BANCA D'ITALIA

EUROSISTEMA

Temi di discussione

(Working papers)

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September 2009

Number 720

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THE ANNOUNCEMENT OF MONETARY POLICY INTENTIONS

by Giuseppe Ferrero* and Alessandro Secchi**

Abstract

Whether a central bank should share with the public its views about the future evolution of short term interest rates is an unresolved issue. Disclosing this information might allow a more precise control of market expectations and a more effective achievement of the ultimate goals of the monetary authority. Yet, if the public do not understand the conditional nature of this forecast, it could also undermine the credibility of the central bank. We provide new evidence on the effects of this announcement on private expectations about future short term interest rates. The communication of policy intentions tends to be associated with a greater predictability of monetary policy decisions. Moreover, focussing on New Zealand, where the central bank releases interest rate projections, we find that market expectations react significantly and persistently to the unexpected part of such forecasts. Finally it emerges that the predicted component of the changes in these projections is large, suggesting that market operators understand their conditionality.

JEL Classification: E58, E52, E43.
Keywords: monetary policy, communication, interest rates.

Contents

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1 Introduction*

Until the late 1980s, the conventional wisdom was that central banks communication should be limited in scope and opaque. This approach was consistent with theoretical results suggesting that only the unexpected component of policy decisions can influence private behavior. Yet over the last two decades this widespread preference for murkiness in communication has been progressively replaced by an increasing emphasis on the need for greater transparency about monetary policy. This change has been driven by important theoretical developments. The analysis of Kydland and Prescott (1977) and Barro and Gordon (1983) provided crucial results on why surprises cannot be used in a systematic way by monetary authorities to improve economic outcomes and on the advantages of implementing policies which are credibly committed to transparently announced rules. A further impulse towards greater openness in communication was provided by the New-Keynesian revolution. In the New-Keynesian framework the presence of nominal rigidities enhances the role of expectations in shaping the dynamics of economic variables and, in turn, also the role of transparency in monetary policy. Only a systematic and predictable monetary authority can in fact influence the expectation formation mechanism so as to obtain a more efficient and effective achievement of its final goals.[1] These theoretical developments were followed by a progressive increase in the wealth of information provided by central banks about their objectives, their strategies and their policy decisions. Despite the growing recognition of the importance of transparency in monetary policy-making, a consensus on whether full transparency is indeed optimal has not emerged yet - neither among academics nor among central banks.

*We would like to thank Paolo Angelini, Eugenio Gaiotti, Stephan Gerlach, Michael Ehrmann, Francesco Lippi, an anonimous referee and seminar participants at the Bank of Italy-CEPR Conference on Monetary Policy Design and Communication (September, 2007) for their useful comments. The opinions expressed in this paper are those of the authors and do not necessarily reflect those of the Bank of Italy.

[1]Using the words of Woodford (2005), *"not only do expectations about policy matter, but () very little else matters"*.

One of the most debated aspects of central bank transparency concerns the disclosure of views about the future evolution of short term interest rates, in particular when this information is released in the form of a quantitative projection. The literature and policy discussions highlight a series of advantages and drawbacks associated with this type of announcement. In particular, the release of future policy intentions might be beneficial because: (i) it might affect private expectations about the future evolution of monetary policy and, in turn, allow a more efficient pricing of financial assets (Archer, 2005; Kahn, 2007; Svensson, 2006); (ii) it helps to enforce the optimal policy under commitment (Archer, 2005; Khan, 2007; Mishkin, 2004; Svensson, 2006; Woodford, 2005); (iii) it increases the accountability of the central bank and the incentives for producing good forecasts (Archer, 2005; Mishkin, 2004); and, finally, (iv) it also fosters discussion within the monetary policy committee on policy objectives and on the appropriate models to be used in assessing the evolution of the economy (Archer, 2005). On the contrary, on top of the general observation that the provision of public information is not necessarily beneficial (Morris and Shin, 2002), it has been argued that the costs of an explicit announcement of policy intentions might outweigh the benefits if the central bank is already very transparent, in particular when the public does not understand its conditional nature. In such a situation a monetary policy decision which is not in line with the announced policy intentions can in fact undermine the credibility of the central bank (Mishkin, 2004; Khan, 2007; Woodford, 2005). It has also been argued that, moreover, when the monetary policy committee is large, it may prove to be quite hard to reach an agreement on the future evolution of the policy rates (Goodhart, 2005; Mishkin, 2004).

Notwithstanding the great importance of this issue, the evidence on the empirical importance of the aforementioned list of advantages and drawbacks is scant.[2] The

[2]According to Blinder et al. (2008) *" ... the publication of projected paths for the central bank's policy rate appears to be the "new frontier" in central bank communication. () this should be a*

contribution of theoretical literature, which is also in its infancy, is similarly modest.[3] To our knowledge, the only empirical analyses on the effects of the announcement of monetary policy intentions on private expectations are those of Archer (2005) and Moessner and Nelson (2008). Both focus on New Zealand since the Reserve Bank of New Zealand (RBNZ) is the only central bank which has published interest rate projections for a period of time that is sufficiently long to allow for a meaningful statistical analysis of the data. Archer (2005) finds that the unexpected component of the interest rate path released by the RBNZ exerts a limited effect on the slope of the term structure. He argues that this evidence supports the notion that financial markets understand the conditional nature of the projections. Moessner and Nelson (2008) perform a similar exercise and verify if private expectations about the future evolution of short term interest rates, measured by the returns on future contracts, move consistently with the unexpected component of the announced interest rate path. Similarly to Archer (2005) they also find evidence of a limited reaction to this type of monetary policy news.[4]

In this paper we provide new evidence on the impact of this type of announcement on private expectations. Our analysis is twofold. First, focusing on the euro area, New Zealand, Norway, Sweden and the U.S., we evaluate the effect of the release of policy intentions on the predictability of policy decisions. While this type of predictability is only an indirect signal of the ability of the central bank to steer market expectations, this exercise allows us to test whether a more precise communication (e.g. the publication of an interest rate projection as opposed to the provision of verbal hints about policy intentions) tends to be associated with more

high-priority area for future research".

[3]Rudebusch and Williams (2006) and Eusepi and Preston (2008) are among the few theoretical analyses available.

[4]Moessner and Nelson (2008) also provide some evidence against the hypotheses (i) that the announcement of monetary policy intentions reduces the impact of other macroeconomic news on market expectations about the future evolution of short term interest rates, (ii) that markets do not understand the conditionality of this type of announcement and, finally, (iii) that deviations from the announced interest rate path unsettle markets.

precise predictions by private agents. In the second part of the paper we analyze more directly the effect of the publication of an interest rate projection on private expectations by focusing on New Zealand. Our empirical exercise consists in verifying if private expectations about future short term interest rates move consistently with the unexpected change in the announced interest rate path. The analysis improves on the available evidence in three crucial directions. First, we allow private agents to use more general expectation formation mechanisms when they have to predict the interest rate path that will be announced by the central bank. This is a fundamental step for the correct identification of the unexpected component included in the publication of the interest rate path. Second, we show that neglecting the presence of risk premiums when extracting private expectations about future interest rates from financial futures has a sizeable impact on the results. Third, we take explicitly into account the possibility that, on those days when the interest rate path is announced, changes in market expectations about future interest rates might also be driven by other types of policy communication (e.g. the announcement of a change in the policy rate) or by the release of macroeconomic data. In a nutshell, our findings suggest that the announcement of future policy intentions, either quantitative or qualitative, improves the ability of market operators to predict monetary policy decisions. Moreover, building on the experience of New Zealand, we find that market expectations show a significant and persistent reaction to the unexpected component of the interest rate projection released by the central bank. The size of this effect is, from an economic point of view, not negligible since it accounts for about 40 per cent of the overall variation of market expectations at the 3-month horizon (50 per cent at the 12-month horizon) on those days when projections are disclosed.[5] Finally we also notice that the changes in the projections released by the

[5]To put these numbers in perspective, note that the unexpected component of the policy decision accounts for about 30 per cent of the total variation of market expectations at the 3-month horizon and 10 per cent at the 12-month horizon.

RBNZ are largely predicted by the markets, a finding which weakens the practical importance of concerns about the possible misunderstanding of the conditionality of this announcement.

The paper is organized as follows. In Section 2 we evaluate the impact of the announcement of policy intentions on the predictability of policy decisions. In Section 3, which is focused on New Zealand, we measure the effect of the publication of interest rate projections on market expectations and we assess the economic importance of the results. Robustness results are presented in Section 4. In Section 5 we provide some evidence in favor of the hypothesis that financial markets understand the conditional nature of the projections. Section 6 concludes.

2 The announcement of policy intentions and the predictability of policy decisions

In this section we verify if the adoption by a central bank of more open communication about the likely future evolution of short term interest rates is associated with a greater predictability of its policy decisions. The empirical strategy is to check whether an increase in the transparency of the information about policy intentions of the central bank tends to be associated with a decrease in the volatility of very short term interest rates when the policy decision is announced. Since very short term interest rates are not affected by the expected future evolution of official rates, their reaction to a monetary policy decision only reflects the unexpected component of the policy decision itself. Walsh (2007) observes that evidence of an association between the degree of predictability and the transparency of the announcement of policy intentions might reflect a lock-in effect in which the central bank feels it has to validate private sector expectations. While the theoretical validity of this observation is incontestable, a series of reasons suggest that its empirical importance

might be limited. The lock-in effect is in fact likely to be mitigated by the fact that central banks can use speeches during the inter-meeting period to signal and explain to the public a change in intentions and they can also employ a series of communication devices which can be used both to emphasize the conditional nature of the announcement (e.g. fan charts around the interest rate path) and to make the relationship between a policy decision and the announcement of policy intentions less stringent (e.g. many central banks announce the path of a non-official short term interest rate).

A first step towards the identification of an empirical relationship between transparency in the announcement of policy intentions and the predictability of policy decisions is the construction of an empirical measure of the former. To this end we classify transparency about policy intentions in three groups: (i) *quantitative announcement* - the release of a numerical interest rate path, (ii) *qualitative announcement* - the use of verbal hints about the future evolution of short term interest rates and (iii) *no announcement* - the absence of any communication related to future interest rates. While the identification of a *quantitative announcement* is uncontroversial, some form of judgment is unavoidable in evaluating whether a central bank is adopting a *qualitative announcement* or a *no announcement* communication strategy. In the empirical analysis presented here we consider that a central bank, in a given period of time, was adopting a *qualitative announcement* communication strategy if, after a policy meeting, the official communication released by the central bank includes, on a systematic base, wording that literally refers to the future evolution of interest rates.[6] However we also take into account the fact that, in some particular circumstances, a central bank might also decide to provide information about the future evolution of official interest rates through coded sentences which

[6] An example of this kind of communication strategy is provided by the following example taken from the Press Release of the Swedish Riksbank after the December 2005 Meeting of the Executive Board: *"It is reasonable to assume that the repo rate will need to be increased in future, as the market is currently assuming."*

are not literally related to the future evolution of official interest rates but that are used, and understood by the public, exactly in this way. An example of this communication strategy is the use of coded phrases like *"monitor very closely"* or *"strong vigilance"* as found in the Introductory Statements of the President of the ECB in the period 2005-2007.[7]

These criteria are applied to a group of central banks which includes the European Central Bank (ECB), the Federal Reserve (Fed), the Norges Bank (NB), the Reserve Bank of New Zealand (RBNZ) and the Sveriges Riksbank (SR) over the period January 1999 to July 2007.[8] A summary description of the announcement regimes adopted since early 1999 by the central banks under investigation is presented in Table 1.[9]

Figure 1 presents the first evidence concerning the relationship between the clarity of the information released by the central banks on their policy intentions and the predictability of their policy decisions. For each year and each central bank, we provide the average of the daily absolute variation of 1-month interest rates on meeting days (an inverse measure of the predictability of policy decisions) and the communication strategy used during the same year to release information about policy intentions (white bar for no announcement, grey for qualitative announcement and black for quantitative announcement).[10]

Three main insights emerge from the inspection of Figure 1. First, independently

[7]Our interpretation is supported by the fact that indexes based on these keywords, like the "hawkometer" of the Deutsche Bank, were commonly used by researchers and market operators as synthetic indicators of the policy intentions of the ECB. Bini-Smaghi (2006) confirms that in the last tightening cycle the ECB provided verbal guidance about the short term evolution of the official interest rate.

[8]While this group of central banks allows us to span a sufficient degree of differentiation among the alternative announcement regimes (*no announcement*, *qualitative announcement* and *quantitative announcement*), the inclusion of some other observational units like, for example, the Bank of England and the Swiss Bank would be an important step to verify the robustness of our results. We do not include observations after July 2007 to protect our analysis from the effect of the subprime crisis on money market rates.

[9]Details are available in Appendix A.

[10]In the figure the color of a bar denotes the announcement regime which has been in place for most of the year.

