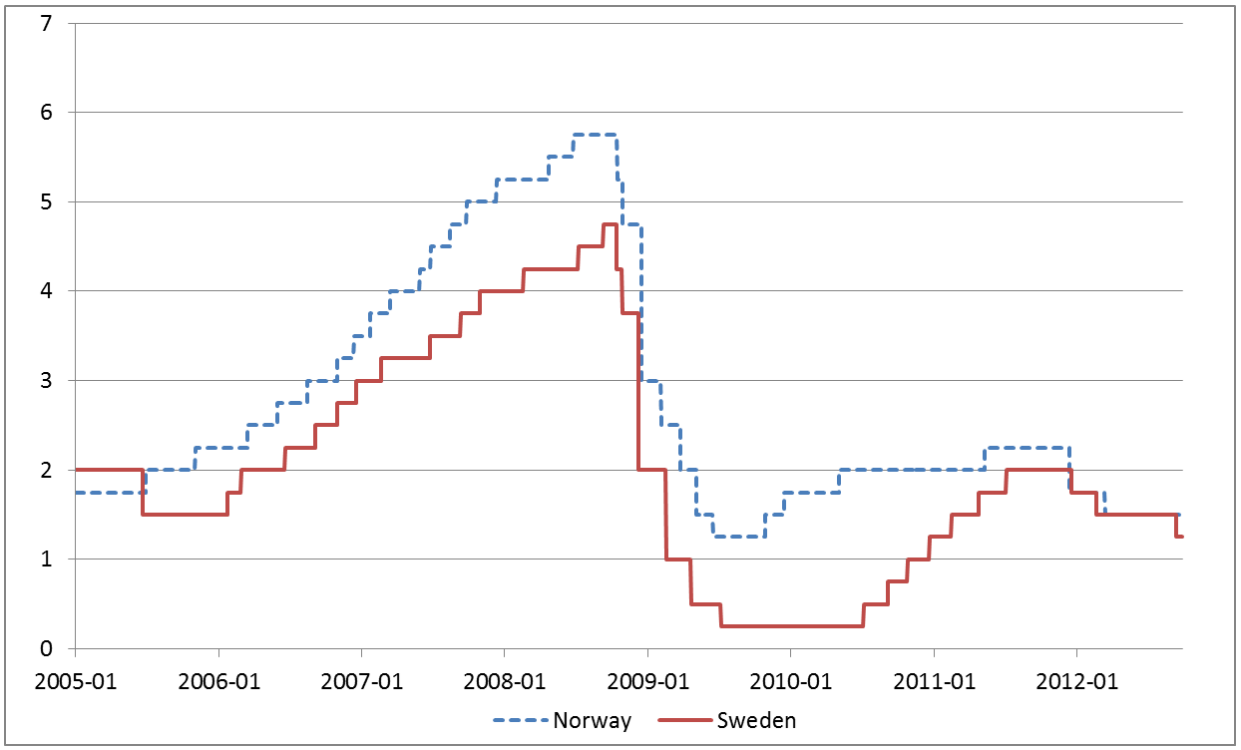
Norges Bank's forecasts of the sight deposit rate are those published in the *Inflation Report* or *Monetary Policy Report* from October 2005 to June 2012.[3] Similarly, Sveriges Riksbank's forecasts of the repo rate are those published in the *Monetary Policy Report* and *Monetary Policy Update* from February 2007 to July 2012. Data on market expectations inferred from financial market data were provided by Norges Bank and Sveriges Riksbank.

In our empirical analysis, we focus on forecast performance at three different horizons: one quarter, one year and two years. Figures A2 to A4 in the appendix show the forecast errors – defined as $e_{t+h|t} = i_{t+h} - i_{t+h|t}$, where i_{t+h} is the policy rate at time $t+h$ and $i_{t+h|t}$ is the forecast made at time t – at the different horizons in Norway. Figures A5 to A7 in the appendix show the corresponding forecast errors in Sweden.

Figure 1 shows the policy interest rates in Norway and Sweden from January 2005 to September 2012. As can be seen, the sample employed for our evaluation includes the tightening phase which ended in late 2008, the dramatic cuts of late 2008 and early 2009 and the period of very low rates which ensued.

[3] Norges Bank changed the name of their main report from *Inflation Report* to *Monetary Policy Report* in 2007.

Figure 1. Policy interest rates in Norway and Sweden.



3. Empirical analysis

Our empirical analysis is divided into two parts. First, we test for unbiasedness and efficiency. Second, we assess the forecast precision of the different forecasts and expectations. The framework employed is standard in the forecast evaluation literature; see, for example, Mehra (2002), Mankiw *et al.* (2003), Baghestani (2008) and Jonsson and Österholm (2011).

