Does Central Bank Tone Move Asset Prices?*

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Abstract

This paper shows that changes in the *tone* of central bank communication have a significant effect on asset prices. Tone captures how the central bank frames economic fundamentals and its monetary policy. A positive tone surprise is associated with increases in stock prices and interest rates whereas credit spreads and volatility risk premia decrease. These tone effects are robust to controlling for policy actions as well as for conventional measures of monetary policy shocks. Our results suggest that communication tone is a powerful instrument of monetary policy, which affects risk premia embedded in asset prices.

JEL Classification: G10, G12, E43, E44, E58

Keywords: Monetary policy, central bank communication, textual analysis, risk premia, stock returns, volatility risk, credit spreads.

"As I had often remarked, monetary policy is 98 percent talk and 2 percent action."

Ben Bernanke (2016, p. 498)

"I don't think I'm stepping up my rhetoric on inflation, Draghi said [...]. Financial market analysts nonetheless detected a shift in tone if not in substance of monetary policy."

Reuters, April 4th, 2012

"All eyes will be on the ECB this afternoon. If the tone is clearly dovish, then it could maybe stop the bleeding on the market." Reuters, August 7th, 2014

1. Introduction

Monetary policy strongly affects asset prices, a prime example being the effect of monetary policy announcements on stock prices (e.g., Bernanke and Kuttner, 2005; Lucca and Moench, 2015; Cieslak et al., 2019; Neuhierl and Weber, 2021). A large part of the information released on announcement days comes in the form of verbal communication, rather than quantitative releases, and central banks (CBs) use such communication to explain their policy decisions, the economic outlook, and to shape market expectations. CB communication is thus closely followed by market participants, extensively covered by the financial press, and CBs evaluate the media coverage of their statements to gauge the effectiveness of their communication.[1] Importantly, market participants do not only pay attention to the content but also, as the above quotes illustrate, to the *tone* of CB statements, i.e., to *how the central bank frames* its policy decisions and the economic outlook. Hence, a natural question is: Does communication matter for asset prices beyond policy actions? Ben Bernanke's view that "monetary policy is 98 percent talk and 2 percent action" suggests that it should.

The contribution of our paper is to answer this question, by showing that the tone of CB communication matters for asset prices. A positive tone surprise is associated with higher equity market returns, lower volatility risk premia (a proxy for risk aversion implied by equity options) and lower credit spreads (in particular for financial institutions). At the same time, a positive tone surprise is associated with higher risk-free interest rates. Our results suggest

[1] For an overview of the literature on CB communication see, e.g., Woodford (2005) and Blinder et al. (2008). Berger et al. (2011) discuss how the ECB evaluates communication effectiveness via media reception.

that *policy tone* affects risk premia embedded in asset prices and that these effects are very similar to those of *policy actions* on stocks (e.g., Bernanke and Kuttner, 2005), variance risk premia (e.g., Bekaert et al., 2013), and credit spreads (e.g., Gertler and Karadi, 2015). Given that our analysis controls for policy actions, our findings imply that communication tone is an additional policy tool that supplements other instruments of monetary policy.

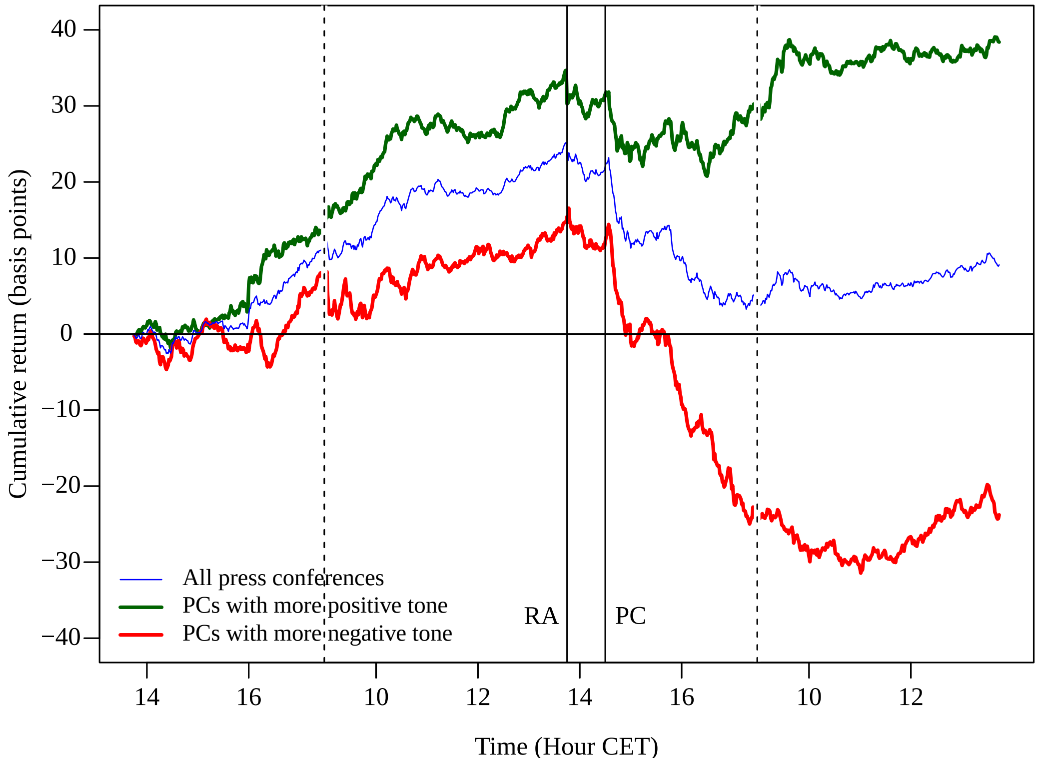
In the empirical analysis, we measure the tone of the ECB president in press conferences held after policy meetings, which offers an ideal setup for our analysis:[2] The ECB holds scheduled monetary policy meetings on Thursdays and announces its interest rate decision at 13:45 CET. The policy statement issued at that time contains little to no information other than the actual interest rate decision. At 14:30, the press conference (PC) starts. Since PCs take place during trading hours, financial markets can react to new information instantaneously, and the staggered timing of rate announcement and PC allows to disentangle market reactions to news about policy rates and communication (e.g., Ehrmann and Fratzscher, 2009).

To quantify tone, we use the financial dictionary developed by Loughran and McDonald (2011) to identify *negative* words and evaluate each statement's tone by assessing the prevalence of negative words. We verify that tone indeed captures how the ECB frames macroeconomic fundamentals, by showing that phrases such as "global imbalances", "disorderly correction", "excessive deficit" and discussions about fundamentals that, e.g., "remain weak" are among the most important drivers of tone.

Turning to the relation between CB communication and asset prices, we first study how equity markets respond to changes in tone. Figure 1 illustrates our results by plotting the average cumulative returns of the EuroStoxx 50 (a European large cap stock index) in a 48-hour window around policy rate announcements of the ECB.

[2] The ECB was the first major central bank to use press conferences to inform the public about the rationale behind its decisions and to provide an outlook, but recently, other central banks (including the Fed) have started to adopt similar communication strategies.

Figure 1: Stock returns in the 48 hours around ECB policy rate announcements



This Figure shows the cumulative returns of the EuroStoxx 50 index in the 48 hours around ECB policy rate announcements. The ECB announces its rate decision at 13:45 (CET) and then holds a press conference, which starts at 14:30 CET. The time-window shown is from 13:45 on the day before until 13:45 on the day after the announcement. The dashed vertical lines indicate the end of a trading day whereas the two solid lines indicate the time of the policy rate announcement ("RA") and the start of the press conference ("PC"), respectively. The three lines correspond to all press conference days (middle line, blue), the subset of days with positive tone changes (upper line, green) or negative tone changes (lower line, red).

The middle line (in blue) shows the average cumulative return across all 241 press conferences in our sample. There is a pre-announcement drift before the policy rate announcement at 13:45 CET (indicated by the solid vertical line labeled "RA"), akin to the findings in Lucca and Moench (2015) for FOMC meetings. Contrary to the FOMC pre-announcement drift, however, these returns are completely reversed in the 24 hours after the announcement. The other two lines show average cumulative returns over the same time window but separately for press conferences (PCs) with a more positive tone (upper line, in green) and PCs with a more negative tone (lower line in red) compared to the previous PC. Three effects stand out from this figure. First, PCs with a more positive tone are associated with higher returns than PCs with a more negative tone. Second, tone-conditional returns co-move until the beginning of the press conference and then start to diverge. Third, unlike the pre-announcement drift, the return spread between PCs with positive and negative tone changes is not reversed.

The link between tone changes and equity markets is statistically significant for intraday returns measured from the beginning of the PC as well as for returns measured over the full PC day, for Eurozone indices as well as for country indices. Our key finding is that the effect of tone changes on returns is robust to controlling for market-based proxies for financial conditions leading up to the policy meeting, the ECB's policy rate and unconventional policy announcements, interest rate-based measures of monetary policy shocks associated with the rate announcement and the press conference (e.g. Altavilla et al., 2019) as well as past tone changes and other textual characteristics. Accounting for all these control variables, we can interpret our results in terms of *tone surprises* that move stock prices, and we validate this interpretation using the residuals from autoregressive (AR) models of ECB tone as well.

Our results imply that surprises in ECB tone convey new information for stock markets, which raises the question of *why* and *how* tone matters for asset prices. To shed light on this question, we explore tone effects in riskfree interest rates and other classes of risky assets.

We start by documenting that a positive tone surprise is associated with higher (risk-free) interest rates, which implies that tone does not move stock prices through a simple discount rate effect. Instead, we show that tone surprises have a large effect on risk premia embedded in asset prices.

When ECB tone becomes more positive, the VSTOXX volatility index (similar to the VIX in the US) decreases, which implies that volatility insurance becomes cheaper. At the same time, realized volatility is essentially unrelated to tone changes. As a consequence, changes in the price of volatility insurance are primarily driven by lowered risk premia required by investors in excess of expected volatility. This, in turn, implies that positive tone surprises are associated with market participants lowering their risk aversion. Thus, our finding represents a communication-based analogue to Bekaert et al. (2013), who find that monetary easing decreases risk aversion as measured by variance risk premia.

As an alternative proxy for risk premia, we analyze the response of credit spreads to tone changes. We find that a positive tone surprise is associated with a decrease in credit spreads, i.e. the yield differential of BBB- and AAA-rated corporate bonds, and this result is most pronounced for the credit spreads of financial institutions. These tone responses of credit spreads as well as the responses of stocks and interest rates are qualitatively the same as the joint asset price responses due to changes in the risk aversion of the financial sector in Gilchrist and Zakrajšek (2012).

Since positive tone shocks are associated with higher stock prices and higher interest rates, they bear a resemblance to central bank information effects (e.g., Nakamura and Steinsson, 2018; Jarociński, 2020). To explore this further, we expand our analysis of tone surprises to account for information effects and find that controlling for information shocks does not crowd out the effect of tone shocks on asset prices. These empirical results cannot distinguish whether the significance of tone stems from being a novel, text-based proxy for information effects or whether tone matters through a separate channel. However, they clearly show the central bank tone moves for asset prices because it conveys news not captured by empirical measures of policy and information shocks.

At the beginning of the introduction, we asked the question whether a central bank's communication matters for asset prices beyond policy actions. We find that it does. Our results suggest that central bank tone affects the risk-taking of market participants and the risk premia they require, which implies that communication tone is an important instrument in the monetary policy toolkit.

Related literature. Our work relates to previous research that analyzes the effects of monetary policy on the prices of stocks and other assets as well as to the literature on central bank communication.

Bernanke and Kuttner (2005) are among the first to show that Fed policy decisions have a strong effect on stock prices. Other studies of equity returns around policy meetings provide evidence for a pre-announcement drift leading up to FOMC meetings (Lucca and Moench, 2015) and weekly return patterns over FOMC cycles (Cieslak et al., 2019). Neuhierl and Weber (2019) show that the expected path of monetary policy, measured from Fed Fund futures, predicts stock returns. There is ample evidence that monetary policy affects prices of other assets as well (e.g., Rigobon and Sack, 2004; Campbell et al., 2020) and our work is most closely related to those who document risk premium effects, for example, in term premia (e.g., Shiller et al., 1983; Gertler and Karadi, 2013; Hanson and Stein, 2015), equities (e.g., Bernanke and Kuttner, 2005), credit spreads (e.g., Gilchrist and Zakrajšek, 2012; Gertler and Karadi, 2015), and options-implied measures of risk premia (e.g., Bekaert et al., 2013).

A related literature focuses on quantifying monetary policy surprises from changes in asset prices in short windows around policy announcements (e.g., Kohn and Sack, 2004; Guerkaynak et al., 2005; Nakamura and Steinsson, 2018; Cieslak and Schrimpf, 2019; Ferrari et al., 2021; Leombroni et al., 2021; Swanson, 2021). In our empirical analysis, we use the interest rate shocks proposed by Altavilla et al. (2019) and Jarociński (2020) as well as the policy and information shocks identified by Jarociński and Karadi (2020) from the joint market reactions of interest rates and equities.

Since we measure tone from central bank statements, our work relates to the large literature on central bank communication (e.g., Woodford, 2005; Blinder et al., 2008, for a comprehensive survey). Early work includes Romer and Romer (2004) who apply a narrative approach to identify monetary policy shocks from central bank documents. Lucca and Trebbi (2009) analyze the content of FOMC statements by semantic orientation scores estimated from a large information set obtained through search engines. Jegadeesh and Wu (2017) assess how the market responds to different topics discussed in FOMC minutes. Hansen et al. (2017) investigate how transparency affects deliberation of FOMC members, and Hansen and McMahon (2016) study how FOMC communication about economic conditions and forward guidance affect economic and financial variables. More recently, Ehrmann and Talmi (2020) use a human scoring approach to investigate how (small) changes in central bank communication affect financial markets. Picault and Renault (2017) develop a lexicon to quantify ECB communication and show that it is helpful in explaining future monetary policy outcomes. Other papers that analyze different communication characteristics (such as content, tone, similarity, readability, etc.) include Bligh and Hess (2007); Rosa and Verga (2007); Rosa (2011); Amaya and Filbien (2015).

Our contribution to these branches of research is to show that policy communication matters for asset prices through a risk-based channel, beyond policy actions, because tone surprise convey news not captured by monetary and information shocks.

2. Measuring central bank tone

Our empirical analysis focuses on the European Central Bank (ECB). Throughout our sample period from 1999 to 2021, the ECB has held its monetary policy meetings on Thursdays (scheduled well in advance), announced its interest rate decision at 13:45 CET, and held a press conference (PC) at 14:30.

The announcements and PCs take place during European trading hours and are closely followed by market participants who can react to new information instantaneously. The staggered timing of rate announcement and PC provides an ideal setup for disentangling market reactions to news about policy rates and communication tone. Our focus is on the tone surprise revealed during the PC, controlling for any information released with the rate announcement 45 minutes earlier.[3]

The ECB was the first major central bank to adopt this form of communication and thus offers the longest history to study the impact of central bank tone on asset prices. Importantly, other central banks have recently followed the ECB's example and started to hold press conferences after their policy meetings. For example, the Federal Reserve has started to hold press conferences very similar to the ECB's setup in April 2011, but only after every other FOMC meeting. Boguth et al. (2018) provide first evidence that markets pay higher attention and respond more strongly to FOMC meetings with PCs than without PCs. In 2018, chairman Jay Powell has announced that the Fed will hold PCs after every FOMC meeting from 2019, emphasizing that increasing the number of press conferences is no indication about future policy actions but only about improving communication.[4] With more and more central banks seeking to improve communication with the public by holding PCs after policy meetings, our results should be a useful benchmark for assessing the likely effects of PCs on financial markets as central banks adopt this form of communication as well.[5]

In total, our sample covers 241 ECB press conferences from January 1999 (the introduction of the Euro) to December 2021. For these PCs, we obtain transcripts of the ECB president's

[3]For most of our sample, i.e. 1999 to 2016, the statement issued at 13:45 contained little to no information other than the ECB's interest rate decision. From March 2016 onwards, the press release reports all monetary policy decisions, including unconventional monetary policy actions which had previously been announced during press conferences. Since July 2016, the ECB has also included rate guidance in the press release. With the onset of the COVID19 crisis, the length of the press releases has increased considerably, mostly due to the ECB announcing pandemic-related policy decisions.

[4]In his PC on June 13, 2018 (link), Chairman Powell states, "As Chairman, I hope to foster a public conversation about what the Fed is doing to support a strong and resilient economy. And one practical step in doing so is to have a press conference like this after every one of our scheduled FOMC meetings. [...] I want to point out that having twice as many press conferences does not signal anything about the timing or pace of future interest rate changes. This change is only about improving communications."

[5]Other central banks include the Bank of England, who started to hold press conferences after inflation reports in 2015, but also the central banks of, e.g., New Zealand, Norway, Sweden, and Switzerland.

opening statements, which are carefully drafted in advance with a twofold purpose: to inform the general public about the rationale underlying the interest rate decision made by the Governing Council and to provide a general outlook.

Below, we discuss how we measure tone, present summary statistics for ECB tone, and provide evidence that the ECB uses its tone to frame its judgement about economic conditions and to adumbrate its future actions.

2.1. Measuring tone from ECB press conference statements

The objective of our paper is to quantify how changes in central bank tone matter for asset prices. For our analysis, we deliberately choose a simple dictionary-based measure of tone that we quantify from ECB statements as described below. Additionally, we use the transcripts to compute other text-based measures proposed by previous research to capture changes in the statements' wording, complexity, and lexical diversity. We discuss the processing of transcripts and the measurement of these textual characteristics in detail in Appendix A.

We use the transcripts of the ECB press conferences to construct a proxy for CB tone based on the financial dictionary developed by Loughran and McDonald (2011, LM). More specifically, we use this dictionary to identify words that can be classified as *negative* in financial contexts. In each transcript, we count the number of negative words (N) as well as the total number of words (T), and define CB tone (τ) as

$$\tau = 1 - N/T, \tag{1}$$

such that lower values reflect a more negative CB tone and higher values imply a less negative tone. Our empirical analysis focuses on *changes in tone*, $\Delta\tau$, measured as the first difference in τ between two subsequent press conference. Accordingly, we interpret increases in τ as tone becoming more positive and decreases in τ as tone becoming more negative.

Our choice to measure CB tone based on negative words listed in the LM dictionary is driven by our objective to use a simple, transparent approach which does not require any form of subjective judgement and thereby minimizes concerns related to data mining. More specifically, our considerations are as follows.

First, we only use negative words because the usefulness of positive words for measuring tone is very limited. On the one hand, positive words are frequently negated (whereas negative words are not) and the framing of bad news often involves positive words (e.g., Loughran and McDonald, 2011, 2016).[6]

Second, by relying on the well-established LM dictionary we avoid the need for a subjective classification of words as being negative or not. The LM dictionary is explicitly designed to be informative for financial documents (in contrast to, e.g., the widely used Harvard Dictionary), and while it was originally applied to 10-K filings it has proven useful in other financial contexts as well; see, e.g., Gurun and Butler (2012), Hillert et al. (2014), and the surveys of Loughran and McDonald (2016, 2020). Alternatively, we could build our own dictionary of CB language, either by labelling words as negative based on common sense or based on a statistical procedure that classifies certain words as negative based on the market's reaction to the occurrence of these words. However, defining such a list ourselves would essentially mean that we have control over the resulting time series of tone and, thus, the outcome of our empirical analysis later in the paper, which could make our results susceptible to p-hacking concerns (e.g., Loughran and McDonald, 2020). Using a statistical procedure to generate a word list would either require to reserve some of data for training the model (which limits the sample available for the economic analysis) or to use the data twice, first to build the dictionary and subsequently to analyze the effect of tone on asset prices (which creates hindsight bias).

Finally, and again to avoid data mining concerns, we choose to measure tone by means of simple word counts rather than more elaborate techniques. Approaches such as term weighting or topic modelling use the full sample, which implies hindsight bias. Hence, to avoid all these potential biases, we choose simplicity and transparency over more elaborate alternatives in our empirical tests.[7]

[6] For example, Loughran and McDonald (2016) note (p. 1217) that "*The framing of negative information is so frequently padded with positive words that the measured positive sentiment is ambiguous*" such that ultimately there typically is "*little incremental information in positive word lists.*" One could attempt to account for negations by training an algorithm to ignore or re-interpret positive words in the vicinity of negations, however, doing so raises data-mining concerns and does not increase the accuracy of tone measurement. On the other hand, previous research suggests that market participants tend to focus on negative words while paying less attention to positive words (e.g., Loughran and McDonald, 2020).

