WORKING paper

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The Signaling Effects of Tightening and Easing Monetary Policy

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ABSTRACT

This paper establishes the asymmetric transmission of monetary policy to nominal yields of the four largest euro area countries. We document that the effect of easing monetary surprises is stronger than the effect of monetary tightening. The asymmetry holds beyond the nonlinearities related to the economic or financial environment and does not stem from information effects. We provide evidence that this asymmetry is driven by signals about the future policy path. Decomposing euro area interest rates between common and country-specific components, we show that the common component, likely capturing expectations of future short-term rates, generates the differentiated effects, while risk premium signals amplify the asymmetry. Using textual analysis to extract policymakers' signals about the future monetary policy space from press conferences, we find that central bank communication can affect this asymmetric transmission to yields. Our results suggest a key role for the signaling channel in determining long-term interest rates.

Keywords: Term Structure, Asymmetric Effects, Central Bank Communication, Signaling, Long-Term Interest Rates.

JEL classification: E43, E52, E58, G12.

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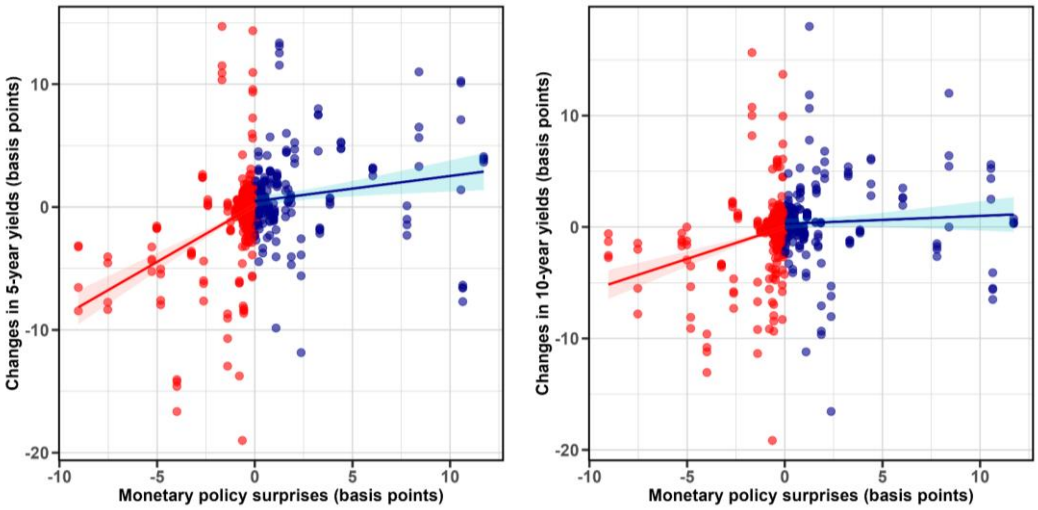
NON-TECHNICAL SUMMARY

Monetary policy affects long-term interest rates not only through the direct impact of its instruments such as the short-term policy rate or asset purchases, but also by shaping market expectations about the future path of these policy instruments. While the effects of monetary policy actions on financial markets have been widely studied, much less is known about whether investors respond symmetrically to tightening versus easing monetary policy. This paper investigates this question in the context of the euro area, examining whether sovereign bond markets react asymmetrically to monetary policy surprises from the European Central Bank. These monetary surprises should be seen as shocks to the information set of investors and reflect the unanticipated component of policy decisions.

We find strong evidence of asymmetric effects: easing monetary surprises—those that suggest a more accommodative stance than financial markets expected—lead to significantly larger declines in sovereign bond yields of the four largest euro area economies than the corresponding increases observed after tightening surprises. More specifically, a 100 basis point easing surprise reduces 5-year sovereign bond yields in these countries by approximately 92 basis points, while a 100 basis point tightening surprise increases them by only 21 basis points. This asymmetric pattern, evidenced graphically in Figure A, holds across short-, medium-, and long-term maturities and is robust to alternative specifications.

Figure A. Monetary surprises and sovereign interest rate changes



Note: This figure shows the scatterplot of monetary policy surprises measured as high-frequency changes in OIS rates around policy decision announcements and changes in 5-year (left hand side) and 10-year (right hand side) sovereign yields over the same window for Germany, France, Italy and Spain. The sample period goes from 2001 to 2023. Two regression lines with their confidence interval are plotted for negative (red) and positive (blue) monetary policy surprises.

We explore the potential drivers of this asymmetry. We find that the asymmetry does not stem from central bank information effects (i.e. macroeconomic information implicitly revealed by policy decisions) or from differences in prevailing economic and financial conditions. We provide evidence that the asymmetry is driven by signals about the likely future policy path. Investors appear to view an unexpected easing as a signal of a more persistent stance, while an unexpected tightening is perceived as more limited or transitory.

To understand how policy signals translate into yield changes, we decompose sovereign bond yields into a component that is common to all euro area countries, and a country-specific component, which captures notably risk and term premia. The common component reacts more strongly to easing surprises, suggesting that investors interpret these as signals of a more persistent shift in the expected

policy path. In contrast, tightening surprises tend to affect the country-specific component, reflecting adjustments in risk or term premia that partially offset the positive effect of the expectations hypothesis (the common component) on yields.

Finally, we examine how central bank communication during ECB press conferences shapes investors' reactions. By conducting textual analysis of press conference transcripts, we derive a measure of the policy stance signals conveyed in ECB communication. These signals affect how investors interpret monetary surprises. These surprises have stronger effects when combined with communication suggesting greater future policy space, and weaker effects when that space appears limited. This underscores the importance of forward-looking signals in the monetary policy transmission to long-term yields.

Overall, this paper provides novel evidence on the asymmetric effects of monetary policy on the sovereign yields of the four largest euro area countries. Easing surprises have a stronger and more persistent impact on long-term yields than tightening surprises. These findings have important implications for central bank communication, particularly in low-interest-rate environments where the signaling channel plays a central role.

Les effets de signal des resserrements et assouplissements de la politique monétaire

RÉSUMÉ

Cet article documente la transmission asymétrique de la politique monétaire aux taux d'intérêt nominaux de la zone euro. Nous montrons que l'effet d'un assouplissement monétaire est plus fort que l'effet d'un resserrement monétaire. L'asymétrie se maintient au-delà des non-linéarités liées à l'environnement économique ou financier et ne découle pas de potentiels effets d'information. Nous trouvons que cette asymétrie est induite par des signaux sur la trajectoire future de la politique monétaire. En décomposant les taux d'intérêt de la zone euro entre une composante commune et une composante spécifique à chaque pays, nous montrons que la composante commune, qui reflète les anticipations des taux à court terme futurs, génère les effets différenciés, et que des signaux sur la prime de risque amplifient l'asymétrie. En utilisant une analyse textuelle pour extraire des conférences de presse les signaux des banquiers centraux sur la future marge de manœuvre de la politique monétaire, nous constatons que la communication de la banque centrale peut affecter cette transmission asymétrique aux taux d'intérêt. Nos résultats suggèrent que le canal du signal joue un rôle clé dans la détermination des taux d'intérêt à long terme.

Mots-clés : structure des taux, effets asymétriques, communication de la banque centrale, signalisation, taux d'intérêt de long-terme.

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1 Introduction

The yield curve, a representation of interest rates across different maturities, serves as a key indicator of economic dynamics and financial market expectations of future economic conditions. Monetary policy in turn aims to influence nominal yields. Our work is motivated by two considerations. First, long-term interest rates are a key driver of investors' decisions, households' saving and debt decisions, firms' investment decisions, and overall economic activity (Bernanke and Blinder 1992). Second, monetary policy has been found to have asymmetric effects on economic variables (Tenreyro and Thwaites 2016).

Monetary policy shocks, by definition, have transitory effects only. Thus, they should not affect long-term yields. However, there is ample empirical evidence that monetary policy announcements do affect long-term interest rates (Cochrane and Piazzesi 2002, Gürkaynak et al. 2005a). One explanation relates to the effect of monetary policy on the term premium (Hanson and Stein 2015, Kaminska et al. 2021). Another explanation is that central bank announcements convey signals about policymakers' perceptions of the economic outlook (Melosi 2017, Nakamura and Steinsson 2018) or about the likely future policy path (Gürkaynak et al. 2005b). A third one relates to investors updating their beliefs about the central bank reaction function and the parameters shaping the endogenous policy response (Bauer and Swanson 2023, Bauer et al. 2024, Bocola et al. 2024).

One potential feature of the transmission of these long-term news relates to the sign of monetary policy surprises and the different signals conveyed by tightening and easing surprises. Hanson et al. (2021) suggest that easing decisions are specifically associated with a decline in the term premium because of yield-seeking behaviors. In addition, the asymmetric nature of monetary policy cycles (gradual in tightening and more abrupt in easing episodes, see Cieslak and Vissing-Jorgensen 2021) is likely to convey information on the persistence of the monetary policy stance and to affect differently long-term rates.

This paper aims to document how investors learn about these long-term factors, and whether they learn differently from tightening and easing monetary policy surprises. We exploit a key feature of the eurozone framework for identifying news about the future path of monetary policy with respect to country-specific factors: the short-term policy rate is unique for all euro area countries but long-term interest rates are not. The effect of news about future short-term rates is uniform across all countries because they share the same policy rate. Changes in long-term sovereign yields unrelated to this common factor are mechanically due to changes in country-specific factors (term and risk premia) as opposed to changes in expectations of future short-term rates.

To do so, we measure monetary policy surprises (MPS) using a principal component analysis of high-frequency changes in OIS rates over a narrow window around the press release of the policy announcement. We capture the yield curve response to monetary policy considering the changes, around the same window, in 2-, 5-, and 10-year sovereign yields for the four largest euro area economies (Germany, France, Italy and Spain). There

is a trade-off between using more elaborated parametric representations of the term structure of interest rates such as the arbitrage-free Nelson and Siegel (1987) model and the use of intraday data for identification.[1] We lean towards a non-parametric and parsimonious measure that satisfies the liquidity condition of intraday data.

Based on this empirical framework and using the 221 ECB policy announcements from 2001 to 2023, we revisit as a starting point the standard linear effects of monetary policy surprises on the term structure of interest rates. We find that a 100 basis points (bp) monetary surprise is associated with a 59, 47 and 26 bp increase in 2-, 5- and 10-year yields respectively in the narrow window around the time of the policy announcement. This decreasing effect along maturities is consistent with a stronger pass-through to shorter maturities than to longer ones (Evans and Marshall 1998).

We then establish a number of novel facts about the asymmetric effects of monetary policy on nominal yields. We document a stronger effect of easing monetary surprises compared with tightening ones. The difference is robust and highly significant. A 100 bp easing surprise is associated with a 92 bp decrease in 5-year yields, while a 100 bp tightening surprise increases 5-year yields by 21 bp. A similar asymmetric pattern is observed for 2- and 10-year yields. We show that this pattern is driven by pure monetary policy shocks as opposed to central bank information shocks. These asymmetric effects hold beyond the nonlinearities related to the economic or financial environment. This evidence suggests that investors interpret (otherwise similar) monetary surprises differently according to their sign such that they may convey different signals.

We explore whether the asymmetry is driven by the type of policy instrument used. We leverage the fact that monetary surprises can be decomposed into news about the current decision, the future policy path and asset purchase policies, following Gürkaynak et al. (2005b) and Altavilla et al. (2019). On the one hand, unconventional policies aim to affect long-term yields more directly than the conventional instrument (Vayanos and Vila 2021). In a sample where easing surprises are predominantly related to unconventional instruments, the asymmetry would stem from a composition effects. On the other hand, if the mechanism at work operates through yield-seeking behavior and term premium, interest rate decisions should move long-term rates the same way as unconventional policies (Hanson and Stein 2015). We find that the asymmetry is entirely driven by the future policy path component of monetary surprises. While both tightening and easing surprises in target and long-term components lead to symmetric effects on yields, easing path surprises have almost three times the effect of tightening ones. A 100 bp easing (tightening) path surprise is associated with a 159 bp decrease (56 bp increase) in 5-year yields. It suggests that the asymmetry likely relates to signals about the future policy stance.

To further explore this question, we exploit the fact that, in the euro area, the short-term policy rate is unique for all countries but long-term interest rates are not. Orthogonalizing

[1] See Duffie and Kan (1996), Diebold and Li (2006), Christensen et al. (2011).

sovereign rates to 1-year OIS rates, we are able to identify common and country-specific components in sovereign rates (Leombroni et al. 2021, Gnewuch 2022). We find that two complementary forces are at play in creating the asymmetric effect. The common component reacts asymmetrically such that easing surprises convey stronger signals about the future policy cycle. In addition, tightening surprises convey signals about term or risk premia that attenuate the response of interest rates. It suggests that the asymmetry stems from signals about low-frequency policy cycles, and that signals about term and risk premia magnify this asymmetry. It is worth stressing that this decomposition and the decomposition of monetary surprises across instruments point in the same direction. Taken together, our findings provide novel evidence that unexpected policy announcements, depending on their sign, convey different signals about the future policy stance.

We also assess whether and how central bank communication may affect this asymmetric transmission to interest rates and the signals about long-term policy news (Brand et al. 2010). The ECB two-step communication procedure (policy decisions are released at 14:15, followed by a press conference at 14:45) allows us, using intraday data, to isolate investors' reaction to the initial policy decision from their reaction to the subsequent communication. First, the different size and sign of interest rate responses to the press release and press conference suggest that the signals conveyed during the latter are crucial for investors. Second, using textual analysis, we derive a measure of the policy stance signals conveyed during the press conference, following the approach of Cieslak and McMahon (2023). We show that this variable is correlated with the near-future policy stance in the short-run, but also signals the available future policy space in the long-run following a mean-reverting process. We find that tightening surprises have strong effects when associated with signals of more upward future policy space, and muted effects with more downward space. A similar pattern is at work for easing surprises: they have strong effects on interest rates if associated with signals about more downward future policy space. These results suggest that central bank communication about the long-run monetary outlook is a powerful instrument that can induce or offset interest rate responses beyond signals from the policy decision.