3.1 Unbiasedness and efficiency

We first test for unbiasedness, that is, whether the forecast errors have a zero mean. Results are shown in Table 1. For the available samples, all forecasts at all horizons have on average over-predicted the policy-rate outcome in both countries. The extent of the over-prediction is larger in Sweden at one- and two-year horizons and owes in part to the very low interest rates that prevailed during 2009 and 2010. Having quantified the extent of the over-prediction, we ask whether it constitutes a significant bias. This is tested by running the regression

$$i_{t+h} - i_{t+h|t} = \lambda + \omega_t, \qquad (1)$$

where i_{t+h} and $i_{t+h|t}$ are defined as above and ω_t is an error term. The null hypothesis $H_0 : \lambda = 0$ is then tested using a standard *t*-test.[4] As can be seen from Table 1, the null hypothesis can be rejected at the two-year horizon for both Norges Bank's forecasts (at the ten percent level) and the market expectations (at the five percent level). In Sweden, both the Riksbank's forecasts and market pricing are found to have a significant bias (at conventional levels) at the two longest forecast horizons. Biased forecasts constitute a violation of rational expectations when the forecaster has a symmetric quadratic loss function (which is a common assumption in the literature on forecast evaluations) but not necessarily so if the loss function is asymmetric. [5] In reality, the forecasters' loss function is not known, clouding an assessment of whether forecasts have been rational over this sample. One should also keep in mind that the sample is short and contains much variation in the policy cycle. For example, forecasts and expectations at the two-year horizon in Sweden from 2007 and the first half of 2008 were generated by agents who were blissfully unaware of the upcoming financial crisis and who overestimated the repo rate substantially.

[4] Newey-West standard errors are used to address the serial correlation in the residuals.

[5] See, for example, Elliott *et al*. (2008).

Table 1. RMSEs and results from tests of bias and efficiency.

	Norway			Sweden		
	Mean error	Efficiency	RMSE	Mean error	Efficiency	RMSE
1 quarter						
Central bank	-0.11	-0.10	0.43	-0.14	-0.13	0.43
	(0.09)	(0.08)		(0.10)	(0.08)	
Market pricing	-0.13	-0.06	0.36	-0.08	-0.14	0.44
	(0.08)	(0.05)		(0.11)	(0.09)	
Naive	-0.13	-	0.79	-0.14	-	0.76
	(0.23)			(0.22)		
1 year						
Central bank	-0.65	-0.55[b]	1.46	-0.94[c]	-0.72[a]	1.74
	(0.43)	(0.23)		(0.47)	(0.19)	
Market pricing	-0.63	-0.44[b]	1.36	-0.85[c]	-0.66[a]	1.62
	(0.39)	(0.23)		(0.44)	(0.19)	
Naive	-0.27	-	1.81	-0.52	-	1.92
	(0.65)			(0.61)		
2 years						
Central bank	-1.37[c]	-0.69[b]	2.18	-2.01[a]	-0.78[a]	2.60
	(0.65)	(0.31)		(0.63)	(0.16)	
Market pricing	-1.41[b]	-0.68[c]	2.21	-1.90[a]	-0.83[a]	2.53
	(0.65)	(0.33)		(0.62)	(0.13)	
Naive	-0.59	-	2.41	-1.09	-	2.58
	(0.94)			(0.89)		

Note: "Mean error" gives $\hat{\lambda}$ from equation (1). "Efficiency" gives $\hat{\beta}$ from equation (2). [a], [b] and [c] indicate significance at the one, five and ten percent level respectively. Newey-West standard errors in parentheses (). Regressions have 22, 19 and 16 observations at the one-quarter, one-year and two-year horizons in Norway. Regressions have 31, 26 and 20 observations at the one-quarter, one-year and two-year horizons in Sweden.

Next, we test for efficient use of macroeconomic data when forming expectations. A straightforward test of efficient use of data tests whether current information about the policy rate is systematically related to the forecast error and is based on the regression

$$i_{t+h} - i_{t+h|t} = \alpha + \beta i_t + \nu_t, \qquad (2)$$

where i_{t+h} and $i_{t+h|t}$ are defined as above and ν_t is an error term. As i_t was in the information set at time *t*, efficient use of data requires that it cannot explain variation in the forecast errors. The null hypothesis $H_0 : \beta = 0$ is tested using a standard *t*-test (with Newey-West standard errors). Results

are given in Table 1.[6] At the one-quarter horizon, there are no signs of inefficient use of data in either country. However, looking at the results for the two longest horizons, we see that both the forecasts of the central banks as well as market expectations are judged inefficient (at the five or ten percent level in Norway and at the one percent level in Sweden). While bias is not necessarily a sign of lack of rationality, inefficient use of data is incompatible with strictly rational expectations. However, both central banks and private agents operate with incomplete information about the economy and its dynamics, making fully rational expectations perhaps an excessively demanding benchmark.