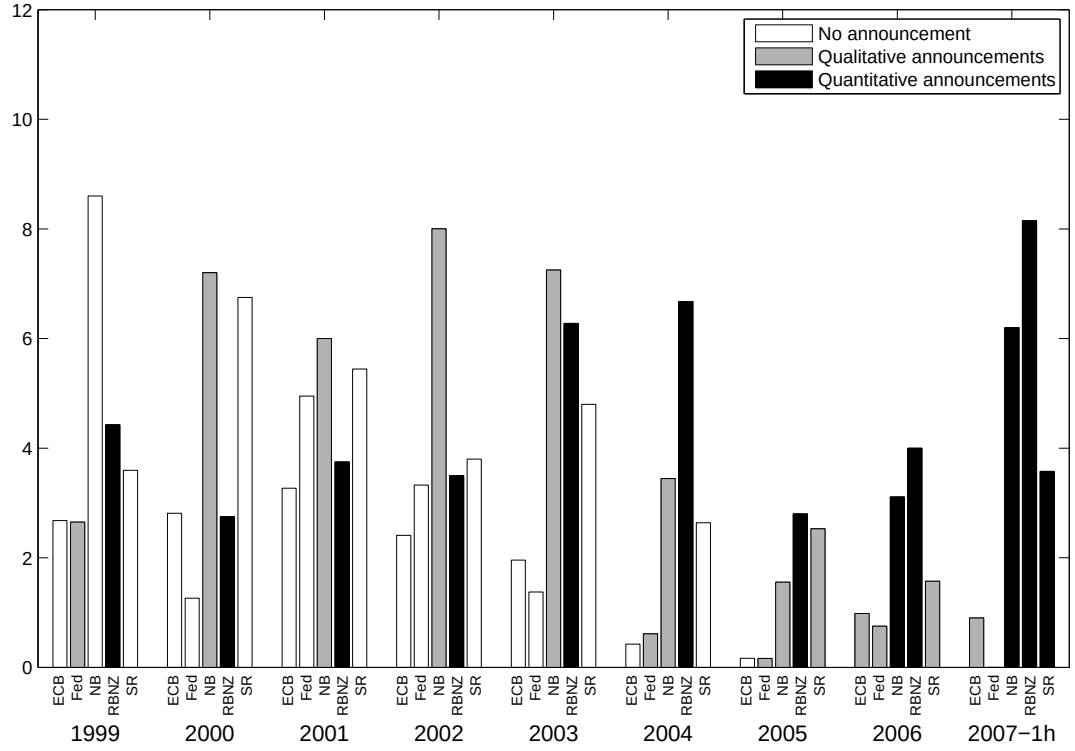
Table 1: The announcement of policy intentions.

Institution	*From*	*To*	*Announcement regime*
European Central Bank	Jan. 1999	Oct. 2005	No announcement
	Oct. 2005	Jun. 2007	Qualitative announcement
Federal Reserve	Jan. 1999	May. 1999	No announcement
	May. 1999	Feb. 2000	Qualitative announcement
	Feb. 2000	Aug. 2003	No announcement
	Aug. 2003	May. 2005	Qualitative announcement
	May. 2005	Jun. 2007	No announcement
Norges Bank	Jan. 1999	May. 2000	No announcement
	May. 2000	Nov. 2005	Qualitative announcement
	Nov. 2005	Jun. 2007	Quantitative announcement
Reserve Bank of New Zealand	Jan. 1999	Jun. 2007	Quantitative announcement
Sveriges Riksbank	Jan. 1999	Mar. 2005	No announcement
	Mar. 2005	Feb. 2007	Qualitative announcement
	Feb. 2007	Jun. 2007	Quantitative announcement

Note: See Appendix A for details about the classification presented here.

of the communication strategy, policy decisions of larger central banks (the ECB and the Fed) tend to be more predictable than those of smaller central banks. Second, the greater degree of transparency about future policy intentions observed after 2003 (signaled by the increased number of grey and black bars) is associated, in particular during 2005 and 2006, with a greater predictability of policy decisions (suggested by the reduction in the height of the bars). However, it also appears that in the first part of 2007, notwithstanding the increase in the transparency of communication about policy intentions, the predictability of policy decisions of smaller central banks deteriorated significantly. Different factors not directly connected with the quality of the announcements may however explain this contrasting evidence. One of these factors is a different variability of official interest rates. There is in fact ample literature showing that larger changes in official interest tend to be predicted less precisely - Ross (2002), Wilhelmsen and Zaghini (2005) and Cassola and Morana (2006) on the euro area; Swanson (2006) on the U.S. Moreover the variability of the short term interest rate can also be affected by the characteristics of the money

Figure 1: Announcement of policy intentions and predictability of policy decisions.
(average absolute changes in 1-month interest rates during meeting days; basis points)



Note: European central bank (ECB), Federal Reserve (Fed), Norges Bank (NB), Reserve Bank of New Zealand (RBNZ) and Swedish Riksbank (SR). - The height of the bars measures the annual average of the daily absolute variation of 1-month interest rates on scheduled meeting days; basis points. - The color of the bar denotes the communication regime adopted to release information about future policy intentions: no announcement (white), qualitative announcement (grey) and quantitative announcement (black).

market, and in particular by its liquidity.

To control for the the impact of the aforementioned factors and to obtain a more precise assessment of the relationship between the quality of the announcements about policy intentions and the predictability of policy decisions we run a battery of regressions. In particular, the absolute changes of the 1-month interest rate on the meeting days of the ECB, the Fed, the NB and the SR, $\left|\Delta i^{1m}_{t,meet}\right|$, is regressed on dummies that measure the degree of transparency about policy intentions (constructed using the information provided in Table 1) and a series of controls. Depending on the specification adopted, the set of controls includes: the absolute change in

the official interest rate, $\left|\Delta i^{off}_{t,meet}\right|$, a set of dummies that allows for the possibility of a non-linear relationship between the size of the change in official interest rates and the variability of the 1-month interest rate, Dum. $\left|\Delta i^{off}_{t,meet}\right|$ == # basis points, a measure of the average daily volatility (excluding meeting days) of the 1-month interest rate and, finally, a series of country and unscheduled meeting dummies.[11] The results of these regressions are presented in Table 2.

Columns (1) and (2) of Table 2 report the results based on a specification that assumes that the impact on the predictability of policy decisions is equivalent in the qualitative and quantitative announcement regimes (i.e. "Dum. announcement" is equal to 1 both in a qualitative and quantitative announcement regime and zero otherwise). In particular, column (1) presents a specification that includes among the regressors only a measure of the volatility of official interest rates and country dummies. The specification presented in column (2) augments the baseline by allowing for the possibility that changes in 1-month interest rates on meeting days might be influenced non-linearly by policy decisions and reflect peculiar characteristics of the money market (e.g. liquidity) which might vary both across countries and throughout time. In line with the results already available in the literature, column (1) shows that greater volatility of official rates exerts a positive effect on the variability of 1-month interest rates on meeting days (i.e. it makes policy decisions less predictable). Moreover the specification presented in column (2) points to the presence of some form of non-linearity in the relationship between changes in official interest rates and those of 1-month interest rates and signals that the variability of 1-month interest rates on meeting days is related to the variability

[11] In the case of the RBNZ, the country dummy is perfectly collinear with the dummy that measures the degree of transparency about future policy intentions. This implies that the effects of these two variables on the predictability of policy decisions cannot be separately identified. For this reason the RBNZ has been excluded from the empirical analysis. The ECB and the SR had a single unscheduled meeting in September 2001, the Fed had three unscheduled meetings in 2001 and the NB had four unscheduled meetings at the beginning of 1999 (until the mid of 1999 the meetings of the NB were not scheduled in advance) and one in 2001.

Table 2: Announcement of policy intentions and predictability of policy decisions.

	Dependent variable: $\left\|\Delta i^{1m}_{t,meet}\right\|$					
	(1)	(2)	(3)	(4)	(5)	(6)
Dum. announcement	-2.020**	-1.506**	...	...	...	...
	(0.329)	(0.298)				
Dum. qualitative	...	...	-1.783**	-1.488**	...	...
			(0.612)	(0.323)		
Dum. quantitative	...	...	-3.679**	-1.893*	-2.999**	-1.275**
			(0.837)	(1.115)	(0.555)	(0.553)
Dum. qualitative clear[a]	...	...	...	...	-2.529**	-2.288**
					(0.379)	(0.335)
Dum. qualitative vague[a]	...	...	...	...	-0.787	-0.510
					(1.144)	(0.958)
$\left\|\Delta i^{off}_{t,meet}\right\|$	0.138**	0.186**	0.134**	0.192**	0.133**	0.205**
	(0.038)	(0.085)	(0.042)	(0.088)	(0.043)	(0.097)
Dum. $\left\|\Delta i^{off}_{t,meet}\right\| == 25bp$	...	-1.446	...	-1.573	...	-1.816
		(2.530)		(2.628)		(2.785)
Dum. $\left\|\Delta i^{off}_{t,meet}\right\| == 50bp$	...	-1.960	...	-2.254	...	-3.043
		(4.161)		(4.712)		(5.295)
Dum. $\left\|\Delta i^{off}_{t,meet}\right\| == 100bp$	...	-14.559*	...	-15.171*	...	-16.750*
		(7.680)		(8.193)		(9.303)
Volatility 1m int. rate[b]	...	3.815**	...	3.587**	...	3.592**
		(1.727)		(1.762)		(1.754)
Dum. Norges Bank	3.455**	0.908	4.035**	1.192	3.195**	0.374
	(0.150)	(1.116)	(0.538)	(1.465)	(0.485)	(1.011)
Dum. Sveriges Riksbank	0.921**	0.685**	0.997**	0.710**	0.687**	0.382**
	(0.129)	(0.132)	(0.186)	(0.177)	(0.156)	(0.137)
Dum. Federal Reserve	-1.107**	-1.118**	-1.135**	-1.132**	-1.080**	-1.091**
	(0.277)	(0.229)	(0.253)	(0.188)	(0.301)	(0.224)
Constant	1.694**	0.957**	1.678**	0.993**	1.796**	1.109**
	(0.149)	(0.306)	(0.135)	(0.351)	(0.200)	(0.350)
Unscheduled meeting dummies	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.612	0.632	0.616	0.632	0.618	0.635
Sample size	354	354	354	354	354	354

Note: Sample: Jan. 1999 - Jun. 2007. Dependent variable and regressors (when relevant) are measured in basis points. OLS estimation with robust standard errors clustered by country in parentheses. A star denotes significance at the 10% level, a double star significance at the 5% level. - [a] Qualitative information about the future evolution of short term interest rates is defined "clear" when it refers to a decision to be taken at a precise point in time (normally the next meeting); it is "vague" in all the other cases. - [b] Median of the daily absolute difference between the 1-month interest rate and its moving average (3 terms, centered).

observed during normal days. More importantly for our purposes, the coefficient on the announcement dummy suggests that the announcement of policy intentions, either quantitative or qualitative, is associated with greater predictability of policy

decisions. The size of the improvement in predictability, between 1.5 and 2 basis points depending on the specification, is not negligible since the average variability of 1-month interest rates on meeting days from 1999 to 2006 ranged from around 2 basis points in the euro area and in the U.S. to 5.5 basis points in Norway.

The specifications presented in columns (3) and (4) allow for the possibility that qualitative and quantitative announcements might have different effects on the predictability of policy decisions. The results confirm the importance of including a series of controls and do not point to a statistically significant difference between the impact of qualitative and quantitative announcements.[12] This evidence might reflect the fact that quantitative announcements, even if very precise in terms of the size of the expected variation in short term interest rates, might be opaque about the exact timing of the decision. On the contrary, qualitative announcements might be less informative in terms of the size but very precise about the timing of the official decision.[13] This hypothesis is evaluated through the regressions presented in columns (5) and (6), which are based on a further qualification of the definitions used to classify communication strategies. In particular we have divided the *qualitative announcement* group into the *clear qualitative announcement* and the *opaque qualitative announcement* sub-groups. The first includes all the situations in which the qualitative information about future policy decisions refers to a clearly identified meeting. This sub-group includes the ECB since late 2005 and the Federal Reserve from late 2003 to mid-2006, the second includes all the remaining cases.[14] These more precise definitions shed new light on the impact of the communication about policy intentions on the predictability of policy decisions. Two aspects are worthy

[12]Formal econometric tests do not reject the null of equal effect at conventional significance levels.

[13]Quantitative announcements normally convey a central bank's expectations about interest rates in the form of a series of quarterly averages. This type of information provides precise information about the likely level of the short term interest rate but it is opaque as far as the precise timing of the incoming policy decisions is regarded. In some cases qualitative announcements are instead very precise about the timing of the decision (e.g. next meeting).

[14]See Appendix A for details.

of note. First of all, simply providing a bias regarding future policy decisions without specifying the exact timing for their likely implementation (i.e. the adoption of *opaque qualitative announcements*) has no effect on the predictability of policy moves. On the contrary, communication which is unambiguous about the timing of the policy intentions is associated with greater predictability of the policy decisions. Even if not significantly different at conventional statistical levels, the point estimates presented in column (6) signal that the improvement in predictability associated with the use of *clear qualitative announcements* could be even higher than that attainable with *quantitative announcements*.