These findings have important implications for monetary policy-making. First, the asymmetric transmission suggests that investors extract different signals according to the sign of monetary surprises: easing surprises are interpreted as signals of longer and more persistent monetary cycles than tightening ones. This means that policymakers should take this feature into account when considering the persistence of the effects of their decisions. Second, the fact that signals conveyed during press conferences can either strengthen or weaken the transmission of monetary policy to nominal yields informs the design of central bank communication strategies.

The contribution of this paper is twofold. First, it provides original empirical evidence on the asymmetric effects of monetary policy on euro area yields and the role of news about the future policy path. Second, the state-dependent effects of monetary policy to

central bank communication signals are also new to the literature. The closest two papers to ours are Adrian et al. (2024) and Leombroni et al. (2021). The former assesses the asymmetric effects of Fed monetary policy surprises on US long-term yields and spillover effects to global yields.[2] Leombroni et al. (2021) do not estimate asymmetric effects but assess how communication shocks (from ECB press conferences) affect euro area yields.

Overall, this paper relates to analyses of the term structure of interest rates and asset prices. Campbell and Shiller (1991), Rudebusch (1995), Fuhrer (1996) and Gerlach and Smets (1997) analyze the expectation hypothesis. Dai and Singleton (2002), McCallum (2005), Piazzesi (2005) and Goliński and Spencer (2024) decompose the term structure between various components including term or risk premium. Cochrane and Piazzesi (2005), Diebold et al. (2006), Gürkaynak et al. (2007) and Smith and Taylor (2009) characterize the functional form of the yield curve. Ang et al. (2011), Gürkaynak and Wright (2012), Hanson and Stein (2015), Ireland (2015), Wu and Xia (2016), Drechsler et al. (2018) and Tillmann (2020) explore how the macroeconomy and monetary policy affect the yield curve. Gottardo and Siena (2022) and Odendahl et al. (2024) analyze whether the monetary policy transmission depends on the shape of the yield curve. Finally, Levieuge and Sahuc (2021) document asymmetric responses of bank lending rates to monetary policy, while Bauer and Rudebusch (2014) and Neuhierl and Weber (2019) explore the signaling effects of policy decisions. We contribute to this literature along two dimensions. We explore the asymmetric effect of monetary policy on interest rates and characterize the role of central bank communication.

Our paper also connects to the literature on the identification of monetary policy that decomposes monetary policy surprises in different components. Romer and Romer (2000), Ellingsen and Söderström (2001) and Campbell et al. (2012) suggest that policymakers' actions can reveal their views of the state of the economy. Such signals embedded in policy announcements has given rise to the so-called central bank information effects (Jarociński and Karadi 2020 and Miranda-Agrippino and Ricco 2021). In Cieslak and Schrimpf (2019), the sign of the covariance between short-term and long-term interest rates is key to understanding the nature of non-monetary news. In contrast, we focus on the asymmetric effects of monetary surprises on nominal yields.

Finally, this paper relates to a large literature that analyses the effect of central bank communication (see Ehrmann and Fratzscher 2007). We build on various papers that use textual analysis to characterize central bank communication (Heinemann and Ullrich 2007, Lucca and Trebbi 2011, Apel and Blix-Grimaldi 2014, Hansen and McMahon 2016, Picault and Renault 2017, Ehrmann and Talmi 2020, and Fadda et al. 2022).

[2] Their analysis focuses on target (Kuttner 2001) shocks until 2007 and they consider an overall monetary surprise (Nakamura and Steinsson 2018) that encompasses the effect of all policy instruments over a longer sample ending in 2021. They do not identify future policy path surprises specifically.

2 Monetary policy and euro area sovereign interest rates

To measure the causal effect of monetary policy, we need an instrument for exogenous changes in the monetary policy stance. As standard in the literature, we identify unanticipated changes in the policy stance - usually called monetary policy surprises (*MPS*) - using high-frequency changes in asset prices around the policy decision release. We rely on the Euro-Area Monetary Policy Event-Study Database of Altavilla et al. (2019) which provides intraday changes in various asset prices in narrow windows around the press release (PR), the press conference (PC) and the monetary event (ME, *i.e.*, the reunion of the two latter events) from January 1999 to October 2023. Specifically, our baseline measure of monetary surprises is the first principal component of changes in 1-month, 3-month, 6-month and 1-year Overnight Index Swap (OIS) rates around the press release of the policy decision. We rescale this component such that it has a unit effect on 1-year OIS rates. Changes in OIS rates can be interpreted as the unanticipated component of monetary policy, as they reflect shifts in investors' expectations of short-term interest rates following the policy announcement.

Figure 1: Monetary policy surprises

Note: The baseline measure of monetary policy surprises is the first principal component (PC1) of changes in 1-month, 3-month, 6-month and 1-year OIS rates during the Press Release (PR) window as measured by Altavilla et al. (2019). It is scaled to have a unit effect on 1-year OIS rates. The y-axis is in basis points.

Figure 1 shows the evolution of monetary surprises over 221 ECB monetary policy announcements, from November 2001 to June 2023. While the standard deviation of *MPS* is 2 bp, the largest positive *MPS*, amounting to +11.7 bp, was recorded on 6 November 2008, following a 50 bp rate cut. The largest negative MPS, amounting to -9.03 bp, was recorded on 3 November 2011, following a 25 bp rate cut.[3] Later in the paper (Section 3.1), we decompose these overall monetary surprises, that are standard in the literature (see Nakamura and Steinsson 2018 and Bauer and Swanson 2023), into surprises associated to each type of instrument (short-term policy rate, forward guidance and asset purchases) following Altavilla et al. (2019) and Swanson (2021).[4]

[3] Appendix Tables A1 and A2 provides a summary data description and descriptive statistics.

[4] We restrict our decomposition of overall surprises to three factors, but some works decompose further the content of asset price changes in the announcement window (Akkaya et al. 2024, Ricco et al. 2024).

To capture the monetary policy transmission to sovereign nominal interest rates, we use the changes in 2-year, 5-year and 10-year sovereign yields of the four largest euro area countries during the PR window: Germany, France, Italy and Spain. Appendix Figures A1, A2, and A3 illustrate how these nominal yields evolve during the PR window over time. Using this panel of four euro area countries over 221 ECB meetings from November 2001 to June 2023, we estimate the link between monetary policy surprises and interest rates:

$$\Delta Y_{i,t}^{PR} = \alpha + \beta MPS_t + \gamma_i + \epsilon_{i,t} \tag{1}$$

where $\Delta Y_{i,t}^{PR}$ is successively the intraday change in 2-year, 5-year and 10-year yields of euro area country i during the PR window. MPS_t denotes our measure of monetary policy surprises and γ_i are country fixed effects.

Columns (1) to (3) of Table 1 show the outcome of Equation (1) estimated with OLS and Huber-White heteroskedasticity-robust standard errors. We find that the pass-through of monetary policy surprises is stronger to short-term yields than to longer ones (Evans and Marshall 1998). A 100 basis point (bp) monetary policy surprise is associated with a 59 bp increase in 2-year yields, a 47 bp increase in 5-year yields and a 26 bp increase in 10-year yields during the PR window.

Table 1: Monetary surprises and nominal yields

	2001 - 2023			**Excl. 2010 - 2016**			**2010 - 2016**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$
MPS_t	0.59***	0.47***	0.26***	0.52***	0.42***	0.22**	0.75***	0.59***	0.37***
	(0.09)	(0.09)	(0.07)	(0.11)	(0.11)	(0.09)	(0.11)	(0.11)	(0.11)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.19	0.11	0.04	0.14	0.08	0.02	0.42	0.27	0.14
Obs	878	881	884	622	625	628	256	256	256

Note: Robust standard errors in parentheses. **p<0.05; ***p<0.01. Parameters are estimated with OLS based on Equation (1). The dependent variable is the intraday change in 2-year, 5-year and 10-year yields, during the PR window. MPS_t is the first principal component of changes in 1-month, 3-month, 6-month and 1-year OIS rates during the PR window. Equation (1) is estimated over three sub-samples: Nov 2001-Jun 2023 (Columns 1 to 3), Nov 2001-Jun 2023 excluding Jun 2010-Jan 2016 (Columns 4 to 6), and Jun 2010-Jan 2016 (Columns 7 to 9).

One potential concern is that, between June 2010 and February 2016, unconventional decisions were announced during the press conference but not in the press release. Until December 2014, the ECB did not release information on unconventional policies (such as the OMT, LTROs and asset purchases) in the press release. Announcements were revealed during the press conference. From January 2015 to February 2016, the press release would note that further monetary policy measures will be announced in the press conference with no more details. Since March 2016, all policy measures are communicated and described in the press release. This implies that changes in OIS rates during the PR window may not always reflect the full policy announcement, but only the subset of decisions announced in the press release. Since we measure interest rate responses over the PR window (and

not over a larger window that includes the press conference), our estimates do not suffer an omitted variable bias *per se*. However, one cannot rule out that investors anticipated some unconventional policy announcement and reacted to its absence in the PR window. Outside the 2010-2016 period, these standard monetary policy surprises encompass all instruments.

To account for this, we estimate Equation (1) on a subsample excluding the period from May 2010 to February 2016 to ensure that monetary policy surprises are well identified. Estimates are provided in Columns (4) to (6) of Table 1. Columns (7) to (9) provide estimates for the complementary subsample from May 2010 to February 2016. For both subsamples, we find that monetary policy surprises have a stronger pass-through to short-term yields. The pass-through appears larger across all maturities during the 2010–2016 period, but differences with the full sample or the sample excluding these 6 years are not significant. Overall, our estimates of the transmission of monetary policy to interest rates do not seem much affected by this particular feature of ECB policy announcements. In Appendix Table A3, we further account for the fact that our measure of monetary policy surprises – a first principal component – might be associated with a generated regressor bias. We use an observable variable, the change in 1-year OIS rates, as an alternative measure of monetary policy surprises.

3 The asymmetric effects of tightening and easing surprises

3.1 Baseline asymmetric effects

We now explore whether the sign of monetary policy surprises matter for the transmission to nominal yields. The response of interest rates to tightening and easing surprises may not be symmetric, such that a linear framework would not reveal the true data-generating process and the effects of potentially different signals. To test this hypothesis, we estimate Equation (2) that decomposes the response of interest rates to tightening monetary surprises (MPS_t^{Pos}) and easing monetary surprises (MPS_t^{Neg}):

$$\Delta Y_{i,t}^{PR} = \alpha + \beta_P MPS_t^{Pos} + \beta_N MPS_t^{Neg} + \delta \mathbb{1}_t^{Pos} + \gamma_i + \epsilon_{i,t} \tag{2}$$

where $\mathbb{1}_t^{Pos}$ is a dummy variable that equals one when $MPS_t > 0$, such that both the intercept and the elasticity can be different for the two surprises. Estimates are shown in Table 2. Columns (1) to (3) provide the outcomes of the estimation over the entire sample, while Columns (4) to (9) are based on the two subsamples presented in Table 1.

We find that the pass-through of monetary surprises to interest rates is larger for easing surprises than for tightening ones. This is true for all maturities. A 100 bp easing surprise is associated with a 101 bp decrease in 2-year yields, while a 100 bp tightening surprise is associated with only a 31 bp increase in 2-year yields. Similarly, a 100 bp easing surprise decreases 5- and 10-year yields by 92 bp and 57 bp, while an equivalent tightening surprise

is associated with 21 bp and 7 bp increases (both non significant) in 5- and 10-year yields. The difference between the two parameters is statistically significant at the 1% level for all three maturities (see the *p*-values for the difference between responses to positive and negative surprises in the bottom part of Table 2). It is worth stressing that these tightening and easing surprises are otherwise similar (see Appendix Table A2). We find the same pattern over the two subsamples excluding or focusing on 2010-2016: the asymmetry between tightening and easing surprises is always at work and very significant.

Table 2: The asymmetric effects of monetary policy

	2001 - 2023			**Excl. 2010 - 2016**			**2010 - 2016**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$
MPS_t^{Pos}	0.31**	0.21	0.07	0.29**	0.18	0.06	0.25	0.16	0.06
	(0.12)	(0.12)	(0.09)	(0.14)	(0.14)	(0.11)	(0.18)	(0.17)	(0.18)
MPS_t^{Neg}	1.01***	0.92***	0.57***	0.97***	1.02***	0.63***	1.03***	0.85***	0.54***
	(0.10)	(0.13)	(0.12)	(0.25)	(0.27)	(0.23)	(0.08)	(0.11)	(0.13)
Diff *p-val*	0.00	0.00	0.00	0.02	0.01	0.02	0.00	0.00	0.03
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.24	0.15	0.06	0.17	0.12	0.04	0.51	0.35	0.19
Obs	878	881	884	622	625	628	256	256	256

Note: Robust standard errors in parentheses. **p<0.05; ***p<0.01. Parameters are estimated with OLS based on Equation (2). The dependent variable is the intraday change in 2-year, 5-year and 10-year yields, during the PR window. The specifications include a dummy $\mathbb{1}_t^{Pos}$ that equals 1 when $MPS_t > 0$. Equation (2) is estimated over three sub-samples: Nov 2001-Jun 2023 (Columns 1 to 3), Nov 2001-Jun 2023 excluding Jun 2010-Jan 2016 (Columns 4 to 6), Jun 2010-Jan 2016 (Columns 7 to 9).

This asymmetry is robust. In Appendix Table A4, we use changes in 1-year OIS rates during the PR window as an alternative measure of monetary policy surprises to circumvent the generated regressor bias. To further address this point, we also estimate Equation (2) with standard errors obtained from 1000 bootstrap simulations (see Appendix Table A5). The asymmetry is also robust to clustering standard errors at the country level (see Appendix Table A6). In Appendix Table A7, we truncate the distribution of monetary surprises at the 5th and 95th percentiles. Although Figure 1 suggests the presence of large events, we show that the asymmetry is not driven by outliers. These results suggest that investors extract different signals from the sign of monetary policy surprises. The two types of surprises appear to be interpreted in different ways: easing surprises being understood as having potentially more long-lasting effects on interest rates than tightening surprises.