3.2 Forecast accuracy

As the last step in our assessment of the policy-rate expectations, we compare the forecasting precision of the central banks' forecasts to the expectations inferred from market pricing. Results are once again given in Table 1.

Turning to Norway, forecast errors generally are small at the one-quarter horizon. The root mean square errors (RMSEs) for Norges Bank and market expectations are 0.43 and 0.36 respectively. Reflecting the difficulties of forecasting, absolute forecast errors are on average larger the longer the forecast horizon. At the one-year horizon, Norges Bank's RMSE is 1.46 and market expectations' 1.36; at the two-year horizon, the corresponding numbers are 2.18 and 2.21. As can be seen from Figures A2, A3 and A4, both market-inferred expectations and Norges Bank over-predicted the future policy rate substantially before the dramatic cut of December 2008. This is particularly evident for one- and two-year ahead forecasts in which the forecast miss affects forecast errors for several subsequent periods.[7] The market-inferred expectations exhibit slightly higher forecast precision than Norges Bank's forecasts at the two shorter horizons but the difference is small at all horizons. Naïve forecasts exhibit the largest RMSEs at all horizons.

To test if there are any significant differences in forecasting performance between Norges Bank and the alternatives we conduct a modified Diebold-Mariano test under the assumption of a quadratic loss function.[8] This is based on the regression

$$\left(e_{t+h|t}^{CB}\right)^2 - \left(e_{t+h|t}^{alt}\right)^2 = \delta + \chi_t, \tag{3}$$

[6] We do not test for efficient use of data when it comes to the naïve forecast. It is after all a simple benchmark and should of course be treated as such.

[7] Recall that by definition the forecast error of an *h*-step ahead forecast is serially correlated. Even an efficient forecast for horizon *h* has an MA(*h*-1) structure.

[8] We use the modified test of Harvey *et al*. (1997) rather than the orignial one suggested by Diebold and Mariano (1995) since our samples are fairly small.

where $e^{CB}_{t+h|t}$ are the forecast errors of the central bank and $e^{alt}_{t+h|t}$ are the forecast errors of the alternative method we are comparing it to, that is, either market pricing or the naïve forecast; χ_t is an error term. The null hypothesis is that the forecast accuracy of the central bank is equal to that of the alternative and is tested by comparing a transformation of the *t*-statistic on $\hat{\delta}$ to the relevant critical value from the *t*-distribution. Results are shown in Table 2. The null hypothesis cannot be rejected in a single case and we hence conclude that there is no support for a difference in forecast accuracy.

Table 2. Results from modified Diebold-Mariano test.

	Norway	Sweden
1 quarter		
Market pricing	0.90	-1.58
Naive	-1.39	-1.44
1 year		
Market pricing	1.29	1.72[c]
Naive	-1.03	-0.83
2 years		
Market pricing	-0.13	0.64
Naive	-0.33	0.08

Note: Entries in the table are the test statistic from the modified Diebold and Mariano test of Harvey *et al*. (1997). [a], [b] and [c] indicate significance at the one, five and ten percent level respectively. Regressions have 22, 19 and 16 observations at the one-quarter, one-year and two-year horizons in Norway. Regressions have 31, 26 and 20 observations at the one-quarter, one-year and two-year horizons in Sweden.

The results for Sweden show that the Riksbank has the lowest RMSE at the one-quarter horizon, albeit only marginally less than that of market-inferred expectations. At the one- and two-year horizons, the Riksbank's forecasting performance is slightly poorer than that of market-inferred expectations; at the one-year horizon, the modified Diebold-Mariano test suggests that this difference is statistically significant at the ten percent level. At the two-year horizon, the Riksbank also performs worse than a naïve forecast but the differences between the different measures at this horizon are quantitatively small and in no case statistically significant.

Overall, there is little support for a qualitative difference between central banks' forecasts and market-implied expectations of the policy rate. The forecasts follow similar patterns over time and it is evident from Figures A2 to A7 that neither the central banks nor markets foresaw the abrupt cut in policy rates in the immediate wake of the financial crisis.

