The Post-ECB Announcement Drift

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Abstract

This paper documents a drift in equity prices in the days following monetary policy announcements of the European Central Bank (ECB). Using intraday data from European equities and yields between 2002 and 2020, I construct monetary policy shocks and analyze the long run response of European equities to these shocks. I find a prolonged drift in equity prices for up to 20 days. This drift is particularly strong in response to information shocks amounting to 160 (-114) basis points for positive (negative) shocks. To rationalize the drift I investigate the role of investor disagreement on ECB announcement days. As measures of investor disagreement I consider trading volume, textual data from Q&A sessions of the ECB press conference, and forecast dispersion among participants of the ECB Survey of Professional Forecasters. My findings suggest that higher levels of disagreement are associated with a stronger price drift in the days following the monetary policy event.

Keywords: ECB, Monetary Policy Shocks, Return Drift, Macro News
JEL Codes: E43, E44, E52, E58, G12, G17

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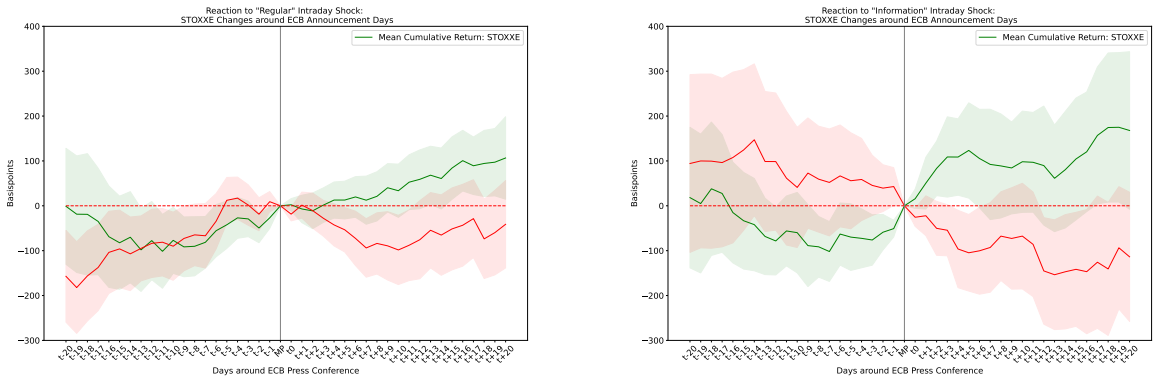
1 Introduction

Monetary policy and asset prices have been two widely studied areas of economic research. With rising influence of central banks, the intersection of both has been analyzed in much detail. Special attention has been on the identification of different monetary policy shocks. Studies such as Bernanke and Kuttner (2005), Nakamura and Steinsson (2018), and Jarociński and Karadi (2020) have found evidence for the presence of shocks contained in monetary policy communication which relate to information about the real economy. These so called information shocks have a strong effect on financial market participants as they learn about the central bank's view on economic conditions.

In this paper, I want to analyze the interplay of the ECB's monetary policy shocks and the European stock market with a special focus on information shocks. Using intraday changes in benchmark rates and equity prices to identify information shocks, I relate these shocks to a prolonged drift in cumulative returns of European equities. Following monetary policy announcements by the ECB, I find that stock markets continue to drift in the direction of the intraday shock observed at the time of the monetary policy announcement. As shown in Figure 1, these drifts can be observed for up to 20 days after monetary policy announcements. While this is true for events of either type, namely regular and information shocks, information shock events tend to display a drift of higher magnitude both upwards and downwards. Positive (negative) regular shocks induce a drift of 104 (-41) basis points after 20 days, while information shocks lead to a drift of 160 (-114) basis points.[1]



(a) Regular Shocks **(b)** Information Shocks

Figure 1: Cumulative Return after Intraday Shocks in Press Conference Window

[1]Given the dismal performance of the *Euro Stoxx* (Price) Index with an annualized return of 0.66%, the drift cannot be explained by the general trend in equity markets alone.

My findings show that this drift is present in response to the ECB Press Conference while no drift can be found following the monetary policy decision in the Press Release. Thus, information conveyed in the press conference contain relevant news that influence stock markets for up to 20 days following the announcement.

Figure 2 displays the results of a simple univariate regression in which I regress cumulative returns on the direction of the intraday equity change. Although I later demonstrate that other factors are at play, this simple regression demonstrates the predictive power of the intraday equity change that stands in contrast to intraday benchmark interest rate changes (such as the OIS 2Y), which do not successfully predict cumulative returns based on the shock direction.

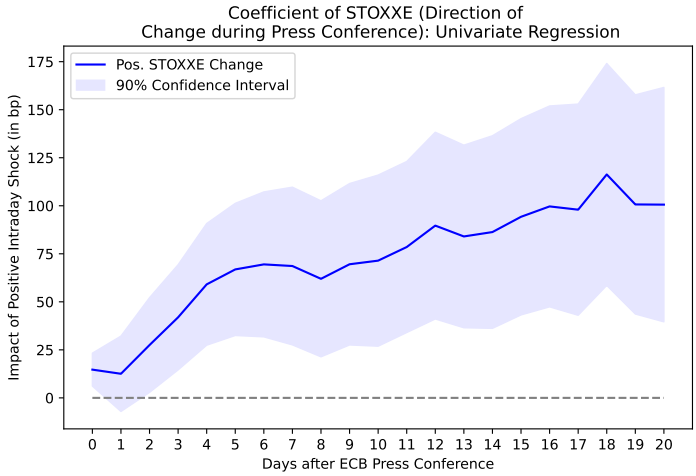


Figure 2: Coefficient of Dummy for Pos. Intraday Change during Press Conference

As I show in my empirical analysis, the observed return drift is stronger for monetary policy events that contain information shocks (also see Figures A.3 and A.4). Including both the intraday equity shock as well as an OIS rate shock in my analysis, I show that monetary policy events with an information shock exhibit a strong drift where the first half of the drift can be attributed to the positive momentum of the intraday equity shock while the continued drift after two weeks can be attributed to the intraday OIS rate change (Figure 3). In an additional analysis of the reaction of *Euro Stoxx* subindices, I demonstrate that the drift in returns in response to intraday equity shocks in cyclical stocks is stronger compared to defensive stocks. This stronger drift is particularly pronounced on information shock events compared to regular monetary policy events. The stronger reaction of cyclical stocks to information shocks underscores how information about the real economy contained in central bank communication affect stock prices of stocks with a high exposure to the business cycle.

While there has been a growing literature on momentum around monetary policy announcements such as Neuhierl and Weber (2021), there has not yet been a study that connects the momentum literature with studies on information shocks in the context of the Euro area. This paper goes beyond documenting the observed drift in cumulative returns and provides evidence for potential drivers of this prolonged drift in equity prices. In line with the observation that a stronger drift is present following information shocks, I argue that this drift can be rationalized by investor disagreement. As argued in Hong and Stein (2007), higher disagreement in times of high news exposure can lead to elevated trading volume. Analyzing trading volume in the wake of ECB announcements, I show that information shocks are followed by a prolonged period of elevated trading volume. Higher disagreement may also arise from ECB Press Conferences that do not convey a clear message. Using textual analysis of Q&A sessions during ECB Press Conferences, I find that a higher variation in sentiment among answers by the ECB president is associated with a stronger drift in equity prices. The same can be found when looking at point forecasts of the ECB Survey of Professional Forecasters (SPF). Higher dispersion of individual forecasts is associated with a higher impact of intraday shocks on the drift in equity prices.

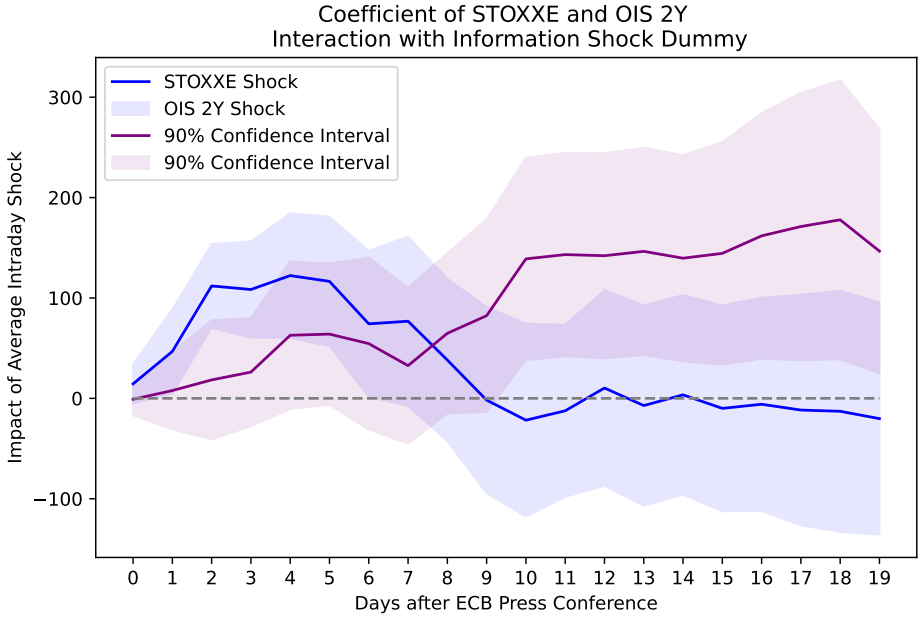


Figure 3: Impact of Average Intraday Shock (Interaction with Information Shock) for $t+x$

To support my results I also show how different trading strategies can exploit the observed drift and which strategy yields the highest cumulative return. A simple strategy that exits the market after negative intraday equity shocks and goes long following positive shocks, beats the benchmark by more than 145 percentage points. My findings with respect to the

significance of information shocks are supported by the fact that the same strategy, but only applied following information shocks, beats the benchmark and is more than four times as profitable as a strategy that only trades on "regular shock" events.

The paper is structured as follows: First, I give a short introduction to the institutional framework of the ECB's monetary policy decisions. In the next section I provide an overview of the related literature followed by a description of the data used in my analysis. Subsequently, I show evidence for the equity drift in my empirical analysis and perform several robustness checks before elaborating on possible explanations for the observed drift. The final chapter concludes my analysis.

1.1 Institutional Framework

As most modern central banks the ECB uses several channels to communicate its monetary policy to the public. First, there are speeches by members of the Governing Council that often clarify the ECB's current stand on monetary policy topics. Second, Governing Council meetings during which monetary policy decisions were made are accompanied by a press conference since the creation of the ECB in 1998. While there have been 12 meetings per year prior to 2015, this has changed to a six week interval with eight press conferences per year.

Governing Council meetings with monetary policy decisions usually end on a Thursday. The meeting is followed by a press release at 1:45 pm and a press conference at 2:30 pm. While press releases used to only contain monetary policy decisions regarding the interest rate on main refinancing operations as well as the marginal lending facility and the deposit facility, the ECB also started to include all decisions related to non-standard measures such as asset purchases and targeted longer-term refinancing operations (TLTROs). During press conferences the ECB President reads out a prepared introductory statement after which journalists are allowed to ask individual questions in a Q&A session. The introductory statement contains additional comments on the monetary policy decisions and the ECB's view on economic and monetary conditions. The final parts of the introductory statement assess fiscal policy and structural reforms in the Euro area.

It is important to note that the ECB committed to a so called "quiet period" before key meetings. Members of the Governing Council refrain from commenting on any topic re-

lated to the monetary policy decision in order to avoid any potential influence on market participants' expectations.[2]

2 Literature Review

Effects of central bank communication on asset prices have been studied extensively going back to Kohn and Sack (2003) as well as Bernanke and Kuttner (2005). Literature on high-frequency monetary policy shocks goes back to Kuttner (2001) who uses changes in federal funds futures to distinguish anticipated from surprising changes in the federal funds target rate. Gürkaynak et al. (2005) extend this analysis by employing factor rotation and find two factors which influence asset prices.