3.2 Central bank information effects

We then explore whether the asymmetry between tightening and easing surprises is driven by signals about the economic outlook revealed by policy decisions - the so-called central bank information effects. Following Jarociński and Karadi (2020), we decompose monetary policy surprises into two components: pure monetary policy (MP) shocks and central bank information (CBI) shocks. Using their discrete decomposition, we classify a monetary policy surprise as a pure MP shock (CBI shock) when OIS rates move in the opposite

(same) direction as the Eurostoxx50 index during the PR window. We further decompose both MP and CBI shocks according to their sign, and estimate Equation (3):

$$\begin{aligned}\Delta Y_{i,t}^{PR} = \alpha + \beta_1 MP_t^{Pos} + \beta_2 MP_t^{Neg} + \beta_3 CBI_t^{Pos} + \beta_4 CBI_t^{Neg} \\ + \delta_1 \mathbb{1}_t^{MP>0} + \delta_2 \mathbb{1}_t^{CBI>0} + \gamma_i + \epsilon_{i,t}\end{aligned} \tag{3}$$

where $\mathbb{1}_t^{MP>0}$ and $\mathbb{1}_t^{CBI>0}$ are dummy variables that equal one when MP shocks and CBI shocks are positive. Estimates are presented in Table 3.

We find that the asymmetry between tightening and easing surprises is driven by pure monetary policy shocks. These shocks have strong asymmetric effects on 2-, 5- and 10-year yields, with the difference between responses of interest rates to positive and negative shocks being highly significant (see *p*-values in bottom part of Table 3). Specifically, a 100 bp easing monetary policy shock decreases 5-year yields by 118 bp, while a 100 bp tightening monetary shock is associated with a 3 bp (non significant) increase. In contrast, there is no asymmetry in the effects of central bank information shocks. The responses of interest rates to positive and negative CBI shocks are not statistically different for any of the three maturities. These results suggest that investors are not interpreting differently tightening and easing surprises with respect to signals about the state of the economy. The asymmetric interpretation of these surprises seems related to monetary policy.

Table 3: Central bank information shocks

	(1) $2Y_{PR}$	(2) $5Y_{PR}$	(3) $10Y_{PR}$
MP_t^{Pos}	0.18	0.03	-0.08
	(0.16)	(0.14)	(0.11)
MP_t^{Neg}	1.25***	1.18***	0.77***
	(0.14)	(0.20)	(0.18)
CBI_t^{Pos}	0.61***	0.62***	0.36***
	(0.13)	(0.14)	(0.09)
CBI_t^{Neg}	0.52***	0.38**	0.17
	(0.19)	(0.19)	(0.19)
MP Diff *p-val*	0.00	0.00	0.00
CBI Diff *p-val*	0.71	0.31	0.35
Country FE	Yes	Yes	Yes
R^2	0.27	0.19	0.10
Obs	878	881	884

Note: Robust standard errors in parentheses. **p<0.05; ***p<0.01. Parameters are estimated with OLS based on Equation (3) over the sample Nov 2001-Jun 2023. The dependent variable is the intraday change in 2-year, 5-year and 10-year yields, during the PR window. MPS_t is decomposed into two components according to Jarociński and Karadi (2020) discrete decomposition procedure: pure monetary policy shocks (MP_t) and central bank information shocks (CBI_t). The specification includes two dummy variables $\mathbb{1}_t^{MP_t>0}$ and $\mathbb{1}_t^{CBI_t>0}$ that equal one when MP_t, resp. CBI_t, are positive.

While the discrete specification of *MP* and *CBI* is simple, transparent and does not require a first-stage estimation, it is based on the assumption that each monetary policy announcement is categorized as either a monetary policy shock or central bank information

shock, which may be considered as a restrictive assumption. In Appendix Table A8, we employ the continuous decomposition proposed by Jarociński and Karadi (2020) to identify MP and CBI shocks. This methodology allows for the simultaneous presence of both types of shocks in a given monetary surprise. Our main result is robust to this alternative decomposition: the asymmetry comes from monetary policy shocks. For all maturities, the pass-through of easing shocks is stronger and the difference is highly significant.[5]

3.3 Target, Path and Long-Term components

We now assess whether the asymmetric transmission between tightening and easing surprises is driven by a particular type of policy instrument, such as short-term policy rate, forward guidance and asset purchases. To do so, we decompose the overall monetary surprise around policy announcements into three components, each of them affecting different segments of the yield curve. We follow Gürkaynak et al. (2005b), Altavilla et al. (2019) and Swanson (2021), and identify *Target*, *Path* and *Long-Term* (LT) components. The Target surprise refers to unexpected changes in the current policy decision, the Path surprise is informative about the likely future policy path in the medium-term, and the LT surprise primarily captures asset purchases via their influence on long-term yields.

We measure Target surprises as changes in 1-month OIS rates around the PR window. To identify Path surprises, we consider the changes in 3-month, 6-month and 1-year OIS rates around the PR window ($\Delta OIS^{PR}_{h,t}$) that are not explained by both positive and negative Target surprises. For this reason, we proceed differently from the papers mentioned above, but the spirit of the approach is similar. For each maturity – $\Delta OIS^{PR}_{3m,t}$, $\Delta OIS^{PR}_{6m,t}$, $\Delta OIS^{PR}_{1y,t}$ –, we estimate Equation (4). Path surprises are then measured as the first principal component of the residuals from these three regressions. Path surprises are rescaled so that a one-unit change in the principal component corresponds to a 100 bp change in 1-year OIS rates. By construction, Path surprises are therefore orthogonal to both positive and negative Target surprises.

$$\Delta OIS^{PR}_{h,t} = \alpha + \beta_1 Target^{Pos}_t + \beta_2 Target^{Neg}_t + \epsilon_t \tag{4}$$

We identify LT surprises as of January 2015, when the ECB announced its quantitative easing program focusing on sovereign bonds (in the spirit of Altavilla et al. 2019). We consider the changes in 2-year, 5-year and 10-year OIS rates around the PR window that are not explained by positive and negative Target and Path surprises. For each maturity – $\Delta OIS^{PR}_{2y,t}$, $\Delta OIS^{PR}_{5y,t}$, $\Delta OIS^{PR}_{10y,t}$ –, we estimate Equation (5). LT surprises are then measured as the first principal component of the residuals from these three regressions. LT surprises are rescaled so that a one-unit change in the principal component corresponds to a 100 bp change in 5-year OIS rates. By construction, LT surprises are orthogonal to positive and

[5]The response of long-term interest rates to negative CBI shocks even displays a counter-intuitive pattern: negative signals about the economic outlook – lower economic growth or inflation – increase interest rates.

negative Target and Path surprises. Appendix Figure A7 shows the evolution of Target, Path and Long-Term surprises from 2001 to 2023.

$$\Delta OIS_{h,t}^{PR} = \alpha + \beta_1 Target_t^{Pos} + \beta_2 Target_t^{Neg} + \beta_3 Path_t^{Pos} + \beta_4 Path_t^{Neg} + \epsilon_t \tag{5}$$

To test whether the asymmetry between tightening and easing surprises is driven by one, or more, of the three components of monetary surprises, we estimate Equation (6):

$$\begin{aligned}\Delta Y_{i,t}^{PR} = \alpha &+ \beta_1 Target_t^{Pos} + \beta_2 Target_t^{Neg} + \beta_3 Path_t^{Pos} + \beta_4 Path_t^{Neg} \\ &+ \beta_5 LT_t^{Pos} + \beta_6 LT_t^{Neg} + \delta_1 \mathbb{1}_t^{Target>0} + \delta_2 \mathbb{1}_t^{Path>0} + \delta_3 \mathbb{1}_t^{LT>0} + \gamma_i + \epsilon_{i,t}\end{aligned} \tag{6}$$

where $\mathbb{1}_t^{Target>0}$, $\mathbb{1}_t^{Path>0}$ and $\mathbb{1}_t^{LT>0}$ are dummy variables that equal one when Target, Path and LT surprises, respectively, are positive. Estimates are presented in Table 4.

Table 4: Target, Path and Long-Term components

	Target and Path			**Adding a Long-Term factor**		
	(1)	(2)	(3)	(4)	(5)	(6)
	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$
$Target_t^{Pos}$	0.19***	0.09	0.01	0.20***	0.11***	0.04
	(0.06)	(0.05)	(0.05)	(0.06)	(0.04)	(0.05)
$Target_t^{Neg}$	0.32***	0.20**	0.05	0.33***	0.21**	0.06
	(0.09)	(0.09)	(0.07)	(0.09)	(0.08)	(0.07)
$Path_t^{Pos}$	0.53***	0.56***	0.39***	0.58***	0.62***	0.45***
	(0.12)	(0.13)	(0.08)	(0.10)	(0.09)	(0.04)
$Path_t^{Neg}$	1.46***	1.59***	1.20***	1.51***	1.66***	1.28***
	(0.14)	(0.12)	(0.11)	(0.16)	(0.16)	(0.15)
LT_t^{Pos}				1.12***	1.66***	1.64***
				(0.16)	(0.11)	(0.19)
LT_t^{Neg}				1.17***	1.56***	1.65***
				(0.20)	(0.16)	(0.19)
Target Diff *p-val*	0.24	0.29	0.67	0.27	0.34	0.82
Path Diff *p-val*	0.00	0.00	0.00	0.00	0.00	0.00
LT Diff *p-val*	.	.	.	0.86	0.61	0.96
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.39	0.35	0.22	0.53	0.60	0.53
Obs	878	881	884	878	881	884

Note: Robust standard errors in parentheses. **p<0.05; ***p<0.01. Parameters are estimated with OLS based on Equation (6) over the sample Nov 2001-Jun 2023. The dependent variable is the intraday change in 2-year, 5-year and 10-year yields, during the PR window. The specifications include three dummy variables $\mathbb{1}_t^{Target_t>0}$, $\mathbb{1}_t^{Path_t>0}$, $\mathbb{1}_t^{LT_t>0}$ that equal one when $Target_t$, $Path_t$ and LT_t are positive.

Columns (1) to (3) present estimates of a specification of Equation (6) that focuses on the effect of Target and Path surprises only. Columns (6) to (9) reports estimates of the full specification of Equation (6) that includes LT surprises. We find that the asymmetry in the transmission of tightening and easing monetary policy surprises to nominal yields is driven by Path surprises. This result holds in the two specifications with and without LT

surprises. Target surprises and LT surprises do affect interest rates (with the latter having more traction on longer maturities) but their effects are not asymmetric as shown by the p-values at the bottom of Table 4. In contrast, Path surprises have clear asymmetric effects on interest rates at all three maturities. For instance, a 100 bp easing Path surprise decreases 10-year yields by 120 bp, but a 100 bp tightening Path surprise is associated with only a 39 bp increase. The difference in interest rate responses to both positive and negative Path surprises is highly significant. Our results are robust to identifying LT surprises as of January 2008 to account for the set of unconventional measures implemented before 2015 (see Appendix Table A9 and Pagliari 2024 for a list of unconventional policy measures in the euro area since the Great Financial Crisis). While estimates in Section 3.2 support that the asymmetry is not related to information effects but to signals about monetary policy, estimates from Table 4 refine this result and suggest that investors extract different signals about the future policy path from tightening and easing surprises.

3.4 Common vs. country-specific factors

To further explore the nature of the signals underlying the asymmetric transmission of monetary policy to interest rates, we complement the previous section with another approach. We leverage the fact that, in the euro area, the short-term policy rate is unique for all countries but long-term interest rates are not, so that we can identify a common component in sovereign yields together with country-specific components. Indeed, the asymmetry could be driven by some specific countries that structurally react differently to ECB monetary policy (Almgren et al. 2022) beyond the country fixed effects. It could also be that the asymmetry is due to differentiated effects of asset purchases (especially with capital key deviations) on some countries' sovereign yields (Altavilla et al. 2021, Hubert et al. 2024).

For each country, we decompose 2-, 5- and 10-year sovereign yields into a common component and a country-specific component (Leombroni et al. 2021, Gnewuch 2022). To do so, we orthogonalize sovereign interest rates to 1-year OIS rates – which reflect movements in the common euro area short-term interest rate – based on Equation (7):

$$\Delta Y_{i,t}^{PR} = \alpha + \beta \Delta OIS_{1Y,t}^{PR} + \epsilon_t \tag{7}$$

The fitted values of changes in sovereign yields at each maturity estimated from Equation (7) capture the common component. We assume that this common component reflects changes in expectations of future short-term interest rates and can be seen as an "ECB component" similar in spirit to the Expectation Hypothesis (EH) component of the term structure of interest rates. The EH theory predicts that changes in long-term rates are driven by changes in expected future short-term rates (see Mumtaz and Surico 2009 for a test of this hypothesis). The residuals of this estimation capture the country-specific component. This component measures all yield changes not accounted for by the common factor. This

can include some country-specific term premium, risk premium and/or country-specific effects of asset purchases, among other factors (see Piazzesi and Schneider 2006 for complementary reasons why investors demand higher returns to hold long-term bonds). The literature has extensively documented that monetary policy can affect risk perceptions of investors (Bernanke and Kuttner 2005, Kekre and Lenel 2022, Pflueger and Rinaldi 2022).

By construction, in a linear specification, one would expect the common factor to react mechanically one-for-one to monetary policy surprises (themselves measured as changes in 1-year OIS rates). We deviate from this configuration in two ways. First, we consider a non-linear specification to assess the effect of both tightening and easing monetary policy surprises. Second, we use a broader measure of monetary policy surprises that encompasses changes in 1-month to 1-year OIS rates. The link between monetary surprises and the common factor is therefore less mechanical. We estimate that link and the effect of monetary surprises on the country-specific factors using Equation (2) with both components of 2-, 5- and 10-year yields as dependent variables.

Table 5: Common vs. country-specific factors

	Common factor			**Country-specific factor**		
	(1)	(2)	(3)	(4)	(5)	(6)
	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$
MPS_t^{Pos}	0.71***	0.69***	0.48***	-0.41***	-0.48***	-0.41***
	(0.06)	(0.06)	(0.05)	(0.08)	(0.08)	(0.07)
MPS_t^{Neg}	0.90***	0.87***	0.61***	0.11	0.05	-0.03
	(0.07)	(0.06)	(0.05)	(0.07)	(0.08)	(0.09)
Diff *p-val*	0.05	0.03	0.06	0.00	0.00	0.00
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.75	0.77	0.74	0.09	0.11	0.07
Obs	878	881	884	878	881	884

Note: Robust standard errors in parentheses. **p<0.05; ***p<0.01. Parameters are estimated with OLS based on Equation (2) over the sample Nov 2001-Jun 2023. The dependent variable is the intraday change in common vs country-specific factors, during the PR window. The specifications include a dummy $\mathbb{1}_t^{Pos}$ that equals 1 when $MPS_t > 0$.

Estimates are presented in Table 5. Columns (1) to (3) show the response of the common component to tightening and easing monetary policy surprises, while columns (4) to (6) refer to the country-specific component. It is worth stressing that we find evidence of an asymmetric transmission to the common component of sovereign yields. Easing surprises again have more effect on the common component than tightening surprises and this difference in responses is significant. This is consistent with the result that the asymmetry is driven by Path surprises as evidenced in Section 3.3 and reinforces the interpretation that investors extract different signals about the dynamics of policy cycles from tightening and easing surprises.

The country-specific component also exhibits an asymmetric transmission that in fact reinforces the pattern: tightening surprises have a negative effect on the country-specific component thereby reducing the transmission of monetary policy to interest rates, while

easing surprises have no effect so they do not offset the transmission. The negative effect of tightening surprises on the country-specific component of interest rates is strong and very significant and suggests that tightening surprises reduce term or risk premia. We assess the robustness of this latter result in various ways. We use changes in 2-year OIS rates (as 1-year rates are part of the monetary policy measure) and in 1-year German sovereign yields (as a different measure of a risk-free rate) as alternative proxies for the common short-term interest rate in the euro area. Estimates in Appendix Table A10 show that this negative effect of tightening surprises on this country-specific component is robust. In Appendix Table A11, we focus on sovereign risks as one particular aspect of country-specific factors (see Motto and Özen 2022 on the heterogeneous transmission of monetary policy across sovereign segments). We use the 2-year, 5-year and 10-year sovereign spreads of France, Italy and Spain with respect to Germany. We do not find a negative effect of tightening surprises on sovereign spreads suggesting that the asymmetric mechanism may operate through term premium more than sovereign risks.[6]

The asymmetric effect on country-specific factors can be explained in three ways. First, tightening surprises signal higher future short-term interest rates and so, higher long-term rates. This can lead investors to adjust the extra yield they require for holding longer-term bonds, i.e. the term premium (Ireland 2015). Second, tightening surprises can reduce uncertainty by signaling a commitment to controlling inflation. Lower uncertainty can decrease risk premium, as investors require less compensation for risk (Amisano and Tristani 2023). Third, tightening surprises lead to lower stock prices, so investors shift their portfolios towards bonds, therefore reducing the risk premium on bonds (Drechsler et al. 2018). This result suggests that two complementary forces are at play in creating this asymmetric transmission: easing surprises convey signals about the future policy cycle that amplify the response of interest rates, while tightening surprises convey signals about term or risk premia that attenuate the response of interest rates. It appears that the asymmetry stems from signals about monetary cycle dynamics, and that signals about term and risk premia magnify this asymmetry. It is also worth stressing that the decomposition of nominal yields in this section and the decomposition of monetary surprises across instruments from Section 3.3 provide consistent evidence.

3.5 Asymmetric effects beyond the economic environment

We finally explore whether the asymmetric transmission of monetary policy could reflect a state-dependence to the economic of financial environment, focusing on the monetary context, business cycle dynamics, as well as uncertainty.

[6] In Appendix Table A12, we estimate Equation (2) with the decomposition of monetary surprises between Target, Path and LT shown in Section 3.3. The stronger effect of easing monetary surprises on nominal yields is clearly driven by path surprises, for both the common and country-specific factors. The negative effect of tightening surprises on the country-specific component is driven by target surprises.

First, we account for the monetary policy environment considering the potential influence of the level and cycle of interest rates, using the dynamics of 1-year OIS rates. Second, we analyze business cycle dynamics, focusing on inflation and output gap measures. We consider the Hodrick-Prescott cyclical components of euro area inflation and industrial production. Third, we examine the influence of financial and economic uncertainty using the VSTOXX, the Eurostoxx50 implied volatility index, a standard measure of financial market volatility, and the average Economic Policy Uncertainty (EPU) index developed by Baker et al. (2016) for Germany, France, Italy and Spain.

Table 6: The influence of the economic environment

	MP level	**MP cycles**	**Inflation**	**Output**	**VSTOXX**	**EPU**
	(1) $10Y_{PR}$	(2) $10Y_{PR}$	(3) $10Y_{PR}$	(4) $10Y_{PR}$	(5) $10Y_{PR}$	(6) $10Y_{PR}$
$MPS_t^{Pos} \mid z_t^H$	-0.14	-0.07	-0.01	-0.02	0.23***	0.11
	(0.09)	(0.15)	(0.09)	(0.12)	(0.08)	(0.13)
$MPS_t^{Pos} \mid z_t^L$	0.31***	0.19	0.39	0.22	-0.60***	0.001
	(0.12)	(0.11)	(0.23)	(0.13)	(0.09)	(0.05)
$MPS_t^{Neg} \mid z_t^H$	0.54**	1.75***	0.56***	1.23**	0.54***	0.52***
	(0.23)	(0.50)	(0.14)	(0.60)	(0.13)	(0.13)
$MPS_t^{Neg} \mid z_t^L$	0.61***	0.42***	0.75***	0.51***	0.85***	0.78***
	(0.14)	(0.09)	(0.19)	(0.10)	(0.24)	(0.24)
High Diff *p-val*	0.01	0.00	0.00	0.05	0.05	0.03
Low Diff *p-val*	0.11	0.11	0.24	0.08	0.00	0.00
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Z_t	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.09	0.09	0.08	0.08	0.13	0.07
Obs	884	884	884	884	884	884

Note: Robust standard errors in parentheses. **p<0.05; ***p<0.01. Parameters are estimated with OLS based on Equation (8) over the sample Nov 2001-Jun 2023. The dependent variable is the intraday change in 10-year yields during the PR window. The specifications include a dummy variable $\mathbb{1}_t^{Pos}$ that equals 1 when $MPS_t > 0$ and a dummy variable Z_t^H that equals one when the state variable is high.

For each variable considered, we define two dummies equal to one when such variable is *High* (z_t^H) or *Low* (z_t^L). We consider the interest rate level to be high when 1-year OIS rates are above their mean over our sample of Governing Council meetings (*i.e.* 1.29%). We define monetary policy to be in a tightening cycle when the 40-business day variation in 1-year OIS rates is positive. This corresponds to changes from one meeting to another. Because of the gradual and persistent nature of monetary policy cycles (Rudebusch 2002), using changes between two meetings is akin to using changes over longer horizons without the drawback of losing observations. For business cycle dynamics, we define the dummy as high when the cyclical components of euro area inflation and industrial production are positive. Finally, we consider financial and economic uncertainty to be high when the VSTOXX level on the day preceding a press conference, or when the EPU index in the month preceding a press conference, are above their median over our sample. We estimate, for each variable, the following Equation (8):

$$\Delta Y_{i,t}^{PR} = \alpha + \beta_1 MPS_t^{Pos} \mid z_t^H + \beta_2 MPS_t^{Pos} \mid z_t^L + \beta_3 MPS_t^{Neg} \mid z_t^H + \beta_4 MPS_t^{Neg} \mid z_t^L + \delta \mathbb{1}_t^{Pos} + \kappa z_t^H + \gamma_i + \epsilon_{i,t} \tag{8}$$

where positive and tightening monetary policy surprises are interacted with the two dummies previously defined (z_t^H and z_t^L). We report estimates of the transmission of monetary policy to 10-year yields in Table 6. Appendix Tables A13 and A14 show the response of 2- and 5-year yields respectively.

We find that the asymmetry in the effect of tightening and easing monetary surprises does not depend on the economic environment. It does not appear that the differentiated effects of the positive and negative surprises can be captured by one of these characteristics. The transmission of easing surprises to 10-year yields is always effective, while the transmission of tightening surprises appears much weaker and less stable.

4 The influence of central bank communication

4.1 The importance of the press conference

Signals conveyed during ECB press conferences may also influence the transmission of monetary policy to nominal yields, above and beyond the policy decision revealed in the press release. Ehrmann and Fratzscher (2009) and Hayo et al. (2022) provide evidence that financial markets pay strong attention to the ECB press conference. There is also ample evidence of sizable market reactions to press conferences held by other central banks such as the Federal Reserve (Gorodnichenko et al. 2023, Swanson and Jayawickrema 2024, Narain and Sangani 2025). Press conferences may help understand policy decisions and therefore affect the interpretation of tightening and easing monetary surprises.

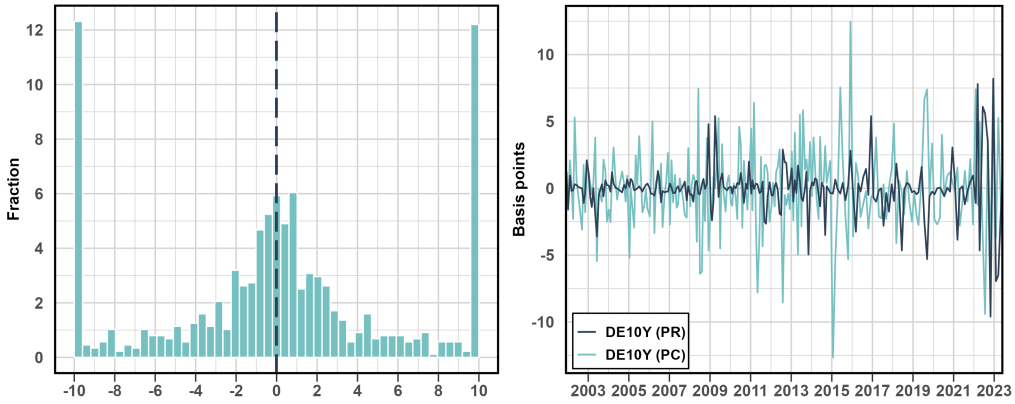
The ECB communication setting offers a relevant framework to disentangle information revealed during the press conference from the effect of policy decisions, revealed in the press release. ECB monetary policy events are organized as follows: (i) the press release is published at 14:15, and (ii) the press conference starts at 14:45 and is split between the reading of the introductory statement by the ECB President and a Q&As session with journalists.[7] Many central banks have a similar setting, but with much less history. The FOMC started to hold press conferences systematically in 2019 only while the ECB started in 1999. Our analysis in this section is motivated by two observations.

First, Figure 2 provides evidence of sizable responses of interest rates in the press conference window. The left panel plots the distribution of the ratio of changes in 10-year yields during the PC window over changes in 10-year yields during the PR window.[8] In 73% of ECB meetings, changes in 10-year interest rates are larger in the press conference

[7] Before July 2022, the press release was published at 13:45 and the press conference started at 14:30.
[8] For the sake of brevity, we focus on 10-year yields, but similar patterns are observed for 2- and 5-year yields.

than in the press release (the ratio is superior to one in absolute value). This suggests that ECB communication during press conferences provides investors with additional insights compared with the initial policy decision release.

Figure 2: Characterizing changes in nominal yields in press conferences



Note: The left panel plots the distribution across the 221 meetings of our sample of the ratio $\Delta 10Y_{PC}/\Delta 10Y_{PR}$ for the four euro area countries studied. The ratio is winsorised at -10 and 10 values. The vertical dashed line represents the mean of the winsorised ratio (-0.006) across the 221 observations. The right panel plots the intraday changes in DE 10-year yields around the PR and PC windows.

Second, the sign of interest rate responses varies considerably between the press release and press conference windows. In 46% of ECB meetings, the ratio of PC changes over PR changes is negative indicating that the sign of changes in 10-year yields flipped in the two windows. The right panel of Figure 2 – which shows the two components of the ratio for Germany – further illustrates this point.[9] This shift indicates different signs of monetary policy news in the two windows, hinting at potential conflicting signals, that would in turn affect the transmission of monetary policy.

We investigate this hypothesis, defining conflicting signals as cases when monetary policy news, measured as changes in OIS rates during PR and PC windows, have opposite signs (see Herbert et al. 2025 on the importance of these meetings for the transmission of monetary policy).[10] We then distinguish between ECB announcement days associated with consistent (158 meetings) and conflicting signals (63 meetings). For each of these two subsamples, we estimate Equation (9) considering the change in interest rates in the full monetary event (ME) - including both PR and PC windows - as the dependent variable.

$$\Delta Y_{i,t}^{ME} = \alpha + \beta_P MPS_t^{Pos} + \beta_N MPS_t^{Neg} + \delta \mathbb{1}_t^{Pos} + \gamma_i + \epsilon_{i,t} \tag{9}$$

Estimates are shown in Table 7. Columns (1) to (3) show the response of nominal yields to monetary policy surprises over the ME window for the entire sample of meetings.

[9] See the corresponding plot for France, Italy and Spain in Appendix Figures A4, A5, and A6.

[10] A second criteria is that the absolute difference between the two opposite-sign variations exceeds 1 basis point so the two signals are actually different and not near zero.

Columns (4) to (6) report estimates of the effect of monetary policy on nominal yields for monetary events with consistent signals, while Columns (7) to (9) provide the corresponding estimates for monetary events with conflicting signals.