Both Norges Bank and the Riksbank do reasonably well relative to a naïve forecast. Norges Bank outperforms it at all horizons, as does the Riksbank at the three-month and one-year horizons. That is, central banks add information above and beyond a naïve forecast at reasonably long horizons, calling into question Goodhart and Lim's (2011) suggestion that central banks should adopt a more mechanical approach – such as a no-change or implied forward market rate assumption – at horizons beyond two quarters.[9]

Goodhart and Lim's (2011) recommendation can also be questioned on other grounds. Both a constant policy interest rate over the forecast horizon and implied forward market rates have been used and later abandoned by several central banks (including Norges Bank and Sveriges Riksbank); drawbacks included difficulties in generating and interpreting the forecasts and indeterminacy in forecasting scenarios.[10] There is also intuitive theoretical appeal in the idea that communicating the outlook aids private agents' decision making about consumption and investment – thereby improving the implementation of monetary policy. Publishing endogenous interest-rate forecasts is also in line with the conclusions of Faust and Leeper (2005) and Faust and Wright (2008) that unconditional forecasts of the policy interest rate (and goal variables) provide a more effective means of communication than conditional forecasts.

4. Conclusions

The results in this paper reveal only modest differences in forecast precision between central banks' policy-rate projections and market-implied rate expectations. From a policy point of view, this is interesting for a number of reasons. First, it is probably comforting for proponents of endogenous interest-rate path publications that the central bank's forecast precision is roughly on par with the market's and generally superior to a naïve forecast. From that benchmark, concerns that publication of central-bank projections may prompt a deterioration in other agents' forecasts seems unwarranted.[11] Second, the relatively even forecast performance – combined with the fact that the central banks do fairly well compared to a naïve forecast – does not lend support for Goodhart and Lim's (2011) recommendation that central banks should abandon their own forecasts in favour of market-implied expectations or no-change forecasts. Third, when divergences do arise between the central bank and the market-implied forecasts, the results in this paper do not give strong priors about how the divergence will be resolved. After all, market-implied expectations have, over these samples, been as fair a guide to future developments as central-bank forecasts.

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[9] Specifically, Goodhart and Lim (2011) evalutate short-term interest rate forecasts in New Zealand and the United Kingdom where the former are the forecasts of the Reserve Bank of New Zealand and the latter have been derived from money market yield curves. They conclude (p. 135) that the forecasts *"… have been excellent for the immediate forthcoming quarter, reasonable for the next quarter, and useless thereafter"*.

[10] See, for example, Ólafsson (2007) for a discussion.

[11] Dale *et al*. (2011) suggest that a central bank which publishes forecasts of poor quality risks causing the private sector's forecast precision to deteriorate.

However, both central-bank projections and expectations inferred from market pricing fail tests for bias and inefficiency at longer forecast horizons. This may reflect difficulties in forecasting during a turbulent period or more fundamentally, incomplete knowledge of the structure and dynamics of the economy. The results nevertheless indicate that forecasts do not live up to the demanding standards of fully rational expectations.

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Appendix

Figure A1. Repo rate and forecasts/expectations in Sweden.