Literature on the Fed information effect, i.e., a better knowledge about the real economy by the Fed compared to other market participants, has been documented in Romer and Romer (2000). Cieslak and Schrimpf (2019) analyze communication by other major central banks and try to dissect monetary and non-monetary news finding evidence for an information effect. Similarly, Jarociński and Karadi (2020) find a positive effect of tighter monetary policy when it is accompanied by an information effect. Nakamura and Steinsson (2018) also find evidence for a Fed Information Effect. To the contrary Bauer and Swanson (2020) argue that what is often observed as a Fed information effect can rather be attributed to a "Fed response to news" channel where the Fed updates its monetary policy in response to news which also lead to a revision of expectations by the private sector. While I cannot reject their hypothesis in my paper, the fact that I observe both equities and interest rates at high-frequency in my analysis strongly support that there must indeed be an information effect at play when stocks and rates move in the same direction.

In recent years there has been a growing field of literature that employs textual analysis in Economics and Finance with a special focus on monetary policy (announcements). Schmeling and Wagner (2017) use the dictionary developed by Loughran and McDonald (2011) to measure the tone of ECB statements and find significant effects on asset prices. Cieslak et al. (2019) also apply textual analysis and provide evidence of the Fed reacting to stock prices which adds to the earlier literature on the Fed's reaction to the stock market such as Rigobon and Sack (2003) .

Additional studies on the effects of monetary policy on asset prices include Lucca and Moench (2015) who document a pre-announcement drift in the days prior to FOMC announcements

[2]For more information see https://www.ecb.europa.eu/explainers/tell-me/html/what-is-the_quiet_period.en.html

by the Fed as well as Neuhierl and Weber (2021) who find that expectations about monetary policy influence asset prices.

As the unique institutional framework of the ECB allows to distinguish interest rate shocks from communication shocks through the time difference between press release and press conference, some studies have exploited this feature to analyze different dimensions of shocks. In Altavilla et al. (2019) the authors use high-frequency changes in short and long term OIS rates to extract different monetary policy shocks through factor rotation. Besides providing a database of intraday changes of various European yields and stock price changes, they demonstrate that monetary policy did effectively influence asset prices by using an external instrument VAR. VARs with exogenous monetary shocks have been used by Gertler and Karadi (2015) and others. Identifying VARs through external instruments has been pioneered by Stock and Watson (2012). Mertens and Ravn (2013) apply a similar approach using narrative restrictions.

In this paper I analyze the impact of ECB monetary policy decisions on European asset prices and relate my findings to literature on momentum and investor disagreement. Specifically, I identify drivers of the observed equity price drift by looking at proxies of investor disagreement. Relevant studies of the role of investor disagreement and its price impact include Hong and Stein (2007), Banerjee et al. (2009) as well as Banerjee (2011).

3 Data and Methodology

In this section I describe the data and techniques used in the main empirical analysis. Effectively, I combine intraday data from the "Euro Area Monetary Policy Event-Study Database" by Altavilla et al. (2019) and Eikon with daily closing prices of European equitiy indices that are also obtained from Eikon. I update the monetary policy shocks from Altavilla et al. (2019) using their replication code and use these shocks in my analysis. For my analysis of investor disagreement I collect the texts of press conferences and point forecasts of the Survey of Professional Forecasters from the ECB's website. Trading volume of the *Euro Stoxx* Index (STOXXE) has been downloaded from Eikon.

3.1 Description of Dataset

The analysis is partly based on data from the "Euro Area Monetary Policy Event-Study Database" (EA-MPD) first introduced in Altavilla et al. (2019). Specifically, I use intraday changes in OIS rates as well as government benchmarks from the updated dataset to extend

the authors' shock series until 2020. Shocks are constructed using the *Julia* code provided by the authors (see Figure A.16). A more detailed section on the construction of shocks can be found in Section A.6 of the Appendix.

In addition to intraday changes from the EA-MPD, I collect intraday price data for the *Euro Stoxx* Index.[3] The *Euro Stoxx* Index represents a subset of the *STOXX Europe 600 Index*, namely companies from the Eurozone countries Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Spain.[4] Price data is collected from the Thomson Reuters Tick History (TRTH) database.

Intraday returns for different sectors are then calculated around the press release (1:45 pm), the press conference (2.30 pm) and around the entire monetary event window.[5] Additionally, I collect daily close prices for the *Euro Stoxx* Index from Eikon These close prices are then used to calculate cumulative returns around ECB announcement days. For each day $t + x$ I divide the close price by the price at the end of the ECB Press Conference window as described in the Appendix. Cumulative returns and intraday shocks are then transformed into basis points. I also calculate the return on the announcement day $(t + 0)$ by dividing the closing price by the price at the end of the ECB Press Conference window.

For the analysis of disagreement around ECB announcement days I look at three metrics. First, textual data from the ECB Press Conference's Q&A session. Second, expectations of market participants from the ECB Survey of Professional Forecasters (SPF). Third, trading volume of equities around ECB announcement days.

I download textual data of ECB Press Conferences, i.e., statements and the Q&A session, from the ECB's website.[6] Data on individual point forecasts of the SPF's survey participants can also be obtained from the ECB's website. I concentrate on forecasts for real GDP growth as information shocks mostly stem from news about the real economy. Finally, I download all data on trading volume for the *Euro Stoxx* Index from Eikon.

[3] I select the *Euro Stoxx* Index rather than the *Euro Stoxx 50* Index as is covers a broader range of stocks without a bias towards large caps and has higher trading volume.

[4] https://www.stoxx.com/index-details?symbol=sxxe

[5] See A.2 for the exact time windows and calculation method.

[6] https://www.ecb.europa.eu/press/pressconf/html/index.en.html

3.2 Information Shocks

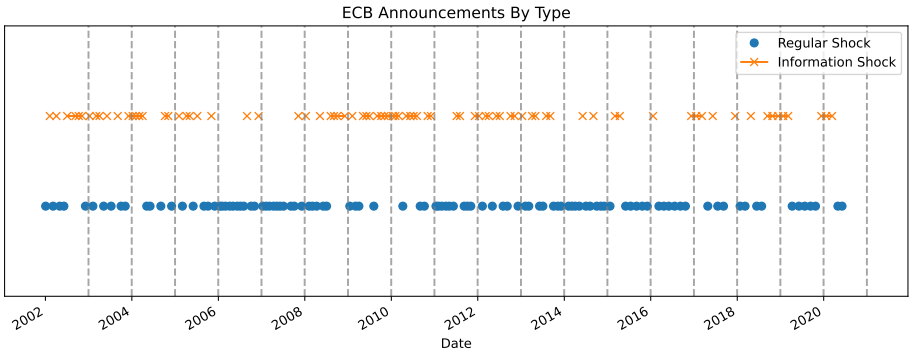


Figure 4: Distribution of Meetings by Shock Type

The identification of information shocks is straightforward as I apply the "poor man's" version similar to Jarociński and Karadi (2020). Using intraday changes for the STOXXE and the OIS 2Y rates, I classify events during which returns move in the same direction as information shocks. While economic theory suggests that higher interest rates should be associated with lower returns in equities, information shocks are characterized by positive (negative) news about the real economy which leads to an increase (decrease) of both equities and yields.

As displayed in Figure 4 information shocks are not unusual but appear frequently throughout the sample period. Among the 194 events in my dataset, there are 4 events where either stocks or two year OIS yields did not move during the press conference window. Thus, I do not characterize them as either regular or information shock events. The remaining 190 ECB announcements consist of 107 events with regular shocks and 83 events with information shocks. Due to the small sample size sample splits have been omitted in the robustness checks.

	OIS 2Y	DE10Y	STOXXE	Target	Timing	FG	QE
count	107.00	107.00	107.00	107.00	107.00	107.00	107.00
mean	0.33	0.30	-0.09	-0.13	0.42	0.13	0.15
std	4.52	3.36	0.58	2.25	2.29	3.84	2.10
min	-22.50	-12.65	-2.55	-13.20	-8.27	-25.38	-7.66
25%	-1.34	-1.48	-0.29	-0.46	-0.24	-1.41	-0.98
50%	0.25	0.35	-0.07	-0.24	0.32	0.17	0.07
75%	2.12	1.73	0.17	0.20	1.02	1.32	1.10
max	19.40	12.46	1.79	11.97	10.78	10.27	6.24

Table 1: Selected Intraday Data for Regular Shock Events

	OIS 2Y	DE10Y	STOXXE	Target	Timing	FG	QE
count	83.00	83.00	83.00	83.00	83.00	83.00	83.00
mean	-0.96	-0.47	-0.13	0.18	-0.52	-0.10	-0.17
std	3.75	2.61	0.50	2.42	2.18	3.02	1.91
min	-17.72	-6.25	-2.06	-11.01	-12.16	-15.49	-7.46
25%	-2.50	-2.30	-0.33	-0.44	-0.89	-1.26	-1.11
50%	-0.48	-0.70	-0.12	-0.19	-0.10	-0.00	-0.11
75%	0.59	1.25	0.14	0.34	0.53	1.40	0.72
max	8.70	5.85	0.96	11.94	3.20	7.78	4.79

Table 2: Selected Intraday Data for Information Shock Events

As displayed in Table A.2 in the Appendix, there have been more regular shocks during the presidency of Mario Draghi and Jean-Claude Trichet. Those events of my sample that fall within the presidencies of Wim Duisenberg and Christine Lagarde have a slightly higher share of information shock events. However, as my sample starts in 2002 and Christine Lagarde has only been president since 2019, the difference can not be considered as meaningful.

4 Empirical Analysis

The empirical analysis consists of three main parts. First, I regress the cumulative return at $t + x$ days after the ECB Announcement on the announcement day's intraday stock return and OIS 2Y rate change during the Press Conference. These results demonstrate that the intraday equity shock is a superior predictor for future returns compared to the rate shock within the Press Conference window, both as a dummy and as a continuous variable. Results are displayed in Section A.9 in the Appendix.

Then, I add additional monetary policy shocks calculated as in Altavilla et al. (2019) to demonstrate that the intraday equity shock has a significant impact on the drift in stock prices irrespective of other monetary policy shocks. The basic version of these results is displayed in Table 3 in Section 4.2. In a next step, I run several regression models which include combinations of more covariates such as equity volatility and other macro news that do not stem from the ECB Press Conference. To account for the specific effects coming from information shocks, I include interaction terms for intraday equity and rate shocks on information shock events. Section 4.1 briefly describes these regression models. For the sake of brevity I provide only two tables to display these results, Table 4 refers to the short term impact while Table 5 displays results for the longer horizon.

The second part of the empirical analysis in Section 4.3 rationalizes the observed drift through investor disagreement. Using evidence from trading volume after ECB announcement days, ECB Press Conference Q&A sessions, and variations in the ECB Survey of Professional

Forecasters, I show that disagreement among investors has a significant impact on the magnitude of the drift. Finally, I show in Section 4.4 that a trading strategy that exploits intraday changes in equities on ECB announcement days, yields significant positive returns.

4.1 Methodology

For a benchmark results I regress the cumulative return at $t + x$ days after the ECB Announcement on the announcement day's intraday equity and OIS 2Y rate change as well as my update of the Altavilla et al. (2019) monetary policy shocks:

$$y_{t+d} = \alpha + \beta \times \Delta_t + \gamma \times OIS_t + \boldsymbol{\nu}'\boldsymbol{\xi}_t + \epsilon_t \tag{1}$$

where y_{t+d} is the cumulative return on d days after the ECB Press Conference on date t as described in Section 3.1. The intraday equity shock is denoted at Δ_t, the intraday OIS 2Y change is OIS_t, and the vector $\boldsymbol{\xi}_t$ represents the monetary policy shocks.

In a next step, I run several regression models with variations of the following form:

$$y_{t+d} = \alpha + \beta \times \Delta_t + \gamma \times OIS_t + \kappa \times \Delta_t \times IS_t + \lambda \times OIS_t \times IS_t + \boldsymbol{\nu}'\boldsymbol{\xi}_t + \rho \times X_t + \epsilon_t \tag{2}$$

where IS_t is a dummy for information shock events, and the vector X_t contains covariates such as macro news and other intraday asset changes depending on the regression model.