3 The quantitative announcement of policy intentions: evidence from New Zealand

In the previous section we saw that more openness in the communication of policy intentions is associated with greater predictability of policy decisions. In this section we enrich the analysis of the empirical effects of the communication of policy intentions by focusing on the impact of the release of an interest rate projection (*quantitative announcement*) on market expectations. We evaluate this issue restricting our attention to the Reserve Bank of New Zealand (RBNZ) which is the only central bank in the world with a long tradition of publishing its own interest projections.[15] Our interest in the RBNZ is also due to the fact that it is probably the most transparent central bank in the world.[16] This implies that evidence in favor of a sizeable impact of the release of interest rate projections on private expectations would play a fundamental role in dismantling a commonly cited critique of this form

[15]The RBNZ has released interest rate projections since 1997. This communication strategy has also been adopted recently by the central banks of Norway, Sweden, Iceland and the Czech Republic.

[16]For a ranking of central bank transparency see, for example, Eijffinger and Geraats (2006).

of communication, namely the possibility that it might turn out to be ineffective when a central bank is already very transparent in other areas.

Before starting with the formal analysis we briefly describe how monetary policy is implemented in New Zealand. Since March 1999 the official cash rate (OCR) is the sole instrument used by the RBNZ for setting and communicating the stance of monetary policy. Decisions about changes in policy settings are limited, in normal circumstances, to eight scheduled dates per year. After the OCR revisions of March, June, September and December the RBNZ releases a Monetary Policy Statement which consists of a policy assessment, an extensive analysis of the macroeconomic environment and a set of projections on the future evolution of key macroeconomic variables.[17] This set also includes expectations about 3-month interest rates (yield on 90 days bank bills) which are disclosed as quarterly averages over a horizon of two/three years.[18] This interest rate projection is produced using a combination of the RBNZ's core macroeconomic model projections and policy-maker judgment. In particular, first a *no-judgment* projection is obtained from the RBNZ's macroeconomic model, where the short-term interest rates are modeled as a reaction function that responds to (six to eight quarters ahead) forecast deviations of annual inflation from central target.[19] Successively, the no-judgment projection is passed to (and adjusted by) the Monetary Policy Committee, other Bank staff, and the Governor in order to take into account special circumstances and information that are not included in the model (for example, climatic conditions, bilateral exchange rate developments, and trading partner developments).

[17] After the intervening OCR revisions of January, April, July and October, the RBNZ only releases a general evaluation on how the outlook for growth and inflation has changed since the last meeting and on the implications for monetary policy.

[18] From early 1999 to mid 2000 the RBNZ has provided its expectations about short term interest rates in the form of semiannual averages. In the empirical exercises we have used interpolation to obtain proxies for quarterly averages also for this period.

[19] Under this framework, the model increases short-term interest rates when inflation is projected to persist above the mid-point of the target band six to eight quarters in the future, and lowers interest rates when inflation is projected to persist below the mid-point of the target band six to eight quarters in the future.

The amount of analysis on the effects of the communication of the interest rate path on market expectations is very limited. Archer (2005) provides a graphical assessment of the reaction of the slope of the term structure[20] to the unexpected component included in the publication of the interest rate path and concludes that the control of the central bank on market expectations is, if anything, weak. Moessner and Nelson (2008) provide a more formal assessment and find that the surprises in the RBNZ forecasts have a significant, but quantitatively limited, influence on the returns implicit in future contracts on short term interest rates expiring up to eight quarters ahead. Our analysis improves on the available evidence in three crucial directions. First, we allow private agents to use more general expectation formation mechanisms when they have to predict the interest rate path that will be announced by the central bank. This is a fundamental step for the correct identification of the unexpected component included in the publication of the interest rate path. Second, we show that neglecting the presence of risk premiums when extracting private expectations about future interest rates from financial futures imposes a sizeable distortion on the results. Third, we take explicitly into account the possibility that, on those days in which the interest rate path is announced, changes in market expectations about future interest rates might also be driven by other types of policy communication (e.g. the announcement of a change in the policy rate) and by the release of macroeconomic data.

3.1 Interest rate volatility on announcement dates

As preliminary evidence of the effects of the publication of interest rate projections, we compare the variability of short and long term interest rates on the days the OCR is revised and a projection is released, with those observed when on the

[20] In particular he analyzes the slope of the segments of the term structure included between 3 and 12 months and between 1 and 3 years.

OCR-revision dates when a projection is not published. If the interest rate path contains information which is valuable for the markets, then we should expect it to be associated with a greater variability of market interest rates. The volatilities of short term interest rates (official cash rate and interest rates with maturity up to 3 months), of long term rates (interest rate on swap contract with maturity up to 10 years) and, in particular, of the returns implicit on future contracts on 3-month interest rates, which are the *natural* counterpart of the expectations published by the RBNZ, are presented in Figure 2.[21] The evidence is based on the sample period March 1999 - June 2007.[22] Grey bars measure interest rates' average absolute variation computed on all business days excluding OCR-revision dates, white bars focus on OCR-revision dates with no publication of interest rate projections and, finally, black bars on interest rate projections' publication dates. The evidence presented in the figure suggests that the volatility of the returns implicit in future contracts on 3-month interest rates which expire from 3 to 12 months ahead is statistically higher if it is measured on the days when an interest rate projection is released than in all the other samples.[23] The increase in volatility is around 40 per cent, with respect to that computed in OCR-revision date with no release of a projection, and around 200 per cent, with respect to the one computed in normal business days. On the contrary, the publication of the interest rate path does not have any effect on 1-month interest rates and a limited (but not significant) one on 3-month interest rates. While the absence of any effect on very short term interest rates is due to the fact that the interest rate projections released by the RBNZ do not contain any information concerning this horizon (the very short term rates are instead affected

[21]There are four different future contracts on 3-month interest rates available for each calendar year which expire respectively around the middle of March, June, September and December.

[22]The sample is limited on one side by the date in which the OCR became the key instrument of monetary policy and, on the other, by the onset of the sub-prime crisis.

[23]The volatility of the return on future contracts with longer expiration horizons (more than 12 months ahead) shows a reaction to the publication of the interest rate path similar to the one related to the shorter maturities shown in Figure 2.

by unexpected policy decisions), the limited impact on 3-month interest rates signals that, according to the markets, the information included in the interest rate projection regarding the policy decision that will be taken on the following OCR-revision day (normally around 5 weeks ahead) is limited. From Figure 2 it also emerges that interest rate projections have an impact on the volatility of interest rates which is hump-shaped with respect to their maturity. This evidence reflects the fact that the announcement of policy intentions has no effect on the very short term interest rates, which are mainly affected by policy decisions, and a limited effect on long term interest rates since the RBNZ provides information about its policy intentions up to 2/3 years ahead.

3.2 The effect of interest rate projections on expectations

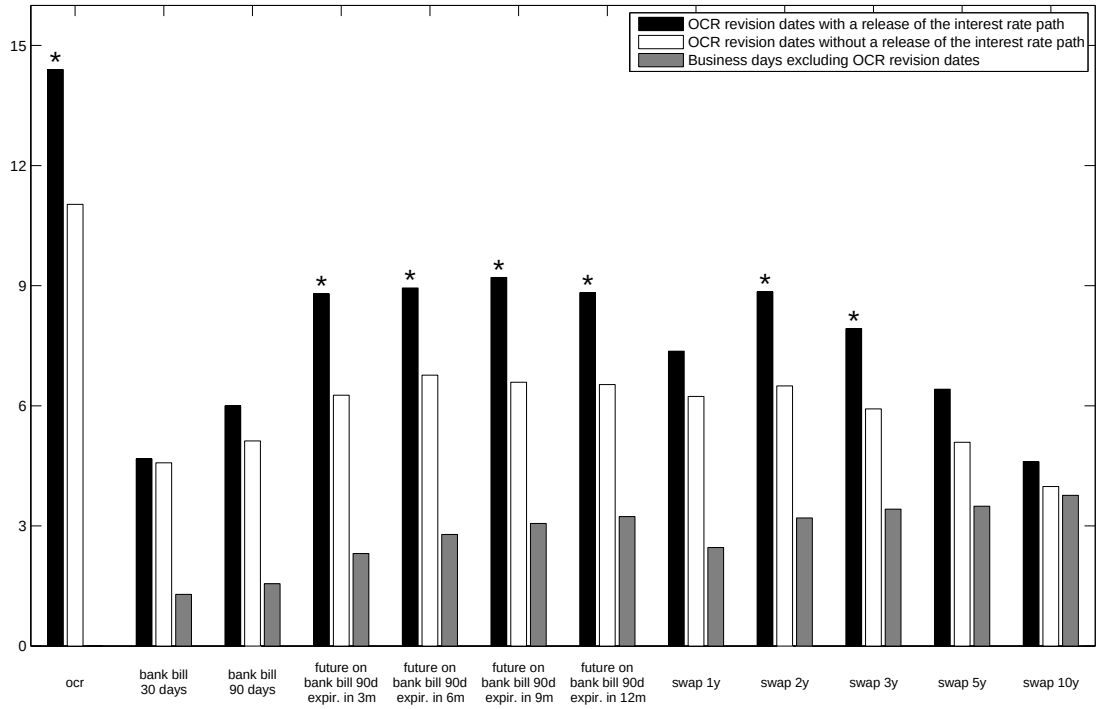
3.2.1 The general framework

In this section we assess more directly the ability of the RBNZ to steer market expectations through the publication of interest rate projections. To this end we identify the unexpected part of this policy communication and we measure the reaction of market expectations to this component. Denoting respectively with $E_t^M(i_{t+n})$ and $E_t^{CB}(i_{t+n})$ market and central bank expectations on day t about the level of the short term interest rate on day $t+n$ and assuming that a new interest rate projection is released on day t, a test of the ability of the RBNZ to steer market expectations is obtained evaluating the sign and the size of the parameter β_1 in:

$$E_t^M(i_{t+n}) - E_{t-1}^M(i_{t+n}) = \beta_1\left(E_t^{CB}(i_{t+n}) - E_{t-1}^M\left(E_t^{CB}(i_{t+n})\right)\right) + \beta_2 X_t + \epsilon_t, \quad (1)$$

where $E_t^M(i_{t+n}) - E_{t-1}^M(i_{t+n})$ is the change in market expectations after the release of policy intentions, $E_t^{CB}(i_{t+n}) - E_{t-1}^M\left(E_t^{CB}(i_{t+n})\right)$ measures the unexpected component of the announcement (henceforth projection shock, PS) and X_t is a vector of

Figure 2: Publication of interest rate projections and volatility of interest rates.
(average absolute variation of interest rates; basis points)



Note: Sample period: Mar. 1999 - Jun. 2007. - Spot yields on bank bills are from the Reserve Bank of New Zealand. Prices of future contracts on 90 day bank bills (mid-price, end of regular trading session) are from Bloomberg. For each day of the year we define as its matching "3-month ahead future contract" the first traded contract with an expiration date at least 45 days ahead and as 6, 9 and 12-month ahead futures the next three contracts with the closest expiration dates. - A star on top of a black bar denotes that it is statistically different from the corresponding white one at the 5 per cent confidence level.

controls. To obtain an estimable version of equation (1) it is necessary to find empirical proxies for the expectational terms included therein. While $E_t^{CB}(i_{t+n})$ can be directly and uncontroversially measured using the information included in the projection released by the central bank at t, the identification of empirical counterparts for $E_t^M(i_{t+n})$ and, especially, $E_{t-1}^M\left(E_t^{CB}(i_{t+n})\right)$ is not univocal. We proceed as follows. In Section 3.2.2 we present estimates of equation (1) based on two sets of assumptions on $E_t^M(i_{t+n})$ and $E_{t-1}^M\left(E_t^{CB}(i_{t+n})\right)$. According to the first set, $E_t^M(i_{t+n})$ is measured using the return implicit in the price of the interest rate future contract which expires at $t+n$, f_t^{t+n}. At the same time we assume that markets form

their expectations about the interest rate projection that will be released by the RBNZ in exactly the same way in which they form their own expectations about the future level of short term interest rates, $E_{t-1}^{M}\left(E_{t}^{CB}\left(i_{t+n}\right)\right)=E_{t-1}^{M}\left(i_{t+n}\right)=f_{t-1}^{t+n}$. The second set of assumptions departs from the first one in taking into account the presence of *time-varying risk premiums* in the price of future contracts and in setting $E_{t}^{M}\left(i_{t+n}\right)=f_{t}^{t+n}-rp_{t}^{t+n}=\tilde{f}_{t}^{t+n}$, where rp_{t}^{t+n} is the risk premiums measured at t and associated with the future contract expiring at $t+n$. Also in this case we assume that $E_{t-1}^{M}\left(E_{t}^{CB}\left(i_{t+n}\right)\right)=E_{t-1}^{M}\left(i_{t+n}\right)$. This last assumption is relaxed in Section 3.2.3 where we allow for more flexibility in private agents' formation of their expectations about central bank expectations.