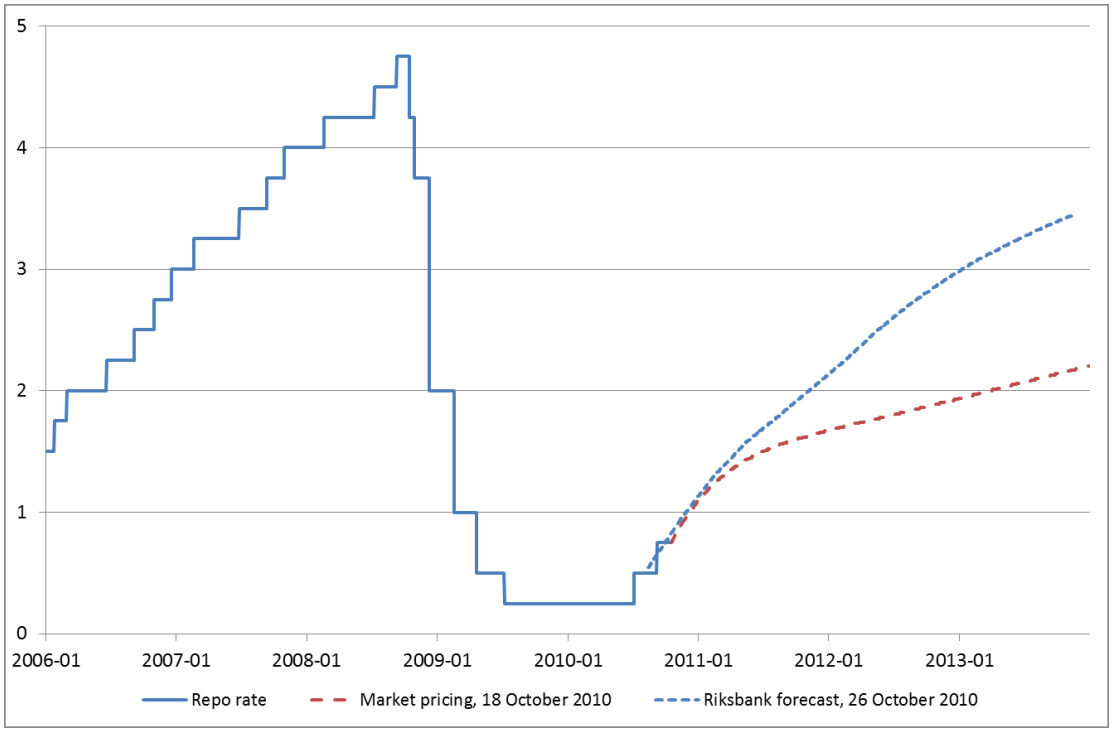
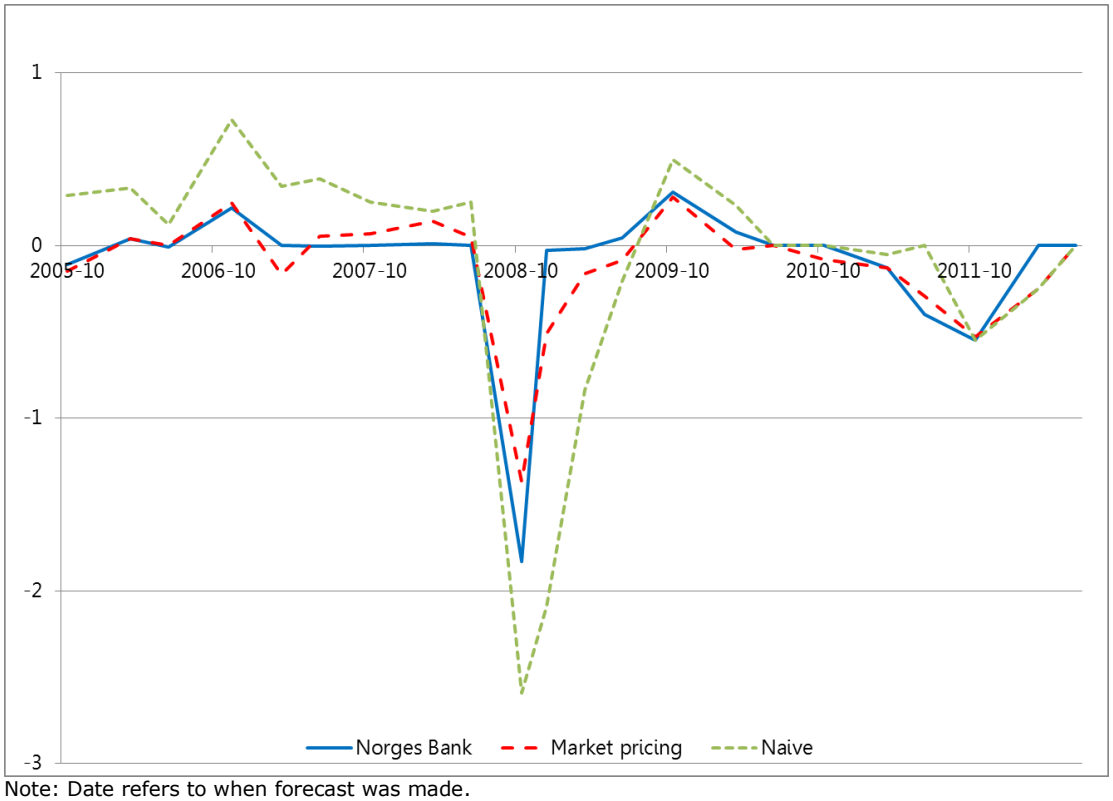
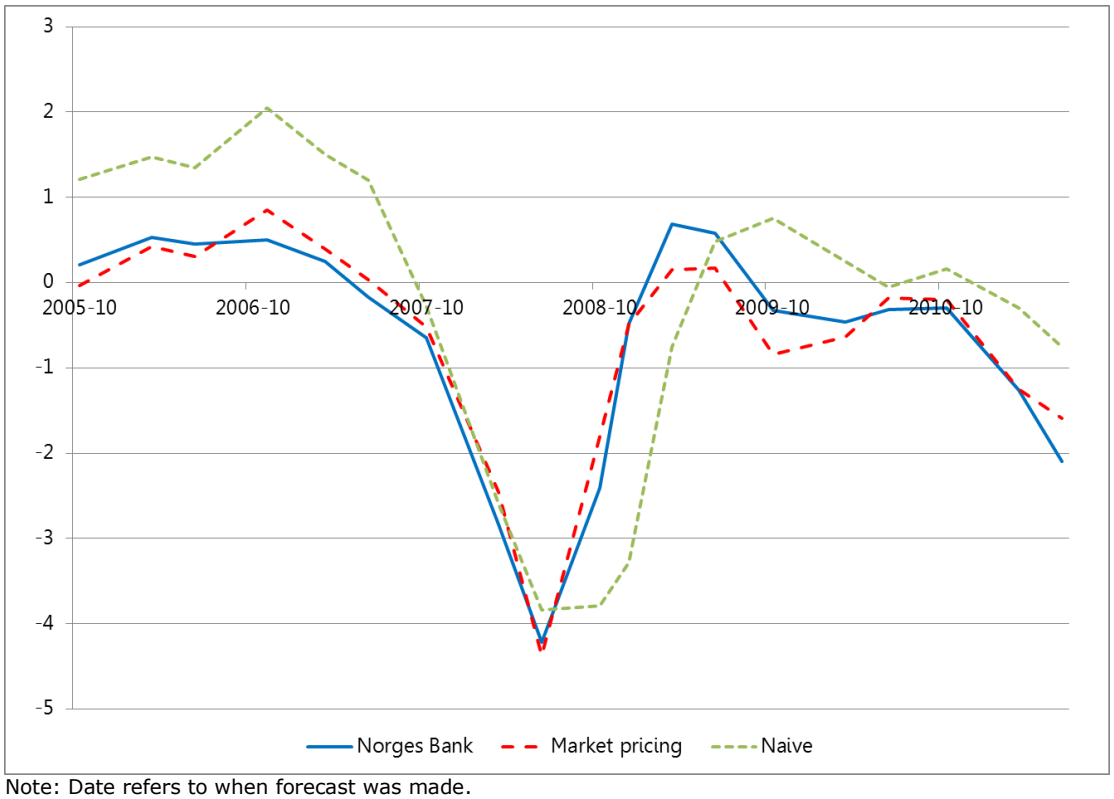