For models 12 and 13 I include dummy variables that capture individual effects of ECB presidents:

$$y_{t+d} = \alpha+\beta\times\Delta_t+\gamma\times OIS_t+\kappa\times\Delta_t\times IS_t+\lambda\times OIS_t\times IS_t+\boldsymbol{\nu}'\boldsymbol{\xi}_t+\rho\times X_t+\mu\times President_t+\epsilon_t \tag{3}$$

The analysis employs a standard OLS framework with robust standard errors. Instead of using the level of the VSTOXX to capture uncertainty, I take the deviation from the 90-day moving average to better account for periods of elevated uncertainty.

4.2 Main Empirical Findings

The benchmark results from Equation 1 are displayed in Table 3. This underlines that even when controlling for other monetary policy shocks, the intraday equity change during the press conference window does still provide a significant predictive power for cumulative returns for up to 20 days after the monetary policy announcement. At the same time, changes on the OIS 2Y rate do not seem to contain predictive power in this specification.

However, once information shock events are included in the analysis, short term rate changes will provide some additional explanatory power.

	(1) t0	(2) tp2	(3) tp4	(4) tp6	(5) tp8	(6) tp10	(7) tp12	(8) tp14	(9) tp16	(10) tp18	(11) tp20
STOXXE	0.55***	0.90**	1.76***	1.70***	1.33**	1.26*	1.66**	1.46**	1.46**	1.46*	1.40*
	(4.75)	(2.33)	(3.34)	(2.96)	(2.26)	(1.95)	(2.35)	(2.11)	(2.08)	(1.90)	(1.91)
OIS 2Y	1.44	26.05	29.10	2.57	-1.31	-25.45	-59.48	-11.23	23.70	70.99	56.14
	(0.12)	(0.72)	(0.53)	(0.05)	(-0.02)	(-0.41)	(-0.85)	(-0.15)	(0.26)	(0.73)	(0.56)
Target	1.10	1.78	4.42	21.23**	30.35***	33.58**	52.72***	50.40***	43.09***	36.82**	49.11***
	(0.31)	(0.17)	(0.32)	(1.98)	(2.99)	(2.43)	(5.08)	(4.10)	(2.63)	(2.39)	(3.25)
Timing	4.46	-14.58	-9.59	7.93	-2.06	28.35	65.91	23.53	-1.15	-57.06	-53.75
	(0.36)	(-0.36)	(-0.15)	(0.14)	(-0.03)	(0.39)	(0.83)	(0.28)	(-0.01)	(-0.52)	(-0.49)
FG	-0.76	-20.55	-19.05	10.92	13.60	33.33	66.91	10.85	-21.62	-69.07	-53.58
	(-0.06)	(-0.55)	(-0.33)	(0.22)	(0.24)	(0.52)	(0.94)	(0.14)	(-0.23)	(-0.70)	(-0.53)
QE	-4.07	-18.57*	-26.89*	-14.64	-19.68	-16.47	1.26	-4.75	-23.22	-41.91*	-42.59*
	(-1.10)	(-1.74)	(-1.69)	(-1.07)	(-1.23)	(-1.01)	(0.07)	(-0.25)	(-1.07)	(-1.85)	(-1.90)
Constant	-3.57	10.02	7.42	-9.86	-11.54	-18.50	-32.48	-18.63	16.04	26.72	38.27
	(-0.59)	(0.56)	(0.33)	(-0.37)	(-0.41)	(-0.56)	(-0.93)	(-0.49)	(0.40)	(0.60)	(0.86)
Observations	190	190	190	190	190	190	190	190	190	190	190
R^2	0.19	0.09	0.17	0.12	0.10	0.08	0.12	0.09	0.08	0.07	0.08
F	4.54	2.84	5.95	3.32	3.52	2.50	5.36	3.93	2.36	2.43	3.91

The t-stats (in parentheses) are based on White heteroscedasticity-consistent standard errors.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Benchmark without Information Shocks

The results of the regressions specified in Equations 2 and 3 are displayed in Tables 4 and 5. The results for the full range of model specifications are only displayed for days $t+5$ and $t+15$ to demonstrate which factors influence the short end and the long end of the drift.

Eventually, I will use regression model 8 from Tables 4 and 5 in most of the following regressions as this model captures the impact of the equity shock in the short run and the longer term impact of the OIS rate while controlling for all factors from Altavilla et al. (2019). The full set results (including coefficients for all days between $t0$ and $t+20$) of simple univariate regression models (1) and (3) as well as regression models (7) and (8) can be found in Section A.9.

My results for $t+5$ show that the intraday equity shock has a significant impact on cumulative returns. This finding is valid for various specifications including cases where the OIS 2Y yield change is included or where I simultaneously test for the effect of the equity shock in the press release window.

However, once I include a dummy that is set to one for information shock events, the statistical significance shift to the interaction with that dummy variable. The effect of a one basis point STOXXE change during the press conference window is amplified by 3 basis points if this STOXXE change appears together with an information shock.

While the magnitude slightly varies depending on the econometric specification, it remains significant throughout regression models that include an interaction effect for information shocks. Although the inclusion of an interaction of information shock and OIS 2Y rate change has some statistical power, the coefficient on the intraday equity shock has a stronger impact. When including both interaction effects and controlling for other monetary policy shocks, only the equity shock interaction with the information shock remains significant.

This changes when looking at day $t+15$ in Table 5. For longer horizons the predictive power of the equity shock vanishes when controlling for for OIS 2Y rate changes. For the case of day $t+15$ the additional effect of a one basis point OIS 2Y rate change on cumulative return in $t+15$ is about 57 basis points.

Higher levels of the VSTOXX or ECB President fixed effects as well as experience of the ECB President proxied by the number of meetings under the respective presidency do not seem to have a significant impact on the effect of the intraday shock. This is true for both the short run as in $t+5$ and the longer run as in $t+15$.

	(1) tp5	(2) tp5	(3) tp5	(4) tp5	(5) tp5	(6) tp5	(7) tp5	(8) tp5	(9) tp5	(10) tp5	(11) tp5	(12) tp5	(13) tp5
STOXXE	1.50***	1.50***		1.62***	0.33		0.12	0.07	0.38		0.16	0.28	0.27
	(2.68)	(2.66)		(2.74)	(0.60)		(0.18)	(0.13)	(0.69)		(0.26)	(0.36)	(0.35)
STOXXE Press Release		0.05											
		(0.07)											
OIS 2Y			9.98	12.48*		-6.41	-5.78	-50.44		-30.88	-5.49	-8.20	-8.45
			(1.41)	(1.79)		(-1.21)	(-0.85)	(-1.13)		(-0.68)	(-0.79)	(-1.03)	(-1.04)
STOXXE × OIS 2Y				0.01									
				(0.11)									
Information Shock × STOXXE					3.15***		2.55***	3.12***	3.37***		1.91*	2.21**	2.20**
					(3.33)		(2.76)	(3.22)	(3.33)		(1.87)	(2.39)	(2.34)
Information Shock × OIS 2Y						45.97***	26.29*	24.72*		47.03***	30.21**	32.66*	33.63*
						(3.30)	(1.79)	(1.69)		(3.26)	(2.01)	(1.92)	(1.93)
Target								18.11*	18.79*	12.60			
								(1.72)	(1.82)	(0.92)			
Timing								47.51	5.41	26.14			
								(0.99)	(0.39)	(0.53)			
FG								42.96	0.70	23.67			
								(0.99)	(0.12)	(0.53)			
QE								-13.11	-22.73**	-9.40			
								(-1.21)	(-2.51)	(-0.73)			
STOXXE × VSTOXX MA Dev.											0.04		
											(1.52)		
STOXXE Up × Trichet												1.50	-10.51
												(0.02)	(-0.09)
STOXXE Up × Draghi												-1.56	-10.47
												(-0.02)	(-0.09)
STOXXE Up × Lagarde												28.64	31.51
												(0.31)	(0.34)
STOXXE Up × Numbr. of Meeting													0.29
													(0.25)
Constant	-6.21	-6.11	-19.60	-1.86	-0.80	-4.15	3.30	-6.52	1.09	-10.19	3.75	-30.35	-32.99
	(-0.30)	(-0.30)	(-0.92)	(-0.09)	(-0.04)	(-0.21)	(0.17)	(-0.29)	(0.06)	(-0.43)	(0.19)	(-0.34)	(-0.37)
Observations	190	190	190	190	190	190	190	190	190	190	190	190	190
R^2	0.08	0.08	0.02	0.11	0.16	0.12	0.18	0.23	0.20	0.14	0.19	0.21	0.21

The t-stats (in parentheses) are based on White heteroscedasticity-consistent standard errors.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Main Regression $(t + 5)$

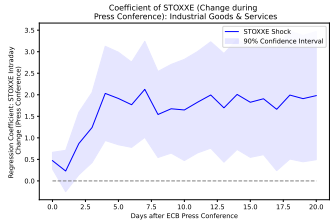
	(1) tp15	(2) tp15	(3) tp15	(4) tp15	(5) tp15	(6) tp15	(7) tp15	(8) tp15	(9) tp15	(10) tp15	(11) tp15	(12) tp15	(13) tp15
STOXXE	1.10*	1.14*		1.19*	0.86		0.36	0.42	1.09		0.40	-0.00	-0.00
	(1.66)	(1.73)		(1.67)	(1.22)		(0.46)	(0.55)	(1.34)		(0.50)	(-0.00)	(-0.00)
STOXXE Press Release		-1.76*											
		(-1.79)											
OIS 2Y			5.76	7.59		-16.05	-13.75	-22.59		-24.69	-13.55	-9.66	-9.62
			(0.54)	(0.70)		(-1.64)	(-1.17)	(-0.27)		(-0.30)	(-1.14)	(-0.71)	(-0.71)
STOXXE × OIS 2Y				0.01									
				(0.12)									
Information Shock × STOXXE					0.65		-0.75	-0.06	0.80		-1.19	-0.98	-0.88
					(0.43)		(-0.55)	(-0.04)	(0.50)		(-0.72)	(-0.71)	(-0.63)
Information Shock × OIS 2Y						61.16***	61.72***	56.57**		61.61***	64.48***	53.76**	51.86**
						(2.88)	(2.81)	(2.57)		(2.93)	(2.80)	(2.13)	(2.00)
Target								50.60***	53.28***	49.70***			
								(3.09)	(3.38)	(3.14)			
Timing								16.08	14.06	15.92			
								(0.18)	(0.63)	(0.18)			
FG								3.11	-1.66	2.53			
								(0.04)	(-0.17)	(0.03)			
QE								-12.72	-16.44	-12.44			
								(-0.62)	(-1.15)	(-0.62)			
STOXXE × VSTOXX MA Dev.											0.03		
											(0.67)		
STOXXE Up × Trichet												188.84	264.43
												(0.95)	(1.22)
STOXXE Up × Draghi												142.95	203.95
												(0.73)	(0.97)
STOXXE Up × Lagarde												313.58	306.92
												(1.61)	(1.55)
STOXXE Up × Numbr. of Meeting													-1.69
													(-0.97)
Constant	0.01	-3.50	-10.18	2.97	1.13	10.38	10.73	10.52	4.13	8.11	11.05	-118.48	-114.04
	(0.00)	(-0.11)	(-0.31)	(0.09)	(0.04)	(0.34)	(0.35)	(0.28)	(0.13)	(0.22)	(0.36)	(-0.68)	(-0.64)
Observations	190	190	190	190	190	190	190	190	190	190	190	190	190
R^2	0.02	0.03	0.00	0.02	0.02	0.08	0.08	0.15	0.10	0.15	0.08	0.09	0.09

The t-stats (in parentheses) are based on White heteroscedasticity-consistent standard errors.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

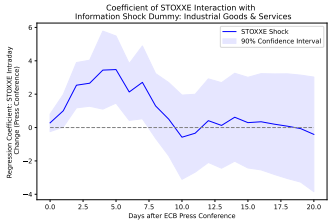
Table 5: Main Regression $(t + 15)$

4.2.1 Euro Stoxx Sectors

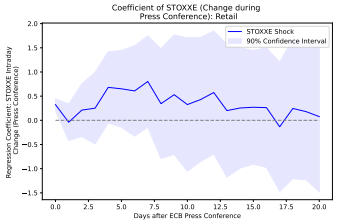
As the *Euro Stoxx* Index covers a range of stocks from different euro zone countries and industries, a deeper analysis of the observed equity drift needs to look at the index' different sectors. The left hand side of Figure 5 below displays the results of a simple univariate regression of sector specific cumulative returns on intraday changes in the *Euro Stoxx* Index. For illustrative purposes only one example of cyclical and defensive sectors is shown. The right hand side displays the regression coefficient of the interaction term of intraday *Euro Stoxx* changes and a dummy for information shock events. Notably, a prolonged drift can mostly be observed in cyclical stocks while defensive stocks appear to only be affected in the first few days after an announcement. The additional effect of information shocks is more pronounced for cyclical stocks which is in line with the notion that economic news contained in information shocks are the most relevant driver of the observed drift. The higher magnitude of the shock as observed in Panel (b) underscores the economic significance of information shocks for stocks with strong exposure to the business cycle. Figure A.5 in Section A.3 of the Appendix shows that the co-movement of stocks is higher on ECB announcement days compared to regular trading days. However, the degree of co-movement is particularly strong on ECB announcement days with an information shock.