[7] For the same reason, we do not ask human readers to evaluate CB statements. For instance, while a potential advantage of that approach may be that human readers are better in processing certain nuances of texts, a disadvantage is that human judgement cannot be avoided in the scoring process, thereby neither guaranteeing an avoidance of misclassification nor 'reader-fixed effects' in tone measures (e.g., Ehrmann and Fratzscher, 2007). Moreover, it would be difficult to set up a proper out-of-sample analysis of how CB tone

The downside of our approach, as for any other method of textual analysis, is that there can be misclassifications, i.e. cases where a phrase is identified as being negative even though it is not. Below we document the usefulness of our tone measure by providing excerpts from PC statements and showing which words and phrases drive ECB tone.

2.2. Descriptive statistics for ECB tone

Table I presents some descriptives statistics for ECB press conferences. The first column shows that PCs take place regularly but not at equidistant intervals. The average PC cycle is around 23 trading days, with 9 and 49 days for the shortest and longest intervals, respectively. The second column summarizes statistics for the ratio of the number of negative words to the number of total words (N/T), which we use to compute the tone measure defined in Equation (1). The average N/T is around 2.5% and is associated with substantial variability within the range of 0.4% and 5.7%. The third column shows that tone changes ($\Delta\tau$) are close to zero on average and at the median but exhibit substantial variation in the range from -2.4% to $+2.0\%$ as well as a significant first-order autocorrelation. Of the 240 ECB tone changes in our sample, we find that tone increases at 128 press conferences and decreases in 112 cases. Figure 2 plots the time series of ECB tone and changes in ECB tone. The grey vertical lines mark the dates of the ECB press conferences. Panel (a) shows that ECB tone reaches its minimum at the end of 2008/beginning of 2009 during the financial crisis and Panel (b) illustrates that the volatility of tone changes over time.

2.3. Which words drive ECB tone?

To provide evidence that tone indeed captures how the ECB frames macroeconomic fundamentals, we present summary statistics for the most frequently used negative words that drive our tone measure as well as for bigrams and trigrams (i.e., sequences of two and three adjacent words) in which they appear. Table II shows that the most frequently used negative words are "weak", "decline", and "imbalances".[8] The most common bigrams and trigrams involving negative words include, for instance, "global imbalances", "weaker (than) expected", "disor-

matters for asset prices, as multiple readers would have to be trained on a large body of statements.

[8]These counts are based on aggregating words by their word-stem; for example, the 467 occurrences we summarize for "weak" are the sum of occurrences for "weak" (194), "weaken" (6), "weakened" (22), "weakening" (58), "weaker" (121), "weakness" (60), and "weaknesses" (6).

derly correction", "financial market volatility", and "high level (of) unemployment". This suggests that our simple, dictionary-based measure correctly captures negative phrases commonly used by the ECB. With this first evidence for tone picking up how the ECB interprets and judges economic developments, we provide several press conference excerpts, to illustrate the broader context in which tone is measured.

Table III presents excerpts from the press conference held on January 15, 2009, which our measure identifies to exhibit the most negative tone during our sample period. In these excerpts, we highlight word sequences involving negative words that we have identified in multiple statements (in red italic font) and mark the negative words by asterisks (*). From this statement, the sentence having the largest impact on our tone measure is from the discussion of economic risks, stating that

> "They relate mainly to the potential for a stronger impact on the real economy of the **turmoil* in financial markets*, as well as to **concerns** about the emergence and intensification of protectionist pressures and to *possible *adverse* developments* in the world economy stemming from a **disorderly* *correction* of global *imbalances**."

In general, reading through these paragraphs, we find support for the view that our tone measure picks up the ECB's framing of economic and financial conditions as well as the economic outlook. To provide a broader picture of what our tone measure captures, we present additional excerpts in the Internet Appendix in Section IA.A.

3. Central Bank Tone and Equity Returns

In this section, we document a strong link between stock prices and the tone of ECB press conference statements. A more positive (negative) tone compared to the previous press conference is associated with higher (lower) equity market returns. These results are robust to controlling for market-based proxies for financial conditions leading up to the policy meeting, the ECB's policy actions, and interest rate-based measures of monetary policy shocks associated with the rate announcement and the press conference.

3.1. Equity returns around ECB press conferences

Akin to the literature that quantifies monetary policy shocks from changes in market prices in short windows around policy announcements, we start by studying the impact of tone changes on asset prices in daily data. The high-frequency results, shown above in Figure 1, suggest that the effect of ECB tone changes on EuroStoxx 50 prices over the full trading day is very similar to that arising during the press conference. Accordingly, we should find similar PC effects in daily data when we compute returns from the closing prices on the day preceding the PC and the day on which the PC is held.

To study the the effect of changes in ECB tone on Eurozone equity returns obtain daily equity data for (i) the EuroStoxx 50 (ESX50), which covers the 50 largest firms in the Eurozone, from STOXX; (ii) the MSCI EMU Index, a broad Eurozone index, from Datastream; (iii) ten MSCI country indices, for EMU countries with data from 1999 through 2021 (Austria, Belgium, Finland, France, Germany, Ireland, Italy, Netherlands, Portugal, Spain), from Datastream as well. The data covers the period from the first to the last PC in our sample, i.e., January 7, 1999 to December 16, 2021, with 5,825 daily observations, of which 240 are PC days (with tone changes) and 5,585 are non-PC days. Table IA.3 in the Internet Appendix reports summary statistics for equity index returns over the full sample as well as separately for Non-PC days and PC days.

Table IV provides such evidence for the ESX50 as well as the broad MSCI EMU index and ten EMU country indices. In the left part of Table IV, we report results from regressions of daily returns on PC-day dummies and find that not a single coefficient is significantly different from zero. Hence, there is no general premium on PC days, unlike the FOMC premium for the US documented in Lucca and Moench (2015). The right part of the table presents results for regressing returns on separate dummies for PCs with positive tone changes and negative tone changes, respectively, and testing whether the estimated coefficients are equal. All dummies for positive tone changes carry a positive slope coefficient and all dummies for negative tone changes have a negative coefficient estimate; many of the estimates for positive and/or negative tone change dummies are significantly different from zero. Moreover, we can reject equality of coefficients (based on an F-test) at the 5%-level for both EMU market indices and all ten countries.

3.2. Regressions of equity returns on ECB tone changes

The above results suggest that there is no PC-day premium in EMU equity markets but that stocks react differently when the ECB's tone change is positive or negative. We now provide evidence that tone changes convey new information for stock returns that is not subsumed by control variables that account for policy actions, market conditions, measures of monetary policy shocks proposed in the literature, and other textual characteristics of the PC statements. We provide relevant details on the construction of the monetary policy shock variables in Appendix B and present summary statistics for all control variables in Table IA.4 in the Internet Appendix.

Table V presents regression results for the ESX50. Specification (i) regresses PC day returns only on tone changes to provide a benchmark estimate. We find a significantly positive effect of tone changes on returns with a coefficient estimate of 0.44. In economic terms, a one standard deviation increase (decrease) in tone changes, where $\sigma(\Delta\tau) = 0.00745$, translates into a positive (negative) return of around 33 basis points on a PC day. With eight to twelve PCs per year, this translates into 2.6% to 3.3% *p.a.*, which seems sizeable given that the average annualized return of the ESX50 during our sample is of a similar magnitude.

Specification (ii) adds lagged tone changes (to control for autocorrelation in tone changes) and various measures of market conditions prior to the PC day, i.e., stock returns, return volatility, implied volatility (VSTOXX), the level of interest rates (German 2-year yield), and the term spread (German 10- minus 1-year yields). These controls are measured from the previous PC to the day before the current PC, to control for the possibility that the ECB might adjust its tone to recent market conditions (e.g., Cieslak and Vissing-Jorgensen, 2021, provide such evidence for the Federal Reserve). In essence, by controlling for lagged tone and financial market developments prior to the press conference, we are testing whether *tone surprises* move stock prices.[9] These controls hardly affect the estimate and significance of the coefficient on tone changes.

In specification (iii), we also control for other textual characteristics of PC statements, discussed in more detail in Appendix A. First, we add a proxy for the distance (DIS_t) of

[9]In robustness checks, we repeat the empirical analysis with tone surprises which we obtain as the residuals from autoregressive (AR) models for the level of tone, as we discuss in Section 5.2.

statements, which captures how much the wording of a statement differs from that of the previous statement. DIS_t might matter for asset prices if changes in communication reflect changes in the monetary policy stance or economic environment (also see, e.g., Ehrmann and Talmi, 2020). Second, we add proxies for changes in readability, as measured by the FOG-index (ΔFOG_t), and lexical diversity, which we measure by the type-token ratio (ΔTTR_t). More complex and lexically diverse statements are potentially harder to interpret, might increase uncertainty and could thus matter for asset prices. However, these three additional characteristics turn out to be insignificant and they also do not affect the significance of tone changes. Hence, we can rule out that tone changes matter for stocks because they capture features of other textual characteristics.

The results of specification (iv) show that policy actions taken by the ECB hardly affect the coefficient on tone changes, by controlling for changes in policy rates and for unconventional monetary policy announcements. More specifically, we compute changes in the rate on main refinancing operations (ΔMRO)[10] and construct a dummy variable (UMP_t) which takes a value of one when an unconventional policy action (according to Cieslak and Schrimpf, 2019) is announced during a press conference, and zero otherwise. Neither of these policy actions are associated with regression coefficients different from zero whereas the coefficient estimate for tone changes remains unchanged and significantly positive.

Finally, we rule out the possibility that changes in tone capture the same information as monetary policy shocks measured from high-frequency changes in interest rates; we discuss the shock construction in detail in Appendix B. In specification (v), we follow Jarociński (2020) and measure shocks as the first principal component (PC1) of changes in short-term interest rates. In the regression, we control for shocks associated with the press release announcing policy rates and shocks associated with the press conference. In specification (vi), we use the term structure-based shock factors proposed by Altavilla et al. (2019), i.e. their target factor for the rate announcement as well as the timing, forward guidance (FG), and quantitative easing (QE) factors for the press conference. For both regressions, we find that coefficient estimates for shocks reflecting responses in short-term rates during the press conference are significantly positive, but the coefficient on tone changes remains largely unchanged and

[10]The MRO rate is the main policy rate but using the rates of the deposit facility or the marginal lending facility does not change the results as all three rates are highly correlated. All ECB-related data can be obtained from the statistics section of the ECB website, i.e. https://www.ecb.europa.eu/stats/.

significantly positive as well.

These results show that changes in ECB tone convey new information for EMU equity markets, which is not subsumed by policy actions, not due to market conditions prior to press conferences, and not captured by measures of monetary policy shocks. In the Internet Appendix, we report additional results that corroborate our findings. Repeating the regressions with ESX50 high-frequency returns measured over different time periods of the PC day, Table IA.5 confirms that the significance of tone changes only arises during the PC, i.e., in the time-window from 14:30 to 17:30 CET, and not before, as already suggested by Figure 1.[11] The results in Table V are also very similar to those for the broader MSCI EMU index (Table IA.6) as well as for country indices, where we find that Ireland is the only case in which equity returns are not significantly related to tone changes in all specifications (see Table IA.7).

4. Why does tone matter?

Our finding that changes in ECB tone significantly move stock markets raises the question of *why* and *how* tone matters for asset prices. To shed light on this question, we now study how the prices of other assets respond to changes in ECB tone.

Our results suggest that the relation between tone changes and stock returns cannot be explained by movements in risk-free rates but must be driven by how tone matters for risk premia embedded in asset prices. A more positive tone is associated with a lower option-implied risk aversion and with lower credit spreads, in particular for financial institutions. We discuss how the tone effects on asset prices are consistent with a risk-based channel of monetary policy and more specifically with the linkages between credit spreads, interest rates, and stock returns documented by Gilchrist and Zakrajšek (2012). We also show that these tone effects are robust to controlling for policy and information shocks as in Jarociński and Karadi (2020), which supports our conclusion that tone surprises primarily affect risk premia.

[11]Figure 1 shows that returns on days with more positive versus negative tone start to diverge at the beginning of the press conference. There appears to be some pre-announcement effect on the day of the press conference, however, most of this can be traced back to the COVID19-related stock market crash in March 2020. The scheduled ECB press conference on March 12 happened to coincide with the Eurostoxx 50 loosing more than 10% in a single day and much of this right after the morning opening. Removing this one outlier day from our sample substantially reduces the spread between the red and green line prior to the PC.

4.1. ECB tone and risk-free government bond yields

A natural starting point for our further analysis of market responses to central bank communication is to consider interest rates. Using German government bonds, Figure 3 presents results for the term structure of yield changes on ECB press conference days.[12]

Panel (a) shows that, on average across all PC days (dashed blue line), yields of all maturities increase and more so for longer as compared to shorter maturities. When we separate PC days with positive (green) and negative (red) tone changes, we see a similar slope effect for both, but the level of yield changes is significantly different across all maturities: when ECB tone becomes more positive, all yields increase and more so for longer maturities. When ECB tone becomes more negative, yields of shorter maturities decrease whereas yields of longer maturities increase on average. Panel (b) presents results from regressing yield changes on tone changes on PC days as well as our standard control variables for other textual characteristics, policy actions, market conditions, and monetary policy shocks. We plot the tone coefficient estimates along with 95% confidence intervals and find that estimates are positive for all maturities with the link being statistically significant for maturities up to five years.

These results show that a more positive ECB tone is not only associated with higher stock prices but also with higher interest rates. Finding that interest rates and equity prices respond to tone changes in the same direction is interesting for two reasons. On the one hand, this finding suggests that tone does not move stock prices through a simple risk-free rate discount effect. Instead, stock returns in response to changes in ECB tone appear to reflect news about risk premia, and we provide evidence supporting this notion below. On the other hand, the positive co-movement of interest rates and equity prices appears similar to that underlying the identification of 'central bank information shocks' (e.g., Nakamura and Steinsson, 2018; Jarociński and Karadi, 2020) as we discuss in more detail in Section 4.4.

[12] We use Bundesbank data for the term structure of German government bond yields. This data is available over our full sample period, whereas European yield data available from the ECB only start in 2004. Over the joint sample period, the German yield curve is highly correlated with the ECB AAA yield curve.

4.2. Does tone matter for risk premia? Evidence from options

Our findings in Section 3 suggest that investors adjust their expectations for the stock market return in response to changes in ECB tone. Conceptually, such adjustments may be driven by changes in the quantity of risk that investors face or the premium they require per unit of risk. To analyze these different dimensions, we assess the realized volatility of ESX50 returns, changes in index options-implied volatility, and the link between realized volatility and changes in implied volatility.[13] We follow Bekaert et al. (2013, 2022), who propose to measure time-variation in risk aversion via variance risk premia implied by equity options. Bekaert et al. (2013) show that unexpected monetary policy easing is associated with a decrease in variance risk premia, which implies a lower risk aversion by market participants. Similarly, we find that a more positive central bank tone is associated with a significant decrease in options-implied volatility as well as in volatility risk premia.

4.2.1 Realized volatility, implied volatility, and risk premia

First, we use high-frequency data to compute the realized volatility (RV) of the ESX50 for each trading day in our sample, following the approach of Bollerslev et al. (2018).[14] For each day, we also compute the realized volatility from 14:30 to 17:30 (RV_{PC}), which captures the time window of the PC on ECB announcement days. Using both estimates, we check whether realized volatility is different on PC and non-PC days and whether realized volatility is different on PC days with positive compared to negative tone changes.

Panel A in Table VI reports the results from regressing RV or RV_{PC} on PC- and PC tone change-dummies. We find that realized volatility is significantly higher on PC days compared to non-PC days, by about 15 basis points over the full trading day and by about 17 basis points in the time period from 14:30 to 17:30. However, the sign of ECB tone changes does not appear to matter for realized volatility, as we are far from rejecting the null hypothesis of equal coefficients when we regress RV and RV_{PC} on separate dummies for PCs with positive

[13] For summary statistics of all volatility quantities, see Table IA.8 in the Internet Appendix.

[14] For each day in our sample, we (i) compute five daily series of squared five-minute log returns, starting at the first five unique one-minute marks, respectively; (ii) compute the sum of squared returns for each of the five series; (iii) obtain that day's estimate of realized variance as the average of the five sums; (iv) take the square root to obtain our estimate of realized volatility. Bollerslev et al. (2018) provide a discussion that this procedure provides an efficient estimate of realized volatility.

and negative tone changes; the p-values of the F-tests are 0.30 for RV and 0.56 for RV_{PC}.

Next, we compute changes in index options-implied volatility, measured by the VSTOXX, which is a volatility index computed from options on the ESX50, similar to the VIX based on S&P 500 options in the US.[15] The VSTOXX can be interpreted as a price of volatility insurance, since $VSTOXX$ is the fixed leg in a volatility swap that pays the difference in implied volatility and future realized volatility of the ESX50. To analyze whether ECB tone matters for the pricing of insurance against future volatility, we compute log changes in VSTOXX from the close on the day before the PC to the close on the PC day, i.e., the timing is exactly the same as in our analysis of stock returns above (e.g. Table V).

The results in Panel A of Table VI show that implied volatility significantly decreases on PC days, by about -1.21% percent.[16] However, once we distinguish between PCs with positive and negative tone changes, we find that implied volatility significantly decreases only on days with positive tone changes (by -2.00%) whereas it is not different from zero on PC days with negative tone changes; accordingly, we can reject the hypothesis of equal dummy coefficients with a p-value of 0.05. Hence, our results suggest that volatility insurance becomes cheaper when ECB tone becomes more positive.

The above findings are intriguing, because they suggest that ECB tone matters for the volatility risk premium and hence for investors' risk aversion. Changes in implied volatility are either due to changes in expected future volatility or changes in the volatility risk premium that investors are willing to pay on top of expected volatility. Given that realized volatility is not significantly different on PC days with positive and negative tone changes, it seems unlikely that ECB tone affects expectations about future realized volatility and we provide more evidence for this view below. Instead, ECB tone appears to affect the VSTOXX through changes in volatility risk premia.

To assess changes in the volatility risk premium (VRP), we compute log changes in the

[15] The VSTOXX is designed to make pure volatility tradable and to be replicable by options portfolios that do not react to ESX50 price changes but only to volatility changes. The VSTOXX is computed from maturity-specific sub-indices, which themselves are computed from ESX50 options in predefined maturity buckets and across moneyness levels. For details see the STOXX (2018).

[16] This finding is similar to the negative VIX changes on FOMC announcement days documented by Boguth et al. (2018). To the extent that such decreases in VIX reflect a reduction in uncertainty, one can rationalize announcement premia in the theoretical framework of Ai and Bansal (2018). Recall, however, from Section 3 that we do not find significant ECB announcement day effects in the ESX50.

VSTOXX relative to realized volatility, using both RV and RV_{PC}.[17] Similar to the VSTOXX, we find that VRPs decrease on PC days and that once we control for the sign of ECB tone changes, this is mostly due to PCs with positive tone changes.

4.2.2 Regressions on ECB tone changes

To provide further evidence for a link of implied volatility and volatility risk premia to ECB tone, we run regressions of changes in VSTOXX and VRPs on tone changes and the set of control variables that we have also used in our analysis of stock returns above. The results in Panel B of Table VI show that the coefficient estimate for tone changes is significantly negative in all specifications, which implies that a positive tone surprise is associated with lower volatility risk premia and a decline in the pricing of volatility insurance.[18]

Beyond these significant tone effects, we also find (mostly significant) negative coefficients for UMP_t in the VSTOXX regressions, which suggests that announcements of unconventional policy actions reduce options-implied volatility, in line with, e.g., Hattori et al. (2016). Moreover, we find that changes in implied volatility and volatility risk premia are positively related to interest rate-based measure of monetary policy shocks, either to the 'PC1 - press release' shock in specification (ii) or the 'QE factor' shock in specification (iii). Put differently, unexpected monetary policy tightening is associated with higher implied volatility and risk premia. Additionally, we repeat the regression analysis for different VSTOXX-maturities, ranging from one month to two years. Figure 4 illustrates that the estimated coefficients are significantly negative and monotonically increase with maturity, except for a small twist at the one-year horizon. These results suggest that communication tone has a stronger impact on short-term compared to longer-term risk premia.

Hence, akin to the finding of Bekaert et al. (2013) that monetary easing decreases variance risk premia, we find that a more positive communication tone is associated with a significant

[17]Our goal is to track changes in VRP at high frequency. Ideally, we would like to measure VRP from a one-day volatility swap that pays the difference between one-day $VSTOXX$ (fixed leg) and realized volatility over the PC day (floating leg), but unfortunately such contracts do not exist. To assess whether VRP increases or decreases, we compare the one-day change in the VSTOXX relative to realized volatility. To rule out the hypothetical case that tone changes may not affect RV and RV_{PC} but realized volatility going forward, we verify that there are no tone-related patterns in realized volatility over the next week, month, and three months; see Table IA.9 in the Internet Appendix.