Figure A2. Forecast errors at the one-quarter horizon in Norway.



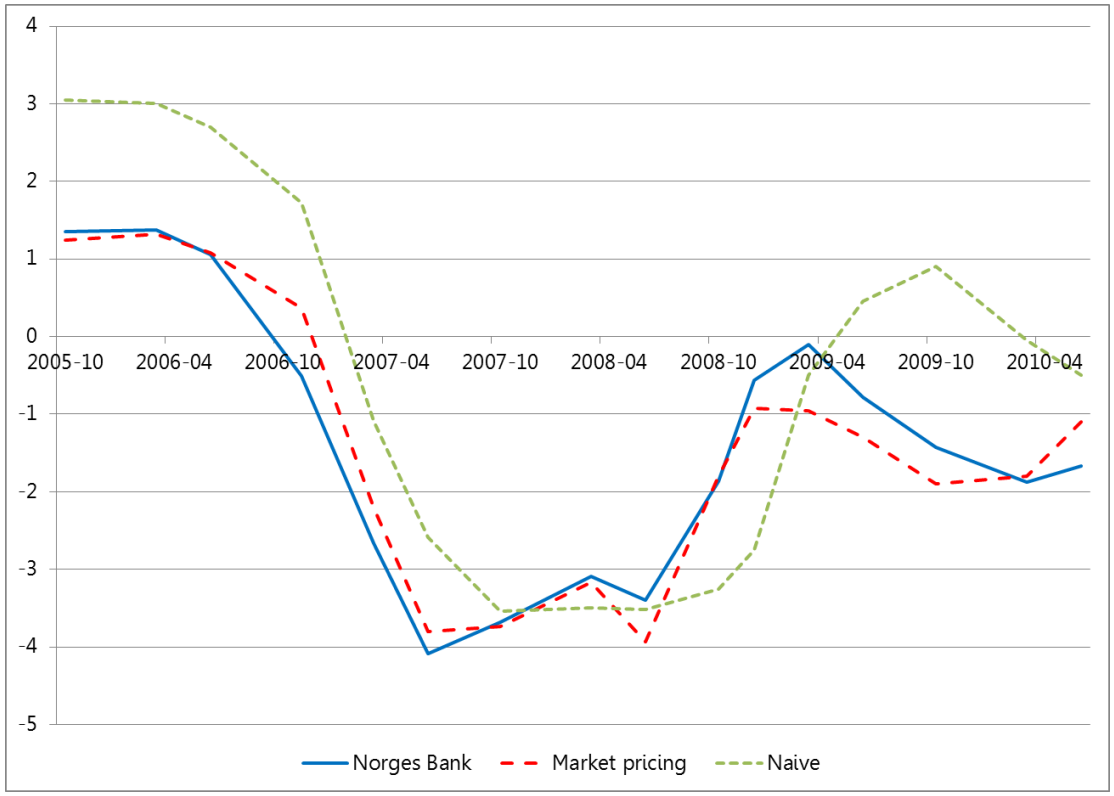
Note: Date refers to when forecast was made.