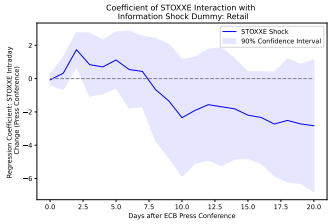
(a) Industrial Goods & Services: STOXXE Shock



(b) Industrial Goods & Services: Information Shock



(c) Retail: STOXXE Shock



(d) Retail: Information Shock

Figure 5: Cyclical and Defensive Stocks Examples: Additional Effect of Information Shock[7]

[7]Results for all sectors can be found in Section A.3.

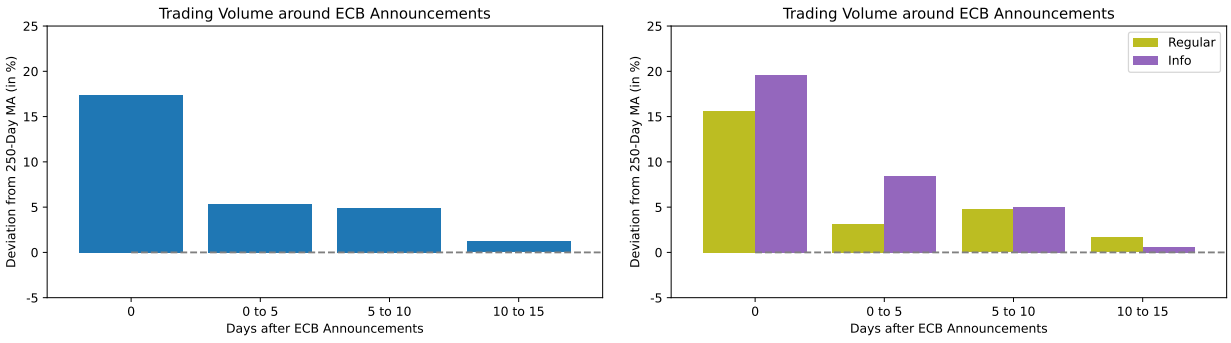
4.3 Investor Disagreement

A large literature such as Hong and Stein (2007), Banerjee et al. (2009), and Banerjee (2011) has highlighted the role of investor disagreement in the context of return drifts. Therefore I investigate three metrics that are proxies for investor disagreement, namely trading volume, forecast dispersion, and deviation of sentiment in answers of ECB president during ECB Press Conferences. My findings show that larger levels of disagreement as proxied by the previously mentioned variables can amplify the drift of equity prices induced by the intraday shock.

4.3.1 Trading Volume

A simple first step is to look at the behavior of trading volume since Hong and Stein (2007) argue that disagreement can manifest itself in higher trading volume in response to news about fundamentals. As trading volume has been fluctuating during the sample period (see Table A.6 for some summary statistics of STOXXE trading volume), I standardize trading volume in the *Euro Stoxx* Index by calculating the deviation of daily trading volume from the 250-day moving average for each day around ECB monetary policy announcements.

Panel (a) of Figure 6 shows that trading volume is generally elevated by nearly 20% on ECB announcement days. Trading volume continues to be high for more than ten days after the announcement. Trading volume is particularly elevated for ECB meetings that contain an information shock as displayed in Panel (b) of Figure 6. This is true not only for the announcement day itself but also for the five days following the announcement.

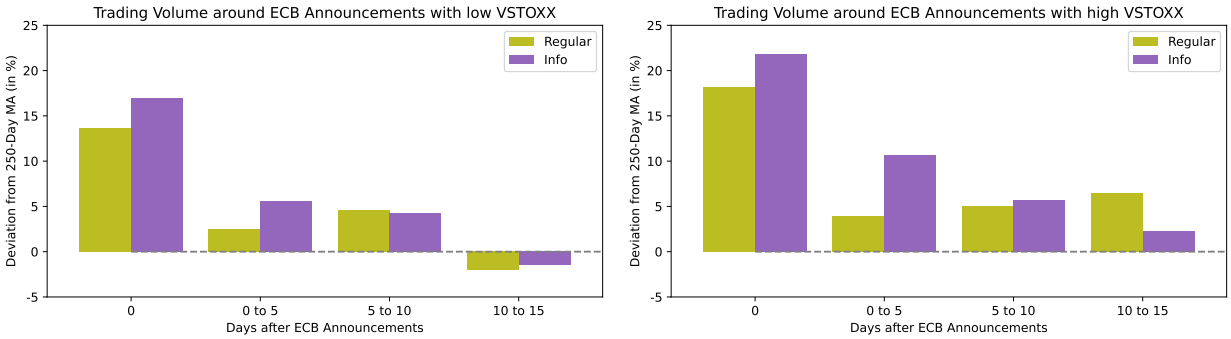


(a) Entire Sample **(b)** By Shock Type

Trading Volume of the *Euro Stoxx* is expressed as the deviation from its 250-day moving average. Except for the ECB announcement day I take the average of five day windows around the ECB announcement.

Figure 6: Trading Volume around ECB Announcement

The pattern described above is particularly pronounced for those events that take place in times of higher uncertainty as proxied by the VSTOXX Index. During times of high VSTOXX levels as displayed in Panel (b) of Figure 7 trading volume is much higher compared to events with low VSTOXX levels (Panel (a)). For high VSTOXX events, the trading volume remains elevated for more than ten days for both regular and information shocks. However, while the five days after ECB announcement day display even higher trading volume for information shocks, the increase after information shocks compared to regular shocks is slightly stronger during episodes of high uncertainty proxied by the VSTOXX.



(a) Low VSTOXX **(b)** High VSTOXX

The categories "Low VSTOXX" and "High VSTOXX" are defined relative to the median of the VSTOXX between 2002 and 2020 which stands at 20.9. Trading Volume of the *Euro Stoxx* is expressed as the deviation from its 250-day moving average. Except for the ECB announcement day I take the average of five day windows after the ECB announcement.

Figure 7: Trading Volume by Shock Type depending on VSTOXX Level

To test whether higher trading volume on ECB announcement days has an influence on the strength of the intraday shock and thus the drift I run a regression analysis that interacts trading volume on the announcement day relative to the previous days with the intraday equity shock. As not only the level of trading volume but also its change relative to the pre-announcement period is relevant, I deem this setup as more informative relative to the 250-day moving average. The results are displayed in Table 6. While no effect can be found in the long run, there seems to be some evidence that higher trading volume on ECB announcement days amplifies the impact of the intraday shock for up to three days.

	(1) tp1	(2) tp2	(3) tp3	(4) tp4	(5) tp5	(6) tp6	(7) tp7	(8) tp8	(9) tp10	(10) tp12	(11) tp14	(12) tp16	(13) tp18	(14) tp20
STOXXE	-0.90**	-1.01**	-0.68	-0.51	-0.33	0.09	0.13	0.26	0.45	0.47	0.50	-0.29	0.75	0.99
	(-2.21)	(-2.00)	(-1.27)	(-0.80)	(-0.48)	(0.11)	(0.14)	(0.27)	(0.45)	(0.42)	(0.42)	(-0.27)	(0.68)	(0.85)
OIS 2Y	18.51	-8.49	-14.84	-28.05	-47.42	-37.96	-42.41	-37.67	-79.13	-123.46*	-72.66	-42.47	-6.01	0.47
	(0.57)	(-0.23)	(-0.40)	(-0.55)	(-1.04)	(-0.68)	(-0.72)	(-0.63)	(-1.20)	(-1.81)	(-0.87)	(-0.46)	(-0.06)	(0.00)
STOXXE × Trading Volume	0.02***	0.02*	0.02*	0.02	0.01	0.01	0.02	0.01	0.00	0.00	-0.00	0.02	-0.01	-0.01
	(3.01)	(1.84)	(1.86)	(1.29)	(0.94)	(0.88)	(1.02)	(0.40)	(0.16)	(0.18)	(-0.01)	(0.81)	(-0.47)	(-0.22)
Information Shock × STOXXE	1.35**	3.08***	2.98***	3.35***	3.18***	2.05*	2.15*	1.05	-0.55	0.31	0.11	0.20	-0.31	-1.01
	(2.11)	(4.97)	(4.17)	(3.72)	(3.33)	(1.91)	(1.73)	(0.87)	(-0.38)	(0.21)	(0.07)	(0.14)	(-0.18)	(-0.62)
Information Shock × OIS 2Y	6.32	10.25	13.02	27.05*	26.76*	23.15	15.77	25.71*	53.70***	55.26***	53.17***	64.97***	65.78**	55.92**
	(0.79)	(0.80)	(1.12)	(1.76)	(1.89)	(1.37)	(1.06)	(1.66)	(2.70)	(2.73)	(2.71)	(2.77)	(2.46)	(2.35)
Constant	11.99	7.88	10.59	3.89	-5.44	-11.97	-22.27	-13.36	-20.49	-35.45	-21.67	14.28	22.28	35.77
	(0.76)	(0.45)	(0.57)	(0.18)	(-0.24)	(-0.44)	(-0.80)	(-0.47)	(-0.62)	(-1.00)	(-0.56)	(0.35)	(0.50)	(0.80)
Observations	190	190	190	190	190	190	190	190	190	190	190	190	190	190
R^2	0.08	0.22	0.24	0.28	0.23	0.15	0.12	0.12	0.13	0.17	0.14	0.14	0.12	0.11
MP Shocks	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

The t-stats (in parentheses) are based on White heteroscedasticity-consistent standard errors.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Trading Volume measures traded volume of the *Euro Stoxx* Index at $t + 0$ relative to the mean of the five days prior to the ECB meeting.