3.2.2 The role of risk premiums and control variables

Under the assumption $E_{t-1}^{M}\left(E_{t}^{CB}\left(i_{t+n}\right)\right)=E_{t}^{M}\left(i_{t+n}\right)=f_{t-1}^{t+n}$, the empirical counterpart of equation (1) is:

$$f_{t}^{t+n}-f_{t-1}^{t+n}=\beta_{1}\left(E_{t}^{CB}\left(i_{t+n}\right)-f_{t-1}^{t+n}\right)+\beta_{2}X_{t}+\epsilon_{t}=\beta_{1}PS_{t,1}^{t+n}+\beta_{2}X_{t}+\epsilon_{t} \qquad (2)$$

where f_{t}^{t+n} is the return implicit at time t in the interest rate future contract expiring at $t+n$, $E_{t}^{CB}\left(i_{t+n}\right)$ is the expectation released at t by the RBNZ on i_{t+n}, and X_t includes a series of controls.[24] Under the alternative set of assumptions which takes into account the presence of risk premiums, $E_{t-1}^{M}\left(E_{t}^{CB}\left(i_{t+n}\right)\right)=E_{t}^{M}\left(i_{t+n}\right)=f_{t}^{t+n}-rp_{t}^{t+n}=\tilde{f}_{t}^{t+n}$, the empirical counterpart of equation (1) is:

$$\tilde{f}_{t}^{t+n}-\tilde{f}_{t-1}^{t+n}=\beta_{1}\left(E_{t}^{CB}\left(i_{t+n}\right)-\tilde{f}_{t-1}^{t+n}\right)+\beta_{2}X_{t}+\epsilon_{t}=\beta_{1}PS_{t,2}^{t+n}+\beta_{2}X_{t}+\epsilon_{t} \qquad (3)$$

[24]In particular, f_{t}^{t+n} is computed as 100 minus the price quoted at t for the future contract on short term interest rates expiring at $t+n$. The short term interest rate used in the empirical analysis is the 90 day yield on bank bills. Both the interest rate path published by the RBNZ and the future contracts refer to this particular interest rate.

where $\tilde{f}_t^{t+n} = f_t^{t+n} - rp_t^{t+n}$ is the return implicit at t in the future contract on short term interest rates expiring at $t+n$ and net of risk premiums, rp_t^{t+n}, and the other terms are defined as above. An empirical measure of time-varying risk premiums is computed as the difference between the return implicit in future contracts and survey expectations.[25] The estimates of the parameters of equations (2) and (3) are presented in Table 3. The upper (lower) panel relates to expectations at the 3-month (12-month) horizon, its left hand (right hand) side relates to the specification reported in equation (2) (equation (3)).[26] For each prediction horizon (3 and 12 months) and baseline specification (equations (2) and (3)) we provide three alternative sets of estimates which differ according to the variables included in X_t. The first is based on the assumption that X_t does not include any variable (as Archer, 2005, and Moessner and Nelson, 2008). The second one assumes that X_t includes the change at time t of the 1-month interest rate, $\Delta i_{t,1m}$, a variable that is customarily used in the literature as a proxy for the unexpected component of the monetary policy decision. Finally the third specification includes in X_t both the change at t of the 1-month interest rate and the change of the 2-month interest rate, 1-month forward, $\Delta i_{t,30\_90d}$.[27] This variable is included to control for the possibility that the change in market expectations about the future evolution of policy rates which are due to the release of unexpected macroeconomic news are spuriously interpreted as the effect of the publication of the interest rate projection.[28] The exclusion from

[25] We use the expectations on 3-month interest rates, 3 and 12-month ahead, published by Consensus Economics. Since these expectations are released once a month, daily time series of the risk premiums are obtained through interpolation. The limited timespan between the release of survey expectations by Consensus Economics and the announcement of the interest rate path by the RBNZ (less than one week) suggests that the interpolation is likely to have a negligible effect on the results of the empirical analysis. A graph and some descriptive statistics on the time series properties of the risk premiums associated with future contracts on 3-month interest rates expiring in 3 and 12 months are presented in Appendix B.

[26] The analysis is limited to the 3 and 12-month horizons since, as explained in note 25, we can only compute risk premiums for these two horizons.

[27] This is the level of the spot 2-month interest rate expected to prevail after 1 month. This interest rate is implicitly defined in the spot 1 and 3-month interest rates.

[28] A piece of macroeconomic news, which is unexpected both for the RBNZ and the public, by influencing the likely evolution of official interest rates has a systematic effect on both the 2-month

the regressions of changes in longer term interest rates reflects the hypothesis that the interest rate projection is a sufficient statistic for the central bank's expectations regarding future values of short term interest rates at horizons longer than 3 months.[29]

Table 3: The effect of the publication of the expected path of interest rates.

	3-month horizon (n=3m)					
Estimated equation:	(2)	(2)	(2)	(3)	(3)	(3)
$PS_{t,i}^{t+n}$	0.055	0.083**	0.052	0.233**	0.193**	0.146**
	(0.077)	(0.040)	(0.046)	(0.098)	(0.073)	(0.071)
$\Delta i_{t,1m}$	...	1.054**	0.470*	...	0.979**	0.495**
		(0.127)	(0.255)		(0.107)	(0.220)
$\Delta i_{t,1m\_3m}$	...	...	0.613**	...	...	0.529**
			(0.247)			(0.235)
Constant	0.017	0.015	0.009	0.000	0.001	0.000
	(0.018)	(0.012)	(0.011)	(0.021)	(0.015)	(0.013)
R^2	0.020	0.530	0.624	0.140	0.589	0.660
Sample size	34	34	34	34	34	34
	12-month horizon (n=12m)					
Estimated equation:	(2)	(2)	(2)	(3)	(3)	(3)
$PS_{t,i}^{t+n}$	0.035	0.038	0.020	0.074**	0.068**	0.052
	(0.034)	(0.035)	(0.035)	(0.030)	(0.035)	(0.033)
$\Delta i_{t,1m}$	...	0.588**	-0.040	...	0.571**	0.046
		(0.263)	(0.411)		(0.230)	(0.346)
$\Delta i_{t,1m\_3m}$	...	...	0.666**	...	...	0.569**
			(0.300)			(0.278)
Constant	0.015	0.014	0.007	-0.004	-0.004	-0.005
	(0.017)	(0.016)	(0.014)	(0.021)	(0.020)	(0.019)
R^2	0.033	0.193	0.303	0.118	0.277	0.363
Sample size	34	34	34	34	34	34

Note: Point estimates and standard errors (small figures). Sample period: Mar. 1999 - Jun. 2007. A star denotes significance at the 10% level, a double star significance at the 5% level.

interest rate, 1-month forward, and on the returns implicit in future contracts but not on the interest rate projection that is released on the same day. Further analysis of the impact of the release of macroeconomic news on our results is presented in Section 4.

[29]This identification hypothesis is necessary since it is not possible to disentangle changes in long term interest rates due to the release of the interest rate projection from changes due to verbal hints about future policy decisions. The fairness of this assumption is supported by the fact that for the horizons under investigation (3 and 12 months) the RBNZ announces specific numerical expectations which, assuming internal consistency in the communication, necessarily reveal its intentions more precisely than any other type of verbal evaluation of the economic situation.

Two main results emerge from the left hand side of Table 3. First of all, on both forecasting horizons the evidence in favor of a significant effect of the unexpected component of the announcement of policy intentions, $PS_{t,i}^{t+n}$, on market expectations is substantially absent. Second, the size of the estimated coefficients associated with changes in spot interest rates, $\Delta i_{t,1m}$ and $\Delta i_{t,1m\_3m}$, and the significant increase in the R^2 of the regressions when these variables are included among the regressors signal that these control variables play a crucial role in the evaluation of the effects of the announcement of policy intentions on market expectations. The estimated effect of the unexpected component of the announcement of policy intentions on market expectations at the 3-month horizon changes in a significant way when one allows for the presence of time-varying risk premiums (upper right hand side of Table 3). In particular, it becomes significantly different from zero even when we include the full set of control variables. On the contrary the effect on the 12-month horizon (lower right hand side of Table 3) remains statistically insignificant. Overall the evidence presented in Table 3 shows the crucial importance of two aspects not taken into account by previous literature on this topic. First of all, it emphasizes that the role of risk premiums is not negligible. Second it supports the idea that, in order to obtain a meaningful assessment of the impact of the unexpected component of interest rate projections on market expectations, it is crucial also to take into account the effect of a series of other factors (e.g. the unexpected component of policy decisions).

3.2.3 Alternative assumptions in the construction of expectations

The assumption that private agents' expectations about the future evolution of short term interest rates coincide with their expectations about the interest rate projection that will be released by the central bank is quite restrictive since it is not difficult to conceive situations in which this hypothesis is unrealistic. For

this reason in this section we assume that market participants will adopt a more flexible expectation formation mechanism when they have to forecast the interest rate path that will be announced by the central bank. We focus on two alternative descriptions of the expectation formation mechanism. According to the first, private agents' forecasts of RBNZ's policy intentions are obtained as a linear function of their own expectations, $E_{t-1}^{M}\left(E_{t}^{CB}\left(i_{t+n}\right)\right) = \alpha_0 + \alpha_1\left(\tilde{f}_{t-1}^{t+n}\right)$. Under this hypothesis the evaluation of the impact of the unexpected component of the interest rate projection on market expectation is obtained estimating the following system of equations:

$$\begin{cases} \tilde{f}_{t}^{t+n} - \tilde{f}_{t-1}^{t+n} = \beta_1 PS_{t,3}^{t+n} + \beta_2 X_t + \epsilon_t \\ E_{t}^{CB}\left(i_{t+n}\right) = \alpha_0 + \alpha_1\left(\tilde{f}_{t-1}^{t+n}\right) + PS_{t,3}^{t+n} \end{cases} \tag{4}$$

where the projection shock, $PS_{t,3}^{t+n}$, is obtained as the residual of a regression of the announcement of the central bank on market expectations (lower equation of system (4)) and, as in equations (2) and (3), an estimate of the impact of the shock on market expectations is obtained regressing the change in market expectations on the shock itself and a series of controls (upper equation of system (4)).

The second expectation formation mechanism weakens the assumption that market participants use only their own expectations to forecast central bank policy intentions. In particular we assume that the market form its expectation about $E_{t}^{CB}\left(i_{t+n}\right)$ using its forecast of the interest rate at that horizon, $E_{t-1}^{M}\left(i_{t+n}\right)$, but also those related to other horizons. In other words, we assume that the slope of the term structure of private expectations might also be useful in predicting the announcement of the central bank. Moreover, as in Moessner and Nelson (2008), we also allow for the possibility that market participants construct their forecast on $E_{t}^{CB}\left(i_{t+n}\right)$ also using the interest rate path previously released by the RBNZ. Including past announcements might in fact be useful if the central bank is sluggish in adjusting its intentions. This alternative expectation formation mechanism can be formally

described as: $E_{t-1}^{M}\left(E_{t}^{CB}\left(i_{t+n}\right)\right)=\alpha_0+\alpha_1\left(\tilde{f}_{t-1}^{t+3m}\right)+\alpha_2\left(\tilde{f}_{t-1}^{t+12m}\right)+\alpha_3 E_{t-3m}^{CB}\left(i_{t+n}\right)$ for $n=3m,12m$. According to this hypothesis $E_{t-1}^{M}\left(E_{t}^{CB}\left(i_{t+n}\right)\right)$ is a linear function of market expectation on both the 3 and the 12-month horizon and of the most recent projection released by the central bank regarding i_{t+n}, namely $E_{t-3m}^{CB}\left(i_{t+n}\right)$.[30] Under this hypothesis the evaluation of the impact of the unexpected component of the policy announcement of market expectation is obtained estimating the following system of equations at the 3 and at the 12-month horizons ($n=3m$ and $n=12m$).

$$\begin{cases} \tilde{f}_{t}^{t+n}-\tilde{f}_{t-1}^{t+n}=\beta_1 PS_{t,4}^{t+n}+\beta_2 X_t+\epsilon_t \\ E_{t}^{CB}\left(i_{t+n}\right)=\alpha_0+\alpha_1\tilde{f}_{t-1}^{t+3m}+\alpha_2\tilde{f}_{t-1}^{t+12m}+\alpha_3 E_{t-3m}^{CB}\left(i_{t+n}\right)+PS_{t,4}^{t+n} \end{cases} \tag{5}$$

where, as in system (4), the projection shock, $PS_{t,4}^{t+n}$, is obtained as the residual of a regression of the announcement of the central bank on market expectations at different horizons and on the central bank expectation released three months before (lower equation of system (5)), and an estimate of the impact of the shock on market expectations is computed regressing the change in market expectations on the shock itself and a series of controls (upper equation of system (5)).

The estimates of the parameters of the systems defined in (4) and in (5) are presented in Table 4.[31] To facilitate the comparison of the results, the first column of the left side (which is related to the 3-month horizon) and the first one of the right side (which is related to the 12-month horizon) of Table 4 replicate the results presented in the last column of Table 3, which is obtained using the more restrictive

[30] Where the time index associated with the expectational operator, $t-3m$, in $E_{t-3m}^{CB}\left(i_{t+n}\right)$ reflects the fact that the RBNZ releases a new interest rate projection every quarter.

[31] Systems (4) and (5) are estimated assuming normality of the residuals in both equations and independence between the error terms of the two equations included in each system. Initial conditions are found using a simplex algorithm, final estimates (and standard errors) are obtained using a standard BFGS algorithm. Since it is well known that estimates obtained with this type of optimization method are heavily dependent on initial conditions (especially when the number of observations is limited, as in our case), in Section 4 we verify the robustness of the results to alternative estimation methods that do not rely on optimization algorithms.

Table 4: The effect of the publication of the interest rate path.

Estimated system:	(3)	(4)	(5)	(3)	(4)	(5)
Horizon:	*3-month*			*12-month*		
	Upper equation			*Upper equation*		
$PS_{t,i}^{t+3m}$	0.146** (0.071)	0.145** (0.066)	0.333** (0.076)	...	...	...
$PS_{t,i}^{t+12m}$	...	...	...	0.052 (0.033)	0.068** (0.033)	0.211** (0.060)
$\Delta i_{t,1m}$	0.495** (0.220)	0.495** (0.230)	0.558** (0.197)	0.046 (0.346)	0.054 (0.311)	0.009 (0.270)
$\Delta i_{t,1m\_3m}$	0.529** (0.235)	0.528** (0.188)	0.354* (0.181)	0.569** (0.278)	0.582** (0.256)	0.550** (0.220)
Constant	0.000 (0.013)	0.011 (0.012)	0.013 (0.011)	-0.005 (0.019)	0.007 (0.015)	0.008 (0.013)
	Lower equation			*Lower equation*		
$\tilde{f}_{t-1}^{t+3m}$	1^a	0.998** (0.028)	0.807** (0.068)	...	...	0.741** (0.104)
$\tilde{f}_{t-1}^{t+12m}$	...	...	-0.083 (0.058)	1^a	1.322** (0.113)	0.350** (0.096)
$E_{t-3m}^{CB}(i_{t+3m})$	...	...	0.267** (0.051)	...	...	...
$E_{t-3m}^{CB}(i_{t+12m})$	...	...	...	...	...	-0.007 (0.085)
Constant	0^a	0.088 (0.180)	0.114 (0.224)	0^a	-1.779** (0.716)	-0.267 (0.365)
Sample size	34	34	34	34	34	34

Note: Point estimates and standard errors (small figures). A star denotes significance at the 10% level, a double star significance at the 5% level. Sample period: Mar. 1999 - Jun. 2007. ^{a} Restricted parameters.

definition of the projection shock presented in equation (3). The estimates of the parameters of the system of equations (4) for the 3 and the 12-month horizons are presented in the middle columns of, respectively, the left and the right side of Table 4. As far as the 3-month horizon is concerned the comparison of the estimates based on equation (3) and on system (4) suggests that allowing for the type of flexibility in the expectation formation mechanism of the private agents described in the lower equation of system (4) affects affect neither qualitatively nor quantitatively the estimated impact of the unexpected component of the interest rate projection on market expectations (the coefficient remains substantially unchanged around 0.14).

The equivalent comparison in relation to the 12-month horizon confirms the conclusion of a negligible economic difference in moving from the specification suggested by equation (3) to the one implied by system (4) (the coefficient which measures the impact of the projection shock shows a very marginal increase from 0.052 to 0.068). Finally, the last columns of the left and of the right hand side of Table 4, respectively for the 3 and the 12-month horizons, report the estimated coefficients of system (5). Firstly, it is worthwhile noting that formal tests reject the restrictions imposed in the specification of system (4) in comparison with system (5). In particular, as far as the 3-month horizon is concerned, the hypothesis that $\alpha_2 = \alpha_3 = 0$ is rejected by the data (Chi-Squared(2) = 45.52, p-value = 0.00), similarly for the 12-month horizon the hypothesis that $\alpha_1 = \alpha_3 = 0$ is also rejected by the data (Chi-Squared(2) = 138.58, p-value = 0.00). These results support the appropriateness of the specification proposed in system (5). Going further into the details of the estimates associated with the 3-month horizon it emerges that including the return of the future contract relative to the 12-month horizon does not significantly improve market prediction of the interest rate projection that will be announced by the RBNZ. In fact the coefficient on $\tilde{f}_{t-1}^{t+12m}$ is not statistically significant. On the contrary the coefficient associated with the information disclosed with the previous release of an interest rate projection, $E_{t-3m}^{CB}(i_{t+3m})$, is highly significant. This supports the hypothesis that market operators make ample use of this piece of information when constructing their expectation for the interest rate projection that is going to be released by the RBNZ. Moreover, using this more flexible approach to measure market operators' expectations about the announcement of the RBNZ, more than doubles the point estimates of the market reaction to the projection shock (from 0.14 to 0.33). As regards the 12-month horizon is regarded, including $\tilde{f}_{t-1}^{t+3m}$ among the set of regressors which are used to obtain a measure of the projection shock has a significant impact on the estimates. In fact this regressor turns out to

be even more important than $\tilde{f}_{t-1}^{t+12m}$ in the prediction of $E_t^{CB}(i_{t+12m})$ (the size of the coefficient associated with $\tilde{f}_{t-1}^{t+3m}$ is twice as large as the one associated with the other regressor). At the same time, and differently from what has been obtained at the 3-month horizon, the information related to the last interest rate projection disclosed by the RBNZ, $E_{t-3m}^{CB}(i_{t+12m})$, does not seem to have any extra predictive power with respect to the two variables mentioned above. The more flexible specification of the expectation formation mechanism also affects the overall evaluation of the impact of the projection shock on market expectations at the 12-month horizon. In particular, the coefficient which measures the reaction of market expectations to the news included in the release of the interest rate projection becomes significantly different from zero and reaches a value of about 0.2.

3.2.4 How precise is the control of expectations?

In this section we verify if, by selecting appropriately the interest rate projection, the RBNZ is able to exert an independent control on the different segments of the interest term structure, that is if it is able to control its curvature. In our framework this possibility can be evaluated by allowing both the 3 and the 12-month projection shocks to enter the regression equations which measure the reaction of market expectations relative to both the 3 and the 12-month horizons. If it turns out that, at each horizon, market expectations react exclusively to the corresponding projection shock, then we would conclude that the RBNZ controls market expectations very precisely. On the contrary if it turns out that market expectations at different horizons are all moved (possibly with a different intensity) by a single projection shock, then we would conclude that there is some constraint on the ability of the RBNZ to influence private expectations.[32] Building on the results presented in Table 4, we

[32]The case in which all the projection shocks enter all the equations which measure the reaction of market expectations at different horizons would be inconclusive in terms of the evaluation of the precision of the control exerted by the RBNZ.

assume that only the return on the futures contracts on the 3-month horizon (net of risk premiums) and the information on the last policy path announced by the RBNZ, $E^{CB}_{t-3m}(i_{t+3m})$, are useful variables to measure the policy path shock at the 3-month horizon. Similarly we assume that only the interest rates implicit in the prices of the futures at the 3 and 12-month horizons (net of risk premiums) enter the construction of the projection shock on the 12-month horizon. Under these hypotheses the evaluation of the impact of the unexpected component of the policy announcement both at the 3 and at the 12-month horizon of market expectation at both horizons is obtained estimating jointly the following system of equations.

$$\begin{cases} \tilde{f}^{t+3m}_t - \tilde{f}^{t+3m}_{t-1} = \beta_1 PS^{t+3m}_{t,5} + \beta_2 PS^{t+12m}_{t,5} + \beta_3 X_t + \epsilon_{t,3m} \\ \tilde{f}^{t+12m}_t - \tilde{f}^{t+12m}_{t-1} = \delta_1 PS^{t+3m}_{t,5} + \delta_2 PS^{t+12m}_{t,5} + \delta_3 X_t + \epsilon_{t,12m} \\ E^{CB}_t(i_{t+3m}) = \alpha_0 + \alpha_1 \tilde{f}^{t+3m}_{t-1} + \alpha_2 E^{CB}_{t-3m}(i_{t+3m}) + PS^{t+3m}_{t,5} \\ E^{CB}_t(i_{t+12m}) = \gamma_0 + \gamma_1 \tilde{f}^{t+3m}_{t-1} + \gamma_2 \tilde{f}^{t+12m}_{t-1} + PS^{t+12m}_{t,5} \end{cases} \tag{6}$$

The results are presented in the first two columns of Table 5. In particular, the estimated coefficients of the equations that provide the projection shock (3rd and 4th equations of system (6)) are presented in the lower part of the table, while the estimated coefficients of the equations that measure the reaction of market expectations (1st and 2nd equations of system (6)) are presented in the upper part of the table. In both cases the 3 and the 12-month horizons are presented, respectively, on the left and on the right hand side.

From the first column of Table 5 it emerges that the projection shock related to the 12-month horizon does not influence market expectations at the 3-month horizon. In line with the evidence presented in Table 4 this short term expectation continues to be driven by the projection shock related to the 3-month horizon and by the monetary surprises included in the 30-day and in the 30-day forward yield on 60-day bank bills. On the contrary, the inclusion of the projection shock related

Table 5: The effect of the publication of the expected path of interest rates.

Estimated system:	(6)		(6) restricted	
Horizon:	*3-month*	*12-month*	*3-month*	*12-month*
$PS_{t,5}^{t+3m}$	0.232**	0.320**	0.321**	0.422**
	(0.088)	(0.115)	(0.071)	(0.095)
$PS_{t,5}^{t+12m}$	0.084	0.093	...	...
	(0.053)	(0.070)		
$\Delta i_{t,1m}$	0.544**	0.143	0.575**	0.179
	(0.205)	(0.284)	(0.207)	(0.268)
$\Delta i_{t,1m\_3m}$	0.385**	0.327	0.349**	0.284
	(0.180)	(0.245)	(0.171)	(0.233)
Constant	0.013	0.010	0.013	0.011
	(0.011)	(0.014)	(0.011)	(0.015)
$\tilde{f}_{t-1}^{t+3m}$	0.720**	0.728**	0.730**	...
	(0.043)	(0.046)	(0.044)	
$\tilde{f}_{t-1}^{t+12m}$	...	0.387**	...	...
		(0.059)		
$E_{t-3m}^{CB}(i_{t+3m})$	0.302**	...	0.291**	...
	(0.042)		(0.046)	
Constant	-0.091	-0.467*	-0.077	...
	(0.129)	(0.279)	(0.126)	
Sample size	34		34	

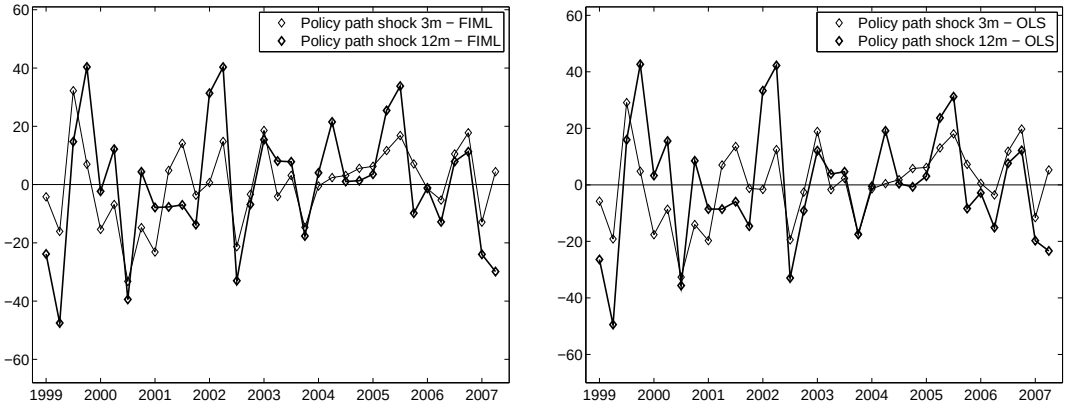
Note: Point estimates and standard errors (small figures). A star denotes significance at the 10% level, a double star significance at the 5% level. Sample period: Mar. 1999 - Jun. 2007.

to the 3-month horizon changes significantly the evidence on the reaction of market expectations at the 12-month horizon (second column of Table 5). In particular it turns out that market expectations at the 12-month horizon are driven by the same set of variables that move expectations at the 3-month horizon and that, somewhat surprisingly, this set does not include the 12-month projection shock. In the last two columns of Table 5 we therefore present an estimate of the system of equations (6) which imposes the restriction $\beta_2 = \delta_2 = 0$.[33] Taken at face value these results suggest that the RBNZ has some control on the level and the slope of the term structure but cannot control its curvature or, to put it differently, cannot control expectations related to different horizons in an independent way. A caveat is important on this

[33]The appropriateness of this restriction is supported by the evidence that it is not rejected by a formal econometric test, Chi-Squared(2) = 2.73, p-value = 0.25.

point. The time series of the estimated projection shocks on the 3 and the 12-month horizons (Figure 3, FIML estimates in the left panel, single equation OLS estimates in the right panel) show an high degree of comovement (the coefficient of correlation is around 0.7). This suggests that the estimates presented in Table 5 might be affected by multicollinearity which can obfuscate the individual contribution of the 3 and the 12-month policy path shocks in shaping market expectations. From this perspective a more robust assessment of the relative importance of these two shocks will be possible only when more observations are available and, in particular, if these new data are characterized by a low degree of comovement between the 3 and the 12-month projection shocks.

Figure 3: Projection shocks, 3 and 12-month horizons.