Figure A3. Forecast errors at the one-year horizon in Norway.



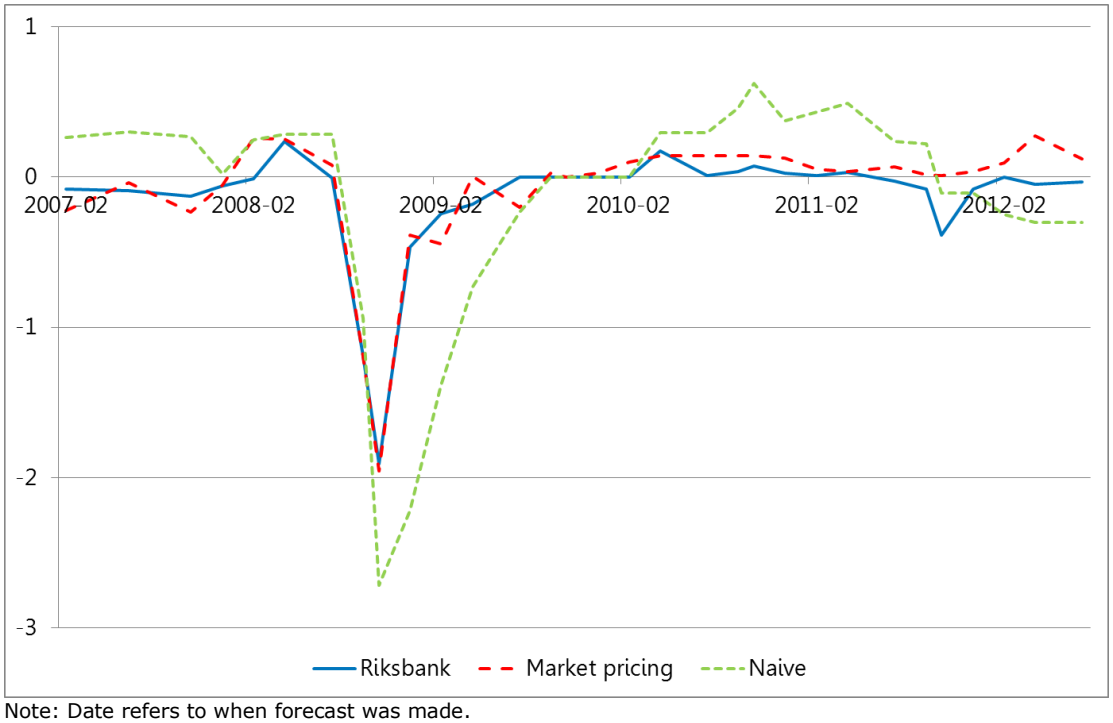
Note: Date refers to when forecast was made.

Figure A4. Forecast errors at the two-year horizon in Norway.