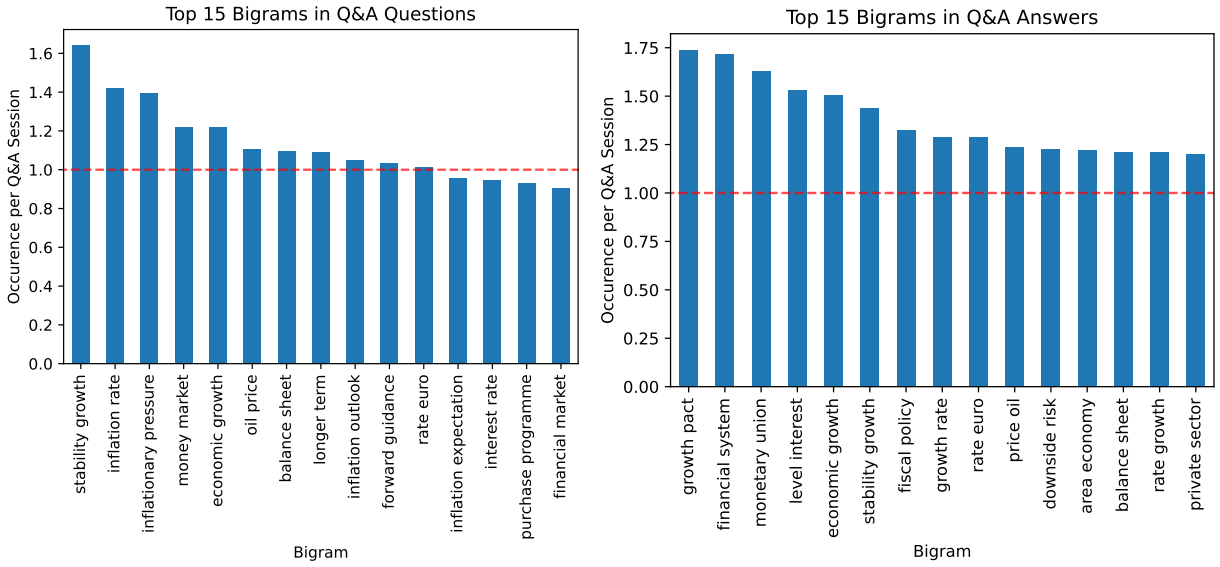
Table 6: Trading Volume and Cumulative Returns

4.3.2 Information Content of Q&A of ECB Press Conference

In addition to the simple analysis of trading volume I will further assess what information are conveyed during the ECB Press Conferences. To connect this with the approach of measuring disagreement, I evaluate whether the ECB sends a signal to market participants that is easy to interpret or that needs additional processing to be correctly interpreted.

As the Press Conference window consists of both the statement as well as Q&A session, information can be contained in either one. However, only the Q&A session allows journalists to ask questions that are directly related to topics that they want to clarify or focus on. Thus, I analyzed the Q&A session with respect to differences between regular Q&A sessions and those that occur on days with information shocks.

In a first step, I collect the most common bigrams that are used during the statements at the beginning of the press conferences. These bigrams are then filtered to exclude less meaningful phrases that relate to certain points in time such as "last quarter" or to the organization of the Governing Council Meeting such as "press conference" or "governing council". Finally, I calculate the share of occurences of each bigram per Q&A sessions for questions and answers separately. In Figure 8 I display the ratio of occurrences on information shock relative to regular events for each bigram.[8]



(a) Questions **(b)** Answers

Figure 8: Q&A: Most Popular Bigrams

[8] A more detailed description of the individual steps can be found in Section A.8.2.

As one can see in Panel (a) of Figure 8 questions during Q&A sessions of information shock events frequently contain phrases related to growth of the real economy and inflation. A similar pattern emerges when looking at Panel (b) where answers of ECB presidents likewise often contain phrases related to the real economy such as "economic growth" or "area economy" but also seem to deal with the state of the financial system as a whole. This underscores my interpretation of information shocks as events where markets learn about the state of the economy through news by the central bank.

In an additional exercise, I calculate the standard deviation of negativity in answers during the Q&A session. This is done using the Loughran and McDonald (2011) Dictionary which contains words that have a negative connotation in the context of Finance. A more detailed description of all steps related to the textual analysis can be found in Section A.8.

The regression results in Table 7 support the notion that higher disagreement induced by dispersion in answer sentiment leads to a stronger drift for up to 8 days as a given intraday shock has a higher effect on cumulative returns following the announcement. However, this effect seems to less pronounced for information shock events which seems to contradict the previous argument. Nonetheless, this finding can help to explain the drift observed on regular shock events.

	(1) t0	(2) tp1	(3) tp2	(4) tp3	(5) tp4	(6) tp5	(7) tp6	(8) tp7	(9) tp8	(10) tp10	(11) tp12
STOXXE	0.44***	-0.14	-0.24	-0.01	0.19	0.19	0.76	0.90	0.58	0.64	0.69
	(3.53)	(-0.44)	(-0.75)	(-0.02)	(0.43)	(0.39)	(1.19)	(1.20)	(0.84)	(0.80)	(0.79)
OIS 2Y	-1.54	15.81	-11.76	-16.52	-32.33	-50.00	-41.41	-48.45	-40.65	-80.79	-127.86*
	(-0.12)	(0.51)	(-0.34)	(-0.46)	(-0.66)	(-1.13)	(-0.77)	(-0.83)	(-0.68)	(-1.23)	(-1.83)
Information Shock × STOXXE	0.33	1.11*	2.76***	2.74***	3.07***	2.93***	1.68	1.85	0.88	-0.72	0.11
	(1.20)	(1.72)	(4.45)	(3.76)	(3.45)	(3.07)	(1.57)	(1.47)	(0.72)	(-0.50)	(0.07)
Information Shock × OIS 2Y	-0.52	2.23	6.65	9.40	24.12	24.60*	20.69	12.82	24.81	53.55***	55.75***
	(-0.15)	(0.28)	(0.52)	(0.82)	(1.57)	(1.73)	(1.20)	(0.85)	(1.58)	(2.62)	(2.71)
Std. in Answers × STOXXE	0.38*	0.95***	1.32***	1.10**	1.05*	1.05**	1.64***	0.97	0.58	0.79	0.67
	(1.66)	(3.58)	(2.68)	(2.55)	(1.88)	(2.15)	(3.17)	(1.55)	(1.08)	(0.85)	(0.83)
Information Shock × Std. in Answers × STOXXE	-0.36	-0.86***	-1.47***	-1.00*	-1.35**	-1.30**	-2.11***	-1.44*	-0.93	-1.18	-1.45
	(-1.44)	(-2.71)	(-2.75)	(-1.89)	(-2.05)	(-2.02)	(-3.08)	(-1.69)	(-1.14)	(-1.01)	(-1.12)
Constant	-3.53	11.20	8.54	10.30	4.79	-4.26	-9.44	-21.12	-12.06	-18.34	-32.28
	(-0.60)	(0.72)	(0.50)	(0.57)	(0.22)	(-0.19)	(-0.36)	(-0.78)	(-0.43)	(-0.56)	(-0.92)
Observations	190	190	190	190	190	190	190	190	190	190	190
R^2	0.22	0.08	0.23	0.24	0.29	0.23	0.17	0.12	0.13	0.13	0.18
MP_Shocks	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

The t-stats (in parentheses) are based on White heteroscedasticity-consistent standard errors.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: *Std. in Answers* refers to the demeaned standard deviation of negativity in answers of the ECB President during ECB Press Conference Q&A sessions. Negativity is measured using the Loughran and McDonald (2011) dictionary while accounting for negations which may preceed a given word in the text of the president's answer. Results beyond $t + 12$ are not displayed for the sake of brevity. The sample period is 01/2002 - 07/2020.

Table 7: Sentiment Disparity in ECB President Answers

4.3.3 ECB Survey of Professional Forecasters

Each quarter the ECB conducts a survey among professionals to collect individual opinions regarding the outlook on Inflation, Core Inflation, GDP Growth, and Unemployment. As a proxy for disagreement I look at the dispersion in point forecasts of survey participants. In each quarter participants are asked to provide their view on the above mentioned metrics for the current year as well as different points in the future. I concentrate on forecasts for GDP Growth for the next year and calculate the difference between the 90th percentile of individual point forecasts and the 10th percentile. As surveys are only conducted once per quarter, I match only those ECB meetings that are closest to the last round of the Survey of Professional Forecasters. Thus, I can match 75 meetings for which I conduct a regression analysis that looks at the impact of higher disagreement on cumulative returns.

In line with the expected economic impact of higher disagreement, the drift appears to be stronger for events that have higher disagreement among forecast participants. Given that participants of the Survey of Professional Forecasters can be considered to proxy for the opinion of market participants, a higher dispersion of beliefs is associated with a stronger drift in equity prices. Market participants receive information from the ECB which leads to an update of their beliefs. A stronger update of these beliefs as it is necessary when disagreement is strong manifests itself in a longer drift. As displayed in Table 8, the effect of higher disagreement can influence asset prices for up to 10 days after an ECB announcement.

	(1) t0	(2) tp1	(3) tp2	(4) tp3	(5) tp4	(6) tp5	(7) tp6	(8) tp7	(9) tp8	(10) tp10	(11) tp12
STOXXE	0.21*	-0.43	-0.39	-0.53	-0.25	-0.39	-0.15	0.25	0.57	0.31	0.55
	(1.68)	(-0.67)	(-0.76)	(-0.97)	(-0.42)	(-0.60)	(-0.20)	(0.28)	(0.56)	(0.28)	(0.37)
OIS 2Y	-2.03	-38.67	-48.79	-64.54	-73.43	-65.15	-41.56	-66.70	-60.17	-66.28	-98.81
	(-0.11)	(-0.91)	(-0.96)	(-1.43)	(-1.25)	(-1.53)	(-0.91)	(-1.28)	(-1.16)	(-1.32)	(-1.36)
Information Shock × STOXXE	-0.57	0.16	1.79	1.75	1.54	2.46	2.31	2.59	1.25	-0.39	1.55
	(-1.34)	(0.12)	(1.49)	(1.39)	(0.82)	(1.10)	(0.88)	(0.76)	(0.33)	(-0.14)	(0.43)
Information Shock × OIS 2Y	6.12	17.96	16.04	28.44**	46.13***	35.80***	17.46	20.08	30.42*	53.98***	56.45**
	(1.14)	(1.43)	(1.04)	(2.32)	(3.13)	(2.85)	(1.39)	(1.39)	(1.69)	(3.29)	(2.37)
STOXXE × SPF Disagreement	0.06	-0.04	1.27***	0.74***	0.99***	0.62**	0.16	0.30	0.35	1.50***	-0.04
	(1.24)	(-0.15)	(5.95)	(4.22)	(4.33)	(2.55)	(0.61)	(1.08)	(1.19)	(4.29)	(-0.08)
Information Shock × SPF Disagreement × STOXXE	2.50*	1.37	0.08	2.42	3.13	3.23	3.44	2.11	2.07	0.37	0.46
	(1.69)	(0.43)	(0.02)	(1.00)	(0.95)	(1.07)	(0.97)	(0.45)	(0.34)	(0.09)	(0.08)
Constant	-7.91	-18.97	7.61	15.21	23.29	19.48	0.56	-14.50	-5.69	-5.41	-12.12
	(-0.98)	(-0.87)	(0.33)	(0.66)	(0.84)	(0.74)	(0.02)	(-0.41)	(-0.16)	(-0.14)	(-0.26)
Observations	75	75	75	75	75	75	75	75	75	75	75
R^2	0.21	0.04	0.32	0.41	0.46	0.43	0.26	0.22	0.26	0.31	0.29
MP Shocks	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

The t-stats (in parentheses) are based on White heteroscedasticity-consistent standard errors.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: *SPF Disagreement* refers to the difference in point forecasts between the 90th percentile and the 10th percentile of forecasters. I subtract the median from this measure to better capture events with high and low disagreement. Surveys are conducted once per quarter so that only those ECB meetings have been matched which are closest to the last survey round. Results beyond $t + 12$ are not displayed for the sake of brevity. The sample period is 01/2002 - 07/2020.

Table 8: Disparity among SPF Member Point Forecasts

4.4 Trading Strategies

To display the economic significance of my previous results I run several trading strategies that exploit the observed drift in equity prices. The most simple strategy would be to observe the intraday change of the equity index and subsequently exit the market if the observed shock is negative. The decision will only be re-evaluated at the next ECB meeting. This simple strategy already leads to an outperformance of the benchmark (the *Euro Stoxx* Index) by more than 145 percentage points.[9] To demonstrate that the intraday changes are more informative than daily changes, I run the same trading strategy with information coming from daily changes in equity prices on the ECB announcement day. This strategy still outperforms the benchmark but at a significantly lower level compared to the strategy that used intraday changes as a signal. A strategy that does not exit the market after a negative shock but shorts the market leads to even higher returns as displayed in Table 9. While strategies that only trade on one type of shock both yield positive returns in their simple version (without shorting), these returns are higher for the strategy that only trades on information shocks. Although there are less information shocks than regular shocks, these shocks seem to carry more information and induce a higher drift leading to higher returns for the trading strategy that only looks at information shocks.