Table 7: The role of conflicting signals

	2001 - 2023			Consistent signals			Conflicting signals		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	$2Y_{ME}$	$5Y_{ME}$	$10Y_{ME}$	$2Y_{ME}$	$5Y_{ME}$	$10Y_{ME}$	$2Y_{ME}$	$5Y_{ME}$	$10Y_{ME}$
MPS_t^{Pos}	0.79***	0.55***	0.38	0.80***	0.43**	0.20	0.91***	0.91	0.86
	(0.18)	(0.21)	(0.22)	(0.21)	(0.18)	(0.16)	(0.35)	(0.50)	(0.56)
MPS_t^{Neg}	0.82***	0.73***	0.38**	2.91***	3.13***	2.24***	1.05***	0.81***	0.34**
	(0.19)	(0.22)	(0.19)	(0.60)	(0.66)	(0.61)	(0.16)	(0.17)	(0.14)
Diff *p-val*	0.91	0.56	0.99	0.00	0.00	0.00	0.73	0.85	0.37
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.12	0.09	0.05	0.31	0.24	0.16	0.13	0.08	0.06
Obs	878	881	884	627	630	632	251	251	252

Note: Robust standard errors in parentheses. **p<0.05; ***p<0.01. Parameters are estimated with OLS based on Equation (9). The dependent variable is the intraday change in 2-year, 5-year and 10-year yields, during the ME window. Equation (9) is estimated over the sample Nov 2001-Jun 2023 considering all monetary policy events (Columns 1 to 3), monetary events associated with consistent signals (Columns 4 to 6) and conflicting signals (Columns 7 to 9). The specifications include a dummy $\mathbb{1}_t^{Pos}$ that equals 1 when $MPS_t > 0$.

We find that the asymmetry in the transmission of monetary policy to nominal yields only operates when there are consistent signals between the PR and PC windows. In this case, the asymmetry is even more pronounced. In contrast, in the presence of conflicting signals, the asymmetry dissipates. This suggests a crucial role for ECB communication during press conferences: when signals conveyed during the press conference are of opposite signs with those of the press release, they are able to offset the signals conveyed in the press release. This result suggests that central bank communication is able to amplify or offset the transmission of the initial policy shock to interest rates.

4.2 ECB communication about future monetary policy

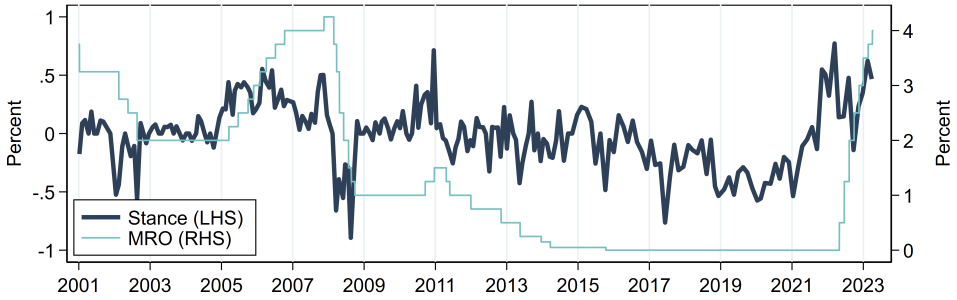
One avenue to measure the stance of monetary policy is to focus on the natural rate of interest (Christensen and Mouabbi 2024). In contrast, we aim to capture policymakers' signals about this stance revealed during the press conference. To quantify these, we employ textual analysis techniques applied to transcripts of ECB press conferences. We follow Cieslak and McMahon (2023) and adapt their procedure to the euro area context. We focus on the content of the introductory statement and the answers provided during the Q&As session to reflect ECB officials' views. First, using a set of key words, we select sentences related to monetary policy. Second, we identify "hawkish" and "dovish" words and account for negations considering that hawkish (dovish) words preceded by a negation are considered as dovish (hawkish). We adapt this procedure to account for the gradual deployment of unconventional monetary policies. The detailed steps of the procedure can be found in Appendix A. We compute a measure of the difference between hawkish and

dovish words, scaled by the length of the introductory statement and the answers after stop words removal, as described in Equation (10).

$$Stance_t = 100 * \frac{Hawkish_t^{IS+A} - Dovish_t^{IS+A}}{Words_t^{IS} + Words_t^{A}} \tag{10}$$

$Hawkish_t^{IS+A}$ is the number of hawkish words in the introductory statement (IS) and the answers (A) of the press conference occurring at date t, $Dovish_t^{IS+A}$ is the number of dovish words in the introductory statement and the answers, and $Words_t^{IS}$ and $Words_t^{A}$ are the total number of words of the introductory statement and the answers.

Figure 3: ECB stance



Note: The $Stance_t$ variable is measured based on the content of the introductory statement and the answers provided during the press conference. The evolution of the Main Refinancing Rate (MRO) is plotted alongside (RHS).

Figure 3 shows the evolution of the stance variable over time, along with the Main Refinancing Operations (MRO) rate.[11] We document in Appendix Table A15 two interesting properties of this $Stance_t$ variable. First, it is *positively* correlated with the near-future policy stance (a more positive/hawkish stance predicts a higher MRO over the next meetings – see Cieslak and McMahon 2023 for a similar result). Second, the $Stance_t$ variable is *negatively* correlated with 2-, 5- and 10-year rates such that a more positive/hawkish stance predicts lower long-term interest rates. These estimates suggest that central bank communication about the monetary stance does not only signal future decisions in the coming months, but also the available future policy space in the long-run, in the spirit of a mean-reverting process.

This interpretation of policymakers' signals is common as investors and central bank watchers are very much forward-looking. One can illustrate this mechanism with some examples of the financial press reaction. On 2 February 2023, the ECB decision triggered a 0.6 bp easing surprise and the stance variable increased. The Financial Times reported: "*European government bond markets surged the most in years while stocks also rallied as investors bet that interest rates on both sides of the Atlantic would soon peak*" (emphasis added). Market participants interpret ECB communication as signaling a reduced upward future policy

[11] We then use a moving average - computed over a 12-meeting window - of this high-frequency stance variable to capture its underlying trend rather than volatile patterns and noisy variations.

space, or said differently, a balance of future policy decisions skewed to the downside (*i.e.* a higher likelihood for future easing decisions). It is important to stress that the upper and lower bounds that define the available monetary space are not related to mechanical constraints, such as the Zero Lower Bound, but to the peak and through of monetary cycles as perceived by investors.

Another example is the 5 July 2012 decision that generated a 7.5 bp easing surprise. The stance variable decreased on that day. However, the Financial Times reported that "*there is now little left for the ECB to do in terms of lowering interest rates*" or "*the ECB now looks to be effectively out of ammunition*" (emphasis added). It is striking that the ECB communication captured by the stance variable is not interpreted as a more dovish current policy stance, but as signals about limited room for further dovish policy rate changes. It signals a limited downward future policy space, or that the balance of future policy decisions is now skewed to the upside.

Another striking example of such signals is when Mario Draghi, on 10 March 2016, announced during the press conference that the ECB didn't expect "*to reduce rates further*", which had the effect to revert asset price dynamics that had followed the (easing) decision announced one hour earlier. The dominant interpretation of investors at the end of the day (reflected in asset prices) was that there was no downward future policy space and the balance of future policy decisions was now only on the upside. Although anecdotal, these examples provide suggestive evidence of how ECB communication about the monetary stance can be interpreted in the light of the long-run *future policy space* available to policymakers. Following a sort of mean-reverting process, a more hawkish stance indicates increased downward monetary space, suggesting a higher likelihood for easing in the more distant future. Conversely, a more dovish stance indicates increased upward monetary space, suggesting a higher likelihood for future tightening. Appendix Table A15 provides empirical evidence of this interpretation of stance signals.

4.3 The effect of ECB signals during the press conference

We finally explore whether ECB signals about the long-run monetary policy space affect the transmission of monetary policy to nominal yields. To do so, we define two dummy variables that categorize whether ECB communication convey signals about more downward future policy space FPS_t^{Down} (that equals one when $\Delta_m Stance_t > 0$), or signals about more upward future policy space FPS_t^{Up} (that equals one when $\Delta_m Stance_t < 0$). To only account for information that has not yet been integrated by financial markets, we focus on new signals revealed in a given press conference and consider the change in the stance variable $\Delta_m Stance_t$, from meeting $m-1$ to meeting m.

Equation (11) present a non-linear specification to assess the influence of these signals from the press conference on the transmission of monetary policy:

$$\begin{aligned}\Delta Y_{i,t}^{ME} = \alpha &+ \beta_1 \, MPS_t^{Pos} \mid FPS_t^{Up} + \beta_2 \, MPS_t^{Pos} \mid FPS_t^{Down} \\ &+ \beta_3 \, MPS_t^{Neg} \mid FPS_t^{Up} + \beta_4 \, MPS_t^{Neg} \mid FPS_t^{Down} \\ &+ \delta_1 \mathbb{1}_t^{Pos} + \delta_2 \mathbb{1}_t^{Up} + \omega X_t + \gamma_i + \epsilon_{i,t}\end{aligned} \tag{11}$$

where $\mathbb{1}_t^{Up}$ is a dummy variable that equals one when the stance variable indicates upward future monetary policy space. We also include a vector of control variables X_t to account for additional news revealed in the press conference. First, we include a dummy for dissent in the monetary policy committee regarding the policy decision, that is revealed during the press conference (using the series of Blot et al. 2025). Second, we include dummy variables to control for unconventional policy announcements and the quarterly release of the ECB macroeconomic projections. Third, we control for the tone of policymakers during the press conference as it also conveys valuable insights to investors (Hansen and McMahon 2016, Correa et al. 2021, Hubert and Labondance 2021, Schmeling and Wagner 2025).[12] Finally, we also control for financial uncertainty using the VSTOXX and CISS prior to the ECB meeting.

Table 8: The role of ECB communication

	(1) $2Y_{ME}$	(2) $5Y_{ME}$	(3) $10Y_{ME}$
$MPS_t^{Pos} \mid FPS_t^{Up}$	1.24***	1.02***	0.80**
	(0.23)	(0.29)	(0.33)
$MPS_t^{Pos} \mid FPS_t^{Down}$	0.35	-0.02	-0.18
	(0.22)	(0.19)	(0.15)
$MPS_t^{Neg} \mid FPS_t^{Up}$	0.42**	0.40	0.16
	(0.19)	(0.21)	(0.18)
$MPS_t^{Neg} \mid FPS_t^{Down}$	1.69***	1.51**	0.92
	(0.56)	(0.64)	(0.60)
Pos Diff *p-val*	0.00	0.00	0.00
Neg Diff *p-val*	0.03	0.10	0.22
Up Diff *p-val*	0.01	0.09	0.10
Down Diff *p-val*	0.03	0.03	0.08
Country FE	Yes	Yes	Yes
X_t	Yes	Yes	Yes
R^2	0.17	0.14	0.10
Obs	878	881	884

Note: Robust standard errors in parentheses. **p<0.05; ***p<0.01. Parameters are estimated with OLS based on Equation (11). The dependent variable is the intraday change in 2-, 5- and 10-year yields, during the ME window. Equation (11) is estimated over the sample Nov 2001-Jun 2023. X_t is a vector of control variables, including (i) the tone of the ECB, (ii) dummy variables accounting for dissent among policymakers, unconventional monetary policy announcements and the release of ECB macroeconomic forecasts, (iii) the level of the VSTOXX and the CISS prior to the ECB meeting.

Table 8 shows the estimates of Equation (11) when monetary policy surprises are split between tightening and easing surprises and according to ECB stance signals. We find that

[12] We measure tone as the difference between positive and negative words, as defined by Loughran and McDonald (2011), scaled by the length of policymakers' intervention.

the ECB communication affects the asymmetric transmission of monetary policy surprises to nominal yields.[13] The pass-through of tightening surprises is strong when associated with signals about more upward future policy space. The point estimates are similar to, if not larger than, those of easing surprises evidenced in Table 2. But the pass-through of tightening surprises is muted when combined with signals about more downward future policy space. In contrast, easing surprises have almost no effect anymore when associated with signals about more upward future policy space, but they have very strong effects on yields when combined with signals about more downward future policy space.

Overall, these results suggest that signals conveyed during ECB press conferences play a crucial role in the transmission of monetary policy to nominal yields. Central bank communication is a powerful tool that is able to induce or offset interest rate responses beyond signals from the policy decision.

5 Conclusion

This paper provides new insights into the asymmetric effects of monetary policy on the euro area nominal yields. We find that easing surprises have stronger effects than tightening surprises at all maturities. Decomposing monetary policy surprises reveals that this asymmetry is not driven by central bank information effects. Evidence suggests that it takes source in signals about the future policy path component, and signals about term and risk premia magnify this asymmetry. Our findings suggest that investors interpret monetary policy surprises differently according to their sign: easing surprises convey signals of longer and more persistent monetary cycles than tightening ones.

Using textual analysis to measure signals about the monetary stance from ECB press conferences, we find that central bank communication can amplify or weaken the asymmetric transmission of monetary policy to nominal yields. The pass-through of monetary policy surprises to nominal yields is stronger when signals about the long-run future policy space align with the direction of the surprise. This has important implications for the design of central bank communication.

[13] Changes in the stance variable could well be anticipated by investors. We show that our findings are robust to controlling for some determinants of the ECB stance variable. In Appendix Table A16, we assess to which extent the change in the ECB stance variable may reflect the economic and financial context. We find that around 41% of its variance only is endogenous to the state of the economy. It suggests that ECB communication convey complementary information beyond the economic and financial variables considered. Augmenting Equation (11) with these controls, we find similar results (Appendix Table A17).

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Appendix
For online publication

Table A1: Data description and sources

$\Delta Y_{i,t}^{w}$	Changes in country i (DE, FR, IT, ES) 2-, 5- and 10-year sovereign yields during window w (PR, PC, ME) in basis points.	Altavilla et al. (2019)
MPS	Monetary Policy Surprises. First principal component of changes in 1-, 3-m, 6-month and 1-year OIS rates during PR.	Altavilla et al. (2019) and own computations
MP	Pure Monetary Policy shock. Value of MPS when MPS and the Eurostoxx50 index moves in the opposite direction during PR.	Altavilla et al. (2019) and own computations
CBI	Central Bank Information shock. Value of MPS when MPS and the Eurostoxx50 index moves in the opposite direction during PR.	Altavilla et al. (2019) and own computations
Target	Target factor. Changes in 1-month OIS rate during PR.	Altavilla et al. (2019)
Path	Path factor. First principal component of changes in 3-, 6-month and 1-year OIS rates during PR unexplained by Target surprises.	Altavilla et al. (2019) and own computations
LT	Long term factor. First principal component of changes in 2-, 5- and 10-year OIS rates during PR unexplained by Target and Path surprises as of January 2015.	Altavilla et al. (2019) and own computations
Stance	ECB stance signals measured in ECB's introductory statement and answers provided during the press conference (based on Cieslak and McMahon 2023).	ECB and own computations
Tone	ECB tone measured in the introductory statement and answers provided during the press conference (based on Loughran and McDonald (2011)'s dictionary).	ECB and own computations
Unconv	Dummy variable that equals 1 on unconventional monetary policy announcements days.	ECB
Forecast	Dummy variable that equals 1 on ECB macroeconomic projections release days.	ECB
Dissent	Dummy variable that equals 1 on days where dissent among policymakers is identified during the press conference.	Blot et al. (2025)
MRO	Main Refinancing Operations rate.	ECB
DFR	Deposit Facility Rate.	ECB
VSTOXX	Eurostoxx50 implied volatility index.	Qontigo
CISS	Euro area (changing composition), New Composite Indicator of Systemic Stress, Index.	ECB
HICP	Euro area growth rate of the Harmonised Index of Consumer Prices (monthly, annual rate of change).	Eurostat
Production	Euro area growth rate of the mining and quarrying, manufacturing, electricity, gas, steam and air conditioning supply production index (monthly, annual rate of change).	Eurostat
Unemployment	Euro area unemployment rate based on the International Labor Organization (ILO) definition.	Eurostat

Table A2: Descriptive statistics

Statistic	Obs	Mean	St. Dev.	Min	Max
OIS1M_PR	221	0.408	2.901	−14.300	21.500
OIS3M_PR	221	0.327	2.553	−9.400	15.980
OIS6M_PR	221	0.322	2.308	−8.300	14.450
OIS1Y_PR	221	0.300	2.341	−12.820	14.500
PC1_PR	221	0.000	2.040	−9.033	11.718
PC1_PR_POS	221	0.461	1.620	0.000	11.718
PC1_PR_NEG	221	−0.461	1.054	−9.033	0.000
MP_PURE_PM	221	0.046	1.707	−9.033	11.718
CBI_PM	221	−0.046	1.115	−7.527	10.554
MP_PURE_MEDIAN	221	0.076	1.686	−5.919	11.577
CBI_MEDIAN	221	−0.076	1.143	−4.695	7.007
TARGET_PR	221	0.408	2.901	−14.300	21.500
PATH_PR	221	−0.000	1.677	−8.480	17.378
LT_PR	221	−0.000	0.960	−4.658	6.547
DE2Y_PR	221	0.153	2.478	−13.400	11.800
FR2Y_PR	215	0.085	2.376	−8.485	11.225
IT2Y_PR	221	−0.273	3.678	−20.900	14.600
ES2Y_PR	221	−0.094	2.265	−12.000	8.300
DE5Y_PR	221	0.042	2.504	−14.600	11.550
FR5Y_PR	218	−0.029	2.597	−14.235	12.535
IT5Y_PR	221	−0.305	3.677	−19.000	14.700
ES5Y_PR	221	−0.169	2.714	−14.050	13.100
DE10Y_PR	221	−0.039	1.898	−9.600	8.200
FR10Y_PR	221	−0.083	2.345	−10.800	10.650
IT10Y_PR	221	−0.276	3.648	−19.150	18.000
ES10Y_PR	221	−0.200	2.644	−11.200	11.850
STANCE	221	−0.006	0.273	−0.894	0.772
STANCE_1D	221	0.003	0.224	−0.667	0.682
TONE	221	−0.895	1.399	−4.859	2.924
VSTOXX	221	23.717	9.289	12.240	58.204
CISS	221	0.182	0.204	0.001	0.915
OIS1Y_DAILY_LEVEL	221	1.291	1.591	−0.593	4.601
HICP	221	2.041	1.741	−0.600	10.100
PRODUCTION	221	0.524	5.548	−21.600	22.000
EPU_EA	221	151.816	59.807	68.270	348.664
UNEMPLOYMENT	221	9.315	1.526	6.500	12.200

Table A3: Alternative MPS (OIS 1Y)

	2001 - 2023			**Excl. 2010 - 2016**			**2010 - 2016**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$
MPS_t	0.80^{***}	0.77^{***}	0.54^{***}	0.79^{***}	0.79^{***}	0.56^{***}	0.83^{***}	0.69^{***}	0.47^{***}
	(0.06)	(0.06)	(0.06)	(0.07)	(0.08)	(0.07)	(0.10)	(0.11)	(0.11)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.46	0.39	0.22	0.44	0.39	0.21	0.52	0.38	0.23
Obs	878	881	884	622	625	628	256	256	256

Note: Robust standard errors in parentheses. $^{**}p<0.05$; $^{***}p<0.01$. Parameters are estimated with OLS based on Equation (1). The dependent variable is the intraday change in 2-year, 5-year and 10-year yields, during the PR window. MPS_t is the change in the 1-year OIS rate during the PR window. Equation (1) is estimated over three sub-samples: Nov 2001-Jun 2023 (Columns 1 to 3), Nov 2001-Jun 2023 excl. Jun 2010-Jan 2016 (Columns 4 to 6), Jun 2010-Jan 2016 (Columns 7 to 9).

Table A4: The asymmetric effects of monetary policy (OIS 1Y)

	2001 - 2023			**Excl. 2010 - 2016**			**2010 - 2016**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$
MPS_t^{Pos}	0.61***	0.57***	0.38***	0.63***	0.60***	0.40***	0.37**	0.23	0.16
	(0.08)	(0.08)	(0.08)	(0.09)	(0.09)	(0.08)	(0.17)	(0.18)	(0.19)
MPS_t^{Neg}	1.03***	1.03***	0.73***	0.98***	1.08***	0.80***	1.10***	0.95***	0.61***
	(0.07)	(0.07)	(0.08)	(0.09)	(0.06)	(0.07)	(0.10)	(0.15)	(0.16)
Diff *p-val*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.49	0.41	0.23	0.46	0.41	0.24	0.59	0.45	0.27
Obs	878	881	884	622	625	628	256	256	256

Note: Robust standard errors in parentheses. **p<0.05; ***p<0.01. Parameters are estimated with OLS based on Equation (2). The dependent variable is the intraday change in 2-year, 5-year and 10-year yields, during the PR window. MPS_t is the change in the 1-year OIS rate during the PR window. The specifications include a dummy $\mathbb{1}_t^{Pos}$ that equals 1 when $MPS_t > 0$. Equation (2) is estimated is estimated over three sub-samples: Nov 2001-Jun 2023 (Columns 1 to 3), Nov 2001-Jun 2023 excl. Jun 2010-Jan 2016 (Columns 4 to 6), Jun 2010-Jan 2016 (Columns 7 to 9).

Table A5: The asymmetric effects of monetary policy - Bootstrapped standard errors

	2001 - 2023			**Excl. 2010 - 2016**			**2010 - 2016**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$
MPS_t^{Pos}	0.31***	0.21***	0.07	0.29***	0.18**	0.06	0.25**	0.16	0.06
	(0.06)	(0.06)	(0.06)	(0.07)	(0.08)	(0.08)	(0.10)	(0.11)	(0.11)
MPS_t^{Neg}	1.01***	0.92***	0.57***	0.97***	1.02***	0.63***	1.03***	0.85***	0.54***
	(0.08)	(0.09)	(0.08)	(0.15)	(0.16)	(0.16)	(0.07)	(0.08)	(0.08)
Diff *p-val*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.24	0.15	0.06	0.17	0.12	0.04	0.51	0.35	0.19
Obs	878	881	884	622	625	628	256	256	256

Note: Bootstrapped standard errors (obtained from 1000 bootstrap simulations) in parentheses. **p<0.05; ***p<0.01. Parameters are estimated with OLS based on Equation (2). The dependent variable is the intraday change in 2-year, 5-year and 10-year yields, during the PR window. The specifications include a dummy $\mathbb{1}_t^{Pos}$ that equals 1 when $MPS_t > 0$. Equation (2) is estimated over three sub-samples: Nov 2001-Jun 2023 (Columns 1 to 3), Nov 2001-Jun 2023 excluding Jun 2010-Jan 2016 (Columns 4 to 6), Jun 2010-Jan 2016 (Columns 7 to 9).

Table A6: Clustering standard errors at the country level

	2001 - 2023			**Excl. 2010 - 2016**			**2010 - 2016**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$
MPS_t^{Pos}	0.31***	0.21***	0.07	0.29***	0.18***	0.06	0.25**	0.16***	0.06
	(0.09)	(0.03)	(0.04)	(0.09)	(0.03)	(0.03)	(0.10)	(0.05)	(0.09)
MPS_t^{Neg}	1.01***	0.92***	0.57***	0.97***	1.02***	0.63***	1.03***	0.85***	0.54***
	(0.11)	(0.08)	(0.09)	(0.13)	(0.06)	(0.02)	(0.12)	(0.12)	(0.14)
Diff *p-val*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.24	0.15	0.06	0.17	0.12	0.04	0.51	0.35	0.19
Obs	878	881	884	622	625	628	256	256	256

Note: Standard errors clustered at the country level in parentheses. **p<0.05; ***p<0.01. Parameters are estimated with OLS based on Equation (2). The dependent variable is the intraday change in 2-year, 5-year and 10-year yields, during the PR window. The specifications include a dummy $\mathbb{1}_t^{Pos}$ that equals 1 when $MPS_t > 0$. Equation (2) is estimated over three sub-samples: Nov 2001-Jun 2023 (Columns 1 to 3), Nov 2001-Jun 2023 excluding Jun 2010-Jan 2016 (Columns 4 to 6), Jun 2010-Jan 2016 (Columns 7 to 9).

Table A7: Truncating the distribution of monetary surprises

	2001 - 2023		
	(1)	(2)	(3)
	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$
MPS_t^{Pos}	0.61**	0.33	-0.13
	(0.25)	(0.28)	(0.30)
MPS_t^{Neg}	1.44***	1.72***	1.25***
	(0.43)	(0.46)	(0.38)
Diff *p-val*	0.09	0.01	0.00
Country FE	Yes	Yes	Yes
R^2	0.14	0.11	0.06
Obs	782	785	788

Note: Robust standard errors in parentheses. **p<0.05; ***p<0.01. Parameters are estimated with OLS based on Equation (2) over the sample Nov 2001-Jun 2023. The dependent variable is the intraday change in 2-year, 5-year and 10-year yields, during the PR window. The distribution of MPS is truncated at the 5th and 95th percentiles. The specification includes a dummy $\mathbb{1}_t^{Pos}$ that equals 1 when $MPS_t > 0$.

Table A8: Central bank information shocks - Median rotation

	(1) $2Y_{PR}$	(2) $5Y_{PR}$	(3) $10Y_{PR}$
MP_t^{Pos}	0.41***	0.30***	0.23**
	(0.12)	(0.09)	(0.11)
MP_t^{Neg}	1.89***	2.06***	1.60***
	(0.24)	(0.27)	(0.24)
CBI_t^{Pos}	0.40	0.17	-0.30
	(0.29)	(0.30)	(0.23)
CBI_t^{Neg}	-0.42	-0.85**	-0.92***
	(0.31)	(0.34)	(0.32)
MP Diff *p-val*	0.00	0.00	0.00
CBI Diff *p-val*	0.07	0.04	0.16
Country FE	Yes	Yes	Yes
R^2	0.34	0.31	0.27
Obs	878	881	884

Note: Robust standard errors in parentheses. **p<0.05; ***p<0.01. Parameters are estimated with OLS based on Equation (3) over the sample Nov 2001-Jun 2023. The dependent variable is the intraday change in 2-year, 5-year and 10-year yields, during the PR window. MPS_t is decomposed into two components according to Jarociński and Karadi (2020) median rotation procedure. The specification includes two dummy variables $\mathbb{1}_t^{MP_t>0}$ and $\mathbb{1}_t^{CBI_t>0}$ that equal one when MP_t, resp. CBI_t, are positive.

Table A9: Target, Path and Long-Term components

	Target and Path			Adding a Long-Term factor		
	(1)	(2)	(3)	(4)	(5)	(6)
	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$
$Target_t^{Pos}$	0.19***	0.09	0.01	0.22***	0.13***	0.06
	(0.06)	(0.05)	(0.05)	(0.05)	(0.03)	(0.04)
$Target_t^{Neg}$	0.32***	0.20**	0.05	0.32***	0.21***	0.07
	(0.09)	(0.09)	(0.07)	(0.05)	(0.06)	(0.07)
$Path_t^{Pos}$	0.53***	0.56***	0.39***	0.59***	0.62***	0.45***
	(0.12)	(0.13)	(0.08)	(0.09)	(0.09)	(0.04)
$Path_t^{Neg}$	1.46***	1.59***	1.20***	1.53***	1.68***	1.28***
	(0.14)	(0.12)	(0.11)	(0.12)	(0.07)	(0.07)
LT_t^{Pos}				1.11***	1.47***	1.36***
				(0.12)	(0.10)	(0.13)
LT_t^{Neg}				1.16***	1.45***	1.37***
				(0.13)	(0.10)	(0.13)
Target Diff *p-val*	0.24	0.29	0.67	0.18	0.26	0.90
Path Diff *p-val*	0.00	0.00	0.00	0.00	0.00	0.00
LT Diff *p-val*				0.80	0.90	0.94
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.39	0.35	0.22	0.65	0.75	0.64
Obs	878	881	884	878	881	884

Note: Robust standard errors in parentheses. **p<0.05; ***p<0.01. Parameters are estimated with OLS based on Equation (6) over the sample Nov 2001-Jun 2023. The dependent variable is the intraday change in 2-year, 5-year and 10-year yields, during the PR window. Target and Path surprises are measured as described in Section 3.3. LT surprises instead are identified as of January 2008. Since high-frequency changes in 5-year and 10-year OIS rates are not available before August 2011, we use high-frequency changes in 5-year and 10-year German sovereign yields prior to that date. The specifications include three dummy variables $\mathbb{1}_t^{Target_t>0}$, $\mathbb{1}_t^{Path_t>0}$, $\mathbb{1}_t^{LT_t>0}$ that equal one when $Target_t$, $Path_t$ and LT_t are positive.

Table A10: Country-specific factors

	OIS2Y			**DE1Y**		
	(1)	(2)	(3)	(4)	(5)	(6)
	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$
MPS_t^{Pos}	-0.19^{***}	-0.31^{***}	-0.32^{***}	-0.33^{***}	-0.39^{***}	-0.32^{***}
	(0.07)	(0.06)	(0.06)	(0.06)	(0.07)	(0.07)
MPS_t^{Neg}	0.01	-0.13	-0.22^{**}	0.49^{***}	0.44^{***}	0.27
	(0.07)	(0.07)	(0.09)	(0.14)	(0.17)	(0.15)
Diff *p-val*	0.04	0.04	0.32	0.00	0.00	0.00
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.03	0.09	0.08	0.10	0.08	0.04
Obs	878	881	884	804	804	804

Note: Robust standard errors in parentheses. **p<0.05; ***p<0.01. Parameters are estimated with OLS based on Equation (2) over the sample Nov 2001-Jun 2023. The dependent variable is the intraday change in country specific factors, during the PR window, measured alternatively using changes in the 2-year OIS rate (Columns 1 to 3) and in the 1-year German sovereign yields (Columns 4 to 6) as alternative proxies for the common short-term interest rate movement in the euro area. The specifications include a dummy $\mathbb{1}_t^{Pos}$ that equals 1 when $MPS_t > 0$.

Table A11: Sovereign spreads with Germany

	(1) $2Y_{PR}$	(2) $5Y_{PR}$	(3) $10Y_{PR}$
MPS_t^{Pos}	−0.18	0.05	0.15
	(0.10)	(0.08)	(0.08)
MPS_t^{Neg}	0.16	0.18**	0.25***
	(0.09)	(0.07)	(0.07)
Diff *p-val*	0.01	0.22	0.34
Country FE	Yes	Yes	Yes
R^2	0.05	0.03	0.04
Obs	657	660	663

Note: Robust standard errors in parentheses. **p<0.05; ***p<0.01. Parameters are estimated with OLS based on Equation (2) over the sample Nov 2001-Jun 2023. The dependent variable is the intraday change in 2-year, 5-year and 10-year sovereign spreads with respect to Germany, during the PR window. The specifications include a dummy $\mathbb{1}_t^{Pos}$ that equals 1 when $MPS_t > 0$.

Table A12: Common vs. country-specific factors

	Common factor			**Country-specific factor**		
	(1)	(2)	(3)	(4)	(5)	(6)
	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$	$2Y_{PR}$	$5Y_{PR}$	$10Y_{PR}$
$Target_t^{Pos}$	0.43***	0.41***	0.29***	-0.23***	-0.30***	-0.25***
	(0.02)	(0.01)	(0.01)	(0.05)	(0.04)	(0.04)
$Target_t^{Neg}$	0.40***	0.39***	0.27***	-0.07	-0.18***	-0.21***
	(0.04)	(0.03)	(0.03)	(0.07)	(0.06)	(0.06)
$Path_t^{Pos}$	0.63***	0.61***	0.43***	-0.05	0.004	0.03
	(0.05)	(0.02)	(0.04)	(0.09)	(0.10)	(0.07)
$Path_t^{Neg}$	1.20***	1.15***	0.80***	0.31***	0.51***	0.47***
	(0.09)	(0.06)	(0.06)	(0.12)	(0.11)	(0.12)
LT_t^{Pos}	0.49***	0.47***	0.33***	0.64***	1.19***	1.31***
	(0.05)	(0.04)	(0.04)	(0.14)	(0.11)	(0.18)
LT_t^{Neg}	0.17***	0.17***	0.12***	1.00***	1.39***	1.54***
	(0.04)	(0.03)	(0.03)	(0.20)	(0.16)	(0.20)
Target Diff *p-val*	0.55	0.47	0.57	0.08	0.12	0.61
Path Diff *p-val*	0.00	0.00	0.00	0.02	0.00	0.00
LT Diff *p-val*	0.00	0.00	0.00	0.15	0.31	0.40
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.92	0.94	0.91	0.27	0.45	0.44
Obs	878	881	884	878	881	884

Note: Robust standard errors in parentheses. **p<0.05; ***p<0.01. Parameters are estimated with OLS based on Equation (2) over the sample Nov 2001-Jun 2023. The dependent variable is the intraday change in common vs country-specific factors, during the PR window. The specifications include three dummy variables $\mathbb{1}_t^{Target_t>0}$, $\mathbb{1}_t^{Path_t>0}$, $\mathbb{1}_t^{LT_t>0}$ that equal one when $Target_t$, $Path_t$ and LT_t are positive.

Table A13: The influence of the economic environment

	MP level	**MP cycles**	**Inflation**	**Output**	**VSTOXX**	**EPU**
	(1)	(2)	(3)	(4)	(5)	(6)
	$2Y_{PR}$	$2Y_{PR}$	$2Y_{PR}$	$2Y_{PR}$	$2Y_{PR}$	$2Y_{PR}$
$MPS_t^{Pos} \mid z_t^H$	0.05	0.06	0.21	0.07	0.50***	0.26
	(0.17)	(0.20)	(0.13)	(0.15)	(0.09)	(0.15)
$MPS_t^{Pos} \mid z_t^L$	0.60***	0.53***	0.79***	0.69***	-0.46***	0.47***
	(0.13)	(0.12)	(0.16)	(0.14)	(0.11)	(0.14)
$MPS_t^{Neg} \mid z_t^H$	0.86***	2.15***	1.07***	1.62**	0.95***	1.02***
	(0.26)	(0.52)	(0.12)	(0.66)	(0.12)	(0.12)
$MPS_t^{Neg} \mid z_t^H$	1.10***	0.86***	0.85***	0.94***	1.31***	0.84***
	(0.10)	(0.07)	(0.17)	(0.07)	(0.17)	(0.23)
High Diff *p-val*	0.01	0.00	0.00	0.03	0.00	0.00
Low Diff *p-val*	0.00	0.02	0.79	0.10	0.00	0.17
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Z_t	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.27	0.28	0.26	0.28	0.31	0.25
Obs	878	878	878	878	878	878

Note: Robust standard errors in parentheses. **p<0.05; ***p<0.01. Parameters are estimated with OLS based on Equation (8). The dependent variable is the intraday change in 2-year yields, during the PR window. The specifications include a dummy variable $\mathbb{1}_t^{Pos}$ that equals 1 when $MPS_t > 0$ and a dummy variable Z_t^H that equals one when the state variable is high.

Table A14: The influence of the economic environment

	MP level	**MP cycles**	**Inflation**	**Output**	**VSTOXX**	**EPU**
	(1)	(2)	(3)	(4)	(5)	(6)
	$5Y_{PR}$	$5Y_{PR}$	$5Y_{PR}$	$5Y_{PR}$	$5Y_{PR}$	$5Y_{PR}$
$MPS_t^{Pos} \mid z_t^H$	-0.07	0.0004	0.11	0.02	0.41^{***}	0.19
	(0.15)	(0.22)	(0.13)	(0.17)	(0.08)	(0.16)
$MPS_t^{Pos} \mid z_t^L$	0.52^{***}	0.38^{***}	0.60^{***}	0.50^{***}	-0.65^{***}	0.27^{***}
	(0.13)	(0.09)	(0.17)	(0.10)	(0.06)	(0.06)
$MPS_t^{Neg} \mid z_t^H$	0.93^{***}	2.33^{***}	0.96^{***}	1.86^{***}	0.86^{***}	0.92^{***}
	(0.28)	(0.59)	(0.16)	(0.72)	(0.15)	(0.14)
$MPS_t^{Neg} \mid z_t^L$	0.93^{***}	0.74^{***}	0.89^{***}	0.82^{***}	1.28^{***}	0.84^{***}
	(0.13)	(0.08)	(0.17)	(0.08)	(0.17)	(0.22)
High Diff *p-val*	0.00	0.00	0.00	0.02	0.01	0.00
Low Diff *p-val*	0.03	0.00	0.23	0.02	0.00	0.01
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Z_t	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.18	0.19	0.17	0.19	0.23	0.16
Obs	881	881	881	881	881	881

Note: Robust standard errors in parentheses. $^{**}p<0.05$; $^{***}p<0.01$. Parameters are estimated with OLS based on Equation (8). The dependent variable is the intraday change in 5-year yields, during the PR window. The specifications include a dummy variable $\mathbb{1}_t^{Pos}$ that equals 1 when $MPS_t > 0$ and a dummy variable Z_t^H that equals one when the state variable is high.

Table A15: The predictive power of ECB stance signals

	Short-run predictive power					
	ΔMRO_m	ΔMRO_{m+1}	ΔMRO_{m+2}	ΔMRO_m	ΔMRO_{m+1}	ΔMRO_{m+2}
$Stance_t$	0.18^{***}	0.13^{***}	0.09			
	(0.05)	(0.05)	(0.05)			
$\Delta_m Stance_t$				2.68^{***}	2.24^{***}	2.34^{***}
				(0.53)	(0.47)	(0.53)
R^2	0.04	0.02	0.01	0.21	0.15	0.16
Obs	221	220	219	221	220	219
	Long-run predictive power					
	2Y_{PC}	5Y_{PC}	10Y_{PC}	2Y_{PC}	5Y_{PC}	10Y_{PC}
$Stance_t$	-1.27	-1.87^{**}	-2.30^{***}			
	(0.85)	(0.85)	(0.68)			
$\Delta_m Stance_t$				-11.47^{**}	-9.91	-11.61^{**}
				(5.82)	(5.97)	(5.39)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.003	0.01	0.01	0.01	0.004	0.01
Obs	878	881	884	878	881	884

Note: Robust standard errors in parentheses. **p<0.05; ***p<0.01. Parameters are estimated with OLS over the sample Nov 2001-June 2023. In the upper panel, the dependent variable is the change in the MRO rate from one meeting to another, from meeting m and up to 2 meetings ahead. In the lower panel, the dependent variable is the intraday change in 2-year, 5-year and 10-year yields, during the PC window. $Stance_t$ denotes our textual measure of ECB's stance signals for a given meeting, while $\Delta_m Stance_t$ is the change in ECB stance signals between meeting m-1 and m.

Table A16: The determinants of ECB stance

	$\Delta_m Stance_t$
$\Delta_m Stance_{t-1}$	0.47***
	(0.05)
R_t	0.0004
	(0.001)
$\Delta_m OIS2Y_t$	0.03***
	(0.01)
$\Delta_m VSTOXX_t$	0.0004
	(0.0002)
$\Delta_m HICP_t$	0.01
	(0.005)
$\Delta_m Unemp_t$	-0.02
	(0.01)
$\Delta_m IndProd_t$	0.001
	(0.001)
R^2	0.41
Obs	220

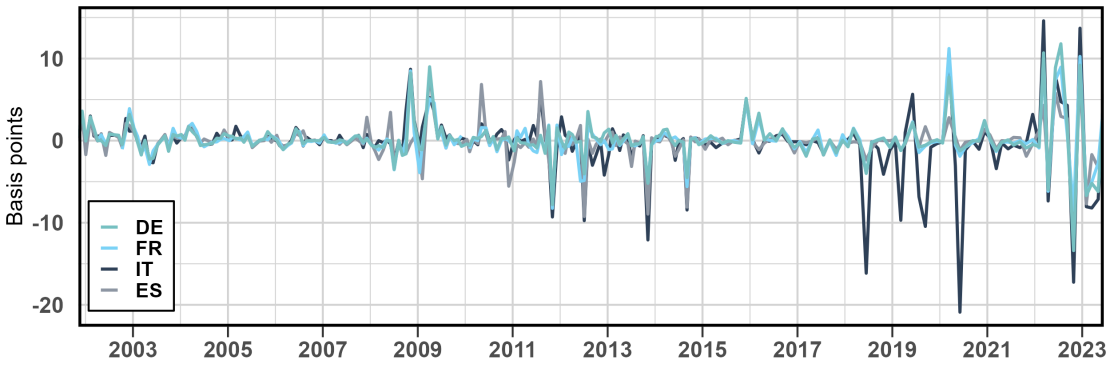
Note: Robust standard errors in parentheses. **p<0.05; ***p<0.01. Parameters are estimated with OLS. The dependent variable is the change in ECB stance signals measured since the last press conference. Independent variables include the lag of the dependent variable, the level of the DFR announced during the PR window, the intermeeting change in (i) 2-year daily OIS rates, (ii) the VSTOXX, (iii) the HICP rate, (iv) the unemployment rate and (v) an industrial production index.

Table A17: Causal effects of ECB stance signals

	(1) $2Y_{ME}$	(2) $5Y_{ME}$	(3) $10Y_{ME}$
$MPS_t^{Pos} \mid FPS_t^{Up}$	1.31***	1.04***	0.79***
	(0.23)	(0.26)	(0.29)
$MPS_t^{Pos} \mid FPS_t^{Down}$	0.31	−0.15	−0.30
	(0.22)	(0.20)	(0.16)
$MPS_t^{Neg} \mid FPS_t^{Up}$	0.43**	0.34	0.09
	(0.18)	(0.21)	(0.17)
$MPS_t^{Neg} \mid FPS_t^{Down}$	1.98***	1.86***	1.16
	(0.60)	(0.71)	(0.65)
Pos Diff *p-val*	0.00	0.00	0.00
Neg Diff *p-val*	0.01	0.04	0.11
Up Diff *p-val*	0.00	0.05	0.06
Down Diff *p-val*	0.01	0.01	0.03
Country FE	Yes	Yes	Yes
X_t	Yes	Yes	Yes
Ω_t	Yes	Yes	Yes
R^2	0.19	0.16	0.12
Obs	877	880	883

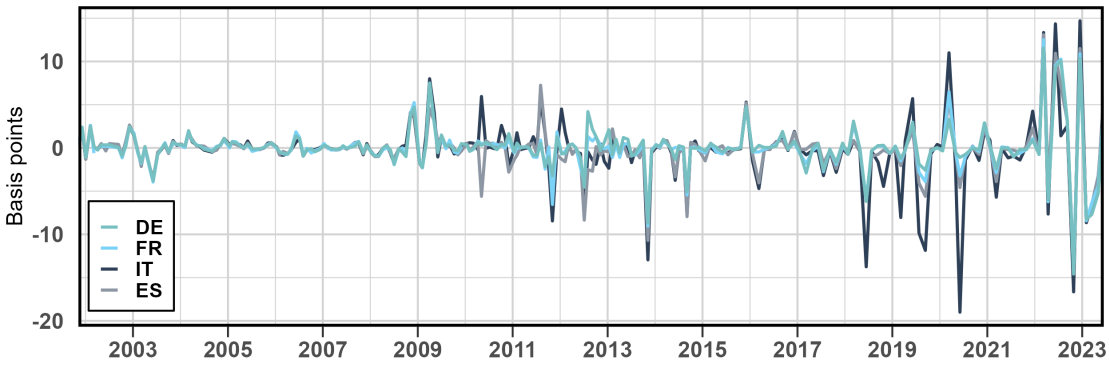
Note: Robust standard errors in parentheses. **p<0.05; ***p<0.01. Parameters are estimated with OLS based on an augmented version of Equation (11). The dependent variable is the intraday change in 2-year, 5-year and 10-year yields, during the ME window. Equation (11) is estimated over the sample Nov 2001-Jun 2023. X_t is a vector of control variables, including (i) the tone of the ECB, measured as the difference between positive and negative words, as defined by Loughran and McDonald (2011), scaled by the length of policymakers' intervention, (ii) dummy variables accounting for dissent among policymakers, unconventional monetary policy announcements and ECB macroeconomic forecasts release, (iii) the level of the VSTOXX and the CISS prior to the ECB meeting. Ω_t controls for the determinants of $\Delta_m Stance_t$ identified in Table A16, *i.e.*, $\Delta_{m-1} Stance_t$ and the changes in the VSTOXX ($\Delta_m VSTOXX_t$) and the 2-year OIS ($\Delta_m OIS2Y_t$) over the intermeeting period.

Figure A1: Changes in 2-year sovereign yields (PR)



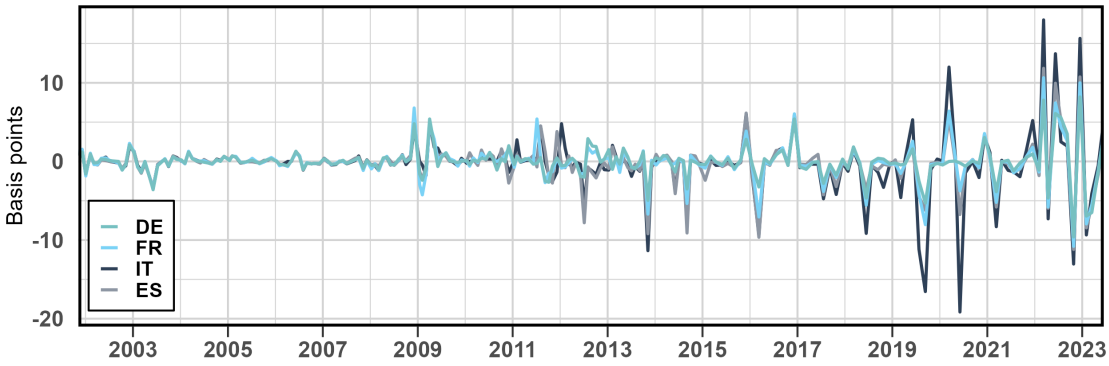
Note: This figure represents the changes in German (DE), French (FR), Italian (IT) and Spanish (ES) 2-year sovereign yields during the PR window.

Figure A2: Changes in 5-year sovereign yields (PR)



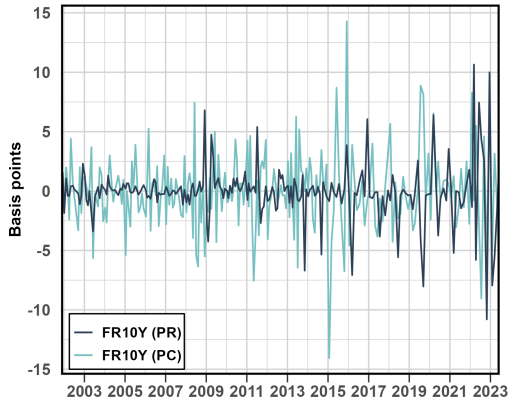
Note: This figure represents the changes in German (DE), French (FR), Italian (IT) and Spanish (ES) 5-year sovereign yields during the PR window.

Figure A3: Changes in 10-year sovereign yields (PR)



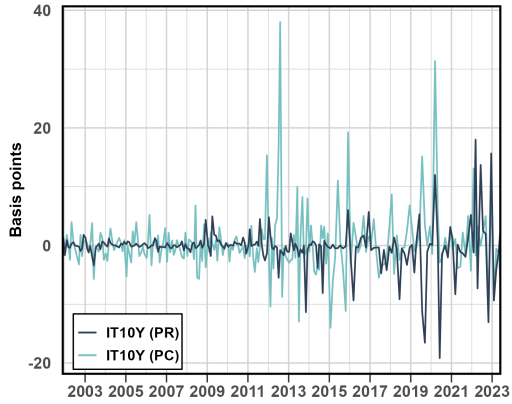
Note: This figure represents the changes in German (DE), French (FR), Italian (IT) and Spanish (ES) 10-year sovereign yields during the PR window.

Figure A4: Changes in France 10-year sovereign yields



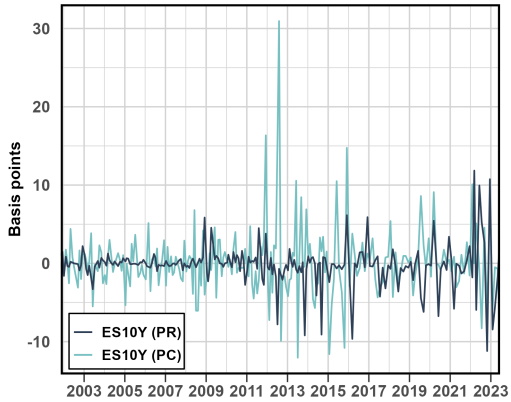
Note: This figure represents the changes in France 10-year sovereign yields during PR and PC.

Figure A5: Changes in Italy 10-year sovereign yields



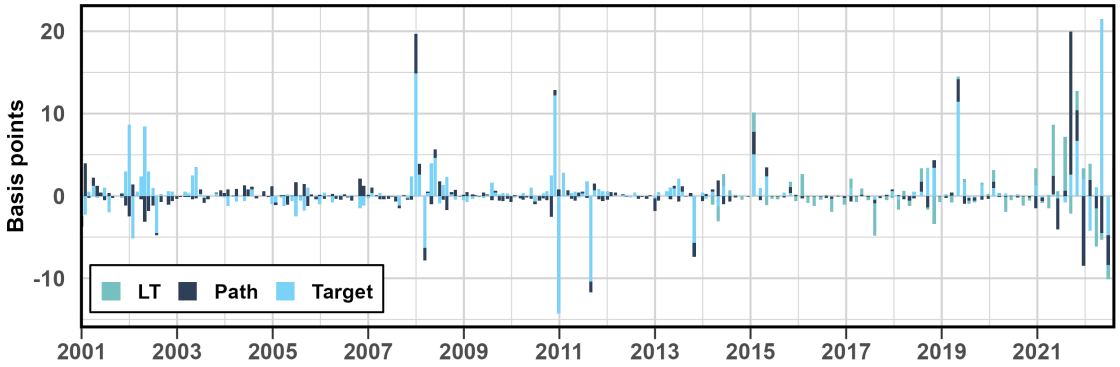
Note: This figure represents the changes in Italy 10-year sovereign yields during PR and PC.

Figure A6: Changes in Spain 10-year sovereign yields



Note: This figure represents the changes in Spain 10-year sovereign yields during PR and PC.

Figure A7: Target, Path and Long Term monetary policy surprises



Note: This figure represents the Target, Path and Long-Term components of monetary policy surprises identified during the PR window and described in Section 3.3.

A Procedure for measuring ECB stance communication signals

In this appendix, we provide the detailed procedure employed to measure ECB stance signals. We adapt Cieslak and McMahon (2023) methodology and follow a three-stage procedure to build a measure of ECB stance signals, reflecting both policymakers views on conventional and unconventional monetary policies. This measure is derived from the transcripts of ECB press conferences, focusing on the introductory statement and the answers provided during the Q&As session.

Baseline approach for the conventional instrument

This section details the methodology used to build the conventional instrument part of the measure of ECB stance. This measure reflects ECB stance regarding conventional monetary policies. It is gradually complemented with additional measures reflecting ECB's stance with respect to unconventional monetary policies.

Step 1:
The first step consists in selecting the sentences related to monetary policy. Two types of sentences are kept in the analysis:

- The sentences containing at least one of the following expressions:
  - rate, rates, ecb rates, ecb rate, policy rate, policy rates, interest rate, interest rates, target rate, target rates, communication, statement, statements, hawkish, dovish, deposit facility rate, dfr, mro, main refinancing operations, mlf, marginal lending facility.
- Or, the sentences containing the words "policy" or "policies" but not any of the following expressions:
  - fiscal policy, fiscal policies, supervisory policy, supervisory policies, public policy, public policies, budget policy, budget policies, tax policy, tax policies, housing policy, housing policies, regulatory policy, regulatory policies, fed policy, fed policies, economic policy, economic policies, government policy, government policies, inventory policy, inventory policies, health care policy, health care policies, macro policy, macro policies, macroeconomic policy, macroeconomic policies, spending policy, spending policies, legislation, laws, regulation, regulations.

Step 2:
Once the relevant sentences selected, we count the occurrences of Hawkish and Dovish terms. Negations are taken into account. We consider as:

- Hawkish any term contained in the following list:
  - tight, tighten, tightening, tightened, hike, hikes, hiked, hiking, increase, increases, increased, increasing, hawkish, taper, tapering, tapered, liftoff.
- Dovish any term contained in the following list:
  - ease, easing, eased, cut, cutting, cuts, dovish, reduce, reduced, reduction, reductions, reducing, decrease, decreases, decreased, decreasing.

We consider as "negation words" any term contained in the following list:

- less, no, not, little, don't, do not, doesn't, does not, hasn't, has not, haven't, have not, won't, will not, shouldn't, should not, didn't, did not.

Any hawkish word preceded by a negation is considered as dovish. Any dovish word preceded by a negation is considered as hawkish. More precisely, Hawkish and Dovish counts are computed as follows:

- **Hawkish** = number of hawkish words – number of hawkish words preceded by a negation + number of dovish words preceded by a negation
- **Dovish** = number of dovish words – number of dovish words preceded by a negation + number of hawkish words preceded by a negation.

Step 1 and Step 2 are applied to the content of the Introductory statement and the Answers provided during the Q&As session of the press conference. The stance variable is then defined as the difference between Hawkish and Dovish counts, scaled by the number of words in the corresponding parts of the press conference after stop words removal.

Accounting for asset purchase policies

From June 2010 onwards (first meeting following the SMP announcement on May 10th, 2010), we complement our stance measure with a measure of ECB stance regarding asset purchase policies.

Step 1:
The first step consists in selecting the sentences related to ECB purchases. Consequently, only the sentences containing at least one of the following words are considered in the analysis:

- Purchase, purchases, purchased

Step 2:
Once the relevant sentences selected, we count the occurrences of Hawkish and Dovish terms. Here, the meaning of Hawkish and Dovish is adjusted to the QE wording. We consider as:

- Hawkish any term contained in the following list:
  - reduce, reduces, reduced, reduction, reductions, reducing, stop, stops, stopped, stopping, taper, tapers, tapered, tapering, discontinue, discontinues, discontinued, discontinuing, decrease, decreases, decreased, decreasing
- Dovish any term contained in the following list:
  - more, accommodative, additional, higher, reinvest, reinvests, reinvested, reinvesting, maintain, maintains, maintained, maintaining, increase, increases, increased, increasing, extend, extends, extended, extending, restart, restarts, restarted, restarting, launch, launches, launched, launching, resume, resumes, resumed, resuming.

Step 1 and Step 2 are applied to the content of the Introductory statement and the Answers provided during the Q&As session of the press conference. The QE stance is then defined as the difference between Hawkish and Dovish counts, scaled by the number of words in the corresponding parts of the press conference after stop words removal.

Accounting for liquidity policies

From December 2011 onwards (December 8th, 2011: meeting corresponding to the first 3-year LTROs announcement), we complement our stance measure with a measure of ECB stance regarding liquidity provision policies.

Step 1:
The first step consists in selecting the sentences related to ECB liquidity provision policies. Consequently, only the sentences containing at least one of the following expressions are considered in the analysis:

- LTRO, LTROs, TLTRO, TLTROs, PELTRO, PELTROs, longer-term refinancing operations, longer term refinancing operations, long-term refinancing operations, long term refinancing operations.

Step 2:
Once the relevant sentences selected, we count the occurrences of Hawkish and Dovish terms. Here, the meaning of Hawkish and Dovish is adjusted to liquidity policies wording. We consider as:

- Hawkish any term contained in the following list:
  - repayment, repayments, repaid
- Dovish any term contained in the following list:
  - new, conduct, conducts, conducted, conducting, carry, start, starts, started, starting

Step 1 and Step 2 are applied to the content of the Introductory statement and the Answers provided during the Q&As session of the press conference. The LTRO stance is then defined as the difference between Hawkish and Dovish counts, scaled by the number of words in the corresponding parts of the press conference after stop words removal.

Computation of the final stance measure

The final stance measure considered in the analysis is the sum of the three above-described measures, capturing signals about both conventional and unconventional policies.