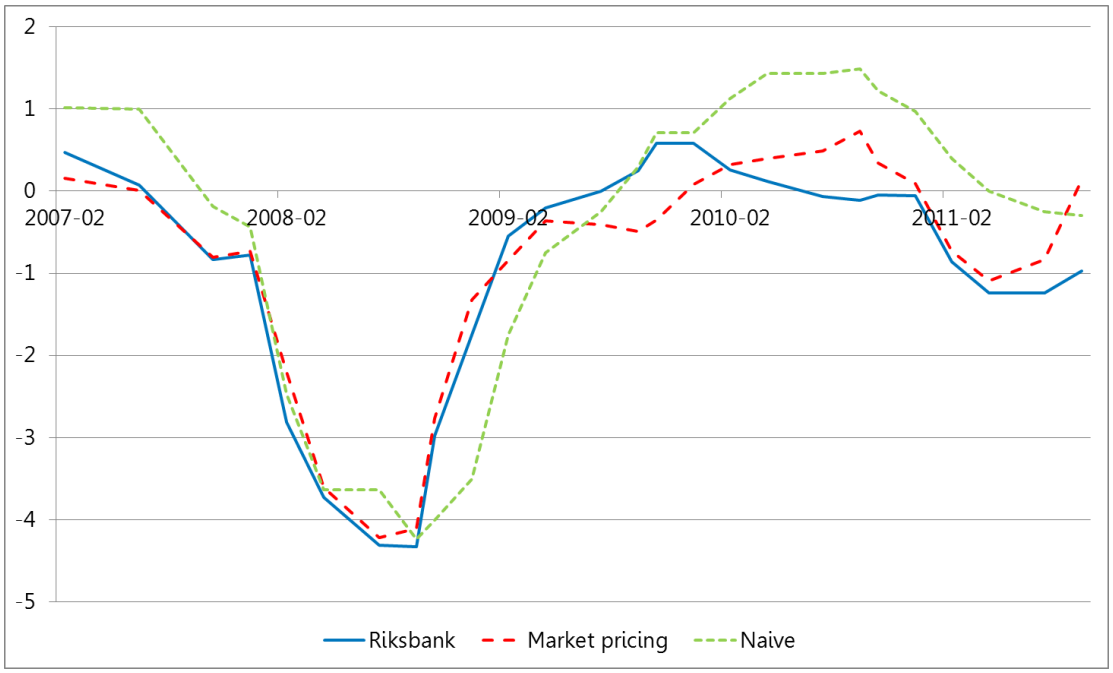
Note: Date refers to when forecast was made.

Figure A5. Forecast errors at the one-quarter horizon in Sweden.



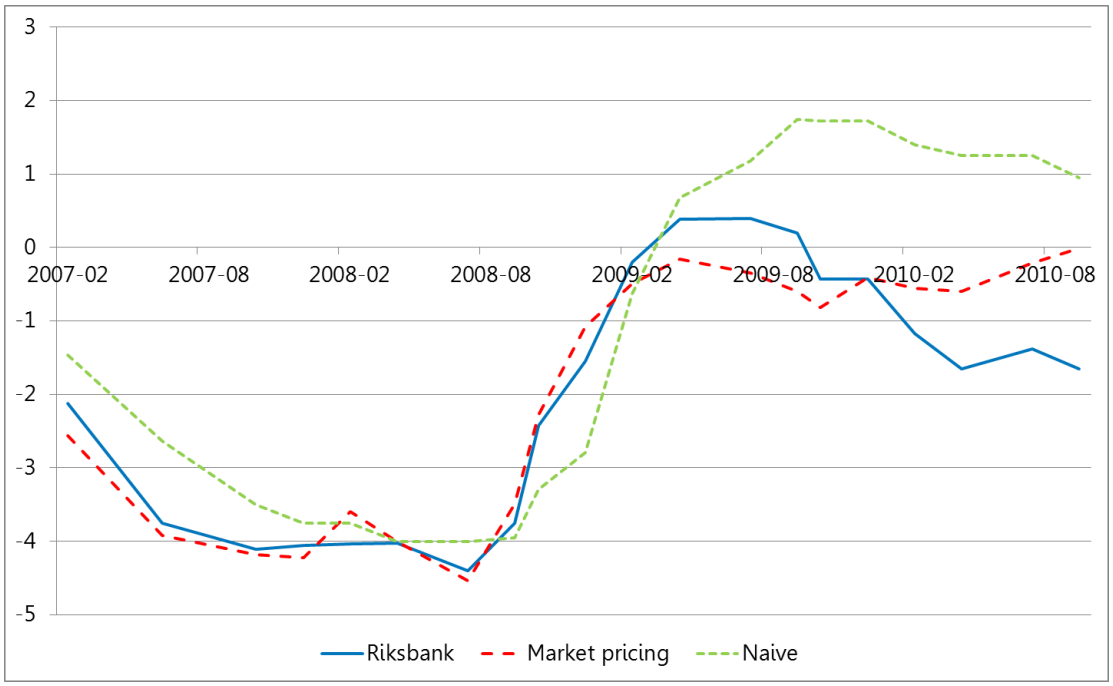
Note: Date refers to when forecast was made.

Figure A6. Forecast errors at the one-year horizon in Sweden.



Note: Date refers to when forecast was made.

Figure A7. Forecast errors at the two-year horizon in Sweden.



Note: Date refers to when forecast was made.

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