	Cumulative Return (in %)	Annualized Return (in %)	Volatility (in %)
Benchmark	-5.16	-0.28	21.07
Strategy 1	142.22	4.77	10.68
Strategy 1 - Daily Return	79.69	3.13	13.36
Strategy 1 w/ Shorting	166.39	5.29	21.06
Strategy 1 w/ Shorting - Daily Return	68.14	2.77	21.06
Strategy 2 - Only Info Shocks	50.99	2.19	11.37
Strategy 2 - Only Info Shocks w/ Shorting	10.05	0.51	21.06
Strategy 3 - Only Regular Shocks	14.97	0.74	13.25
Strategy 3 - Only Regular Shocks w/ Shorting	-31.43	-1.97	21.07

Note: *Strategy 1* refers to a trading strategy that observes the intraday index change and exits the market after negative intraday changes; otherwise the strategy continues to be invested in the market. *Strategy 1 - Daily Return* uses daily index changes in ECB announcement days instead of intraday changes as a signal. *Strategy 2* only trades on information shocks, while *Strategy 3* only reacts to regular shocks. All returns are excess returns. The sample period is 01/2002 - 07/2020.

Table 9: Summary Statistics Trading Strategy

[9] As the *Euro Stoxx* Index is a price index, the cumulative excess return for the benchmark has been negative for the sample period from 01/2002 - 07/2020. All returns are excess returns with the Euribor 3M rate serving as the risk free rate. Using the *Euro Stoxx* Performance Index the (simple) *Strategy 1* still outperforms the benchmark.

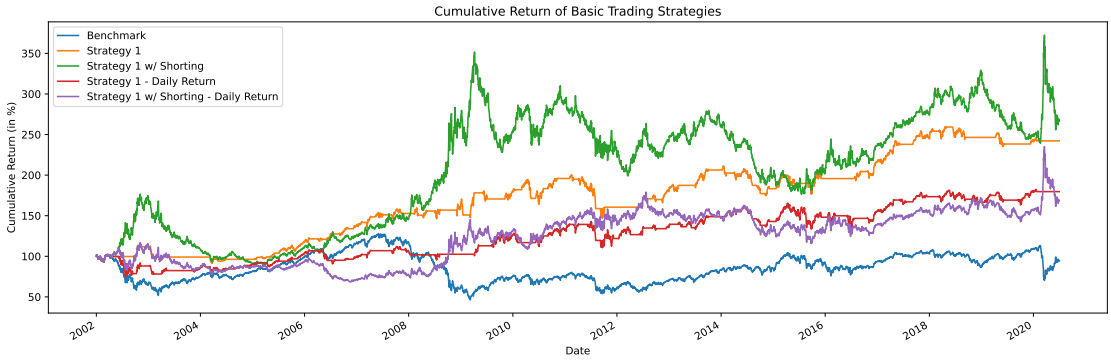
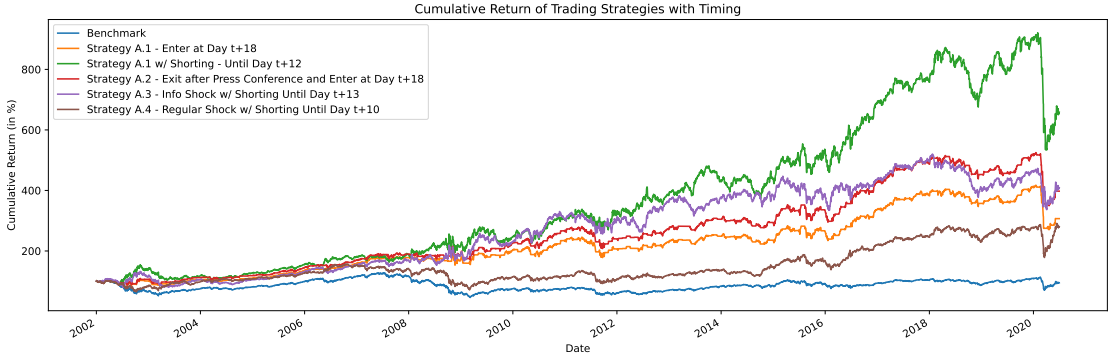


Figure 9: Cumulative Returns for Basic Trading Strategies

In addition to the more "simple" strategies described above, I also run some strategies that try to "time" the market, i.e., exploit the length of the drift. As displayed in Figure 10, there can be a significant outperformance of these strategies. While the simple strategy without shorting as described above yields the best results when it only enters the market again after 18 days, a strategy that short the market has the best performance if it goes long again after 12 days. This can possibly be rationalized by the observation in Figure 1 that negative drifts after negative regular shock events are short lived compared to positive drifts.

A better timing of the market also improves the returns of strategies that only trade on one type of shock. As demonstrated in the empirical analysis, the drift is already present between the end of the press conference and the end of the ECB announcement day. Thus, a strategy that exits (shorts) immediately after ECB Press Conference yields even better returns compared to those that only exit (short) at the end of a given ECB announcment day.



"Timing" Strategies exit (short) the market after a negative shock and only enter (go long) after $x + t$ days. Due to the drift of equity prices, these strategies may yield better returns relative to simple strategies that only change once a new ECB meeting has been held.

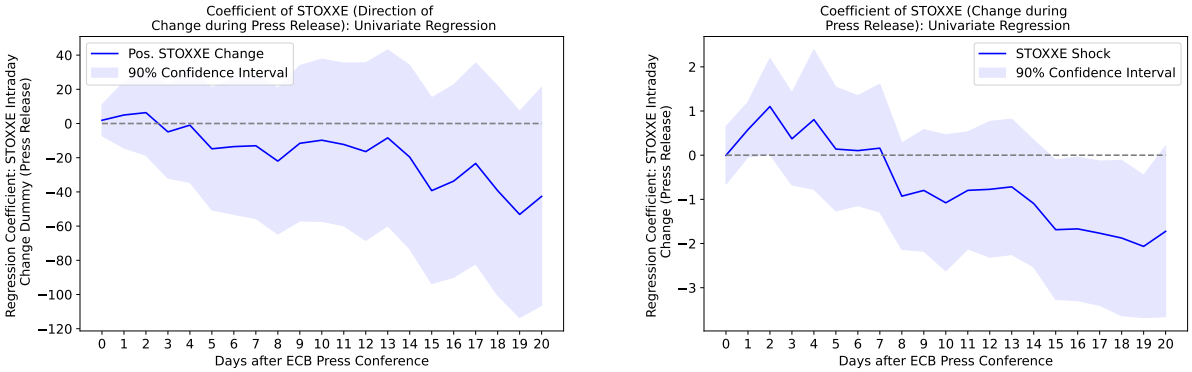
Figure 10: Cumulative Returns for Trading Strategies with Timing

5 Robustness Checks

To demonstrate that the drift in equity prices is indeed related to information conveyed during ECB Press Conferences, I test whether other news available on ECB announcement days can be considered as potential candidates for drivers of the drift. First, I show that in contrast to the press conference window, equity price changes during the press release window are not indicative for future cumulative returns. This applies to both simple univariate regressions of cumulative returns on intraday equity price changes as well as regressions that only regress cumulative returns on a dummies for events with positive (negative) intraday changes. Here, I only display the results of one of the robustness checks. Further results can be found in Section A.9.

5.1 Press Release Shock

One potential concern is that the drift observed after ECB announcements may be not be due to information contained in the press conference but due to, e.g., the press release or even other macro news. As demonstrated earlier in this paper, intraday changes of equities, i.e. the *Euro Stoxx* Index, have superior predictive power with respect to future changes in cumulative returns. Thus, it seems reasonable to investigate whether a similar approach can be taken when analyzing the impact of news during ECB Press Releases.



(a) Coefficient of Dummy for Pos. Intraday Change **(b)** STOXXE (Press Release) Intraday Shock for $t+x$ during Press Release

Figure 11: Press Release Shock

As displayed in Figure 11 neither the directional shock nor the level of the intraday shock during the ECB Press Release have predictive power for subsequent daily cumulative returns. One can conclude that information during the ECB Press Conference are superior for the

prediction of equity prices compared to the monetary policy announcement during the press release. It seems to be indeed the case that information contained during the press conferences are relevant drivers of equity pricers in the weeks following the ECB announcement. Results from the regression analysis are also displayed in Tables 10 and 11.

	(1) t0	(2) tp1	(3) tp2	(4) tp3	(5) tp4	(6) tp5	(7) tp6	(8) tp7	(9) tp8	(10) tp10	(11) tp12	(12) tp14	(13) tp16	(14) tp18	(15) tp20
STOXXE Press Release	-0.00	0.58	1.10*	0.37	0.80	0.14	0.10	0.16	-0.93	-1.08	-0.77	-1.09	-1.67*	-1.88*	-1.72
	(-0.01)	(1.53)	(1.67)	(0.58)	(0.84)	(0.16)	(0.14)	(0.18)	(-1.27)	(-1.15)	(-0.83)	(-1.25)	(-1.69)	(-1.76)	(-1.47)
Constant	-9.64*	2.13	-3.88	-4.59	-16.84	-21.60	-27.60	-36.03	-26.76	-26.92	-35.04	-32.92	-8.88	-11.59	4.88
	(-1.77)	(0.18)	(-0.26)	(-0.29)	(-0.86)	(-1.03)	(-1.18)	(-1.42)	(-1.06)	(-0.96)	(-1.14)	(-1.03)	(-0.27)	(-0.32)	(0.13)
Observations	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190
R^2	0.00	0.01	0.03	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.01	0.01
F	0.00	2.36	2.78	0.34	0.70	0.03	0.02	0.03	1.60	1.33	0.68	1.57	2.85	3.08	2.16

The t-stats (in parentheses) are based on White heteroscedasticity-consistent standard errors.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Press Release STOXXE Shock: 2002-2020

	(1) t0	(2) tp1	(3) tp2	(4) tp3	(5) tp4	(6) tp5	(7) tp6	(8) tp7	(9) tp8	(10) tp10	(11) tp12	(12) tp14	(13) tp16	(14) tp18	(15) tp20
STOXXE (PR) Direction	1.89	4.98	6.36	-4.90	-0.96	-14.80	-13.50	-13.00	-22.01	-9.76	-16.43	-19.65	-33.67	-39.25	-42.62
	(0.34)	(0.42)	(0.42)	(-0.30)	(-0.05)	(-0.68)	(-0.56)	(-0.50)	(-0.85)	(-0.34)	(-0.52)	(-0.60)	(-0.98)	(-1.06)	(-1.10)
Constant	-9.52*	1.17	-5.90	-5.72	-18.67	-22.84	-28.68	-37.20	-26.11	-25.16	-34.38	-31.75	-7.34	-9.93	5.99
	(-1.76)	(0.10)	(-0.39)	(-0.35)	(-0.93)	(-1.07)	(-1.21)	(-1.46)	(-1.03)	(-0.89)	(-1.11)	(-0.99)	(-0.22)	(-0.27)	(0.16)
Observations	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190
R^2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
F	0.12	0.18	0.18	0.09	0.00	0.46	0.31	0.25	0.72	0.11	0.27	0.36	0.97	1.11	1.21

The t-stats (in parentheses) are based on White heteroscedasticity-consistent standard errors.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 11: Press Release STOXXE Directional Shock: 2002-2020

6 Conclusion

As demonstrated in this paper there exists a substantial drift in equity prices after monetary policy decisions by the ECB. In my empirical analysis I find strong evidence for this drift in the wake of monetary policy decisions that are accompanied by an information shock. While empirical evidence in the context of regular shocks is less pronounced, this may well stem from different reactions to positive and negative intraday shocks. As displayed in Panel (a) of Figure 1, there appears to be a strong positive drift after positive "regular" shocks in European equities but not a prolonged negative drift to negative "regular" shocks. This stands in contrast to the reaction after information shocks which exhibits a clear drift in the direction of the intraday shock both positive and negative.

To rationalize my findings I turn to measures of disagreement as higher levels of disagreement have been identified as drivers of price drifts in the literature. Using trading volume, forecast dispersion, and disparity in sentiment, I show that each of these proxies can positively influence the drift of equity prices.

Future work should further elaborate on other measures of disagreement, e.g., by using more high-frequency data on investor expectations around monetary policy announcements. In addition to monetary policy announcements, speeches by members of the ECB governing council may also influence financial markets, particularly in times of high disagreement. Thus, future research may also use the approach of this study and evaluate how governing council members may have influenced financial markets through the information conveyed in their speeches.

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A Appendix

A.1 Institutional Framework

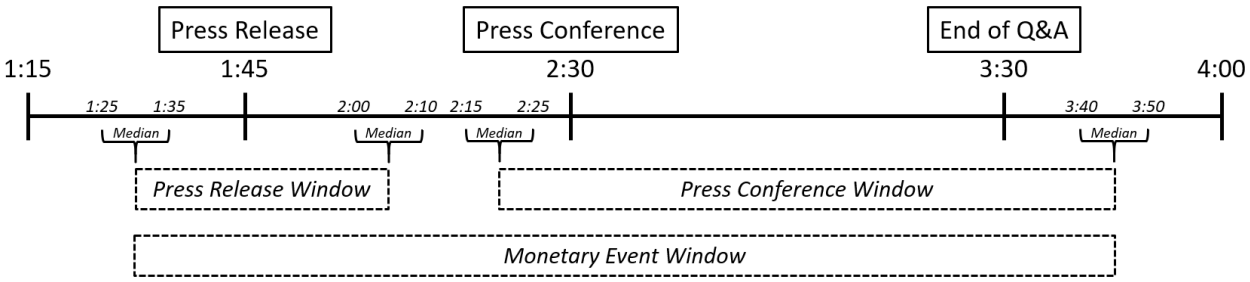
A.1.1 ECB Press Conferences

On the day of ECB press conferences, there is a formal structure which has remained largely unchanged over time. Until the end of 2014 the last day of the ECB Governing Council meeting and hence the ECB press conference has always been on the first Thursday of each month. Starting in 2015 this schedule slightly changed to only eight meetings per year.

As shown in Figure A.1 the monetary policy decision is published as a press release online at 1:45 pm CET on the day of the press conference. This is followed by the ECB press conference at 2:30 pm CET. The press conference is held by the ECB President as well as the Vice-President. In the beginning of the conference the ECB President reads out a prepared statement which again contains the monetary policy decision as well as further information about the Governing Council's view on the economy. After the statement, the ECB President invites journalists to a Question & Answer (Q&A) session during which the media can ask clarifying questions.

Returns in the analysis of this paper have been calculated as in Altavilla et al. (2019), i.e., by calculating changes in asset prices taking the median value of these asset prices in the windows displayed in Figure A.1.

Figure A.1: Structure of ECB Announcement Day Analysis



A.2 Calculation of Intraday Changes

Altavilla et al. (2019) calculate intraday yield and asset price changes by taking the median between certain time intervals before and after the ECB announcement of interest. The exact times are displayed in Table A.1.

Event	Return based on median value in time intervals
Press Release Window	1:25 pm - 1:35 pm and 2:00 pm - 2:10 pm
Press Conference Window	2:15 pm - 2:25 pm and 3:40 pm - 3:50 pm
Monetary Event Window	1:25 pm - 1:35 pm and 3:40 pm - 3:50 pm

Table A.1: Calculation of Intraday Returns

	Duisenberg	Trichet	Draghi	Lagarde
Regular Shock	9	50	46	2
Information Shock	11	40	29	3

Table A.2: Meetings by ECB President and Shock Type

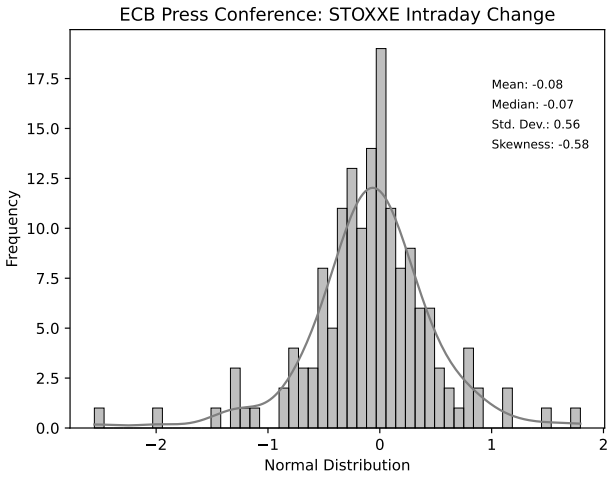


Figure A.2: Press Conference Window: Histogramm of STOXXE Changes (in %)

Day after Announcement	Regular Shock (+)	Information Shock (+)	Regular Shock (-)	Information Shock (-)
1	52.1	67.7	47.5	53.8
2	54.2	77.4	47.5	50.0
3	60.4	67.7	59.3	55.8
4	62.5	67.7	54.2	51.9
5	56.2	74.2	57.6	53.8
6	58.3	67.7	55.9	57.7
7	54.2	58.1	59.3	55.8
8	62.5	54.8	57.6	50.0
9	62.5	67.7	59.3	44.2
10	60.4	67.7	59.3	44.2
11	64.6	67.7	57.6	48.1
12	64.6	71.0	59.3	55.8
13	60.4	67.7	59.3	53.8
14	62.5	67.7	55.9	53.8
15	66.7	64.5	52.5	53.8
16	62.5	71.0	49.2	50.0
17	62.5	67.7	49.2	50.0
18	62.5	67.7	52.5	46.2
19	62.5	71.0	52.5	46.2
20	60.4	71.0	52.5	48.1

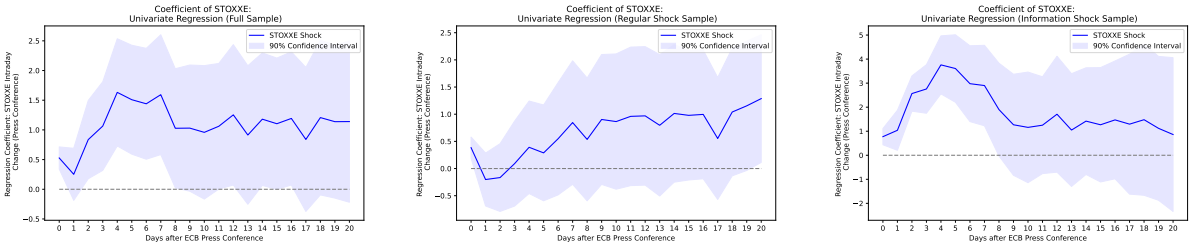
Table A.3: True Positive Rate by Shock Type

Note: On average, the predictive power of intraday STOXXE changes for the direction of future cumulative returns is higher on information shock events compared to regular shocks. However, at closer inspection one can see that this superior predictive power is to a large extent driven by those events that are associated with positive information shocks. Sample period is January 2002 to June 2020.

	Regular Shock (+)	Information Shock (+)	Regular Shock (-)	Information Shock (-)
1	79.8	123.5	-114.2	-152.9
2	91.5	155.2	-153.2	-244.7
3	107.9	220.6	-144.9	-224.0
4	126.2	225.0	-192.0	-355.5
5	146.3	240.1	-206.1	-361.0
6	154.9	257.8	-268.2	-344.0
7	178.2	313.0	-302.0	-385.8
8	161.7	323.0	-306.7	-394.3
9	185.8	254.7	-322.8	-494.4
10	192.7	276.6	-334.8	-505.2
11	207.9	275.2	-337.1	-478.0
12	224.7	284.3	-334.2	-489.5
13	239.8	268.4	-313.9	-529.3
14	234.6	301.5	-351.8	-520.7
15	245.0	363.4	-350.1	-508.8
16	270.2	356.2	-381.9	-573.6
17	261.1	430.6	-367.6	-580.6
18	286.3	457.7	-398.9	-659.3
19	288.1	430.6	-416.5	-579.8
20	330.8	448.5	-399.8	-601.5

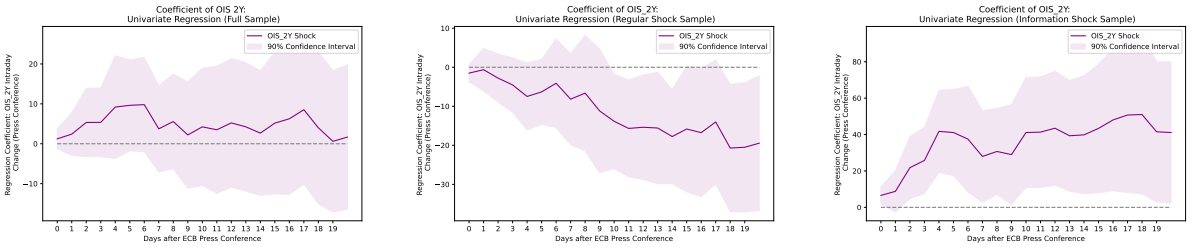
Table A.4: Average Cumulative Return for Correct Signals

Note: This table displays the average cumulative return after an ECB announcement day where the intraday STOXXE change correctly predicted the direction of future cumulative returns.



(a) Entire Sample **(b)** Regular Shock Sample **(c)** Information Shock Sample

Figure A.3: Coefficient of STOXXE Intraday Shock for $t + x$

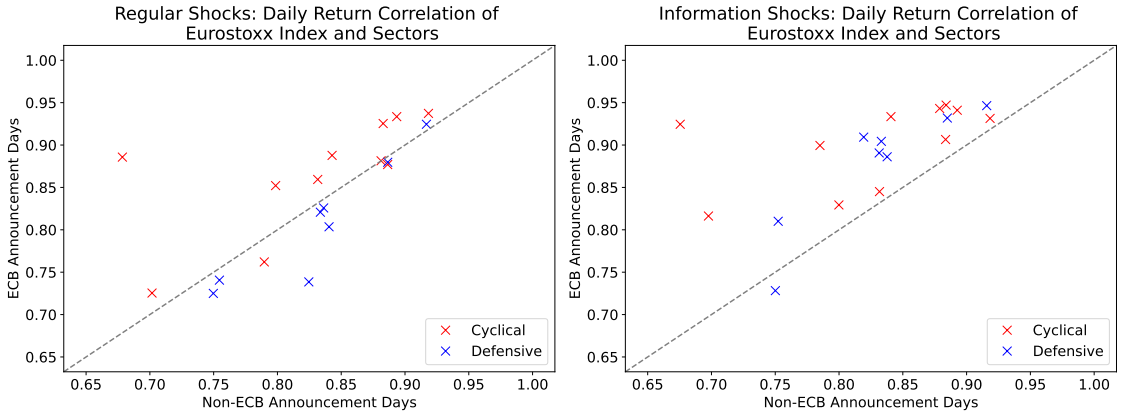


(a) Entire Sample **(b)** Regular Shock Sample **(c)** Information Shock Sample

Figure A.4: Coefficient of OIS 2Y Intraday Shock for $t + x$

A.3 Eurostoxx Sectors

A.3.1 Return Correlation



(a) Regular Shocks **(b)** Information Shocks

Figure A.5: Correlation of Sector Returns and Eurostoxx Index

A.3.2 Average Returns

Sector	Positive	Negative
STOXXE	98.8	-90.8

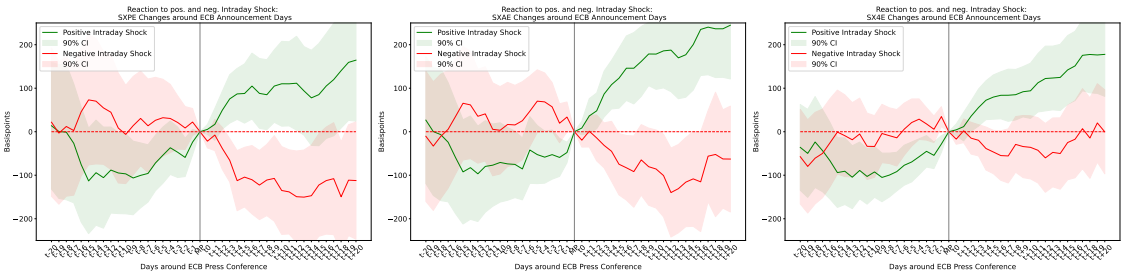
Cyclical Sector	Positive	Negative
SX4E	148.4	-23.0
SX7E	95.0	-178.6
SX86E	79.8	-44.1
SXAE	211.4	-94.5
SXEE	68.0	-87.8
SXFE	139.4	-76.1
SXNE	150.3	-98.6
SXOE	108.4	-68.8
SXPE	116.8	-130.1
SXTE	92.6	-102.8
Mean	**121.0**	**-90.4**

Defensive Sector	Positive	Negative
SX3E	106.2	-43.9
SX6E	108.7	-93.0
SX8E	94.3	-83.4
SXDE	61.4	-22.8
SXIE	123.4	-126.7
SXKE	35.7	-81.5
SXME	59.5	-76.2
SXQE	141.7	1.0
SXRE	95.2	-13.7
Mean	**91.8**	**-60.0**

Table A.5: Drift by Sector[10]: 2002-2020

[10] Average Cumulative Return between Day $t+11$ and $t+20$. *Positive* (*Negative*) refers to a positive (negative) intraday shock of the *Eurostoxx (STOXXE)* Index.

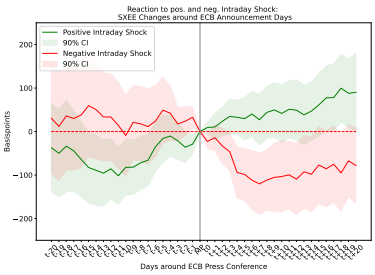
A.3.3 Average Returns: Cyclical Stocks



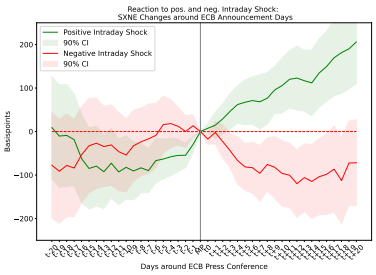
(a) Basic Resources

(b) Automobiles & Parts

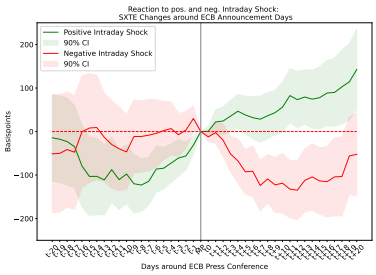
(c) Chemicals



(d) Oil & Gas



(e) Industrial Goods & Services



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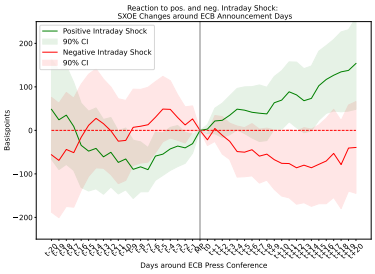
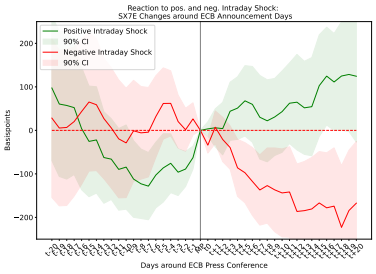
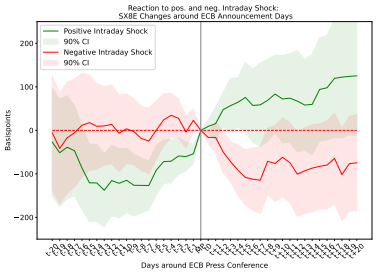


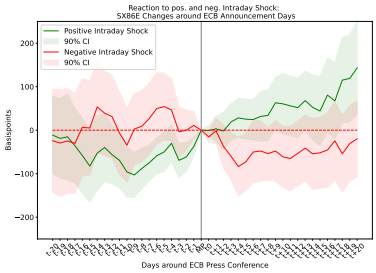
(g) Construction & Materials



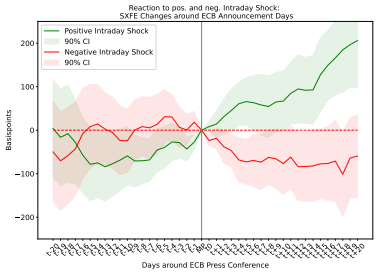
(h) Banks



(i) Technology



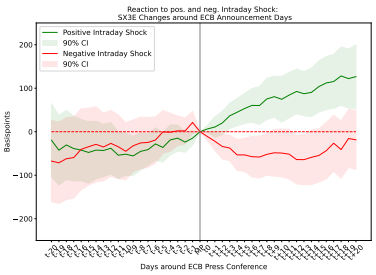
(j) Real Estate



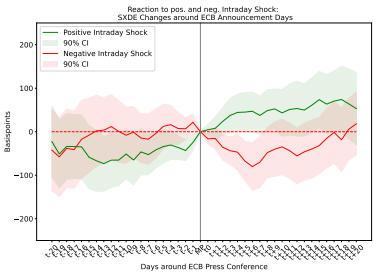
(k) Financial Services

Figure A.6: Response of Cyclical Stocks to STOXXE Intraday Shock

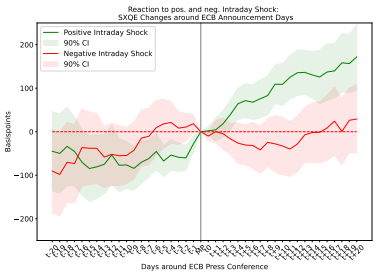
A.3.4 Average Returns: Defensive Stocks



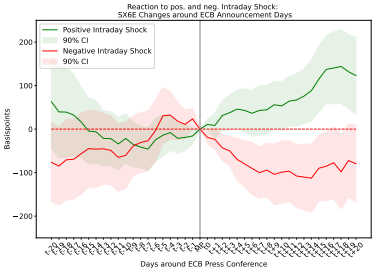
(a) Food & Beverages



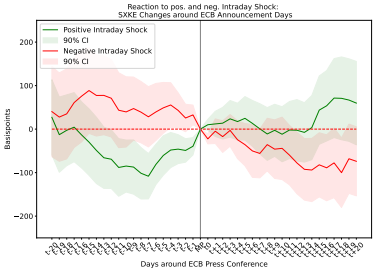
(b) Health Care



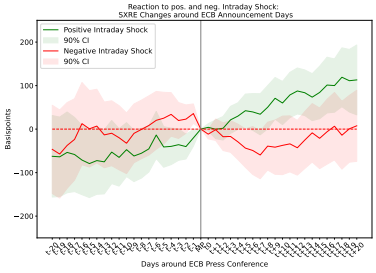
(c) Personal & Household Goods



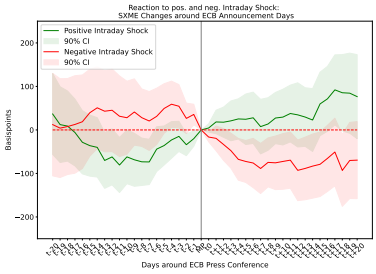
(d) Utilities



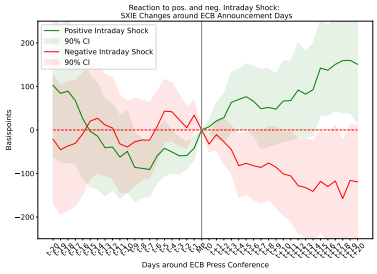
(e) Telecommunication



(f) Retail



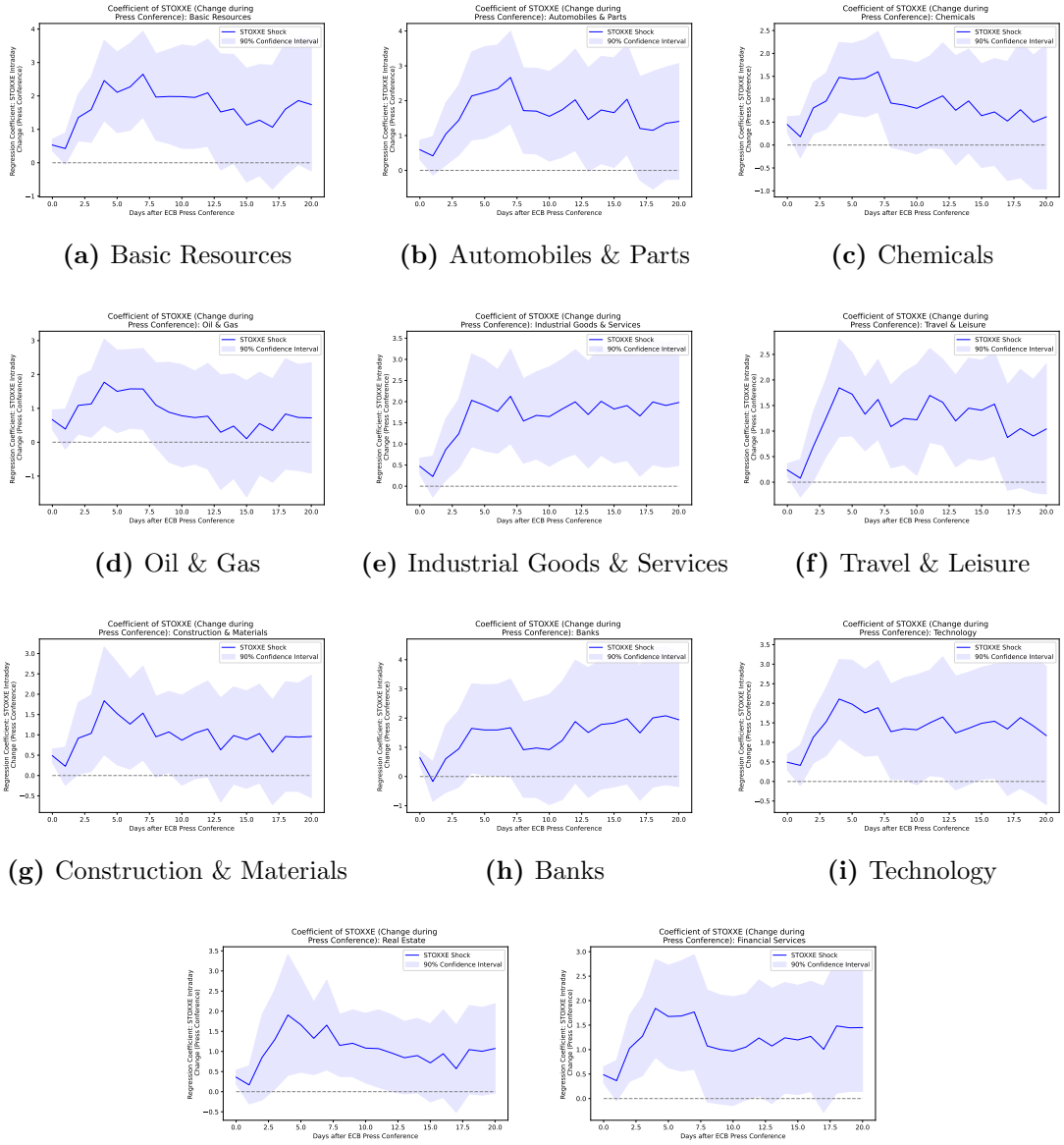
(g) Media



(h) Insurance

Figure A.7: Response of Defensive Stocks to STOXXE Intraday Shock

A.3.5 Univariate Regression: Cyclical Stocks



(a) Basic Resources **(b)** Automobiles & Parts **(c)** Chemicals

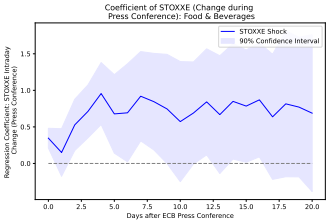
(d) Oil & Gas **(e)** Industrial Goods & