Technical Appendix to "The Impact of Central Bank Announcements on Asset Prices in Real Time"

Generated-Regressor Issue

Direct Method

We estimate the following regression by OLS:

$$f_{t+h} - f_{t-h} = c_1 + c_2 \cdot \left(Index_t^{NEW} - c_3 \cdot \left(f_{t-h} - R_t^{NEW}\right) - c_4 \cdot Index_t^{OLD}\right) + \varepsilon_t, \quad \text{(A1)}$$

where cs are regressor coefficients, and the rest of the notation is the same as in the paper.

Table A1. Explanation of Innovation in Expectations (Futures Rates), Dependent Variable $f_{t+h} - f_{t-h}$

	$t + h =$ 14:45 $t - h =$ 13:25	$t + h =$ 15:45 $t - h =$ 13:25	$t + h =$ 16:45 $t - h =$ 13:25
c_1	0.006	0.008*	0.008*
	(0.004)	(0.004)	(0.005)
c_2	0.029**	0.029**	0.035***
	(0.011)	(0.013)	(0.013)
c_3	1.169**	1.060*	1.019**
	(0.537)	(0.610)	(0.494)
c_4	0.778***	0.805***	0.708***
	(0.145)	(0.187)	(0.172)
R^2	0.224	0.161	0.178
Observations	70	70	70

Note: Monthly observations on days of ECB Governing Council meetings, January 2000–June 2006. The econometric method is ordinary least squares. Heteroskedasticity-consistent standard errors are in parentheses. ***, **, and * denote significance at the 10, 5, and 1 percent level, respectively.

Empirical Confidence Bands

In order to account for the generated-regressor problem when computing coefficient estimates' standard errors, we also check the robustness of our conclusions by using a bootstrap approach to statistical inference (see, e.g., Efron and Tibshirani 1993). More specifically, we apply a sampling-with-replacement raw residuals bootstrap scheme with 1,000 repetitions. The empirical results are qualitatively very similar to those reported in the paper (tables 2, 3, and 4).

Table A2. Explanation of Innovation in Expectations (Futures Rates), Dependent Variable $f_{t+h} - f_{t-h}$

	$t + h = 14{:}45$ $t - h = 13{:}25$	$t + h = 15{:}45$ $t - h = 13{:}25$	$t + h = 16{:}45$ $t - h = 13{:}25$
Constant	0.003	0.005	0.006
NS_t	0.031^{***}	0.033^{***}	0.038^{***}
R^2	0.152	0.130	0.156
Observations	70	70	70

Note: Monthly observations on days of ECB Governing Council meetings, January 2000–June 2006. The econometric method is ordinary least squares. ***, **, and * indicate empirical significance at the 99, 95, and 90 percent level, respectively. The bootstrap scheme is based on 1,000 repetitions.

Econometric Analysis Using Andersen et al. (2003) Equally Spaced Returns

As a further robustness check, we also rerun the previous regressions (estimations reported below) using equally spaced data instead of averaged tick-by-tick data. We construct these artificial data by linear interpolation of the transaction prices immediately before and after the relevant point in time. Then we obtain futures rate returns as the first difference of the new prices (see Andersen et al. 2003, 593). Note that, overall, the empirical findings discussed in this section are qualitatively very similar if we use equally spaced data.

Table A3. Auxiliary Regression to Measure the Expected ECB Announcement Using Ordered Probit

$f_{t-h} - R_t^{NEW}$	1.864^{**}
	(0.742)
$Index_t^{OLD}$	1.967^{***}
	(0.354)
δ_1	-1.552^{***}
	(0.348)
δ_2	1.180^{***}
	(0.333)
Log-Likelihood	−30.052
Pseudo-R^2	0.574
Observations	70

Note: Monthly observations on days of ECB Governing Council meetings, January 2000–June 2006. The econometric method is ML – Ordered Probit (Quadratic hill climbing). ***, **, and * denote significance at the 10, 5, and 1 percent level, respectively.

Table A4. Explanation of Innovation in Expectations (Futures Rates), Dependent Variable $f_{t+h} - f_{t-h}$

	$t + h =$ 14:45 $t - h =$ 13:30	$t + h =$ 15:45 $t - h =$ 13:30	$t + h =$ 16:45 $t - h =$ 13:30
Constant	0.003	0.006	0.005
	(0.003)	(0.004)	(0.004)
NS_t	0.033^{***}	0.032^{**}	0.040^{***}
	(0.011)	(0.013)	(0.014)
R^2	0.170	0.125	0.169
Observations	70	70	70

Note: Monthly observations on days of ECB Governing Council meetings, January 2000–June 2006. The econometric method is ordinary least squares. Heteroskedasticity-consistent standard errors are in parentheses. ***, **, and * denote significance at the 10, 5, and 1 percent level, respectively.

Table A5. Time Needed to Incorporate the News Shock (Futures Rates), Dependent Variable $f_{17} - f_{t^*}$

	$t^* = 14{:}15$	$t^* = 14{:}30$	$t^* = 14{:}45$	$t^* = 15{:}00$
Constant	0.004*	0.003	0.004*	0.004**
	(0.002)	(0.002)	(0.002)	(0.002)
NS_t	0.018*	0.016**	0.007	0.007
	(0.009)	(0.007)	(0.005)	(0.005)
R^2	0.097	0.105	0.023	0.026
Observations	70	70	70	70

Note: Monthly observations on days of ECB Governing Council meetings, January 2000–June 2006. The econometric method is ordinary least squares. Heteroskedasticity-consistent standard errors are in parentheses. ***, **, and * denote significance at the 10, 5, and 1 percent level, respectively.

The Effects of Monetary Policy Shocks

In this section we analyze the effects of monetary policy shocks to futures rates. In particular:

- We explain the change in futures rates around the new policy rate release by the monetary policy shock.
- We show econometrically that monetary policy shocks are completely incorporated in futures rates in less than five minutes.
- Potentially some of the movements that are taking place in the market during the press conference may still be the consequence of the policy rate announcement. If this is the case, our methodology does suffer from an omitted-variables problem. In other words, because the news surprise might be correlated with the interest rate announcement, then our estimates might contain some residuals effect from the interest rate announcement. This will bias the estimated coefficients of the news shock upward. Given the above finding, we can assess how words affect yields, safely disregarding the surprise in the target release. However, to take explicitly into account this issue, as a further robustness check, we reestimate the main regression presented in the paper (see table 3 in the article), controlling also for the monetary policy shock.

Table A6. Explanation of Innovation in Expectations (Futures Rates), Dependent Variable $f_{t+h} - f_{t-h}$

	$t + h = 12{:}45$ $t - h = 12{:}40$	$t + h = 13{:}00$ $t - h = 12{:}40$
Constant	0.009***	0.006***
	(0.002)	(0.002)
MPS_t	0.069***	0.043***
	(0.017)	(0.016)
R^2	0.312	0.124
Observations	99	99

Note: Monthly observations on days of ECB Governing Council meetings, January 2000–June 2006. The econometric method is ordinary least squares. Heteroskedasticity-consistent standard errors are in parentheses. ***, **, and * denote significance at the 10, 5, and 1 percent level, respectively. Note that we have not included two observations (8 June 2000 and 10 May 2001) because they induce two outlier residuals. However, the results continue to hold even if we include both observations.

Table A7. Time Needed to Incorporate the News Shock (Futures Rates), Dependent Variable $f_{13:25} - f_{t^*}$

	$t^* = 12{:}40$	$t^* = 12{:}45$	$t^* = 12{:}55$
Constant	0.006**	−0.003	−0.001
	(0.002)	(0.002)	(0.002)
MPS_t	0.039**	−0.030	−0.007
	(0.019)	(0.024)	(0.021)
R^2	0.100	0.062	0.007
Observations	99	99	99

Note: Monthly observations on days of ECB Governing Council meetings, January 2000–June 2006. The econometric method is ordinary least squares. Heteroskedasticity-consistent standard errors are in parentheses. ***, **, and * denote significance at the 10, 5, and 1 percent level, respectively.

Table A8. Explanation of Innovation in Expectations (Futures Rates), Dependent Variable $f_{t+h} - f_{t-h}$

	$t + h = 14{:}45$ $t - h = 13{:}25$	$t + h = 15{:}45$ $t - h = 13{:}25$	$t + h = 16{:}45$ $t - h = 13{:}25$
Constant	0.007	0.010	0.010
	(0.007)	(0.009)	(0.008)
NS_t	0.030**	0.032**	0.037***
	(0.012)	(0.014)	(0.014)
MPS_t	0.040	0.044	0.039
	(0.051)	(0.071)	(0.065)
R^2	0.163	0.140	0.163
Observations	70	70	70

Note: Monthly observations on days of ECB Governing Council meetings, January 2000–June 2006. The econometric method is ordinary least squares. Heteroskedasticity-consistent standard errors are in parentheses. ***, **, and * denote significance at the 10, 5, and 1 percent level, respectively. There are seventy observations because for the period January 2000–October 2001 we have only considered the first Governing Council meeting of every month.

Econometric Analysis Using Musard-Gies' (2006) Wording Indicator, IndexMG

As a robustness check, in this section we reestimate the main regressions reported in the article using the wording indicator variable, *IndexMG*, proposed by Musard-Gies (2006).

IndexMG takes on a four-value scale from −1 to +2. The value of zero suggests that the current level of the policy rate is appropriate to maintain price stability over the medium term. A negative value characterizes an easing period: it is possible that the policy rate will be cut in the near future. On the other hand, a positive value characterizes a potential future monetary policy tightening.

IndexMG spans a shorter sample, from January 1999 through October 2004. In the econometric analysis reported below, we consider the set of Governing Council meetings where also our *Index* is available (cf. table 9).

Table A9. Auxiliary Regression to Measure the Expected ECB Announcement Using Ordered Probit

$f_{t-h} - R_t^{NEW}$	4.693***
	(1.531)
$IndexMG_t^{OLD}$	3.068***
	(0.711)
δ_1	−2.370***
	(0.687)
δ_2	1.787***
	(0.625)
δ_3	7.068***
	(1.862)
Log-Likelihood	−19.366
Pseudo-R^2	0.717
Observations	51

Note: Monthly observations on days of ECB Governing Council meetings, January 2000–October 2004. The econometric method is ML – Ordered Probit (Quadratic hill climbing). ***, **, and * denote significance at the 10, 5, and 1 percent level, respectively.

Table A10. Explanation of Innovation in Expectations (Futures Rates), Dependent Variable $f_{t+h} - f_{t-h}$

	$t + h =$ **14:45** $t - h =$ **13:30**	$t + h =$ **15:45** $t - h =$ **13:30**	$t + h =$ **16:45** $t - h =$ **13:30**
Constant	0.008**	0.010**	0.011**
	(0.004)	(0.004)	(0.004)
NS_t	0.025**	0.028**	0.029**
	(0.011)	(0.012)	(0.014)
R^2	0.115	0.097	0.095
Observations	51	51	51

Note: Monthly observations on days of ECB Governing Council meetings, January 2000–October 2004. The econometric method is ordinary least squares. Heteroskedasticity-consistent standard errors are in parentheses. ***, **, and * denote significance at the 10, 5, and 1 percent level, respectively.