[18]In the Internet Appendix, Table IA.10 additionally reports regression estimates for all control variables.

decrease in volatility risk premia. Considering that we control for policy actions, changes in market conditions since the last PC day, and yield-based monetary policy shocks, our results suggests that changes in ECB tone affect risk premia embedded in asset prices. In other words, ECB tone matters for asset prices through a risk-based channel by affecting investor risk aversion.

4.3. ECB tone and corporate credit spreads

The results above show that there is a link between central bank tone and economic fundamentals and that tone matters for asset prices through risk premia. To better understand this combination of results, we now study the relation between ECB tone and credit spreads, motivated by previous evidence that changes in credit spreads are driven by risk premia and reflect the risk-bearing capacity of financial intermediaries.

Gilchrist and Zakrajšek (2012) study the interrelations between credit spreads, economic activity, and monetary policy. First, they show that the predictive relation between credit spreads and economic activity is driven by the spreads' embedded risk premia, which also account for most of the spreads' variation. Second, they argue that increases in credit spreads reflect a reduction in the effective risk-bearing capacity of the financial sector, which in turn leads to a reduction in credit supply, a contraction in economic activity, a decline in interest rates, and a fall in stock markets. Third, they provide evidence that shocks to credit spreads are linked to the deterioration in the profitability and creditworthiness of broker-dealers, who are the marginal investors in corporate debt markets. The results of Gilchrist and Zakrajšek (2012) are consistent with earlier evidence that changes in monetary policy that affect the risk-bearing capacity of intermediaries will directly matter for asset prices, such that looser policy leads to a lower price of risk, see, e.g., Adrian and Shin (2008) and Adrian et al. (2010). For a recent survey of this 'risk-taking channel' of monetary policy, see Adrian and Liang (2018). More generally, the idea that financial intermediaries are the marginal investors in asset markets and therefore play a crucial role for the pricing of assets is central to the recent literature on intermediary asset pricing (see, e.g., He and Krishnamurthy, 2013; Adrian et al., 2014; He et al., 2017).

To analyze whether changes in ECB tone matter for EMU credit spreads, we obtain data on IBOXX credit indices to compute corporate yields spread differentials between BBB- and

AAA-rated firms.[19] Table VII presents results for broad credit indices and for indices covering either financial or non-financial firms. Panel A shows that credit spreads tend to decrease on PC days, but the only significant effect we find is for financial firms (−1.39 basis points, t-statistic of −2.36). When we test for differences in PC day-effects conditional on tone becoming more positive or negative, we find a significant difference for financial firms (p-value 0.05), where a more positive tone is associated with a spread decrease of −2.4 basis points. Using the same dummy regressions, we find weaker results for the credit spreads of all firms (p-value of 0.11) and no PC effects for non-financial firms (p-value of 0.30).

Turning to the regression analysis in Panel B, we obtain a similar picture but with more pronounced results.[20] There is a negative relation between changes in credit spreads and changes in ECB tone, with the link being most significant for spreads of financial firms.[21] Among the control variables, we note that the ECB's policy actions have a significant impact on credit spreads as well. UMP announcements significantly lower credit spreads (in line with, e.g., Chodorow-Reich, 2014) in the sample of all corporates, mostly driven by the impact on the spreads of non-financial firms. For financials, we find in our most comprehensive specification that changes in credit spreads are positively related to changes in the policy rate and negatively related to target shocks. Controlling for these and other effects, the coefficient estimate on tone changes are significantly negative in all specifications for financial firms (t-statistics between −2.47 and −2.78), mostly significant for the set of all firms (t-statistics between −1.87 and −2.78) but less so for non-financial firms (t-statistics between −0.86 and −1.91).

Taken together, the confluence of our results suggests that the answer to the question *how* and *why* tone matters for asset prices is a risk-based channel. We find that tone affects risk premia very similarly to policy actions, as shown by, e.g., Bernanke and Kuttner (2005)

[19]For summary statistics of changes in credit spreads, see Table IA.11 in the Internet Appendix. For most of their empirical analysis, Gilchrist and Zakrajšek (2012) use the excess bond return of their self-constructed credit index, because it is the best predictor of future economic activity in their US sample. For the BBB-AAA spread, they find that the predictive ability is less significant but qualitatively the same. We use the BBB-AAA spread, because Krylova (2016) finds that the BBB-AAA spread mostly dominates alternative corporate spread measures as leading indicator for the Eurozone. More recently, Gilchrist and Mojon (2018) provide credit risk indices for the euro area.

[20]In the Internet Appendix, Table IA.12 additionally reports regression estimates for all control variables.

[21]We note that lagged tone changes are significant in some specifications as well and account for this in robustness checks that we present in Section 5.2.

for stocks, Bekaert et al. (2013) for variance risk premia, and Gertler and Karadi (2015) for credit spreads. Put differently, central bank tone moves asset prices because it seems to affect the risk aversion of market participants. More specifically, the ECB tone-related linkages we document between stock returns, interest rates, and credit spreads are qualitatively the same as those that arise in Gilchrist and Zakrajšek (2012) due to shocks to intermediary risk-bearing capacities. Our finding that the results are more pronounced for the credit spreads of financial institutions than for non-financial corporations provides further evidence for a risk-based channel of central bank tone and suggests a link between central bank communication, intermediaries, and asset prices.

4.4. Central bank tone and information shocks

In our empirical analysis we find that changes in central bank tone move stock prices and interest rates in the same direction. We now connect this finding to recent research on central bank information effects, which has proposed to use the co-movement between stocks and interest rates around central bank announcements to distinguish between 'policy shocks' and 'information shocks' (e.g., Nakamura and Steinsson, 2018; Jarociński and Karadi, 2020).

We use the (updated) shock series of Jarociński and Karadi (2020, JK) who identify policy and information shocks from the high-frequency co-movement of interest rates and stock prices via sign restrictions; for details see Appendix B. The intuition is as follows. A monetary *policy* shock, i.e., an unexpected tightening or easing of the monetary policy stance, should move stock prices and interest rates in opposite directions. That is, a tightening shock should increase discount rates and, as a consequence, decrease stock prices. By contrast, interest rates and stock prices co-move in the same direction in case of an information shock, that is, if an announcement reveals unexpectedly good (bad) news about economic conditions, this will drive up (down) both stocks and interest rates.

Our finding that tone surprises move stock prices and interest rates in the same direction raises the question whether these tone effects are similar to the JK information shocks. To address this question for stocks and interest rates as well as for the tone effects in volatility and credit markets, we extend the regression analysis by including the JK policy and information shocks as additional variables. Table VIII reports the main results across asset classes using the Eurostoxx 50 (as in Table V), the two-year German government bond yield (as in Figure 3), options-implied volatility and volatility risk premia (as in Table VI), and the credit spreads of financials (as in Table VII). These results shows that the coefficient estimates for tone changes remain significant in all asset classes.

For interest rates and credit spreads, we find that the results are virtually unchanged when including JK policy and information shocks. For returns on the Eurostoxx 50 as well as changes in the VSTOXX and in volatility risk premia, we find that including policy and information shocks substantially increases the adjusted-R^2 values, somewhat reduces the magnitude of the tone coefficients, but the tone effects remain statistically significant. The coefficient estimates for, both, policy and information shocks are statistically significant as well, with the estimates for information shocks having the same sign as the estimates for the tone surprises whereas the policy shock coefficients taking the opposite sign.

From a conceptual perspective, it is difficult to say whether tone shocks are a new, text-based proxy for central bank information effects, capturing different aspects than the JK information shocks, or whether tone surprises affect asset prices through a separate channel. In other words, it could be that tone and information shocks are (imperfectly correlated) proxies for the same underlying effect.[22] Drawing a clear distinction between these two possibilities presents a challenge, and we defer this task to future research since it is not necessary for the purpose of our study. What we show is that central bank tone indeed matters for asset prices, also when controlling for the policy and information shock measures proposed by Jarociński and Karadi (2020).

5. Additional results and robustness tests

This section summarizes additional results and robustness checks, which we present in the Internet Appendix.

5.1. Robustness over subsample periods

To show that our results are not driven by a particular period in our sample (e.g., the financial crisis), we repeat the empirical analysis for 18 six-year subsamples. In the Internet Appendix,

[22] The sample correlation of tone changes with policy shocks is −0.032 and with information shocks is 0.167.

Figure IA.1 shows that there is a positive spread in stock market returns on days with positive compared to negative tone changes in 17 of the 18 subsamples. For interest rates, we find that positive (negative) tone changes are typically associated with increases (decreases) in the 2-year yield of German government bonds or, at least, less of a decrease (less of an increase). Moreover, we find that a more positive tone is usually associated with a decrease in the VSTOXX, whereas a negative tone change is associated with an increase or a smaller decrease. The inverse relation between tone changes and credit spreads of financial firms appears to have started in 2009, i.e., after the onset of the financial crisis when investors became particularly concerned with the health of financial institutions, and have become less important in recent years. Taken together, these results show how tone effects vary over time and corroborate our conclusion that tone conveys information that matters for asset prices through a risk-based channel.

5.2. Surprises based on AR-models of central bank tone

In our main analysis, we have studied surprises in ECB tone via regressions of asset price responses on tone changes, lagged tone changes and proxies for the information set of market participants prior to the press conference. The advantage of using tone changes and control variables is that all variables are observable in real-time and no separate estimation is required to obtain tone surprises, thereby avoiding generated regressor issues. An alternative approach is to model ECB tone as an autoregressive (AR) process in a first step, potentially including other variables as well, and to obtain tone surprises as the residuals from the AR model. We then use these residuals as tone surprises in a second step, in which we relate changes in asset prices to these tone surprises.

We now repeat the empirical analysis using AR(1)-, AR(3)-, and AR(5)-models for the level of ECB tone in two specifications. In the first specification, we only include lags of ECB tone on the right hand side of the regression. In the second specification, we extend the AR-models to also include other information available to market participants prior to the press conference, i.e. the stock market and interest rate quantities that we have used as control variables for market conditions in our main analysis. We then regress asset price changes on the AR-model tone surprises as well as the control variables we have included in our main analysis (except for the variables already incorporated in the respective AR-models).

We report the results in Tables IA.13 and IA.14 in the Internet Appendix, which show that the tone coefficient estimates have very similar magnitudes and levels of significance as in the regressions reported in Sections 3 and 4 above.

5.3. Tone surprises, policy actions, and fundamentals

Our results suggest that central bank tone moves asset prices through a risk-based channel, with tone surprises affecting risk premia required by market participants. In additional analyses, we check whether tone could also matter for asset prices by signalling news about the future path of monetary policy or economic fundamentals. We discuss our findings below but delegate details of the econometric setup to Internet Appendix IA.B.

First, we show that (lagged) tone changes have some predictive power for future policy rate changes over and above the information contained in lagged MRO changes: A more positive (negative) tone predicts future increases (decreases) in policy rates. This finding is generally consistent with central bank tone surprises being informative about the future policy stance, but we have already shown above that tone-related risk premium effects dominate risk-free discount rate effects.

Second, we use predictive regressions to study whether tone changes are informative about future fundamentals. The signs of the estimated coefficients support the intuition that a more positive tone is associated with better economic conditions, which is in line with our finding that tone surprises share some similarities with central bank information effects. However, we only find some degree of significance for growth in (real) industrial production and, somewhat more pronounced, for business confidence, which may be indicative for either cash flow or risk premium effects; all other estimates are insignificant. Hence, it appears unlikely that tone surprises matter for asset prices mostly due to predictive power for future fundamentals.

5.4. Sovereign yield spreads

In an additional empirical exercise, we examine the effect of tone surprises on the term structures of sovereign yield spreads on Italian and Spanish government bonds compared to German government bonds. Repeating the analysis of the term structure of German government bonds (from Section 4.1), we now present analogous results for sovereign yield spread curves in Figure IA.2 in the Internet Appendix. To have full sample coverage from 1999 to 2021, we focus on maturities of one to ten years. Economically, our findings are consistent with a risk-based channel of tone, i.e. we find in Panel A that a more positive tone is, on average, associated with lower sovereign yield spreads. Panel B shows the results from regressing sovereign yield spread changes on changes in ECB tone ($\Delta\tau$) as well as our standard control variables for other textual characteristics, policy actions, market conditions, and monetary policy shocks. With these control variables, all estimates for maturities of two years or longer are negative but most are not significantly different from zero at the 5% level.

6. Conclusion

We propose to assess market-relevant news in central bank announcements directly from the verbal communication of policy makers. Using a systematic approach to measure the tone of the ECB president in press conferences held after policy meetings, we find that a positive tone surprise is associated with significantly higher stock prices, higher interest rates, lower volatility risk premia, and lower credit spreads. These tone effects are robust to controlling for policy actions and standard measures of monetary policy shocks, which implies that tone surprises convey price-relevant news to the market.

Our findings contribute to the debate on effective central bank communication. We show that a simple measure of central bank tone conveys news for asset prices through a risk-based channel, similarly to the risk premium effects of policy actions. Thus, from the perspective of policy makers, our results imply that communication tone is an important instrument in the monetary policy toolkit. By tilting their communication to have a more positive or negative tone, central bankers can affect the risk appetite of market participants and, thereby, financial conditions and the pricing of risky assets. This may prove particularly useful in times of high uncertainty or when the scope for policy actions is limited.

References

Adrian, T., Etula, E., Muir, T., 2014, "Financial Intermediaries and the Cross-Section of Asset Returns," *Journal of Finance*, 69, 2557–2596.

Adrian, T., Liang, N., 2018, "Monetary policy, financial conditions, and financial stability," *International Journal of Central Banking*, 14, 73–132.

Adrian, T., Moench, E., Shin, H. S., 2010, "Financial intermediation, asset prices and macroeconomic dynamics," *FRB of New York Staff Report*.

Adrian, T., Shin, H. S., 2008, "Financial intermediaries, financial stability, and monetary policy," *Jackson Hole Economic Symposium Proceedings 2008, Federal Reserve Bank of Kansas City*, pp. 287–334.

Ai, H., Bansal, R., 2018, "Risk Preferences and the Macroeconomic Announcement Premium," *Econometrica*, 86, 1383–1430.

Altavilla, C., Brugnolini, L., Gürkaynak, R. S., Motto, R., Ragusa, G., 2019, "Measuring euro area monetary policy," *Journal of Monetary Economics*, 108, 162–179.

Amaya, D., Filbien, J.-Y., 2015, "The Similarity of ECB Communications," *Finance Research Letters*, 13, 234–242.

Bekaert, G., Engström, E., Xu, N., 2022, "The Time Variation in Risk Appetite and Uncertainty," *Management Science*, 68, 3975–4004.

Bekaert, G., Hoerova, M., Lo Duca, M., 2013, "Risk, Uncertainty, and Monetary Policy," *Journal of Monetary Economics*, 60, 771–788.

Berger, H., Ehrmann, M., Fratzscher, M., 2011, "Monetary Policy in the Media," *Journal of Money, Credit and Banking*, 43, 689–709.

Bernanke, B., 2016, *The Courage to Act: A Memoir of a Crisis and its Aftermath*, W. W. Norton & Company.

Bernanke, B. S., Kuttner, K. N., 2005, "What Explains the Stock Market's Reaction to Federal Reserve Policy?," *Journal of Finance*, 60, 1221–1257.

Bholat, D., Hansen, S., Santos, P., Schonhardt-Bailey, C., 2015, "Text Mining for Central Banks," CCBS Handbook No. 33, Bank of England.

Bligh, M. C., Hess, G. D., 2007, "The Power of Leading Subtly: Alan Greenspan, Rhetorical Leadership, and Monetary Policy," *The Leadership Quarterly*, 18, 87–104.

Blinder, A. S., Ehrmann, M., Fratzscher, M., De Haan, J., Jansen, D.-J., 2008, "Central Bank Communication and Monetary Policy: A Survey of Theory and Evidence," *Journal of Economic Literature*, 46, 910–945.

Boguth, O., Gregoire, V., Martineau, C., 2018, "Coordinating Attention: The Unintended Consequences of FOMC Press Conferences," *Journal of Financial and Quantitative Analysis*, forthcoming.

Bollerslev, T., Hood, B., Huss, J., Pedersen, L. H., 2018, "Risk Everywhere: Modeling and Managing Volatility," *The Review of Financial Studies*, 31, 2729–2773.

Campbell, J., Pflueger, C., Viceira, L., 2020, "Macroeconomic Drivers of Bond and Equity Risks," *Journal of Political Economy*, 128, 3148–3185.

Chodorow-Reich, G., 2014, "Effects of Unconventional Monetary Policy on Financial Institutions," *Brookings Papers on Economic Activity*, Spring, 155–227.

Cieslak, A., Morse, A., Vissing-Jorgensen, A., 2019, "Stock Returns over the FOMC Cycle," *Journal of Finance*, 74, 2201–2248.

Cieslak, A., Schrimpf, A., 2019, "Non-Monetary News in Central Bank Communication," *Journal of International Economics*, 118, 293–315.

Cieslak, A., Vissing-Jorgensen, A., 2021, "The Economics of the "Fed Put"," *Review of Financial Studies*, 34, 4045–4089.

Ehrmann, M., Fratzscher, M., 2007, "Communication by central bank committee members: Different strategies, same effectiveness?," *Journal of Money, Credit and Banking*, 39, 509–541.

Ehrmann, M., Fratzscher, M., 2009, "Explaining Monetary Policy in Press Conferences," *International Journal of Central Banking*, 5, 41–84.

Ehrmann, M., Talmi, J., 2020, "Starting from a Blank Page? Semantic Similarity in Central Bank Communication and Market Volatility," *Journal of Monetary Economics*, 111, 48–62.

Ferrari, M., Kearns, J., Schrimpf, A., 2021, "Monetary Policy's Rising FX Impact in the Era of Ultra-Low Rates," *Journal of Banking and Finance*, 129, 106–142.

Gertler, M., Karadi, P., 2013, "QE 1 vs. 2 vs. 3...: A Framework for Analyzing Large-scale Asset Purchases as a Monetary Policy Tool," *International Journal of Central Banking*, 9, 5–53.

Gertler, M., Karadi, P., 2015, "Monetary Policy Surprises, Credit Costs, and Economic Activity," *American Economic Journal: Macroeconomics*, 7, 44–76.

Gilchrist, S., Mojon, B., 2018, "Credit risk in the euro area," *The Economic Journal*, 128, 118–158.

Gilchrist, S., Zakrajšek, E., 2012, "Credit Spreads and Business Cycle Fluctuations," *American Economic Review*, 102, 1692–1720.

Guerkaynak, R., Sack, B., Swanson, E., 2005, "Do Actions Speak Louder Than Words? The Response of Asset Prices to Monetary Policy Actions and Statements," *International Journal of Central Banking*, 1, 55–93.

Gurun, U. G., Butler, A. W., 2012, "Don't Believe the Hype: Local Media Slant, Local Advertising, and Firm Value," *Journal of Finance*, 67, 561–598.

Hansen, S., McMahon, M., 2016, "Shocking Language: Understanding the Macroeconomic Effects of Central Bank Communication," *Journal of International Economics*, 99, S114–S133.

Hansen, S., McMahon, M., Prat, A., 2017, "Transparency and Deliberation within the FOMC: A Computational Linguistics Approach," *Quarterly Journal of Economics*, 133, 801–870.

Hanson, S., Stein, J. C., 2015, "Monetary Policy and Long-Term Real Rates," *Journal of Financial Economics*, 115, 429–448.

Hattori, M., Schrimpf, A., Sushko, V., 2016, "The Response of Tail Risk Perceptions to Unconventional Monetary Policy," *American Economic Journal: Macroeconomics*, 8, 111–136.

He, Z., Kelly, B., Manela, A., 2017, "Intermediary Asset Pricing: New Evidence from Many Asset Classes," *Journal of Financial Economics*, pp. 1–35.

He, Z., Krishnamurthy, A., 2013, "Intermediary Asset Pricing," *American Economic Review*, 103, 732–770.

Hillert, A., Jacobs, H., Müller, S., 2014, "Media Makes Momentum," *Review of Financial Studies*, 27, 3467–3501.

Jarociński, M., 2020, "Central bank information effects and transatlantic spillovers," *ECB Working Paper No. 2482*.

Jarociński, M., Karadi, P., 2020, "Deconstructing Monetary Policy Surprises – The Role of Information Shocks," *American Economic Journal: Macroeconomics*, 12, 1–43.

Jegadeesh, N., Wu, D., 2017, "Deciphering Fedspeak: The Information Content of FOMC Meetings," Working Paper, Emory University.