Note: FIML - Projection shocks are obtained using the unrestricted version of system (6) as presented in the first two columns of Table 5; OLS - Projection shocks are obtained estimating the last two equations of system (6) with OLS.

3.2.5 Is the effect economically important?

In this section we assess if the impact of the projection shocks on market expectations, on top of being statistically significant, is also economically important. We evaluate this issue from two perspectives. First we compute the contribution of the projection shocks to the overall volatility of market expectations on those days when

a new interest path is released and we compare this measure with that associated with the unexpected component of the policy decision. Second, we check if the reaction of market operators to the projection shock is persistent or if it rapidly vanishes. As far as the first objective is concerned we focus only on the 3-month projection shock.[34] Over the sample 1999-2007 this shock ranges between -33 and 32 basis points with an average absolute value of about 11 basis points.[35] Combining this last value with the point estimates presented in the last two columns of Table 5 we find that the absolute average impact on the 3 and the 12-month expectations are respectively around 3.4 and 4.5 basis points.[36] To put these two numbers in perspective it is useful to observe that, on average, in those days in which an interest rate projection is released, the absolute variation of the returns implicit in the price of future contracts expiring in 3 and in 12 months is around 9 basis points on both horizons (see Figure 2). This implies that the projection shock on the 3-month horizon accounts for about 35 per cent of the overall variation of market expectations at the 3-month horizon and 50 per cent at the 12-month horizon. Using the same strategy it is also possible to measure the contribution associated with the unexpected component of the policy decision (measured by $\Delta i_{t,1m}$). Since the point estimates of the coefficients associated with the change in the 1-month interest rate in the 3 and 12-month regressions presented in the last two columns of Table 5 are, respectively, 0.575 and 0.179 and given that the average absolute variation of the 1-month interest rate on OCR-revision days when interest rate projections are released is about 6 basis points, the unexpected component of the policy decision accounts for about 38 per cent of the total variation of market expectations at the 3-month horizon and 12 per cent at the 12-month horizon. Overall, while on the

[34]The results presented in the last subsection suggest that once we control for the effect of the 3-month projection shock, the 12-month projection shock becomes irrelevant.

[35]These statistics are computed on the projection shock obtained using the specification reported in the last two columns of Table 5.

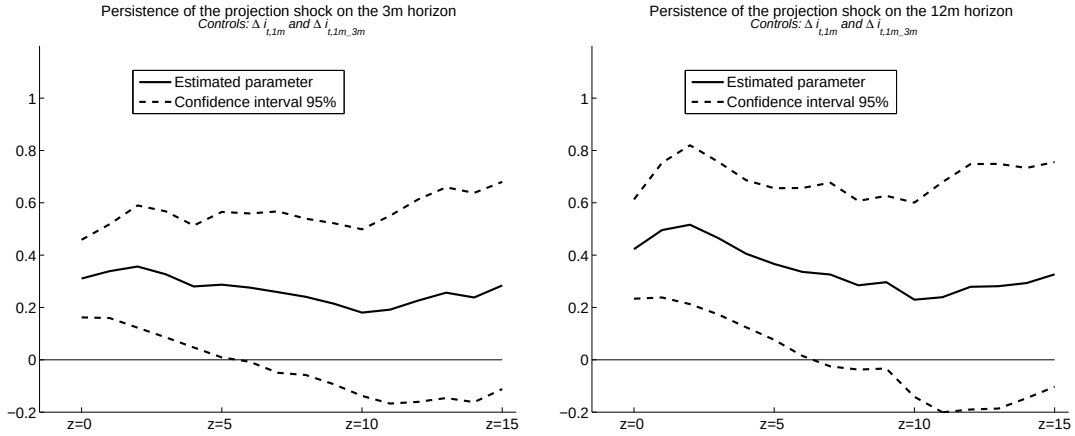
[36]Respectively 11 basis points times 0.321 on the 3-month horizon, and 11 basis points times 0.422 on the 12-month horizon.

3-month horizon the projection shock and the policy decision shock have about the same impact, at the 12-month horizon the impact of the former is much stronger. Finally, it is worthwhile noting that the sum of the two shocks accounts for more than 60 per cent of the total variation of market expectations both at the 3 and the 12-month horizons.

The release of a policy projection, to be a valid instrument for a central bank, has to exert an impact on private expectations which is not only economically important but also persistent. To evaluate the presence of this feature we present the results of a battery of estimations of the restricted version of system (6) (third and fourth columns of Table 5) each characterized by a different definition of the dependent variable. In particular, both for the 3 and the 12-month horizon, we start from a baseline regression in which the dependent variable is the change in the return of the future contract on the day of release of an interest rate projection, $\left(\tilde{f}_t^{t+j} - \tilde{f}_{t-1}^{t+j}\right)$ for $j = 3m, 12m$, then we progressively increase the time span over which the dependent variable is computed, $\left(\tilde{f}_{t+z}^{t+j} - \tilde{f}_{t-1}^{t+j}\right)$ for $j = 3m, 12m$ and $z = 1, 2, ..., 15$, where z denotes business days. If the effect of the policy shock vanishes rapidly, that is if in a few days the expectations implicit in future contract return to the pre-release level, then the coefficient that measures the reaction of market expectations to the shock should also shrink at the same speed. On the contrary a long-lasting impact should be reflected in a persistent estimate of the coefficient which measures the impact of the projection shock. These estimates, together with their 95 percent confidence intervals, are presented in Figure 4. The left panel provides a graphical description of the results associated with the reaction of market expectations at the 3-month horizon, the right panel focuses on the 12-month horizon. In both cases the time span over which the dependent variable is computed, which is measured by z, is reported on the x-axis. Two pieces of evidence emerge from the picture. First, the effect of the announcement is strongly persistent on both horizons, as shown by

the fact that point estimates change only marginally in the 15 days following the publication of the path. Second the confidence bands tend to increase as long as the time horizon over which the dependent variable is computed lengthens. These two pieces of evidence can be reconciled using standard econometric theory on the effects of measurement errors on estimation results. In particular when only the dependent variable is measured with errors, it is well known that the point estimates of the coefficients are unbiased but their standard errors become larger. In our case the measurement errors that affect the dependent variable when the horizon over which it is computed becomes longer is simply the impact of the diffusion of a progressively increasing set of macroeconomic news in the days following the release of the interest rate projection.

Figure 4: Persistence of the effect of the projection shocks, 3 and 12-month horizons.



Note: Projection shocks are obtained using the restricted version of system (6) as presented in the last two columns of Table 5.

4 Robustness

In this section we present a series of exercises aimed at verifying the robustness of the results shown in Section 3.

With the first two we assess the importance of some misalignments in the defini-

tions of the data used in the analysis. In particular, as we have previously observed, the RBNZ publishes its short term interest rate expectations in the form of quarterly averages, while the proxies we use for measuring private expectations (returns implicit in future contracts net of risk premiums) refer to the middle of the last month of the quarter. While this difference is likely to have a negligible effect on longer horizons, the impact on the 3-month horizon could be sizeable. For this reason we have interpolated the sequence of quarterly averages provided in each interest rate projection published by the RBNZ to obtain measures of its interest rate expectations which are more in line with those implicit in future contracts.[37] Using this new definition of RBNZ's expectations we have re-run all the regressions presented in the previous section. The results both at the 3 and at the 12-month horizons are not affected by this change.[38]

The second issue relates to the presence of a time lag of about a week between the finalization of the interest projection by the RBNZ and its release. To take this lag into account we have changed the way in which we compute the projection shocks. In particular we have assumed that to construct their best prediction of $E_t^{CB}(i_{t+n})$ the markets consider that this expectation was finalized at $t-k$ and consequently use only the information available at $t-k$ (e.g. the return implicit in future contracts measured at $t-k$). The use of this alternative method in the construction of the projection shocks has no effect on the results presented in Section

[37] In particular, first, we have assumed that the quarterly average is a good proxy for the expected mid-quarter level - a reasonable assumption when short term interest rates are expected to show a monotonic behavior. Second, we have computed weighted averages of subsequent quarterly data to obtain the most reasonable measure of RBNZ's expectation associated with the middle of the last month of the quarter. For example, under the assumption described above, expectations about the average short term interest rate in the first and second quarter of a given year are good proxies for the RBNZ's expected interest rates on 15 February (approx. middle of the first quarter) and on 15 May (approx. middle of the second quarter). Giving a proportional weight of two thirds to the first observation and one third to the second observation we obtain a proxy for the expectation of the RBNZ associated with 15 March which is in line with the expectation that we extract from future contracts.

[38] The results are not reported to save space and are available upon request.

3.[39] There are at least two reasons that can rationalize this evidence. First, market operators might pay no attention or might not be aware of this time lag. A second, and more likely, reason might be associated with the fact that the RBNZ has better information with respect to the public (i.e. it is informed about the new macro data a few days before the public and includes this information in the interest rate projection using ad hoc corrections).

We now present three more exercises aimed at verifying the robustness of the results to more specific aspects of our analysis. The first verifies the impact of some cases of coincident release of an interest projection and of other important macroeconomic data. The other two assess whether the small size of our sample makes our results fragile.

In Section 3.2.2 we assumed that the change in the 2-month interest rate 1-month forward, $\Delta i_{t,1m\_3m}$, might partially control for the impact of the release of macroeconomic news on market expectations about the future evolution of short term interest rates. This hypothesis rules out the possibility that some macroeconomic release might affect market expectations about policy decisions that will be taken at horizons longer than 3 months without influencing expectations at shorter horizons. Even if this situation is unlikely, it is worthwhile verifying the robustness of our results when one takes this possibility into account.[40] The best strategy to handle this problem would consist in augmenting the baseline specification of the regressions presented in this paper with the unexpected component of the macro news released on the same days on which a policy projection is published. Unfortunately, lack of information (e.g. consensus expectations) and the small size of our sample makes it impossible to pursue this strategy. We have therefore opted for a (less than optimal but) feasible approach which simply consists in removing from

[39] The results are not reported to save space and are available upon request.

[40] This situation is unlikely because it means that the markets assign a probability that is exactly equal to zero to the event that this macroeconomic information might trigger a change in interest rates within three months.

our sample those days on which the disclosure of an interest rate projection has coincided with the release of important macro news. If the results do not change when we restrict the analysis to this subsample we can be confident that the impact of the release of macro news on our results is, at most, limited. A list of daily releases of macro news has been compiled using information from Bloomberg and from the weekly economic report of ANZ, one of the most important commercial banks in New Zealand. To select the macro news that tend to influence financial markets we have exploited previous empirical research (Connolly and Kohler, 2004) and the evaluations of financial analysts. This analysis identifies news on CPI, core CPI, input PPI, the unemployment rate, GDP, current account and retail sales as those which have a measurable impact on financial asset prices and interest rates. In our sample we find 4 days (out of 34) on which the announcement of the interest rate path has coincided with the release of at least one of these macro data. The last two columns of Table 6 report the results of the estimation of the restricted version of system (6), which is presented in the last two columns of Table 5, when these four observations are excluded from the sample. The coefficients that measure the impact of the projection shocks are not significantly different from those obtained using the full sample thus confirming the robustness of our results.

We next present two exercises aimed at verifying to what extent the small size of our sample makes the results presented in Section 3 fragile. The first is a subsample analysis, the second verifies if the results are robust when the FIML estimation methodology is replaced with a methodology which provides closed form formulas both for the estimates of the parameters and of their standard errors (Hoffman, 1987). This comparison is important because both point estimates and the associated standard errors based on the FIML approach do often depend on initial conditions and on the particular algorithm adopted in the estimation. Moreover this observation is likely to be particularly relevant in our case given the very limited

Table 6: Impact of macro news.

Sample:	Full		Excluding macro news	
Estimated system:	(6) restricted		(6) restricted	
Horizon:	*3-month*	*12-month*	*3-month*	*12-month*
$PS_{t,5}^{t+3m}$	0.321**	0.422**	0.272**	0.388**
	(0.071)	(0.095)	(0.089)	(0.109)
$\Delta i_{t,1m}$	0.575**	0.179	0.619**	0.568**
	(0.207)	(0.268)	(0.241)	(0.289)
$\Delta i_{t,1m\_3m}$	0.349**	0.284	0.356*	0.203
	(0.171)	(0.233)	(0.186)	(0.231)
Constant	0.013	0.011	0.016	0.020
	(0.011)	(0.015)	(0.012)	(0.014)
$\tilde{f}_{t-1}^{t+3m}$	0.730**	...	0.713**	...
	(0.044)		(0.041)	
$E_{t-3m}^{CB}(i_{t+3m})$	0.291**	...	0.332**	...
	(0.046)		(0.043)	
Constant	-0.077	...	-0.225*	...
	(0.126)		(0.122)	
Sample size	34		30	

Note: Point estimates and standard errors (small figures). A star denotes significance at the 10% level, a double star significance at the 5% level. Full sample period: Mar. 1999 - Jun. 2007.

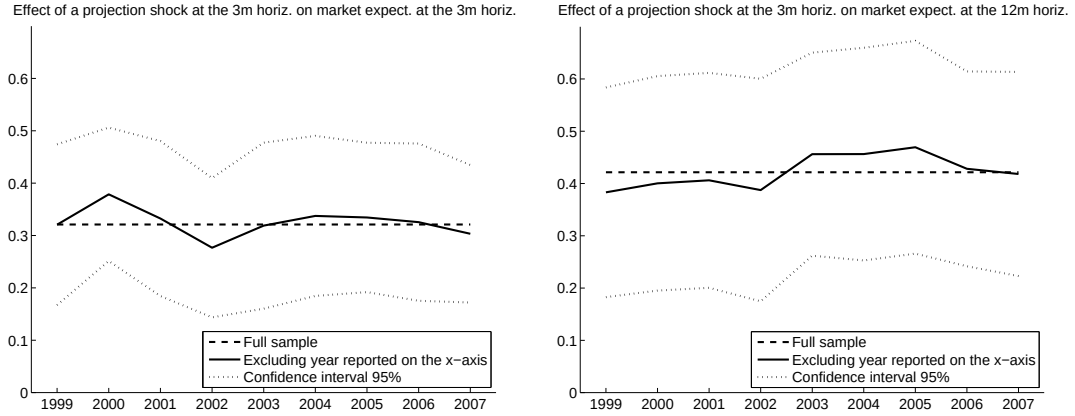
size of the sample.[41]

As far as the first exercise is concerned, the customary approach of splitting the data into two sub-samples is prevented by the need to keep a reasonable number of degrees of freedom in the estimation. We have therefore opted for a different strategy which consists in dropping one year (4 observations) at a time. This approach is useful from two points of view. First, it allows us to check the robustness of our results to the presence of outliers, second, it also allows us to control for the possibility that our results are driven by a particular set of observations (i.e. periods in which the RBNZ might have been particularly transparent or credible). The results of these exercises are presented in Figure 5. The left hand panel reports the profile of the estimated response of market expectations to the projection shock at

[41] On the contrary the advantage of the FIML approach with respect to other procedures is that estimates based on FIML are efficient.

the 3-month horizon. In particular, the dashed line reports the full sample results, the solid line the estimated responses when the four observations associated with the year reported on the x-axis are excluded from the sample and the dotted lines delimit the confidence interval on these parameters. The right hand panel reports the equivalent evidence related to the 12-month horizon. Both panels suggest that the results are robust.

Figure 5: The effect of the projection shocks: sub-samples, 3 and 12-month horizons.



Note: Projection shocks obtained using the restricted version of system (6) as presented in the last two columns of Table 5.

Finally in Table 7 we compare the estimates based on a FIML methodology with those obtained using the approach developed by Hoffman (1987). In short, this alternative estimation strategy is based on three steps. In the first, the projection shocks are estimated using a SURE estimation (on the third and fourth equations of system (6)).[42] Then the estimated projection shocks are used as regressors (together with the standard set of control variables) in the equations that measure the response of market expectations to the unexpected component of policy decisions and communication. Also in this second step the coefficients are estimated using a SURE methodology (on the first and second equations of system (6)). Finally a series of statistics (e.g. estimates of the variance covariance matrices) from both the

[42]Since in our case we only estimate the projection shock associated with the 3-month horizon, this boils down to a simple OLS estimation of the third equation of system (6).

first and the second step are combined to compute the variance covariance matrix of the second step's estimated parameters in such a way as to take into account the presence of generated regressors. The results of this exercise are presented in Table 7. The first two columns report estimates based on a FIML approach, the last two those based on Hoffman (1987). The results are substantially identical. Estimated standard errors based on Hoffman's methodology tend to be slightly larger because this approach is less efficient than the one based on FIML.

Table 7: Robustness to estimation methodology

Methodology:	FIML		Hoffman (1987)	
Estimated system:	(6) restricted		(6) restricted	
Horizon:	*3-month*	*12-month*	*3-month*	*12-month*
$PS_{t,5}^{t+3m}$	0.321**	0.422**	0.311**	0.423**
	(0.071)	(0.095)	(0.076)	(0.097)
$\Delta i_{t,1m}$	0.575**	0.179	0.571**	0.182
	(0.207)	(0.268)	(0.206)	(0.264)
$\Delta i_{t,1m\_3m}$	0.349**	0.284	0.357*	0.280
	(0.171)	(0.233)	(0.184)	(0.236)
Constant	0.013	0.011	0.013	0.011
	(0.011)	(0.015)	(0.012)	(0.015)
$\tilde{f}_{t-1}^{t+3m}$	0.730**	...	0.752**	...
	(0.044)		(0.059)	
$E_{t-3m}^{CB}(i_{t+3m})$	0.291**	...	0.258**	...
	(0.046)		(0.060)	
Constant	-0.077	...	-0.013	...
	(0.126)		(0.158)	
Sample size	34		34	

Note: Point estimates and standard errors (small figures). A star denotes significance at the 10% level, a double star significance at the 5% level. Sample period: Mar. 1999 - Jun. 2007.

5 Do markets understand the conditionality of policy intentions?

In this section we analyze to what extent New Zealand market operators understand the conditionality of the interest rate projections released by the RBNZ. At the two extremes situations described below might emerge.

First, when private agents have a full understanding of the conditionality of the projections, at each release of the interest rate projection they extract information on how the RBNZ maps the macroeconomic outlook and its expected developments in an interest rate projection, and adjust their expectations about short term interest rates accordingly.[43] At the same time they also adjust their own expectations during the inter-meeting period in line with their reading of how the macroeconomic information that is progressively released will modify the future decisions of the central bank. At best, "a successful central bank should be boring" (King 2000) in the sense that news about monetary policy should arise in the macroeconomic news, and not in the actions and announcements of the central bank. On the opposite side there is a situation where market operators take the interest rate projection of the central bank as an unconditional commitment to a sequence of future policy decisions. In such a case private agents would pay no attention to macroeconomic news and would react only to interest rate projections.[44] Two main problems might emerge in this case. First, markets would not provide the central bank with information about their own view of the macroeconomic outlook (and possibly about some particular aspect of the economic outlook about which they have better infor-

[43] Assuming that the macroeconomic information is common knowledge, one could think of this process as one during which market operators gradually learn the parameters of the policy rule followed by the central bank. Using the words of Blinder (2004), "the best a central bank can do is to 'teach' the markets its way of thinking".

[44] In line with the focus of this section in describing this, admittedly extreme, scenario we assume that market operators do not pay attention to any type of monetary announcement other than interest rate projections.

mation). Second, the evolution of the interest rate term structure would alternate between jumps (when a new interest rate projection is released) and long periods of immobility. This would not allow an efficient pricing of financial assets and would destabilize financial markets. Finally in such a situation monetary policy decisions which are not in line with the announced policy intentions could undermine the credibility of the central bank (Mishkin, 2004; Khan, 2007; Woodford, 2005).

We provide two connected pieces of evidence which suggest that New Zealand's case is likely to be better reflected by the first scenario (markets understand the conditionality) rather than the second (markets do not understand the conditionality).[45] Both are based on an evaluation of the inter-meeting volatility of market expectations about future short term interest rates. This should be zero if markets do not understand the conditionality of policy projections, and greater than zero otherwise. The first piece of evidence was already presented in Figure 4 which shows that the impact of the unexpected component of the interest rate path has a persistent effect on market expectations. However the same picture also displays confidence bands around the average response that increase when the time horizon over which the dependent variable is computed lengthens. This evidence suggests that market expectations are not only affected by the release of the projection (if this were the case confidence bands would not increase as the horizon lengthens) but also by macroeconomic news which are disclosed in the days following the release of the interest rate path. This evidence however only tells us that market expectations show some volatility during intermeeting periods but does not tell us whether the amplitude of this volatility is consistent with the full understanding of

[45]In the literature it is often claimed (Archer, 2005; Moessner and Nelson, 2008) that the evidence of a partial reaction of market expectations to the monetary news included in the announcement of future interest rates should be taken as a signal in favor of limited practical importance of the concern that the public might not understand the conditional nature of the projections. However, since the impact response to the monetary news included in the publication of the interest rate path should be the same in both cases we believe that partial reaction should be linked more with other issues like credibility or measurement error.

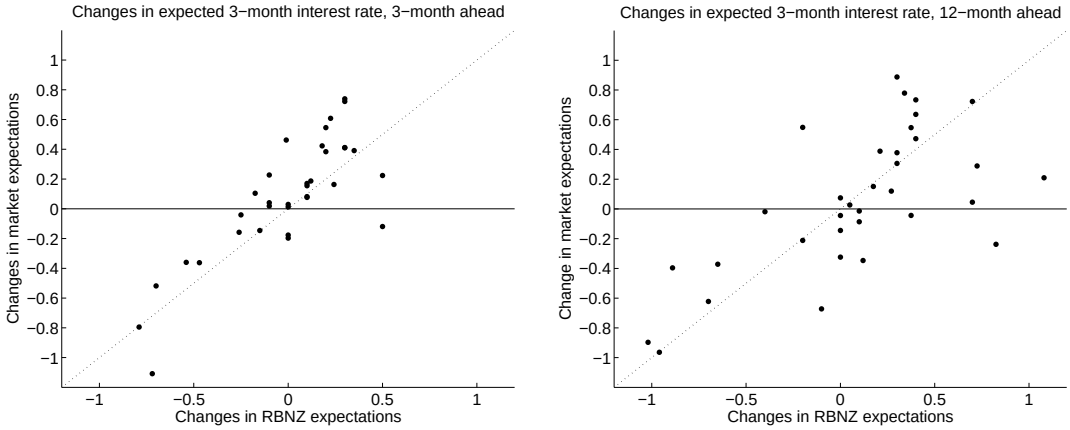
the conditionality of interest rate projections. To investigate this issue we compare the changes in interest rate expectations of the RBNZ in two subsequent releases of the interest rate projection with the changes in market interest rate expectations measured from the release of an interest rate projection to the day before the next one. In the extreme case in which market operators take the interest rate path as completely unconditional this last measure should be zero since the markets only react to the release of an interest rate projection. On the contrary if markets understand the conditionality of the interest rate projection we should expect changes in RBNZ and market expectations to be approximately the same.[46] The changes in RBNZ and market expectations at the 3 and the 12-month horizons are presented in Figure 6.

In both panels the 45 degrees line signals where the points of the scatter should lie if changes in RBNZ expectations were exactly equal to changes in market expectations, a situation that would suggest that markets fully understand the conditionality of the projection. On the contrary the horizontal line located at zero indicates where the scatter points should lie in the opposite situation where markets do not understand conditionality and therefore do not change their expectations about future short term interest rates during the intermeeting periods. With all the caveats which this analysis could imply both the left and the right hand panels tend to suggest that markets understand the conditionality of the projections. This hypothesis is also supported by the fact that this evidence tends to be stronger for the 3-month horizon.[47] Two aspects are likely to have strengthened the understanding

[46]Obviously some further assumptions should be made so that the changes in these two expectations are exactly the same. In practice actual changes might not be exactly the same because the central bank might be endowed with better information on the state of the economy or because the central bank and market operators map macroeconomic news into an expected evolution of official interest rates in a different way. Differences might also be due to unexpected changes in policy rates.

[47]If markets understand conditionality at the 3-month horizon then, *a fortiori*, they should also understand conditionality at the 12-month horizon. From this perspective deviations from the 45 degrees line at the 12-month horizon are likely to be due to reasons other than conditionality.

Figure 6: Changes in market and RBNZ expectations about interest rates.



Note: *Changes in RBNZ expectations:* difference between the 3-month ahead interest rate projection included in a publication of the interest rate path and the corresponding 6-month ahead projection announced in the previous publication (the time span between two publications is normally around three months). The equivalent measure is computed for the 12-month ahead horizon. *Changes in market expectations:* difference between the return implicit in the price of the future contract (net of risk premiums) expiring in three months measured one day before the publication of the interest rate path and the return implicit in the same contract (net of risk premiums) measured on the day of the previous publication of an interest rate path by the RBNZ. The equivalent measure is computed for the 12-month ahead horizon.

of the conditionality of the interest rate projections by market operators in New Zealand. First, the RBNZ, as well as all the other central banks which publish their own expectations, has been extremely careful to emphasize to the markets the conditional nature of these projections.[48] Second, in New Zealand, announcements are not strictly related to the official interest rate (OCR rate) but to a short term rate (3-month interest rates) which is controlled by the RBNZ only indirectly.[49]

[48]Further emphasis could be added by surrounding baseline projections with fan charts and/or providing the evolution of short term interest rates under alternative scenarios.

[49]The trade-off here is between a more direct control on market expectations which can be obtained providing information on an interest rate directly under the control of the RBNZ and more risks of lock-in effects.

6 Conclusions

The announcement of policy intentions is one of the most debated issues related to the optimal level of transparency of a central bank. Theoretical and empirical studies on this particular aspect of communication have emerged only recently and remain scant. The objective of this paper is to provide new evidence on this topic. Our contribution is twofold. First, we assess the impact of the announcement of policy intentions on policy decisions predictability. Second, by focusing on the Reserve Bank of New Zealand, we verify if this central bank, by publishing interest rate projections is able to steer market expectations about short term interest rates.