Kohn, D. L., Sack, B. P., 2004, "Central Bank Talk: Does It Matter and Why?," In: *Macroeconomics, Monetary Policy, and Financial Stability*, pp. 175–206. Ottawa: Bank of Canada.

Krylova, E., 2016, "Leading indicator properties of corporate bond spreads, excess bond premia and lending spreads in the euro area," ECB WP 1911.

Leombroni, M., Vedolin, A., Venter, G., Whelan, P., 2021, "Central Bank Communication and the Yield Curve," *Journal of Financial Economics*, 141, 860–880.

Loughran, T., McDonald, B., 2011, "When is a Liability not a Liability? Textual Analysis, Dictionaries, and 10-Ks," *Journal of Finance*, 66, 35–65.

Loughran, T., McDonald, B., 2016, "Textual Analysis in Finance and Accounting: A Survey," *Journal of Accounting Research*, 54, 1187–1230.

Loughran, T., McDonald, B., 2020, "Textual Analysis in Finance," *Annual Review of Financial Economics*, 12, 357–375.

Lucca, D. O., Moench, E., 2015, "The Pre-FOMC Announcement Drift," *Journal of Finance*, 70, 329–371.

Lucca, D. O., Trebbi, F., 2009, "Measuring Central Bank Communication: An Automated Approach with Application to FOMC Statements," NBER Working Paper 15367.

Nakamura, E., Steinsson, J., 2018, "High Frequency Identification of Monetary Non-Neutrality: The Information Effect," *Quarterly Journal of Economics*, 133, 1283–1330.

Neuhierl, A., Weber, M., 2019, "Monetary Policy Communication, Policy Slope and the Stock Market," *Journal of Monetary Economics*, 108, 140–155.

Neuhierl, A., Weber, M., 2021, "Time Series Momentum around FOMC Meetings," Working Paper, Chicago Booth.

Newey, W. K., West, K. D., 1987, "A Simple, Positive Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix," *Econometrica*, 55, 703–708.

Picault, M., Renault, T., 2017, "Words are not all created equal: A new measure of ECB communication," *Journal of International Money and Finance*, 79, 136–156.

Rigobon, R., Sack, B., 2004, "The Impact of Monetary Policy on Asset Prices," *Journal of Monetary Economics*, 51, 1553–1575.

Romer, C. D., Romer, D. H., 2004, "A New Measure of Monetary Shocks: Derivation and Implications," *American Economic Review*, 94, 1055–1084.

Rosa, C., 2011, "Words that Shake Traders: The Stock Market's Reaction to Central Bank Communication in Real Time," *Journal of Empirical Finance*, 18, 915–934.

Rosa, C., Verga, G., 2007, "On the Consistency and Effectiveness of Central Bank Communication: Evidence from the ECB," *European Journal of Political Economy*, 23, 146–175.

Shiller, R., Campbell, J., Schoenholtz, K., 1983, "Forward Rates and Future Policy: Interpreting the Term Structure of Interest Rates," *Brookings Papers on Economic Activity*, pp. 173–223.

STOXX, 2018, "STOXX Strategy Index Guide," .

Swanson, E. T., 2021, "Measuring the effects of federal reserve forward guidance and asset purchases on financial markets," *Journal of Monetary Economics*, 118, 32–53.

Tetlock, P. C., 2011, "All the news that's fit to reprint: Do investors react to stale information?," *The Review of Financial Studies*, 24, 1481–1512.

White, H., 1980, "A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroscedasticity," *Econometrica*, 48, 817–838.

Woodford, M., 2005, "Central Bank Communication and Policy Effectiveness," NBER Working Paper No. 11898.

Appendix

A. ECB statements and textual characteristics

The transcripts of the ECB press conferences are publicly available on the ECB website, https://www.ecb.europa.eu/press/pressconf/.

After obtaining the transcripts, we follow standard procedures of the textual analysis literature in preparing the transcripts for further analysis: we (i) convert all words to lower case, (ii) remove numbers, (iii) remove punctuation, (iv) remove English stop words (e.g., for, very, and, of, are, etc.), and (v) strip excessive whitespace.

The objective of our paper is to assess how surprises in ECB affect asset prices. Throughout our empirical analysis, we control for other textual characteristics of ECB press conference statements to rule out that tone changes matter for asset prices because they capture features of these other characteristics, which describe in more detail below.

First, we compute the "distance" (DIS_t) between two consecutive PC statements. DIS_t is based on the Euclidean distance between two vectors (one for each PC) where each vector counts the number of occurrences of each word (each word is represented by one row in the two vectors). Thus, larger values imply larger differences in the wording used in the two PCs.[23] We control for DIS_t because Bholat et al. (2015) and Ehrmann and Talmi (2020) suggest that CB communication might affect markets differently depending on how much it deviates from previous communication.

Second, we use the FOG-index to quantifiy the complexity/readability of ECB statements and measure changes in the index (ΔFOG_t) between consecutive PCs. The Fog-Index aims at measuring the number of years of education needed to understand a text on first reading and is computed from the text's average number of words per sentence and its percentage of complex words (defined as words with more than two syllables). For more details about the FOG-index, its application in financial research, and alternative readability measures (that in our application yield very similar results) see the survey of Loughran and McDonald

[23] We choose Euclidean distance for its simplicity. We have also experimented with alternative distance measures such as cosine similarity, which are immune to mechanical effects due to variation in text lengths across documents, and obtained similar results. Moreover, computing distance metrics based on bigrams (e.g. Tetlock, 2011; Amaya and Filbien, 2015) leads to very similar results.

(2016). Third, and somewhat related, we control for changes in the lexical diversity of ECB statements. Specifically, we compute the type-token ratio (TTR), i.e., the ratio of unique words (types) to total words (tokens) and its changes (ΔTTR_t) between consecutive PCs.

We control for ΔFOG_t and ΔTTR_t to account for the possibility that tone changes may be correlated with changes in complexity and lexical diversity. Complex and lexically diverse statements may have a worse 'signal-to-noise' ratio than simpler statements, which could impact on the effectiveness of central bank communication to markets (e.g. Woodford, 2005; Blinder et al., 2008). By controlling for ΔFOG_t and ΔTTR_t we can rule out that tone effects on asset prices may simply reflect that market participants respond differently to complex and lexically diverse compared to simple statements, because these are harder to interpret and lead to more uncertainty.

B. Measures of monetary policy shocks

In our empirical analysis, we control for three sets of monetary policy shock measures. We obtain the monetary policy shock data from Altavilla et al. (2019) as well as the high-frequency asset price data from the (updated) euro area monetary policy database (EA-MPD), which was established by these authors. Additionally, we obtain the updated series of the policy and information shocks proposed by Jarociński and Karadi (2020) from Marek Jarocinski's website. We describe the shock measures below and present summary statistics in Table IA.4 in the Internet Appendix.

First, we use the four factors proposed by Altavilla et al. (2019) as control variables, using the replication data available for their article. Using high-frequency data on the term structure Overnight Index Swaps (OIS) and German yields, they provide four factors, estimated as rotated factors from principal component analyses. The 'Target' factor summarizes the interest rate response to the rate announcement, measured in a narrow time-window around the press release (using median rates between 13:25-13:35 and 14:00-14:10). Using interest rate changes during a narrow time-window around the press conference (using median rates between 14:15-14:25 and 15:40-15:50), they rotate the first three principal components into the 'Timing'-, 'Forward Guidance'-, and 'Quantitative Easing'-factors. The interpretation provided by Altavilla et al. (2019) suggests that the 'timing'-factor captures information relevant for the short run, the 'FG'-factor for monetary policy over the medium-term, and the 'QE'-factor contains information relevant for long-term yields. For more details on the econometric procedure, see their paper. The factor data is available from the beginning of the year 2002 until the end of our sample period.

Second, we follow Jarociński (2020) in measuring surprises in euro area short-term interest rates. To do so, we use high-frequency EA-MPD data and extract the first principal component of changes in the 1-, 3- and 6-months and 1-year OIS rates. We apply the same time-windows as Altavilla et al. (2019) to measure shocks associated with the rate announcement in the press release ('PC1 - Press release') as well as shocks associated with the press conference ('PC1 - Press conference').

Third, we use the updated shock series of Jarociński and Karadi (2020) to assess the importance of controlling for 'policy shocks' and 'information shocks' when testing for the effect of tone surprises on asset price. Jarociński and Karadi (2020) use sign restrictions on the co-movement of short-term interest rates and stock returns to identify 'policy' and 'information' shocks. The key idea can be summarized as follows: Conventional monetary policy shocks should lead to a negative co-movement of interest rates and stocks, because unexpectedly higher rates should depress asset valuations through stronger discounting of future cash flows. One can think of such shocks as, e.g. news about the central bank reaction function. Hence, in a structural VAR framework, such policy shocks can be identified by imposing that shocks to stock prices and short-term rates move in opposite directions. However, news released during a monetary policy event can also refer to information about the central bank's view of the state of the business cycle and/or near-term economic growth. Such news would imply an increase in short-term rates as well as higher stock prices (due to higher cash flows). Imposing this positive co-movement of shocks allows for identifying information shocks. We refer to Jarociński and Karadi (2020) for details on the computation of these shocks.

Table I: The Tone of ECB Press Conference Statements

This table reports descriptive statistics for the 241 ECB press conferences between January 7, 1999 and December 16, 2021. The first column reports the number of business days between press conferences (PCs). N/T reports the ratio of the number of negative words (N) divided by the total number of words (T) in the president's opening statement at the PC (in percentage points). $\Delta\tau$ measures the change in tone τ compared to the tone at the previous PC, where $\tau = 1 - N/T$ as defined in Equation (1); reported numbers are the changes in percentage points. For the 240 realizations of $\Delta\tau$, we also report the coefficient of an AR(1) regression and the associated t-statistic. 'Obs $\Delta\tau > 0$' denotes the number of tone changes when tone becomes more positive and 'Obs $\Delta\tau < 0$' counts the observations when tone becomes more negative.

	Days between PCs	N/T [in %]	$\Delta\tau$ [in %]
Mean	23.2	2.545	-0.006
Std dev	6.9	0.994	0.745
Min	9.0	0.361	-2.409
Median	20.0	2.503	0.028
Max	49.0	5.651	2.015
AR(1)			-0.403
t-statistic			[-6.78]
Obs $\Delta\tau > 0$			128
Obs $\Delta\tau < 0$			112

Table II: Which Words Drive Tone?

This table presents descriptives statistics for the "negative" words (as classified by the dictionary of Loughran and McDonald, 2011) that are most prevalent in ECB press conference statements. The left panel, reports the 20 most frequently used negative words, ordered by the number of their occurrence across all ECB press conferences statements; these counts are based on aggregating words by their word-stem. The center and right panels show the context in which negative words are most frequently used by the ECB by presenting counts for bigrams and trigrams (i.e., sequences of two and three adjacent words), respectively. The analysis is based on 241 ECB press conference statements between January 7, 1999 and December 16, 2021.

Words	#	Bigrams	#	Trigrams	#
weak	467	global imbalances	86	correction global imbalances	38
decline	397	weaker expected	56	global imbalances regard	36
imbalances	233	structural unemployment	50	imbalances regard price	36
concerns	210	fiscal imbalances	39	disorderly correction global	36
negative	202	correction global	38	lagged relationship business	33
slow	176	imbalances regard	37	financial market volatility	32
unemployment	175	disorderly correction	36	reduce structural unemployment	29
crucial	163	possibility disorderly	35	reflect lagged relationship	29
volatility	161	market volatility	34	possibility disorderly correction	26
dampened	150	prolonged period	34	pressures possibility disorderly	25
deficit	149	lagged relationship	33	prolonged period low	25
downward	131	excessive deficit	30	continue reflect lagged	24
challenges	113	reflect lagged	29	structural unemployment boost	24
adverse	98	level unemployment	28	high level unemployment	22
lagging	81	disorderly developments	25	financial market turmoil	21
correction	80	remain weak	25	reducing vulnerabilities implementation	21
disorderly	67	revised downwards	25	vulnerabilities implementation structural	21
restructuring	67	excessive deficits	24	disorderly developments owing	20
excessive	63	high unemployment	24	owing global imbalances	20
turmoil	61	negative impact	24	vulnerabilities emerging markets	20

Table III: Excerpts from the ECB President's Statement on January 15, 2009

This table presents excerpts of the the ECB president's introductory statement, given at the press conference on January 15, 2009. Our measure of central bank tone identifies this statement to exhibit the most negative tone of all statements in our sample. From this statement we present the three paragraphs that have the largest impact on our tone measure, i.e., the three paragraphs with the highest ratio of negative words to total words. Words highlighted in red italic font and marked by asterisks (*) are negative words identified by the dictionary we employ. Other words highlighted in red italic font are common word sequences involving negative words that we have identified in multiple statements.

- Looking further ahead, on the basis of our current analysis and assessment, we continue to see global *economic *weakness** and very **sluggish* domestic demand *persisting** in the coming quarters as the impact of the financial tensions on activity continues. At the same time, we expect the fall in commodity prices to support real disposable income in the period ahead. Furthermore, the euro area should over time reap the full benefit from the effects of policy measures announced over recent weeks.

- In the view of the Governing Council, this outlook for the economy remains surrounded by an exceptionally high degree of uncertainty. Overall, risks to economic growth remain clearly on the downside. They relate mainly to the potential for a stronger impact on the real economy of the **turmoil* in financial markets*, as well as to **concerns** about the emergence and intensification of protectionist pressures and to *possible *adverse* developments* in the world economy stemming from a **disorderly* *correction* of global *imbalances**.

- Risks to price stability over the medium term are broadly balanced. **Unexpected* further *declines** in commodity prices or a stronger than expected slowdown in the economy could put **downward* pressure* on inflation, while upside risks to price stability could materialise particularly if the recent fall in commodity prices were to reverse or if domestic price pressures turn out to be stronger than assumed. It is therefore **crucial** that price and wage-setters fully live up to their responsibilities.

Table IV: ECB Press Conferences, Tone Changes, and Equity Returns

This table presents results for the role of ECB press conferences (PCs) for daily equity returns of Eurozone market and country indices. In the left Panel, we report results from regressing returns on a constant and a dummy, $\mathbb{1}(\mathrm{PC})$, that is one on days with PCs and zero otherwise. In the right panel, we report results from regressing returns on a constant and separate dummies for PC days with positive tone changes ($\Delta\tau > 0$) and negative tone changes ($\Delta\tau < 0$). Numbers in brackets are t-statistics based on White (1980) standard errors. Additionally, we report the p-value of an F-test that the coefficient estimates for both dummies are equal. The data covers the period from the first to the last PC in our sample, i.e., January 7, 1999 to December 16, 2021, with 5,825 daily observations including 241 PCs, i.e., we have 240 PC days with tone changes.

	PC days		PC days with positive vs negative tone changes			
	const	$\mathbb{1}(\mathrm{PC})$	const	$\mathbb{1}(\Delta\tau > 0)$	$\mathbb{1}(\Delta\tau < 0)$	p[F]
EMU market indices						
Eurostoxx 50	1.44	-3.63	1.44	24.13	-35.36	0.01
	[0.85]	[-0.32]	[0.85]	[1.64]	[-2.11]	
MSCI EMU	1.67	-4.65	1.67	21.30	-34.30	0.01
	[1.04]	[-0.44]	[1.04]	[1.57]	[-2.14]	
Country indices						
Austria	2.09	-0.16	2.09	19.95	-23.14	0.05
	[1.03]	[-0.01]	[1.03]	[1.52]	[-1.32]	
Belgium	0.45	-0.58	0.45	32.92	-38.86	0.00
	[0.25]	[-0.05]	[0.25]	[2.74]	[-2.08]	
Finland	2.25	6.91	2.25	40.02	-30.93	0.03
	[0.93]	[0.42]	[0.93]	[2.12]	[-1.14]	
France	2.32	-6.88	2.32	20.90	-38.63	0.01
	[1.44]	[-0.64]	[1.44]	[1.49]	[-2.37]	
Germany	2.18	-8.75	2.18	15.49	-36.44	0.02
	[1.22]	[-0.78]	[1.22]	[1.01]	[-2.24]	
Ireland	0.10	4.41	0.10	29.75	-24.54	0.02
	[0.05]	[0.36]	[0.05]	[1.71]	[-1.54]	
Italy	0.64	-7.62	0.64	20.65	-39.94	0.02
	[0.35]	[-0.61]	[0.35]	[1.40]	[-1.97]	
Netherlands	2.47	-1.43	2.47	19.84	-25.73	0.02
	[1.50]	[-0.15]	[1.50]	[1.55]	[-1.84]	
Portugal	-0.48	-2.69	-0.48	20.92	-29.67	0.00
	[-0.29]	[-0.30]	[-0.29]	[1.88]	[-2.10]	
Spain	0.96	0.85	0.96	27.54	-29.66	0.02
	[0.53]	[0.07]	[0.53]	[1.87]	[-1.59]	

Table V: Equity Market Returns and Changes in ECB Tone

This table presents results on the link between EuroStoxx 50 returns and changes in the ECB's communication tone. On each ECB press conference (PC) day, we compute the change in tone ($\Delta\tau_t$) compared to the previous PC and the equity return from the closing prices on the day preceding the PC and the day on which the PC is held. Our sample includes a total of 240 returns and tone changes, computed from the 241 PCs between January 7, 1999 and December 16, 2021. We regress returns on tone changes and the following control variables. To control for autocorrelation in tone changes, we add lagged tone changes ($\Delta\tau_{t-1}$). To control for ECB policy actions, ΔMRO_t denotes the change in the policy rate announced at the PC at time t and UMP_t is a dummy that takes the value one for PCs at which unconventional monetary policy actions are announced and zero otherwise. To control for monetary policy surprises, we use high-frequency interest rate data, either the first principal component (PC1) of short-term interest rate changes around the press release announcing the policy rates and around the press conference, or the four factors proposed by Altavilla et al. (2019). To control for communication features other than tone, we include the distance in the wording (DIS_t), change in complexity measured by the FOG-index (ΔFOG_t), and change in lexical diversity measured by the type-token-ratio (ΔTTR_t) of the current compared to the previous PC statement. Finally, to account for the information set of market participants prior to the PC day, we control for the stock market return and volatility, changes in the VSTOXX, and interest rates (level and term spread) since the previous PC. We report coefficient estimates, t-statistics based on White (1980) standard errors in brackets, the regressions' adjusted-R^2, and the number of observations.

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Const	-0.00 [-0.18]	0.00 [1.00]	0.00 [0.63]	0.00 [0.67]	0.00 [0.18]	-0.00 [-0.18]
ECB tone						
$\Delta\tau_t$	0.44 [2.34]	0.44 [2.65]	0.46 [2.64]	0.47 [2.71]	0.48 [2.93]	0.54 [2.82]
$\Delta\tau_{t-1}$		0.03 [0.16]	0.02 [0.12]	0.08 [0.47]	0.13 [0.85]	0.15 [0.86]
ECB actions						
ΔMRO_t				0.69 [0.69]	1.98 [1.62]	1.54 [1.04]
UMP_t				0.01 [1.61]	0.01 [1.55]	0.01 [1.63]
Monetary policy shocks						
PC1 - Press release					-0.26 [-2.58]	
PC1 - Press conference					0.07 [2.45]	
Target						-0.16 [-1.50]
Timing						0.12 [2.51]
FG						0.00 [0.08]
QE						-0.02 [-0.36]
Text controls						
Dis_t			-0.00 [-0.10]	-0.00 [-0.22]	-0.00 [-0.11]	0.00 [0.12]
ΔFOG_t			0.05 [0.52]	0.04 [0.39]	0.03 [0.25]	0.06 [0.50]
ΔTTR_t			0.04 [1.30]	0.04 [1.35]	0.05 [1.89]	0.08 [2.59]
Pre-PC market controls						
Market return		0.00 [0.03]	0.01 [0.13]	-0.00 [-0.03]	0.01 [0.12]	0.00 [0.03]
Market volatility		-0.07 [-0.93]	-0.07 [-0.88]	-0.07 [-0.89]	-0.01 [-0.16]	-0.01 [-0.18]
VSTOXX		-0.01 [-0.37]	-0.01 [-0.33]	-0.01 [-0.46]	-0.00 [-0.29]	-0.01 [-0.36]
Interest rate level		1.05 [1.85]	0.95 [1.68]	0.87 [1.54]	0.38 [0.61]	0.20 [0.30]
Term spread		-0.45 [-0.62]	-0.58 [-0.81]	-0.50 [-0.69]	-0.50 [-0.71]	-0.22 [-0.30]
Adj-R^2 (%)	3.20	7.29	6.71	7.71	14.43	11.49
Obs	240	239	239	239	239	206

Table VI: Realized versus Implied Volatility and Changes in ECB Tone

This table presents results on the link between stock market volatility and changes in the ECB's communication tone. For each day in our sample, we measure the realized volatility of the Eurostoxx 50 from intraday data over the full day (RV) and over the time window from 14:30 to 17:30 (RV_{PC}). We measure changes in implied volatility as daily log changes in the VSTOXX, $\Delta log(VSTOXX)$. Finally, as a proxy for changes in the volatility risk premium, we compute the ratio of changes in implied volatility to realized volatility. On each ECB press conference (PC) day, we compute the change in tone ($\Delta\tau_t$) compared to the previous PC. The data covers the period from the first to the last PC in our sample, i.e., January 7, 1999 to December 16, 2021. Panel A reports results from using all days in our sample. On the left, we report results from regressing the volatility quantities on a constant and a dummy, $\mathbb{1}(PC)$, that is one on days with PCs and zero otherwise. In the right part of Panel A, we report results for regressions on a constant and separate dummies for PC days with positive tone changes ($\Delta\tau > 0$) and negative tone changes ($\Delta\tau < 0$). Numbers in brackets are t-statistics based on White (1980) standard errors. Additionally, we report the p-value of an F-test that the coefficient estimates for both dummies are equal. Panel B reports results for PC day regressions of changes in implied volatility and changes in volatility risk premia on tone changes and a set of control variables; for detailed variable descriptions we refer to Table V.

Panel A. ECB Press Conferences and Tone Changes

	PC days		PC days with positive vs negative tone changes			
	const	$\mathbb{1}(PC)$	const	$\mathbb{1}(\Delta\tau > 0)$	$\mathbb{1}(\Delta\tau < 0)$	p[F]
Realized volatility						
Trading day RV	97.67	15.27	97.67	11.33	19.78	0.30
	[44.98]	[4.26]	[44.98]	[2.44]	[3.19]	
From 14:30 to 17:30 RV_{PC}	61.15	17.48	61.15	15.84	19.35	0.56
	[43.76]	[6.48]	[43.76]	[4.34]	[4.40]	
Changes in implied volatility						
$\Delta log(VSTOXX)$	4.23	-121.72	4.23	-200.14	-32.10	0.05
	[0.59]	[-2.81]	[0.59]	[-3.40]	[-0.52]	
Proxies for volatility risk premia						
$\Delta log(VSTOXX)/RV$	-0.34	-1.52	-0.34	-2.17	-0.78	0.09
	[-4.06]	[-3.50]	[-4.06]	[-3.45]	[-1.39]	
$\Delta log(VSTOXX)/RV_{PC}$	-0.34	-1.52	-0.34	-2.17	-0.78	0.09
	[-4.06]	[-3.50]	[-4.06]	[-3.45]	[-1.39]	

Panel B. Regressions on ECB Tone Changes

	$\Delta log(VSTOXX)$			$\Delta log(VSTOXX)/RV$			$\Delta log(VSTOXX)/RV_{PC}$		
	(i)	(ii)	(iii)	(i)	(ii)	(iii)	(i)	(ii)	(iii)
Const	-0.02	-0.01	-0.01	-0.77	-0.35	-0.28	-1.70	-0.90	-0.93
	[-0.91]	[-0.59]	[-0.49]	[-0.32]	[-0.15]	[-0.11]	[-0.47]	[-0.25]	[-0.24]
ECB tone									
$\Delta\tau_t$	-1.48	-1.49	-2.08	-134.49	-135.30	-179.38	-204.94	-206.59	-273.39
	[-2.74]	[-2.84]	[-3.17]	[-2.69]	[-2.72]	[-3.01]	[-2.77]	[-2.86]	[-3.10]
$\Delta\tau_{t-1}$	-0.34	-0.47	-0.50	-11.34	-16.49	-37.91	-18.69	-21.05	-55.99
	[-0.55]	[-0.79]	[-0.69]	[-0.20]	[-0.27]	[-0.53]	[-0.22]	[-0.23]	[-0.52]
ECB actions									
ΔMRO_t	-0.37	-3.93	-3.84	170.51	-2.32	-154.60	295.39	-6.98	-259.02
	[-0.14]	[-1.19]	[-0.99]	[0.81]	[-0.01]	[-0.47]	[0.91]	[-0.02]	[-0.53]
UMP_t	-0.05	-0.04	-0.04	-1.75	-1.68	-1.19	-2.15	-2.04	-1.36
	[-2.39]	[-2.29]	[-1.99]	[-1.25]	[-1.18]	[-0.74]	[-1.20]	[-1.11]	[-0.64]
Monetary policy shocks									
PC1 - Press release		0.73			35.98			65.59	
		[2.52]			[2.40]			[3.08]	
PC1 - Press conference		-0.19			-7.90			-7.45	
		[-1.61]			[-0.83]			[-0.51]	
Target			0.39			21.18			33.45
			[1.42]			[1.36]			[1.52]
Timing			-0.42			-31.32			-39.67
			[-1.97]			[-1.81]			[-1.60]
FG			0.02			10.51			18.92
			[0.18]			[0.89]			[0.99]
QE			0.46			58.24			91.81
			[2.00]			[2.72]			[2.69]
Text controls	X	X	X	X	X	X	X	X	X
Pre-PC market controls	X	X	X	X	X	X	X	X	X
Adj-R^2 (%)	3.20	6.33	4.12	2.16	2.21	3.66	1.21	1.48	2.28
Obs	239	239	206	239	239	206	239	239	206

Table VII: Corporate Credit Spreads and Changes in ECB Tone

This table presents results on the link between changes in corporate credit spreads and changes in the ECB's communication tone. For each day in our sample, we compute changes in credit spreads, defined as the yield differentials of BBB- and AAA-rated bonds of all corporates and separately for financials and non-financials. On each ECB press conference (PC) day, we compute the change in tone ($\Delta\tau_t$) compared to the previous PC. Daily data on credit spreads of corporates and financials is available from April 1999 and for non-financials from August 1999 until December 2021. Panel A reports results from using all days in our sample. On the left, we report results from regressing changes in credit spreads on a constant and a dummy, $\mathbb{1}$(PC), that is one on days with PCs and zero otherwise. In the right part of Panel A, we report results for regressions on a constant and separate dummies for PC days with positive tone changes ($\Delta\tau > 0$) and negative tone changes ($\Delta\tau < 0$). Numbers in brackets are t-statistics based on White (1980) standard errors. Additionally, we report the p-value of an F-test that the coefficient estimates for both dummies are equal. Panel B reports results for PC day regressions of changes in credit spreads on tone changes and a set of control variables; for detailed variable descriptions we refer to Table V.

Panel A. ECB Press Conferences and Tone Changes

	PC days		PC days with positive vs negative tone changes			
	const	$\mathbb{1}$(PC)	const	$\mathbb{1}(\Delta\tau > 0)$	$\mathbb{1}(\Delta\tau < 0)$	p[F]
All corporates	0.02	-0.60	0.02	-1.13	0.01	0.11
	[0.31]	[-1.64]	[0.31]	[-1.74]	[0.04]	
Financials	0.06	-1.39	0.06	-2.44	-0.18	0.05
	[0.27]	[-2.36]	[0.27]	[-2.48]	[-0.30]	
Non-financials	0.01	-0.27	0.01	-0.67	0.18	0.30
	[0.09]	[-0.62]	[0.09]	[-0.86]	[0.75]	

Panel B. Regressions on ECB Tone Changes

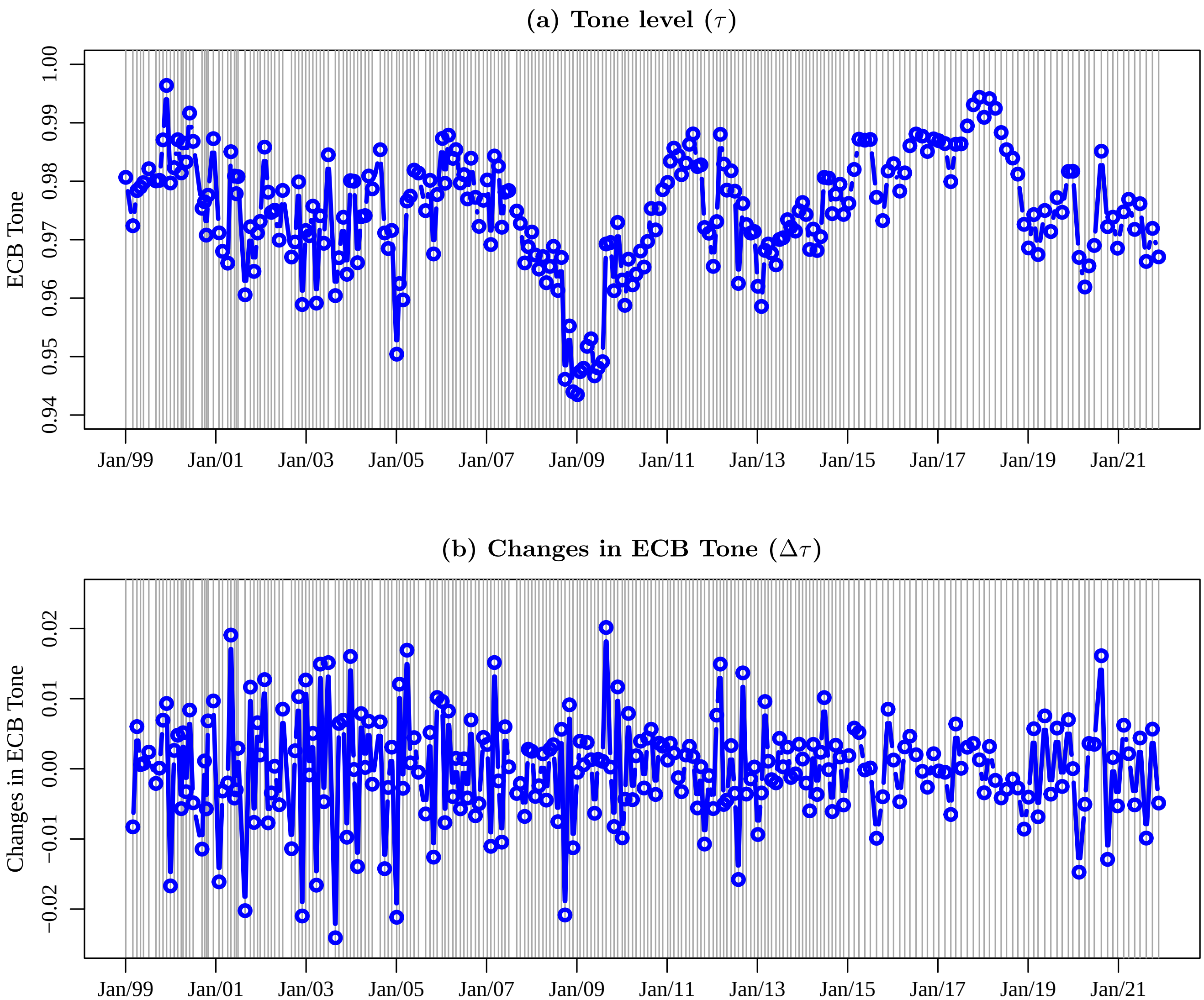
	All corporates			Financials			Non-financials		
	(i)	(ii)	(iii)	(i)	(ii)	(iii)	(i)	(ii)	(iii)
Const	-0.00	-0.00	-0.00	0.00	0.00	0.00	-0.00	-0.00	-0.00
	[-1.18]	[-1.32]	[-1.01]	[0.50]	[0.25]	[0.70]	[-1.17]	[-1.08]	[-1.09]
ECB tone									
$\Delta\tau_t$	-0.01	-0.01	-0.01	-0.02	-0.02	-0.02	-0.01	-0.01	-0.00
	[-2.48]	[-2.51]	[-1.87]	[-2.75]	[-2.78]	[-2.47]	[-1.81]	[-1.91]	[-0.86]
$\Delta\tau_{t-1}$	-0.01	-0.01	-0.01	-0.02	-0.02	-0.00	-0.01	-0.01	-0.01
	[-1.89]	[-1.95]	[-1.46]	[-1.81]	[-2.11]	[-0.34]	[-2.22]	[-2.05]	[-1.85]
ECB actions									
ΔMRO_t	0.09	0.10	0.13	0.16	0.18	0.29	0.01	0.00	0.01
	[1.50]	[1.39]	[1.40]	[1.89]	[1.72]	[2.21]	[0.68]	[0.10]	[0.26]
UMP_t	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	[-1.83]	[-1.92]	[-2.11]	[-1.22]	[-1.34]	[-1.27]	[-2.28]	[-2.06]	[-2.82]
Monetary policy shocks									
PC1 - Press release		-0.00			-0.00			0.00	
		[-0.78]			[-0.84]			[1.51]	
PC1 - Press conference		-0.00			-0.00			-0.00	
		[-0.15]			[-0.80]			[-0.38]	
Target			-0.00			-0.01			-0.00
			[-1.14]			[-2.34]			[-0.05]
Timing			0.00			-0.00			-0.00
			[0.28]			[-0.98]			[-0.39]
FG			-0.00			-0.00			-0.00
			[-0.79]			[-0.68]			[-0.88]
QE			-0.01			-0.01			-0.01
			[-1.80]			[-1.33]			[-1.49]
Text controls	X	X	X	X	X	X	X	X	X
Pre-PC market controls	X	X	X	X	X	X	X	X	X
Adj-R^2 (%)	4.14	3.70	5.05	12.63	12.94	19.69	2.49	1.88	1.28
Obs	239	239	206	239	239	206	235	235	206

Table VIII: ECB Tone and Policy Shocks vs. Information Shocks

This table presents results on the link between asset price responses and changes in ECB tone, controlling for 'policy shocks' and 'information shocks' as proposed by Jarociński and Karadi (2020). Each column refers to a different asset class: ESX50 refers to returns in the Eurostoxx50 equity index, 2Y to changes in the German two-year government bond yield, VSTOXX to log changes in the VSTOXX volatility index, VRP and VRP-PC to changes in the proxies for variance risk premia (i.e., log changes in the VSTOXX scaled by realized volatility measured over the full day or from 14:30 – 17:00), and Credit-Fin to changes in the credit spread of financial institutions. On each press conference, we regress the asset price responses on changes in ECB tone compared to the previous press conference, a large set of control variables (for detailed variable descriptions we refer to Table V), as well as policy and information shocks. We report coefficient estimates, t-statistics based on White (1980) standard errors in brackets, the regressions' adjusted-R^2, and the number of observations.

	ESX50	2Y	VSTOXX	VRP	VRP-PC	Credit-Fin
Const	0.00	0.00	-0.02	-0.97	-1.86	0.00
	[1.06]	[1.01]	[-1.08]	[-0.40]	[-0.51]	[0.30]
ECB tone						
$\Delta\tau_t$	0.27	0.01	-0.96	-94.80	-151.91	-0.02
	[2.27]	[2.75]	[-2.05]	[-1.96]	[-2.13]	[-2.68]
$\Delta\tau_{t-1}$	-0.02	0.00	-0.08	6.95	11.56	-0.02
	[-0.20]	[0.40]	[-0.15]	[0.12]	[0.14]	[-2.08]
ECB actions						
ΔMRO_t	-0.25	0.04	1.97	360.63	512.42	0.18
	[-0.22]	[1.81]	[0.64]	[1.51]	[1.41]	[2.04]
UMP_t	0.00	0.00	-0.03	-0.86	-0.91	-0.00
	[1.07]	[2.32]	[-2.01]	[-0.73]	[-0.58]	[-1.21]
Monetary policy shocks						
Policy shock	-0.23	-0.00	0.58	43.10	64.43	-0.00
	[-5.12]	[-0.07]	[3.40]	[4.33]	[4.48]	[-0.50]
Information shock	0.25	0.00	-0.61	-49.07	-59.52	-0.00
	[6.05]	[0.66]	[-3.39]	[-3.97]	[-2.96]	[-1.83]
Text controls	X	X	X	X	X	X
Pre-PC market controls	X	X	X	X	X	X
Adj-R^2 (%)	38.30	5.64	16.23	9.59	6.88	13.56
Obs	239	239	239	239	239	239

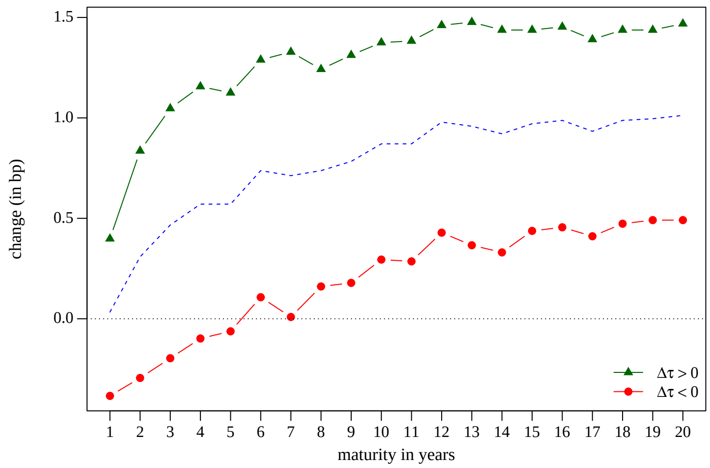
Figure 2: The Tone of ECB Press Conference Statements



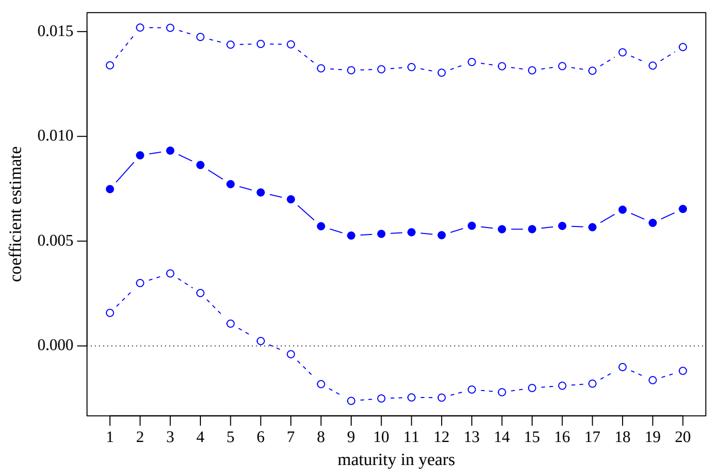
This figure plots the time-series of ECB tone, τ, and changes in ECB tone, $\Delta\tau$, in Panels (a) and (b), respectively. Tone is defined as $\tau = 1 - N/T$, see Equation (1), where N and T denote the number of negative words and the total number of words in a press conference statement. $\Delta\tau$ is measured as the difference in τ between two consecutively held press conferences. Tone is measured form the ECB president's opening statements at the 241 ECB press conferences between January 7, 1999 and December 16, 2021. The vertical lines mark these 241 press conferences.

Figure 3: Government Yield Changes on ECB Press Conference Days

(a) Positive versus negative tone changes on PC days



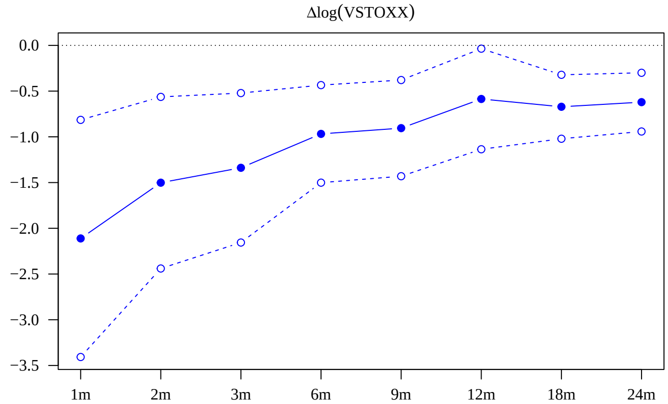
(b) Regressions of PC day yield changes on tone changes



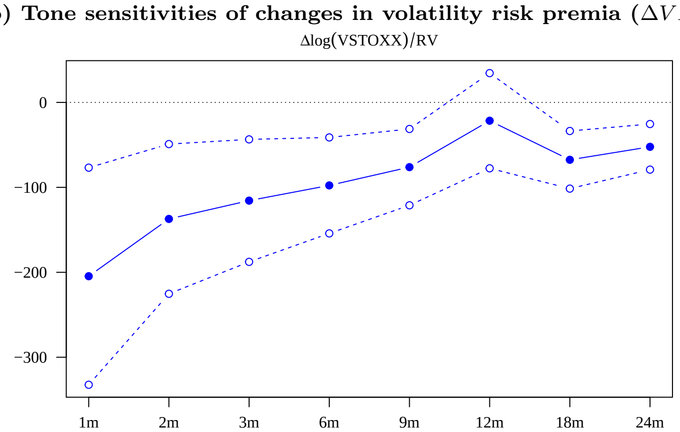
This figure presents results on changes in the German government bond yield curve (for maturities ranging from one to 20 years, x-axis) in response to changes in ECB tone. Panel (a) presents average PC-day yield changes in basis points, for all PC days (dashed lined in blue) as well as conditional on the tone changes at the most recent PC having been positive (green triangles) or negative (red bullets). Panel (b) presents results from regressing PC-day yield changes on changes in ECB tone ($\Delta\tau$) as well as our standard control variables for other textual characteristics, policy actions, market conditions, and monetary policy shocks. We plot the slope coefficients for tone changes, along with 95% confidence bands (based on White (1980) standard errors). The sample spans a total of 240 tone changes from 241 ECB press conferences between January 1999 and December 2021.

Figure 4: Changes in ECB Tone and Term Structures of Volatility Changes

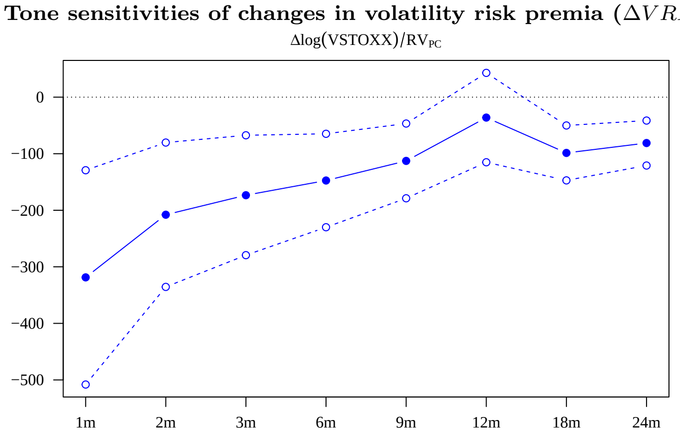
(a) Tone sensitivities of changes in implied volatility (VSTOXX)



(b) Tone sensitivities of changes in volatility risk premia (ΔVRP)



(b) Tone sensitivities of changes in volatility risk premia (ΔVRP_{PC})



This figure shows the slope coefficient estimates from regressions of changes in implied volatility and proxies for volatility risk risk premia on changes in ECB tone and our standard set of control variables. Our sample covers the 241 press conferences (PCs) held by the ECB between January 7, 1999 to December 16, 2021, from which we compute 240 changes in ECB tone. On each PC day, we measure the change in implied volatility as the daily log change in the VSTOXX, $\Delta log(VSTOXX)$, from the closing values of the day preceding the PC and the day on which the PC is held. As proxies for changes in volatility risk premia, we scale changes in implied volatility by the realized volatility, computed from high frequency data either over the full PC day (ΔVRP) or over the time window from 14:30 to 17:30 (ΔVRP_{PC}). We compute changes in implied volatility and volatility risk premia using VSTOXX indices with maturities between one month and 24 months and present coefficient estimates (solid line with bullets) along with 95% confidence bands (dashed lines, based on White (1980) standard errors).

Internet Appendix for

Does Central Bank Tone Move Asset Prices?

(not for publication)

This Internet Appendix reports and discusses additional results and robustness checks.

IA.A. Excerpts from ECB press conference statements

In the main part of the paper, we present excerpts from the press conference in January 2009, which is the PC that our tone measure identifies as the most negative PC in our sample; see Table III. To provide a broader picture of what our tone measure captures, we now present additional excerpts. Table IA.1 presents excerpts from the press conference in February 2010, which has the highest count of commonly used phrases involving negative words across all statements in our sample. Table IA.2 presents excerpts from the press conference in January 2005, which according to our tone measure is the most negative PC in a pre-crisis subsample from January 1999 to June 2007.

While we find that our tone measure leads to only very few misclassifications, i.e., cases in which our procedure incorrectly treats a word or statement negative, in the ECB press conference transcripts, one example is the first sentence of the first excerpt in Table IA.2: "Downside risks to the economic outlook stemming from oil price developments have diminished somewhat over recent weeks." The dictionary identifies 'diminished' as a negative word whereas the overall sentence is obviously not negative. Nonetheless, these excerpts provide further support for the view that our tone measure generally captures the ECB's framing of economic and financial conditions.

IA.B. Tone surprises, policy actions, and fundamentals

This appendix describes how we explore the link between tone changes, policy actions, and macro fundamentals in more detail. The results are summarized and discussed in Section 5.3 in the paper.

IA.B.1. Central bank tone and future policy rates

We now complement the results on the relation between ECB tone and interest rates by showing that changes in tone predict future changes in policy rates (ΔMRO). Table IA.15 reports results for regressions of the form

$$\Delta MRO_{t,t+k} = a + \sum_h \beta_h \Delta MRO_{t-h} + \sum_h \gamma_h \Delta \tau_{t-h} + \epsilon_{t,t+k}, \qquad \text{(IA.B.1)}$$

and

$$\Delta MRO_{t,t+k} = a + \beta \sum_h \Delta MRO_{t-h} + \gamma \sum_h \Delta \tau_{t-h} + \epsilon_{t,t+k}, \qquad \text{(IA.B.2)}$$

where k is the forecast horizon (in terms of future policy meetings) and h is the lag of the predictive variable. With one policy meeting per month on average, these horizons roughly translate into months. We include lagged MRO changes in this regression as it is well-known that central banks often adjust interest rates only gradually (i.e., engage in "interest rate smoothing"). We run these regressions with individual lags of the predictive variables,as specified in equation (IA.B.1), and present results in Panel A, and with multi-period changes in predictive variables,as specified in equation (IA.B.2), Panels B and C).

IA.B.2. Forecasting macro fundamentals

We obtain data for Eurozone fundamentals from Datastream (DS). The DS mnemonics are EMRETTOTG (Retail Sales), EMUNPTOTO (Unemployment), EKIPTOT.G (Industrial Production), EMCPCOR5F (Harmonised Index of Consumer Prices), EMCNFCONQ (Consumer Confidence), EKCNFBUSQ (Business Confidence), and EMGDP...D (GDP).

Table IA.16 reports results for regressions of future growth rates of key Eurozone macro fundamentals on lagged ECB tone changes. We consider log changes in price levels ($\Delta HICP$), industrial production (ΔIP), real industrial production ($\Delta RealIP$), retail sales ($\Delta RetSales$), and unemployment ($\Delta Unemp$), as well as changes in consumer confidence ($\Delta ConsConf$) and business confidence ($\Delta BusConf$) as dependent variables and report the predictive slope coefficients and adjusted R^2s. The left part of the table shows results for univariate predictive regressions of fundamentals on tone changes, the right part shows predictive slopes for lagged tone changes when additionally controlling for the most recent change in the policy rate (ΔMRO), a dummy for unconventional monetary policy announcements, and the most recent revisions in the ECB's one-year projection for future inflation and real GDP growth.

Table IA.1: Excerpts from the ECB President's Statement on February 4, 2010

This table presents excerpts of the the ECB president's introductory statement, given at the press conference on February 4, 2010. Our textual analysis identifies this statement to contain the highest count of commonly used phrases involving negative words of all statements in our sample. From this statement we present the three paragraphs that have the largest impact on our tone measure, i.e., the three paragraphs with the highest ratio of negative words to total words. Words highlighted in red italic font and marked by asterisks (*) are negative words identified by the dictionary we employ. Other words highlighted in red italic font are common word sequences involving negative words that we have identified in multiple statements.

- The Governing Council continues to view the risks to this outlook as broadly balanced. On the upside, confidence may improve more than expected, and both the global economy and foreign trade may recover more strongly than projected. Furthermore, there may be stronger than anticipated effects stemming from the extensive macroeconomic stimulus being provided and from other policy measures taken. On the downside, **concerns* remain* relating to a *stronger or more *protracted* than expected *negative* feedback loop* between the real economy and the financial sector, renewed increases in oil and other commodity prices, the intensification of protectionist pressures and the *possibility of a *disorderly* *correction* of global *imbalances**.

- As regards fiscal policies, many euro area countries are faced with large, **sharply* rising fiscal *imbalances**, leading to less favourable medium and long-term interest rates and lower levels of private investment. Moreover, high levels of *public *deficit* and debt* place an additional **burden** on monetary policy and **undermine** the Stability and Growth Pact as a key pillar of Economic and Monetary Union. Against this background, it is of paramount importance that the stability programme of each euro area country clearly defines the fiscal exit and consolidation strategies for the period ahead. Countries will be required to meet their commitments under the *excessive *deficit* procedures*. Consolidation of public finances should start in 2011 at the latest and will have to exceed substantially the annual adjustment of 0.5% of GDP set as a minimum requirement by the Stability and Growth Pact. A strong focus on expenditure reforms is needed.

- The *key *challenge** in order to reinforce sustainable growth and job creation is to accelerate structural reforms, as the *financial *crisis* has *negatively* affected* the productive capacity of our economies. In the case of product markets, policies that enhance competition and innovation are urgently needed to *speed up *restructuring** and investment and to create new business opportunities. In labour markets, moderate wage-setting, effective incentives to work and sufficient labour market flexibility are required in order to avoid significantly *higher structural *unemployment** over the coming years. Finally, an *appropriate *restructuring** of the banking sector should play an important role. Sound balance sheets, effective risk management and transparent, robust business models are key to strengthening banks' resilience to shocks, thereby laying the foundations for sustainable growth and financial stability.

Table IA.2: Excerpts from the ECB President's Statement on January 13, 2005

This table presents excerpts of the the ECB president's introductory statement, given at the press conference on January 13, 2005. Our measure of central bank tone identifies this statement to exhibit the most negative tone of all statements in a subsample from 1999/01 – 2007/06 (i.e., the pre-crisis period). From this statement we present the three paragraphs that have the largest impact on our tone measure, i.e., the three paragraphs with the highest ratio of negative words to total words. Words highlighted in red italic font and marked by asterisks (*) are negative words identified by the dictionary we employ. Other words highlighted in red italic font are common word sequences involving negative words that we have identified in multiple statements.

- Downside risks to the economic outlook stemming from oil price developments have **diminished** somewhat over recent weeks. As regards exchange rates, we confirm our position, expressed when the euro rose **sharply**, that such moves are **unwelcome** and **undesirable** for economic growth.

- With regard to both fiscal policies and structural reforms, the governments and institutions of the European Union will have to **confront** many important **challenges** in the course of 2005.

- Foremost among these **challenges** is the need to strengthen public finances by **correcting** **excessive** **deficits** swiftly and returning to a path of vigorous fiscal consolidation. Moreover, throughout the European Union there is a need to address the considerable **challenges** that population ageing **poses** to existing pension and social security systems.

Table IA.3: Descriptive Statistics for Equity Index Returns

This table reports descriptive statistics for the returns (measured in basis points) of various equity indices. We report results for two aggregate market indices in the EMU (Eurostoxx 50 and MSCI EMU) and ten country indices (MSCI country indices). For all indices, we report the number of daily observations (Obs), the average return (Avg), the median return (Med), and the standard deviation of returns (Std). We report these statistics for all days in our sample, for all days that are not ECB press conference days (Non-PC days), and for ECB press conference days (PC days). The sample is daily from January 1999 to December 2021.

	All days				Non-PC days				PC days			
	Obs	Avg	Med	Std	Obs	Avg	Med	Std	Obs	Avg	Med	Std
EMU market indices												
Eurostoxx 50	5825	1.29	3.60	143.85	5585	1.44	3.42	142.42	240	-2.19	10.12	174.20
MSCI EMU	5825	1.47	5.49	132.23	5585	1.67	5.47	130.72	240	-2.98	6.80	163.74
Country indices												
Austria	5825	2.09	3.39	154.47	5585	2.09	2.61	153.81	240	1.93	13.84	169.28
Belgium	5825	0.43	4.10	135.21	5585	0.45	3.78	133.46	240	-0.13	13.31	171.15
Finland	5825	2.53	2.39	195.70	5585	2.25	2.90	192.87	240	9.15	-1.18	253.18
France	5825	2.04	4.68	138.73	5585	2.32	4.65	137.31	240	-4.56	5.90	168.66
Germany	5825	1.82	7.42	144.02	5585	2.18	7.37	142.54	240	-6.57	8.05	175.18
Ireland	5825	0.28	1.21	159.07	5585	0.10	0.80	157.87	240	4.51	7.77	185.01
Italy	5825	0.33	4.56	147.69	5585	0.64	3.82	145.41	240	-6.98	10.19	193.45
Netherlands	5825	2.42	4.30	133.68	5585	2.47	4.16	133.03	240	1.05	13.60	148.34
Portugal	5825	-0.59	0.99	123.74	5585	-0.48	0.92	123.02	240	-3.17	2.40	139.69
Spain	5825	1.00	4.35	149.54	5585	0.96	3.96	147.92	240	1.81	17.83	183.56

Table IA.4: Descriptive Statistics for Control Variables

This table reports descriptive statistics for tone (τ_t), tone changes ($\Delta\tau_t$), and the control variables used in our regressions of returns on tone changes. *ECB actions:* ΔMRO_t is change in the policy rate announced at the PC at time t and UMP_t is a dummy that takes the value one for PCs at which unconventional monetary policy actions are announced and zero otherwise. *Monetary policy shocks:* PC1 denote the first principal component of the short-term yield changes in a high-frequency window around the press release or press conference, respectively. The target, timing, forward guidance (FG), and quantitative easing (QE) factors are yield curve factors based on Altavilla et al. (2019). Policy and information shocks are based on Jarociński and Karadi (2020). *Text controls:* DIS_t denotes the distance in wording, ΔFOG_t denotes the change in complexity measured by the FOG-index, and ΔTTR_t denotes the change in lexical diversity measured by the type-token-ratio. *Pre-PC market controls:* Market return is the return on the stock market (ESX50), market volatility refers to realized volatility, changes in the VSTOXX measures implied stock return volatility as well as changes in interest rate level refers to the German 2-year yield and the term spread is computed from the spread in German 10-year and 1-year yields. All five Pre-PC market controls are computed from the previous PC to one day before the current PC. Our sample covers all 241 ECB press conferences in the period from January 7, 1999 to December 16, 2021, i.e., we have 240 PC days with tone changes.

	Obs	Avg	Std	Min	Q5	Med	Q95	Max
ECB tone								
τ_t	241	0.9746	0.0099	0.9435	0.9586	0.9750	0.9879	0.9964
$\Delta\tau_t$	240	-0.0001	0.0074	-0.0241	-0.0130	0.0003	0.0121	0.0201
ECB actions								
ΔMRO_t	240	-0.0001	0.0013	-0.0075	-0.0025	0.0000	0.0025	0.0050
UMP_t	240	0.0583	0.2349	0.0000	0.0000	0.0000	1.0000	1.0000
Monetary policy shocks								
PC1 - Press release	240	0.0013	0.0179	-0.1255	-0.0101	-0.0006	0.0261	0.1008
PC1 - Press conference	240	0.0001	0.0363	-0.1962	-0.0481	-0.0002	0.0507	0.2120
Target factor	206	0.0000	0.0227	-0.1328	-0.0130	-0.0021	0.0291	0.1216
Timing factor	206	0.0000	0.0219	-0.1207	-0.0296	0.0014	0.0248	0.1068
FG factor	206	-0.0000	0.0340	-0.2531	-0.0388	0.0009	0.0471	0.1043
QE factor	206	-0.0000	0.0196	-0.0758	-0.0292	0.0000	0.0336	0.0618
Policy shock	240	0.0044	0.0332	-0.1370	-0.0401	0.0013	0.0531	0.1794
Information shock	240	-0.0015	0.0275	-0.1154	-0.0483	-0.0019	0.0420	0.1079
Text controls								
Dis_t	240	0.3376	0.0756	0.2000	0.2279	0.3331	0.4753	0.6514
ΔFOG_t	240	-0.0001	0.0088	-0.0374	-0.0127	-0.0003	0.0135	0.0259
ΔTTR_t	240	-0.0002	0.0375	-0.1151	-0.0586	-0.0016	0.0618	0.0919
Pre-PC market controls								
Market return	240	0.0026	0.0562	-0.2225	-0.0990	0.0105	0.0794	0.1922
Market volatility	240	0.0488	0.0258	0.0177	0.0247	0.0414	0.0961	0.2014
VSTOXX	240	0.0098	0.2050	-0.8450	-0.2384	-0.0233	0.3624	1.4071
Interest rate level	240	-0.0002	0.0021	-0.0090	-0.0039	-0.0001	0.0030	0.0061
Term spread	240	-0.0001	0.0018	-0.0042	-0.0024	-0.0004	0.0027	0.0091

Table IA.5: Equity Market Returns and Changes in ECB Tone: Intraday Results

This table reports results for regressing Eurostoxx 50 intraday returns on changes in ECB tone and control variables. On days with ECB press conferences (PCs), we use index data sampled at the one-minute frequency to compute the returns over three, non-overlapping time windows: the return from 9:00-13.44 (i.e., from the trading start to just before the policy rate announcement), the return from 13:45 to 14:29 (i.e., from the rate announcement to just before the start of the press conference), and from 14:30 to 17:30 (i.e., from the start of the press conference to the end of the trading day). Otherwise, the setup is identical to Table V in the main paper. The sample period is from January 1999 to December 2021; for more details about the regression specifications and variable descriptions, see Table V. We report coefficient estimates, t-statistics based on White (1980) standard errors in brackets, the regressions' adjusted-R^2, and the number of observations.

	Return from 9:00 to 13:44			Return from 13:45 to 14:29			Return from 14:30 to 17:30		
	(i)	(ii)	(iii)	(i)	(ii)	(iii)	(i)	(ii)	(iii)
Const	0.00	0.00	0.00	-0.00	0.00	0.00	-0.00	-0.00	-0.00
	[2.82]	[0.57]	[0.31]	[-1.20]	[1.97]	[1.48]	[-2.33]	[-1.44]	[-1.09]
ECB tone									
$\Delta\tau_t$	0.07	0.07	0.09	0.03	0.02	0.02	0.24	0.28	0.31
	[0.70]	[0.91]	[1.02]	[0.55]	[0.61]	[0.41]	[2.31]	[2.82]	[2.97]
$\Delta\tau_{t-1}$		0.01	0.05		0.04	0.05		0.05	0.01
		[0.10]	[0.56]		[1.28]	[1.55]		[0.49]	[0.10]
ECB actions									
ΔMRO_t		0.07	-0.15		0.64	0.71		0.92	0.82
		[0.09]	[-0.17]		[1.48]	[1.40]		[1.10]	[0.80]
UMP_t		0.01	0.01		0.00	0.00		0.00	0.00
		[2.30]	[2.48]		[1.87]	[2.16]		[0.10]	[0.09]
Monetary policy shocks									
PC1 - Press release		-0.09			-0.08			-0.08	
		[-1.63]			[-3.59]			[-1.69]	
PC1 - Press conference		0.04			0.01			0.02	
		[2.80]			[1.81]			[0.81]	
Target			-0.09			-0.05			-0.02
			[-1.65]			[-2.43]			[-0.62]
Timing			0.06			0.01			0.04
			[2.70]			[0.78]			[1.06]
FG			0.02			0.00			-0.01
			[0.98]			[0.15]			[-0.53]
QE			-0.02			0.03			-0.06
			[-0.57]			[1.96]			[-1.16]
Text controls									
Dis_t		-0.01	-0.00		-0.00	-0.00		0.01	0.01
		[-0.74]	[-0.63]		[-0.76]	[-0.46]		[1.16]	[0.75]
ΔFOG_t		-0.11	-0.06		0.03	0.00		0.13	0.15
		[-1.71]	[-0.90]		[1.09]	[0.11]		[2.05]	[2.02]
ΔTTR_t		-0.00	0.01		-0.00	-0.01		0.05	0.06
		[-0.20]	[0.68]		[-0.42]	[-0.77]		[2.91]	[2.97]
Pre-PC market controls									
Market return		0.00	0.01		0.01	0.01		-0.03	-0.05
		[0.05]	[0.34]		[1.37]	[1.40]		[-1.31]	[-1.53]
Market volatility		0.03	0.04		-0.03	-0.03		-0.00	-0.01
		[0.92]	[0.80]		[-2.07]	[-1.75]		[-0.00]	[-0.13]
VSTOXX		-0.00	-0.00		-0.00	-0.00		-0.00	-0.01
		[-0.24]	[-0.05]		[-0.17]	[-0.19]		[-0.81]	[-1.06]
Interest rate level		-0.20	-0.24		0.10	0.12		0.45	0.30
		[-0.59]	[-0.62]		[0.65]	[0.77]		[1.18]	[0.65]
Term spread		0.10	0.03		0.04	-0.11		-0.58	-0.16
		[0.27]	[0.07]		[0.20]	[-0.66]		[-1.38]	[-0.35]
Adj-R^2 (%)	-0.07	6.38	7.36	-0.22	29.51	26.93	2.30	7.63	6.93
Obs	240	239	206	240	239	206	240	239	206

Table IA.6: Equity Market Returns and Changes in ECB Tone: MSCI EMU

This table reports results for regressions of MSCI EMU index returns on changes in ECB tone and control variables. The setup is identical to Table V in the main paper, which conducts the same analysis for the Eurostoxx 50. The sample period is from January 1999 to December 2021; for more details about the regression specifications and variable descriptions, see Table V. We report coefficient estimates, t-statistics based on White (1980) standard errors in brackets, the regressions' adjusted-R^2, and the number of observations.

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Const	-0.00	0.00	0.00	0.00	0.00	-0.00
	[-0.27]	[0.92]	[0.67]	[0.72]	[0.25]	[-0.14]
ECB tone						
$\Delta\tau_t$	0.42	0.42	0.44	0.46	0.46	0.53
	[2.32]	[2.73]	[2.69]	[2.77]	[2.97]	[2.85]
$\Delta\tau_{t-1}$		0.06	0.05	0.11	0.15	0.17
		[0.38]	[0.34]	[0.69]	[1.11]	[1.06]
ECB actions						
ΔMRO_t				0.67	1.89	1.35
				[0.73]	[1.67]	[1.01]
UMP_t				0.01	0.01	0.01
				[1.63]	[1.58]	[1.60]
Monetary policy shocks						
PC1 - Press release					-0.25	
					[-2.48]	
PC1 - Press conference					0.07	
					[2.55]	
Target						-0.16
						[-1.51]
Timing						0.12
						[2.57]
FG						0.00
						[0.14]
QE						-0.03
						[-0.47]
Text controls						
Dis_t			-0.00	-0.00	-0.00	0.00
			[-0.24]	[-0.37]	[-0.27]	[0.01]
ΔFOG_t			0.05	0.03	0.02	0.06
			[0.49]	[0.35]	[0.22]	[0.53]
ΔTTR_t			0.03	0.03	0.04	0.07
			[1.09]	[1.16]	[1.71]	[2.44]
Pre-PC market controls						
Market return		0.01	0.01	0.00	0.01	0.01
		[0.12]	[0.23]	[0.05]	[0.22]	[0.16]
Market volatility		-0.07	-0.06	-0.06	-0.01	-0.01
		[-0.88]	[-0.83]	[-0.84]	[-0.10]	[-0.09]
VSTOXX		-0.01	-0.01	-0.01	-0.01	-0.01
		[-0.41]	[-0.38]	[-0.50]	[-0.35]	[-0.38]
Interest rate level		0.94	0.85	0.77	0.30	0.13
		[1.78]	[1.61]	[1.46]	[0.52]	[0.21]
Term spread		-0.42	-0.54	-0.46	-0.46	-0.22
		[-0.60]	[-0.78]	[-0.65]	[-0.67]	[-0.32]
Adj-R^2 (%)	3.30	8.00	7.26	8.32	15.23	12.22
Obs	240	239	239	239	239	206

Table IA.7: ECB Tone and EMU Country Indices

This table reports results for regressions of MSCI country index returns on changes in ECB tone and control variables. The setup is identical to Table V in the main paper, which conducts the same analysis for the Eurostoxx 50. The sample period is from January 1999 to December 2021; for more details about the regression specifications and variable descriptions, see Table V. We report coefficient estimates, t-statistics based on White (1980) standard errors in brackets, and the regressions' adjusted-R^2.

	Specification (iv)		Specification (v)		Specification (vi)	
	$\Delta\tau_t$	Adj-R^2 (%)	$\Delta\tau_t$	Adj-R^2 (%)	$\Delta\tau_t$	Adj-R^2 (%)
Austria	0.54	8.68	0.54	12.03	0.64	15.13
	[3.21]		[3.26]		[3.29]	
Belgium	0.49	5.45	0.50	9.68	0.56	8.93
	[2.55]		[2.63]		[2.43]	
Finland	0.72	1.04	0.72	3.73	0.65	7.94
	[3.02]		[3.15]		[3.14]	
France	0.46	8.48	0.46	15.64	0.51	11.08
	[2.75]		[2.93]		[2.76]	
Germany	0.40	6.79	0.40	13.76	0.49	11.83
	[2.28]		[2.42]		[2.53]	
Ireland	0.29	7.54	0.30	16.08	0.40	5.08
	[1.38]		[1.50]		[1.70]	
Italy	0.53	11.65	0.54	17.37	0.66	16.74
	[2.76]		[2.88]		[2.92]	
Netherlands	0.39	5.43	0.39	12.76	0.45	10.29
	[2.51]		[2.80]		[2.70]	
Portugal	0.42	12.70	0.42	16.93	0.52	17.21
	[3.16]		[3.19]		[3.33]	
Spain	0.49	9.35	0.50	12.89	0.59	10.56
	[2.54]		[2.65]		[2.67]	

Table IA.8: Descriptive Statistics for Realized Volatility, Implied Volatility, and Volatility Risk Premia

This table reports descriptive statistics for the volatility quantities used in the paper. We present summary statistics for the realized volatility of the Eurostoxx 50, measured from intraday data over the full day (RV) and over the time window from 14:30 to 17:30 (RV_{PC}), in basis points; for changes in implied volatility, measured as daily log changes in the VSTOXX, $\Delta log(VSTOXX)$ in basis points; and for proxies of changes in volatility risk premia, computed the ratios of changes in implied volatility to realized volatility. We report the number of daily observations (Obs), the average return (Avg), the median return (Med), and the standard deviation of returns (Std). We report these statistics for all days in our sample, for all days that are not ECB press conference days (Non-PC days), and for ECB press conference days (PC days). The sample is daily from January 1999 to December 2021.

	All days				Non-PC days				PC days			
	Obs	Avg	Med	Std	Obs	Avg	Med	Std	Obs	Avg	Med	Std
Realized volatility												
Trading day RV	5814	98.30	83.31	59.99	5574	97.67	82.85	59.80	240	112.95	97.72	62.66
From 14:30 to 17:30 RV_{PC}	5809	61.88	51.84	39.92	5569	61.15	51.28	39.49	240	78.63	65.38	45.87
Changes in implied volatility												
$\Delta log(VSTOXX)$	5825	-0.78	-49.52	629.42	5585	4.23	-45.19	627.66	240	-117.49	-176.05	659.90
Proxies for volatility risk premia												
$\Delta log(VSTOXX)/RV$	5813	-0.40	-0.55	7.43	5573	-0.34	-0.47	7.46	240	-1.86	-1.86	6.55
$\Delta log(VSTOXX)/RV_{PC}$	5808	-0.76	-0.86	12.94	5568	-0.68	-0.73	13.05	240	-2.73	-2.51	10.06

Table IA.9: Realized volatility

This table extends the analysis of the relationship between tone changes and realized volatility of the Eurostoxx 50 presented in Panel A of Table VI in the main paper. On each day in our sample, we measure the realized volatility of the Eurostoxx 50 from intraday data over the time window from 14:30 to 17:30 (RV_{PC}); the full trading day (RV); a period of five days, including the current day plus the next four trading days, (RV_{5d}); 22 trading days (RV_{22d}); and 66 trading days (RV_{66d}). On each ECB press conference (PC) day, we compute the change in tone ($\Delta\tau_t$) compared to the previous PC. The data covers the period from the first to the last PC in our sample, i.e., January 7, 1999 to December 16, 2021. On the left, we report results from regressing the realized volatility on a constant and a dummy, $\mathbb{1}$(PC), that is one on days with PCs and zero otherwise. In the right part of Panel A, we report results for regressions on a constant and separate dummies for PC days with positive tone changes ($\Delta\tau > 0$) and negative tone changes ($\Delta\tau < 0$). Additionally, we report the p-value of an F-test that the coefficient estimates for both dummies are equal. Numbers in squared brackets refer to t-values based on White (1980) standard errors.

	PC days		PC days with positive vs negative tone changes			
	const	$\mathbb{1}$(PC)	const	$\mathbb{1}(\Delta\tau > 0)$	$\mathbb{1}(\Delta\tau < 0)$	p[F]
Realized volatility 14:30-17:30 (RV_{PC})	61.15	17.48	61.15	15.84	19.35	0.56
	[43.76]	[6.48]	[43.76]	[4.34]	[4.40]	
Realized volatility (RV)	97.67	15.27	97.67	11.33	19.78	0.30
	[44.98]	[4.26]	[44.98]	[2.44]	[3.19]	
Realized volatility 5 days (RV_{5d})	223.75	9.73	223.75	4.96	15.18	0.56
	[45.21]	[1.36]	[45.21]	[0.51]	[1.17]	
Realized volatility 22 days (RV_{22d})	477.40	12.51	477.40	7.24	18.52	0.73
	[47.11]	[0.96]	[47.11]	[0.38]	[0.80]	
Realized volatility 66 days (RV_{66d})	843.45	18.97	843.45	32.08	3.99	0.58
	[51.68]	[0.93]	[51.68]	[1.02]	[0.12]	

Table IA.10: Realized versus Implied Volatility and Changes in ECB Tone: Extended Table

This table extends Table VI by additionally reporting estimates for all control variables. We report coefficient estimates, t-statistics based on White (1980) standard errors in brackets, the regressions' adjusted-R^2, and the number of observations.

	$\Delta log(VSTOXX)$			$\Delta log(VSTOXX)/RV$			$\Delta log(VSTOXX)/RV_{PC}$		
	(i)	(ii)	(iii)	(i)	(ii)	(iii)	(i)	(ii)	(iii)
Const	-0.02	-0.01	-0.01	-0.77	-0.35	-0.28	-1.70	-0.90	-0.93
	[-0.91]	[-0.59]	[-0.49]	[-0.32]	[-0.15]	[-0.11]	[-0.47]	[-0.25]	[-0.24]
ECB tone									
$\Delta\tau_t$	-1.48	-1.49	-2.08	-134.49	-135.30	-179.38	-204.94	-206.59	-273.39
	[-2.74]	[-2.84]	[-3.17]	[-2.69]	[-2.72]	[-3.01]	[-2.77]	[-2.86]	[-3.10]
$\Delta\tau_{t-1}$	-0.34	-0.47	-0.50	-11.34	-16.49	-37.91	-18.69	-21.05	-55.99
	[-0.55]	[-0.79]	[-0.69]	[-0.20]	[-0.27]	[-0.53]	[-0.22]	[-0.23]	[-0.52]
ECB actions									
ΔMRO_t	-0.37	-3.93	-3.84	170.51	-2.32	-154.60	295.39	-6.98	-259.02
	[-0.14]	[-1.19]	[-0.99]	[0.81]	[-0.01]	[-0.47]	[0.91]	[-0.02]	[-0.53]
UMP_t	-0.05	-0.04	-0.04	-1.75	-1.68	-1.19	-2.15	-2.04	-1.36
	[-2.39]	[-2.29]	[-1.99]	[-1.25]	[-1.18]	[-0.74]	[-1.20]	[-1.11]	[-0.64]
Monetary policy shocks									
PC1 - Press release		0.73			35.98			65.59	
		[2.52]			[2.40]			[3.08]	
PC1 - Press conference		-0.19			-7.90			-7.45	
		[-1.61]			[-0.83]			[-0.51]	
Target			0.39			21.18			33.45
			[1.42]			[1.36]			[1.52]
Timing			-0.42			-31.32			-39.67
			[-1.97]			[-1.81]			[-1.60]
FG			0.02			10.51			18.92
			[0.18]			[0.89]			[0.99]
QE			0.46			58.24			91.81
			[2.00]			[2.72]			[2.69]
Text controls									
Dis_t	-0.01	-0.02	-0.01	-7.13	-7.38	-8.25	-8.87	-9.45	-10.03
	[-0.21]	[-0.30]	[-0.15]	[-1.09]	[-1.12]	[-1.09]	[-0.89]	[-0.95]	[-0.88]
ΔFOG_t	-0.03	0.00	0.06	-21.63	-19.29	-14.82	-8.57	-1.83	8.43
	[-0.07]	[0.01]	[0.11]	[-0.54]	[-0.48]	[-0.29]	[-0.13]	[-0.03]	[0.10]
ΔTTR_t	-0.06	-0.09	-0.14	-4.06	-5.87	-10.73	-3.05	-5.84	-12.67
	[-0.53]	[-0.91]	[-1.04]	[-0.39]	[-0.56]	[-0.80]	[-0.19]	[-0.37]	[-0.62]
Pre-PC market controls									
Market return	-0.03	-0.05	-0.03	-8.28	-9.26	-9.49	-9.53	-11.40	-11.87
	[-0.26]	[-0.48]	[-0.29]	[-0.94]	[-1.10]	[-0.96]	[-0.73]	[-0.92]	[-0.81]
Market volatility	0.32	0.16	0.11	30.69	22.94	25.80	44.92	30.68	34.53
	[1.53]	[0.91]	[0.50]	[2.27]	[1.73]	[1.55]	[2.15]	[1.50]	[1.34]
VSTOXX	-0.03	-0.04	-0.03	-7.13	-7.68	-7.30	-10.08	-11.05	-10.09
	[-0.53]	[-0.84]	[-0.60]	[-2.09]	[-2.43]	[-2.03]	[-2.03]	[-2.43]	[-1.92]
Interest rate level	-2.68	-1.34	0.39	-161.78	-98.28	123.06	-307.28	-204.39	128.52
	[-1.25]	[-0.61]	[0.16]	[-0.77]	[-0.45]	[0.46]	[-0.97]	[-0.63]	[0.33]
Term spread	0.44	0.43	-1.52	1.14	0.58	-171.52	-53.61	-55.01	-334.26
	[0.18]	[0.19]	[-0.58]	[0.01]	[0.00]	[-0.73]	[-0.18]	[-0.18]	[-0.94]
Adj-R^2 (%)	3.20	6.33	4.12	2.16	2.21	3.66	1.21	1.48	2.28
Obs	239	239	206	239	239	206	239	239	206

Table IA.11: Descriptive Statistics for Credit Spreads

This table reports descriptive statistics for the credit spreads used in the paper. We present summary statistics for changes in credit spreads, defined as the yield differentials of BBB- and AAA-rated bonds of all corporates and separately for financials and non-financials. We report the number of daily observations (Obs), the average return (Avg), the median return (Med), and the standard deviation of returns (Std). We report these statistics for all days in our sample, for all days that are not ECB press conference days (Non-PC days), and for ECB press conference days (PC days). The sample is daily from April 1999 to December 2021 for the credit spreads of all corporates and financials and August 1999 to December 2021 for the credit spreads of non-financials. All spread changes are reported in basis points.

	All days				Non-PC days				PC days			
	Obs	Avg	Med	Std	Obs	Avg	Med	Std	Obs	Avg	Med	Std
All corporates	5763	-0.00	-0.10	3.93	5524	0.02	-0.10	3.83	239	-0.58	-0.30	5.77
Financials	5765	-0.00	-0.10	11.33	5526	0.06	-0.10	11.40	239	-1.33	-0.50	9.44
Non-financials	5683	-0.01	-0.00	3.51	5448	0.01	-0.00	3.31	235	-0.26	0.00	6.62

Table IA.12: Corporate Credit Spreads and Changes in ECB Tone: Extended Table

This table extends Table VII by additionally reporting estimates for all control variables. We report coefficient estimates, t-statistics based on White (1980) standard errors in brackets, the regressions' adjusted-R^2, and the number of observations.

	All corporates			Financials			Non-financials		
	(i)	(ii)	(iii)	(i)	(ii)	(iii)	(i)	(ii)	(iii)
Const	-0.00	-0.00	-0.00	0.00	0.00	0.00	-0.00	-0.00	-0.00
	[-1.18]	[-1.32]	[-1.01]	[0.50]	[0.25]	[0.70]	[-1.17]	[-1.08]	[-1.09]
ECB tone									
$\Delta\tau_t$	-0.01	-0.01	-0.01	-0.02	-0.02	-0.02	-0.01	-0.01	-0.00
	[-2.48]	[-2.51]	[-1.87]	[-2.75]	[-2.78]	[-2.47]	[-1.81]	[-1.91]	[-0.86]
$\Delta\tau_{t-1}$	-0.01	-0.01	-0.01	-0.02	-0.02	-0.00	-0.01	-0.01	-0.01
	[-1.89]	[-1.95]	[-1.46]	[-1.81]	[-2.11]	[-0.34]	[-2.22]	[-2.05]	[-1.85]
ECB actions									
ΔMRO_t	0.09	0.10	0.13	0.16	0.18	0.29	0.01	0.00	0.01
	[1.50]	[1.39]	[1.40]	[1.89]	[1.72]	[2.21]	[0.68]	[0.10]	[0.26]
UMP_t	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	[-1.83]	[-1.92]	[-2.11]	[-1.22]	[-1.34]	[-1.27]	[-2.28]	[-2.06]	[-2.82]
Monetary policy shocks									
PC1 - Press release		-0.00			-0.00			0.00	
		[-0.78]			[-0.84]			[1.51]	
PC1 - Press conference		-0.00			-0.00			-0.00	
		[-0.15]			[-0.80]			[-0.38]	
Target			-0.00			-0.01			-0.00
			[-1.14]			[-2.34]			[-0.05]
Timing			0.00			-0.00			-0.00
			[0.28]			[-0.98]			[-0.39]
FG			-0.00			-0.00			-0.00
			[-0.79]			[-0.68]			[-0.88]
QE			-0.01			-0.01			-0.01
			[-1.80]			[-1.33]			[-1.49]
Text controls									
Dis_t	0.00	0.00	0.00	0.00	0.00	-0.00	0.00	0.00	0.00
	[0.89]	[0.93]	[0.56]	[0.13]	[0.28]	[-0.06]	[1.32]	[1.28]	[1.24]
ΔFOG_t	0.00	0.00	0.00	0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	[0.71]	[0.60]	[0.48]	[0.22]	[-0.01]	[-0.55]	[-1.23]	[-1.16]	[-0.56]
ΔTTR_t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	[1.30]	[1.32]	[0.81]	[0.73]	[0.78]	[0.10]	[1.21]	[1.13]	[0.72]
Pre-PC market controls									
Market return	0.00	0.00	0.00	-0.01	-0.00	-0.00	-0.00	-0.00	-0.00
	[0.22]	[0.25]	[0.55]	[-1.56]	[-1.53]	[-1.36]	[-2.92]	[-3.07]	[-2.97]
Market volatility	0.00	0.00	0.00	-0.00	-0.00	-0.01	0.00	-0.00	-0.00
	[0.55]	[0.78]	[0.57]	[-1.17]	[-1.06]	[-1.66]	[0.14]	[-0.28]	[-0.52]
VSTOXX	0.00	0.00	0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	[1.27]	[1.24]	[1.39]	[-0.88]	[-0.79]	[-0.72]	[-0.77]	[-1.02]	[-0.77]
Interest rate level	-0.02	-0.02	-0.02	-0.04	-0.05	-0.06	-0.01	-0.00	0.02
	[-0.96]	[-0.97]	[-0.99]	[-1.40]	[-1.37]	[-1.25]	[-0.49]	[-0.28]	[0.89]
Term spread	0.01	0.01	0.02	0.11	0.11	0.11	0.00	0.00	0.00
	[0.54]	[0.54]	[0.81]	[2.90]	[2.95]	[2.84]	[0.16]	[0.16]	[0.16]
Adj-R^2 (%)	4.14	3.70	5.05	12.63	12.94	19.69	2.49	1.88	1.28
Obs	239	239	206	239	239	206	235	235	206

Table IA.13: Regression results using surprises from AR-models of ECB tone

This table presents results on the link between asset price responses and surprises in ECB tone. We measure tone surprises as the residuals from autoregressive (AR) models of ECB tone using one lag (Panel A), three lags (Panel B), or five lags (Panel C). Each column refers to a different asset class: ESX50 to returns in the Eurostoxx50 equity index, 2Y to changes in the German two-year government bond yield, VSTOXX to log changes in the VSTOXX volatility index, VRP and VRP-PC to changes in the proxies for variance risk premia (i.e., log changes in the VSTOXX scaled by realized volatility measured over the full day or from 14:30 – 17:00), and Credit-Fin to changes in the credit spread of financial institutions. We regress the asset price responses on the tone surprises and a large set of control variables; for detailed variable descriptions we refer to Table V. We report coefficient estimates, t-statistics based on White (1980) standard errors in brackets, the regressions' adjusted-R^2, and the number of observations.

Panel A. Tone surprises from AR(1)-model of central bank tone

	ESX50	2Y	VSTOXX	VRP	VRP-PC	Credit-Fin
AR1[τ_t]-resid	0.50	0.01	-1.78	-183.00	-276.43	-0.01
	[3.11]	[2.50]	[-3.20]	[-3.43]	[-3.55]	[-1.66]
Adj-R^2 (%)	14.80	5.33	7.53	3.93	3.11	11.38
Obs	240	240	240	240	240	239

Panel B. Tone surprises from AR(3)-model of central bank tone

	ESX50	2Y	VSTOXX	VRP	VRP-PC	Credit-Fin
AR3[τ_t]-resid	0.50	0.01	-1.70	-166.08	-248.63	-0.02
	[2.94]	[2.69]	[-2.97]	[-3.07]	[-3.17]	[-2.58]
Adj-R^2 (%)	14.79	5.80	7.11	3.12	2.27	11.80
Obs	238	238	238	238	238	238

Panel C. Tone surprises from AR(5)-model of central bank tone

	ESX50	2Y	VSTOXX	VRP	VRP-PC	Credit-Fin
AR5[τ_t]-resid	0.48	0.01	-1.64	-161.30	-237.54	-0.02
	[2.83]	[2.88]	[-2.83]	[-2.94]	[-2.99]	[-2.58]
Adj-R^2 (%)	14.42	5.82	6.90	3.03	2.09	12.09
Obs	236	236	236	236	236	236

Table IA.14: Regression results using surprises from extended AR-models of ECB tone

This table presents results on the link between asset price responses and surprises in ECB tone. We measure tone surprises as the residuals from autoregressive (AR) models of ECB tone using one lag (Panel A), three lags (Panel B), or five lags (Panel C). Additionally, the AR-models include other information available to market participants prior to the press conference, i.e. the stock market and interest rate quantities that we have used as control variables for market conditions in our main analysis. Each column refers to a different asset class: ESX50 to returns in the Eurostoxx50 equity index, 2Y to changes in the German two-year government bond yield, VSTOXX to log changes in the VSTOXX volatility index, VRP and VRP-PC to changes in the proxies for variance risk premia (i.e., log changes in the VSTOXX scaled by realized volatility measured over the full day or from 14:30 – 17:00), and Credit-Fin to changes in the credit spread of financial institutions. We regress the asset price responses on the tone surprises and a large set of control variables, except for those included in the AR-model specification; for detailed variable descriptions we refer to Table V. We report coefficient estimates, t-statistics based on White (1980) standard errors in brackets, the regressions' adjusted-R^2, and the number of observations.

Panel A. Tone surprises from extended AR(1)-model of central bank tone

	ESX50	2Y	VSTOXX	VRP	VRP-PC	Credit-Fin
AR1ext[τ_t]-resid	0.48	0.01	-1.69	-172.44	-261.29	-0.01
	[2.76]	[2.36]	[-2.87]	[-3.17]	[-3.29]	[-0.95]
Adj-R^2 (%)	14.82	5.36	7.89	1.94	1.65	1.83
Obs	240	240	240	240	240	239

Panel B. Tone surprises from extended AR(3)-model of central bank tone

	ESX50	2Y	VSTOXX	VRP	VRP-PC	Credit-Fin
AR3ext[τ_t]-resid	0.49	0.01	-1.64	-158.97	-238.48	-0.02
	[2.68]	[2.59]	[-2.79]	[-2.91]	[-3.00]	[-1.87]
Adj-R^2 (%)	14.87	5.96	7.55	1.25	0.93	2.24
Obs	238	238	238	238	238	238

Panel C. Tone surprises from extended AR(5)-model of central bank tone

	ESX50	2Y	VSTOXX	VRP	VRP-PC	Credit-Fin
AR5ext[τ_t]-resid	0.47	0.01	-1.58	-155.13	-228.64	-0.02
	[2.58]	[2.79]	[-2.66]	[-2.81]	[-2.85]	[-1.94]
Adj-R^2 (%)	14.57	6.35	7.36	1.10	0.72	2.34
Obs	236	236	236	236	236	236

Table IA.15: Forecasting Future Policy Rates

This table reports results for regressions of changes in policy rates (marginal refinancing operation, ΔMRO), on lagged MRO changes and lagged changes in ECB tone ($\Delta\tau$). We consider forecast horizons of $1, 3$, and 12 policy meetings using lagged MRO changes and tone changes from the past three or twelve policy meetings. Panel A presents regression results using the latest three MRO changes and tone changes as predictors. The results in Panel B are also based on the last three policy meeting but uses cumulative MRO and tone changes (rather than using each individual lag as predictor). Panel C repeats the analysis using the MRO and tone changes accumulated over the previous twelve policy meetings. Our sample covers all 241 ECB press conferences in the period from January 7, 1999 to December 16, 2021, i.e., we have 240 days with MRO and tone changes. We report coefficient estimates, t-statistics based on Newey and West (1987) standard errors in brackets, the regressions' adjusted-R^2, and the number of observations.

Panel A. Predicting MRO changes with the latest three MRO and tone changes

	$\Delta MRO_{t,t+1}$		$\Delta MRO_{t,t+3}$		$\Delta MRO_{t,t+12}$	
	(i)	(ii)	(i)	(ii)	(i)	(ii)
Const	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	[-0.48]	[-0.53]	[-0.54]	[-0.60]	[-0.71]	[-0.77]
ΔMRO_{t-1}	0.15	0.18	0.59	0.62	0.98	1.13
	[1.19]	[1.42]	[3.41]	[3.93]	[3.33]	[3.56]
ΔMRO_{t-2}	0.12	0.12	0.45	0.41	0.64	0.54
	[2.16]	[2.08]	[4.52]	[3.99]	[1.92]	[1.47]
ΔMRO_{t-3}	0.25	0.20	0.27	0.27	0.29	0.25
	[2.88]	[2.62]	[1.72]	[1.80]	[0.89]	[0.80]
$\Delta\tau_{t-1}$		-0.01		0.04		0.09
		[-1.07]		[1.38]		[1.61]
$\Delta\tau_{t-2}$		0.03		0.06		0.16
		[1.60]		[1.88]		[2.09]
$\Delta\tau_{t-3}$		0.04		0.04		0.11
		[3.30]		[1.70]		[2.03]
Adj-R^2 (%)	13.33	18.01	19.76	21.66	4.94	6.74
Obs	239	238	239	238	233	232

Panel B. Predicting MRO changes with cumulative MRO and tone changes from the latest three policy meetings

	$\Delta MRO_{t,t+1}$		$\Delta MRO_{t,t+3}$		$\Delta MRO_{t,t+12}$	
	(i)	(ii)	(i)	(ii)	(i)	(ii)
Const	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	[-0.48]	[-0.52]	[-0.53]	[-0.57]	[-1.06]	[-1.13]
$\Delta MRO_{t-3;t-1}$	0.17	0.17	0.44	0.43	0.64	0.63
	[4.49]	[4.53]	[5.29]	[5.56]	[2.72]	[2.79]
$\Delta\tau_{t-3;t-1}$		0.01		0.04		0.12
		[1.63]		[1.71]		[2.14]
Adj-R^2 (%)	13.39	14.28	19.48	21.57	5.18	7.23
Obs	239	238	239	238	233	232

Panel C. Predicting MRO changes with cumulative MRO and tone changes from the latest twelve policy meetings

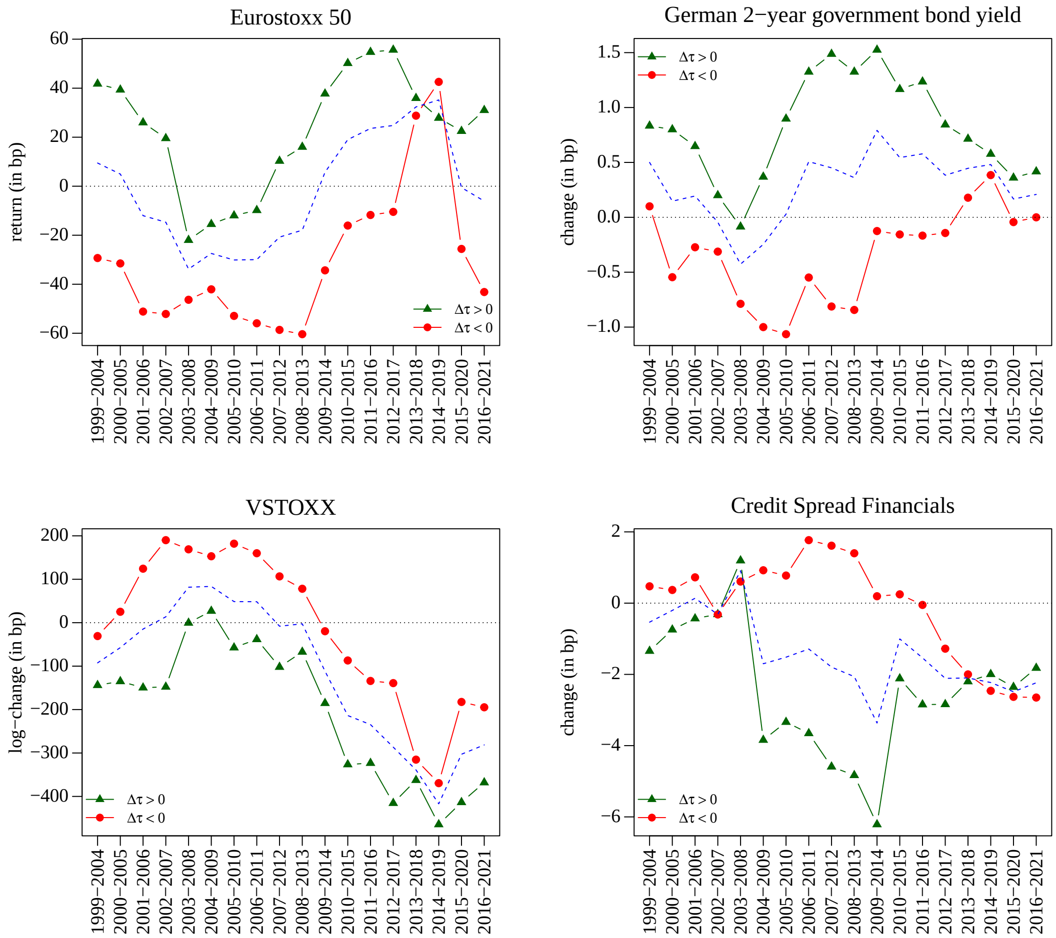
	$\Delta MRO_{t,t+1}$		$\Delta MRO_{t,t+3}$		$\Delta MRO_{t,t+12}$	
	(i)	(ii)	(i)	(ii)	(i)	(ii)
Const	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	[-0.91]	[-0.89]	[-0.90]	[-0.92]	[-1.58]	[-1.73]
$\Delta MRO_{t-12;t-1}$	0.04	0.04	0.09	0.09	0.10	0.07
	[3.13]	[3.12]	[2.37]	[2.30]	[1.03]	[0.77]
$\Delta\tau_{t-12;t-1}$		0.02		0.07		0.21
		[2.46]		[2.57]		[3.12]
Adj-R^2 (%)	5.25	8.27	6.52	16.36	0.66	12.70
Obs	230	229	230	229	224	223

Table IA.16: Forecasting future macro fundamentals

This table reports results for regressions of changes in macro fundamentals on lagged changes in ECB tone. We consider log changes in price levels ($\Delta HICP$), industrial production (ΔIP), real IP ($\Delta RealIP$), retail sales ($\Delta RetSales$), and unemployment ($\Delta Unemp$), as well as changes in consumer confidence ($\Delta ConsConf$) and business confidence ($\Delta BusConf$) as dependent variables. Using forecast horizons in the range from three months to three years, we report the predictive slope coefficients and adjusted R^2s for two sets of regression specifications. The left part of the table shows results for univariate predictive regressions of fundamentals on tone changes, the right part shows predictive slopes for lagged tone changes when additionally controlling for the most recent change in the policy rate (ΔMRO), a dummy for unconventional monetary policy announcements, and the most recent revisions in the ECB's one-year projection for future inflation and real GDP growth. Our sample covers 241 ECB press conferences in the period from January 1999 to December 2021, i.e., we have 240 days with tone changes. Numbers in squared brackets refer to t-statistics based on Newey and West (1987) standard errors.

	Regressions on tone changes					Regressions on tone changes and controls				
	3m	6m	12m	24m	36m	3m	6m	12m	24m	36m
$\Delta HICP$	0.05	-0.03	-0.00	0.01	0.02	0.07	-0.02	-0.00	-0.01	0.01
	[0.88]	[-1.04]	[-0.10]	[0.37]	[0.59]	[1.18]	[-0.57]	[-0.17]	[-0.27]	[0.60]
Adj-R^2 (%)	-0.30	-0.17	-0.54	-0.56	-0.59	5.68	6.28	5.22	7.73	4.73
ΔIP	0.22	0.36	0.55	0.43	0.33	0.13	0.32	0.51	0.89	0.95
	[1.08]	[1.32]	[1.97]	[1.45]	[1.35]	[0.69]	[1.21]	[1.67]	[1.90]	[2.08]
Adj-R^2 (%)	0.23	0.14	0.08	-0.33	-0.46	9.65	3.19	2.97	3.72	10.82
$\Delta RealIP$	0.18	0.39	0.56	0.41	0.31	0.06	0.33	0.52	0.90	0.94
	[0.90]	[1.46]	[1.98]	[1.43]	[1.34]	[0.33]	[1.31]	[1.67]	[1.85]	[2.02]
Adj-R^2 (%)	-0.12	0.24	0.06	-0.36	-0.48	12.11	4.93	3.52	4.47	11.23
$\Delta RetSales$	0.09	0.14	0.11	0.17	-0.05	0.09	0.14	0.17	0.42	0.25
	[1.38]	[1.83]	[1.10]	[1.21]	[-0.32]	[1.44]	[1.74]	[1.33]	[1.53]	[0.86]
Adj-R^2 (%)	0.05	0.17	-0.38	-0.44	-0.60	1.65	0.28	1.07	4.61	4.79
$\Delta Unemp$	-0.34	-0.53	-0.74	-0.87	-0.54	-0.21	-0.19	-0.27	-0.88	-0.86
	[-1.57]	[-1.68]	[-1.64]	[-1.38]	[-0.85]	[-1.03]	[-0.67]	[-0.65]	[-1.31]	[-0.90]
Adj-R^2 (%)	0.53	0.21	-0.08	-0.29	-0.53	20.60	13.76	8.89	3.04	-1.03
$\Delta ConsConf$	0.23	0.15	0.11	-0.14	-0.27	0.21	0.30	0.44	0.67	0.25
	[1.21]	[0.65]	[0.37]	[-0.33]	[-0.77]	[0.95]	[0.94]	[1.03]	[1.01]	[0.62]
Adj-R^2 (%)	-0.23	-0.48	-0.53	-0.55	-0.56	0.45	6.23	5.03	12.70	12.31
$\Delta BusConf$	0.76	0.90	1.01	0.16	-0.04	0.81	1.02	1.53	1.78	1.29
	[2.53]	[2.15]	[1.97]	[0.32]	[-0.11]	[2.47]	[2.23]	[2.38]	[1.74]	[2.01]
Adj-R^2 (%)	1.26	0.26	-0.15	-0.56	-0.61	4.01	5.41	7.21	19.35	25.73

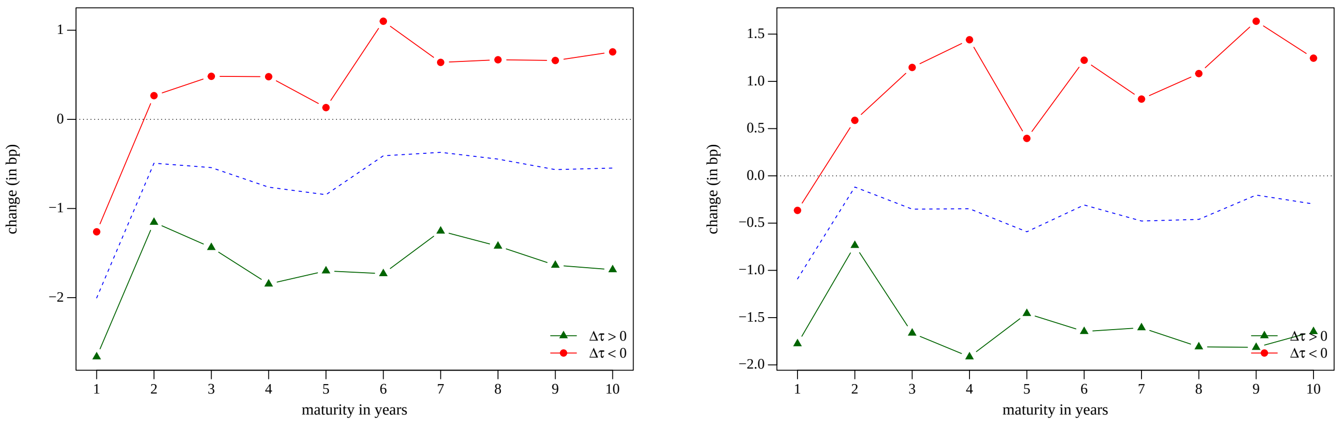
Figure IA.1: Robustness over Subsamples



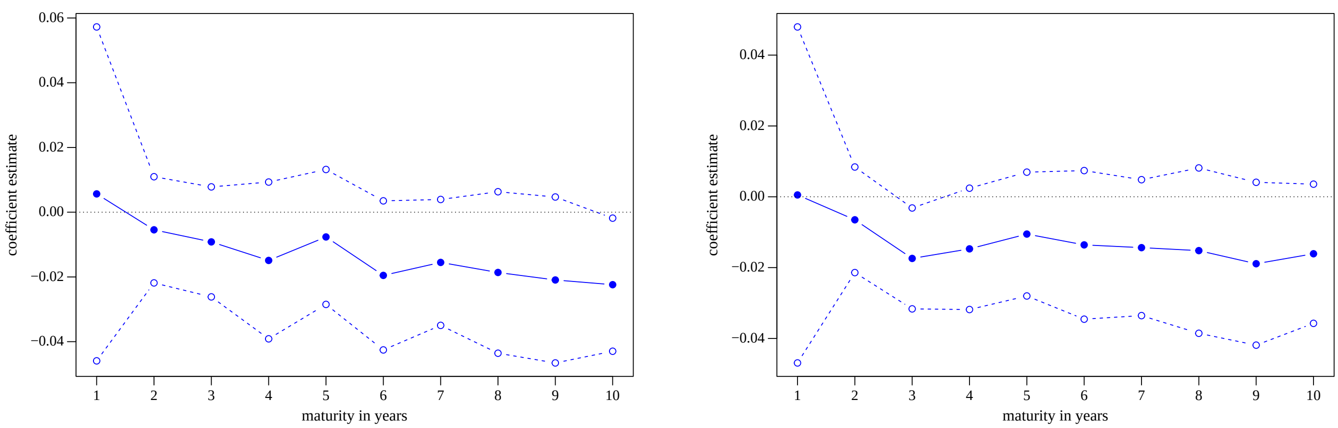
This figure presents results on changes in asset prices in response to changes in ECB tone revealed at press conferences over 18 six-year subsamples (x-axis). The green lines (with triangles) represent averages across subsample's press conferences with positive tone changes, the red lines (with bullets) for negative tone changes; the dashed blue line indicates the average response on ECB press conference days. We report results for the press conference day (i) returns of the Eurostoxx 50, (ii) changes in the 2-year German government bond yield, (iii) log changes in the VSTOXX volatility index, and (iv) changes in credit spreads (BBB−AAA) of financial firms.

Figure IA.2: Sovereign Yield Spread Changes on ECB Press Conference Days

(a) Positive versus negative tone changes on PC days: Italy and Spain vs Germany



(b) Regressions of PC day yield changes on tone changes: Italy and Spain vs Germany



This figure presents results on changes in the Italian and Spanish sovereign yield spreads versus Germany (for maturities ranging from one to ten years, x-axis) in response to changes in ECB tone. Panel (a) presents average PC-day yield changes in basis points, for all PC days (dashed lined in blue) as well as conditional on the tone changes at the most recent PC having been positive (green triangles) or negative (red bullets). Panel (b) presents results from regressing PC-day yield changes on changes in ECB tone ($\Delta\tau$) as well as our standard control variables for other textual characteristics, policy actions, market conditions, and monetary policy shocks. We plot the slope coefficients for tone changes, along with 95% confidence bands (based on White (1980) standard errors). The sample spans a total of 240 tone changes from 241 ECB press conferences between January 1999 and December 2021.