Concerning the first aspect our results, based on the experience of the euro area, New Zealand, Norway, Sweden and the U.S., suggest that the announcement of policy intentions, either in their quantitative or qualitative form, improves the ability of market operators to predict monetary policy decisions. This implies that the communication of future policy intentions might facilitate the understanding by market operators of the systematic part of the policy decisions, a crucial ingredient, together with credibility, in fostering the ability of any central bank to maintain inflation expectations well anchored. As far as the second aspect is concerned, namely the ability of the Reserve Bank of New Zealand to steer market expectations through the publication of interest rate projections, we improve with respect to the (limited) available evidence in three dimensions. First, we allow private agents to use more general expectation formation mechanisms when they have to predict the interest rate projection that will be announced by the central bank. This is a fundamental step for the proper identification of the unexpected component included in the publication of the interest rate projection itself. Second, we show that neglecting the presence of risk premiums when extracting private expectations about future interest rates from financial futures can significantly distort the results. Third, we take

explicitly into account the possibility that, in those days on which the interest rate path is announced, changes in market expectations about future interest rates might also be driven by other types of policy communication (e.g. the announcement of a change in the policy rate) and by the release of other macroeconomic data. Our main finding is that market expectations about short term interest rates over short and medium term horizons respond in a significant, consistent and persistent way to the monetary surprise unleashed by the release of the interest rate projection. The impact of the monetary news included in such a publication is not only statistically significant but also economically important since, on those days on which a projection is released, it accounts, respectively at the 3 and at the 12-month horizons, for around 35 and 50 per cent of the variability of the expectations of market operators about the future evolution of short term interest rates. Finally we provide evidence which supports the hypothesis that in New Zealand market operators understand the conditionality of these projections, a necessary condition to support an efficient pricing of financial assets and to avoid monetary policy decisions which are not in line with the announced policy intentions undermining the credibility of the central bank. The robustness of the results presented in this paper is verified under alternative definitions of the projection shock and under different sample periods and estimation methodologies.

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Appendix

A Implementation of the announcements of future policy intentions

There follows short summaries of the strategies adopted by the ECB, the Federal Reserve, the Norges Bank, the Reserve Bank of New Zealand and the Sveriges Riksbank for communicating their policy intentions since the beginning of 1999.

European Central Bank - The use of particular keywords (e.g. "vigilance", "monitor closely") in the Editorial Statement released each month after the monetary policy meeting by the European Central Bank has been interpreted by market operators as a signal of the short term monetary policy orientation of the ECB.[50] These keywords were systematically used from September 2005 until mid-2007 and sometimes were reinforced by more explicit announcements (*"if our scenario is confirmed, and until now it has been confirmed, further withdrawal of monetary accommodation would be warranted "*, Q&A June 2006). At the same time the use of sentences like *"we do not take ex ante positions"* or *"we never pre-commit to any rate increases"* is intended to emphasize the conditional nature of policy intentions. The ECB has never announced medium term policy intentions.

Federal Reserve - From May 1999 to the beginning of 2000 the U.S. Federal Open Market Committee (FOMC) explicitly announced its expected future policy stance ("policy bias") in the post-meeting statements. 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 bias" meant that the direction of the next policy move was equally likely to be up or down (Rudebusch and Williams, 2006). This type of explicit announcement was interrupted at the beginning of 2000 until mid-2003. In August 2003, in order to convince the market that policy interest rates were going to be kept low for some time, the FOMC reintroduced in the post-meeting statement a direct, though not unambiguous, indication about its future policy intentions ("The Committee believes that policy accommodation can be maintained for a considerable period"). A reference to future policy intentions was maintained also in the following period of official rate increases ("policy accommodation can be removed at a pace that is likely to be measured") and was discontinued in June 2006.

Norges Bank - The Norges Bank started to provide qualitative information on its short term future policy intentions in May 2000. Until mid-2001 this type of information was released at each of the (around) 9 meetings that were held during the year using sentences like *"... in the light of recent trends in the economy and the current balance of risks, the probability that the next change in interest rates will*

[50]Indexes based on these keywords, like the hawkometer of the Deutsche Bank, are commonly used by academia and market operators as synthetic indicators of the monetary policy intentions of the ECB. Also Bini-Smaghi(2006) observes that in the last tightening cycle the ECB has provided guidance over the short term evolution of the official interest rate through coded words.

be an increase is greater than (equal to - smaller than) the probability of a reduction.". Starting from mid-2001, when the Norges Bank became an inflation targeter, the same type of information was communicated in a similar way focusing on the likely evolution of inflation over a two-year horizon in case interest rates were kept unchanged (e.g. *"... according to Norges Bank's assessment, with an unchanged interest rate ahead, the probability that inflation two years ahead will be higher than 2.5 per cent is the same as (greater than - smaller than) the probability that it will be lower."*).[51] From mid-2004 the Norges Bank has sharpened its announcement of future policy intentions in three ways. First it has moved back to a communication directly focused on the official interest rate. Second the announcement has provided information on the likely level of this interest rate at a precise point in time, normally three-four months ahead.[52] Finally, the likely level of the interest rate over the planned horizon has been identified with a quantitative interval of around 1 percentage point (e.g. *" ...the analysis indicates that a sight deposit rate in the interval 1.5-2.5 per cent in mid-March 2005 will, given the outlook for inflation and output, provide a reasonable balance between the objective of reaching the inflation target and the objective of stability in the real economy."*). From the end of 2005 to date the Norges Bank has complemented the communication strategy adopted since mid-2004 with the publication of an official interest rate projection which is released 3 times a year in the Inflation Report / Monetary Policy Report. The published path is constituted by quarterly averages surrounded by confidence intervals (fan chart) and covers a 3-year horizon. The publication of quarterly means, as opposed to the level of the interest rate in a three-four months horizon, as was the case under the previous regime, provides more detailed information on the likely timing of policy moves. The future path of the rates is established by the Board, in a process which takes into account several inputs,[53] and must satisfy some specific criteria in order to be considered appropriate (Qvigstad, 2005; Bergo, 2006).[54] Finally, great

[51]There is some form of judgment in the way we have interpreted the mid-2001 to mid-2004 period of communication of the Norges Bank - that we read as a *qualitative announcement period*. Strictly speaking during this period the Norges Bank was providing only indirect information about the future evolution of short term interest rates since it was communicating the likely future monetary stance using an "inflation bias" as a verbal device. However it must be observed that this was not a voluntary choice to be more clouded about the future evolution of official interest rates, as was the case for the Federal Reserve in early 2000, but it was simply due to the fact that, since the Norges Bank became a strict inflation targeter in mid-2001, it found it more effective to express its policy intentions in these terms. To support our reading it should also be noticed that during this period the Norges Bank published a table in the Inflation Report with the level of the official rate, its changes and the policy bias in terms of inflation, thus reinforcing the link between the evolution of these variables.

[52]However in this period policy intentions were released only 3 times a year (in the section "Monetary policy assessment" of the Inflation Report) and no other systematic information was provided during the other meetings hold between two publications of the Inflation Report.

[53]Among other factors, it reflects the estimates arising from a set of economic models, the information relating to the current situation and the interviews carried out in the institutions and firms in each region relative to the expected development of the economy in their sector

[54]On the basis of such criteria, the appropriate path of the rates must: 1) anchor the inflation expectations, 2) favor a good balancing between inflation and output gap, 3) keep (to a certain

attention is paid to the conditional nature of the rate forecasts and to the clarification of the factors which could, subsequently, determine a deviation from these forecasts. In particular, the Inflation Report underlines that *"a deviation of actual interest rate developments from the forecast must be expected to be the rule rather than the exception"*.

Reserve Bank of New Zealand - The Reserve Bank of New Zealand has been releasing quantitative information on its policy intentions since 1997. In more recent years the announcement of the interest rate path has coincided with the revision dates of the official cash rate of March, June, September and December. In New Zealand the official cash rate (OCR) is revised eight times a year. After the intervening revision dates of January, April, July and October the Reserve Bank of New Zealand only releases a general evaluation on how the outlook for growth and inflation has changed since the last meeting. The interest rate projection is included in the Monetary Policy Statement which provides point estimates for the likely future evolution of a large set of key macroeconomic variables. The Reserve Bank of New Zealand releases its expected path for the 3-month interest rate for each quarter of the following two years. The interest rate projection is produced using a combination of the bank's core macroeconomic model and its policy-maker judgment.

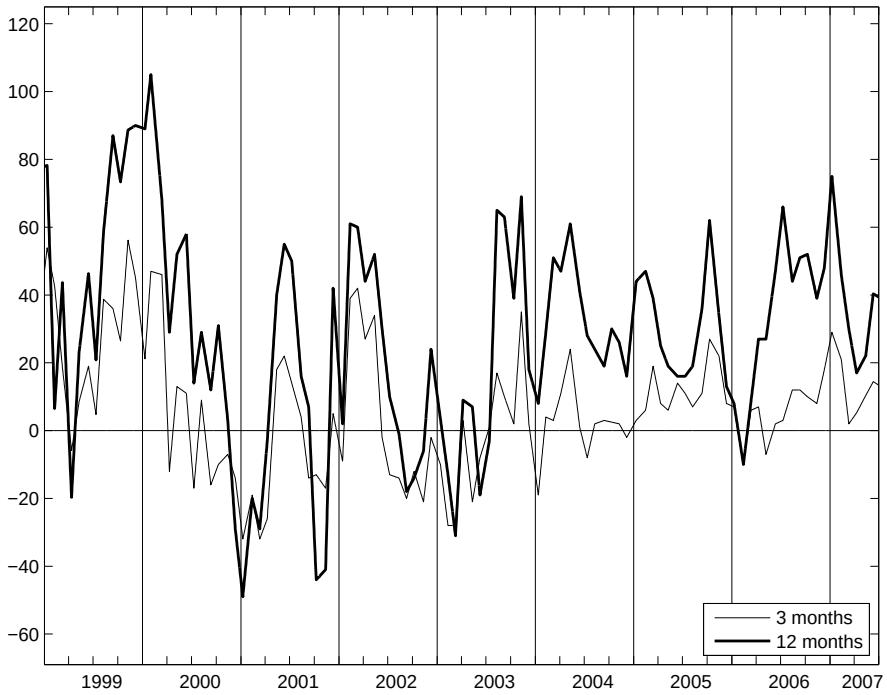
Sveriges Riksbank - For several years after adopting the inflation targeting strategy in 1993 the Riksbank's communication about its policy intentions was based on statements that compared future possible developments of inflation with the target level. The underlying assumption was that the policy rate would not change during the forecast period *"with an unchanged interest rate ahead, the probability that inflation two years ahead will be lower than 2.5 per cent is greater than the probability that it will be higher."*. The main changes in the communication strategy occurred during the years 2005-2007. In March 2005 the Riksbank published forecasts with a horizon of three years, based on the assumption that the repo rate would develop in line with expectations in the financial markets. This was reported as an alternative scenario - the main scenario was still based on the assumption of an unchanged repo rate and extended two years ahead. In October 2005 a main scenario was presented which instead contained forecasts extending three years ahead, based on market expectations about the policy rate, as measured by implied forward rates. This assumption allowed the central bank to introduce suggestions about future policy decisions in a qualitative way. In those cases when the central bank's view of future interest rates differed from that of the market, the central bank explained how *"In line with market expectations, Norges Bank's analysis are now based on a more moderate increase in the interest rate ahead than in the March Report"*. In February 2007 forecasts were published for the first time based on the executive board's own assessment of the official interest rate path three years ahead that would give a well-balanced monetary policy.

degree) such balancing in different scenarios as well, 4) imply moderate (not sharp) variations of the interest rates over time, 5) favor stability in the financial markets, 6) be coherent with the path foreseen by simple rules of monetary policy (provide an explanation if this is not possible).

B Risk premiums on future contracts

Consensus Economics releases on a monthly basis market expectations about the level that the 3-month interest rate (90-day bank bills) will reach in 3 and 12 months. We use this information together with the return implicit in future contracts to construct measures of the risk premiums. In particular for each date of release of *Consensus Forecast* we compute the difference between the return implicit in the future contract with an expiration date closer to 3 and 12 months and the respective forecast. In the months of March, June, September and December the match between the horizon of expectations provided by *Consensus Economics* substantially coincide with the horizon of expectations provided by the price of the future. For example in the month of March *Consensus Economics* provides information about the expectations for the following month of June which is also the expiration month of the future contract. These are precisely the months that we use in our analysis. The time series evolution and some summary statistics on the two series are reported below.

Figure 7: Risk premiums on future contracts expiring in 3 and in 12 months.



Note: Basis points. Difference between the return implicit in future contracts on 90-day bank bills and the expectations on the future (3 and 12-month ahead) value of the same interest rate obtained from *Consensus Economics*.

Table 8: Risk premiums on future contracts expiring in 3 and in 12 months.

	3-month	12-month
Mean	6.44	28.61
Std. Dev.	17.69	29.36
Min.	-32.00	-49.00
Max.	56.17	105.00
10th p.tile	-15.29	-11.85
90th p.tile	31.46	62.57
Correlation	0.84	

Note: Basis points. Sample 1-1-1999 to 30-6-2007.

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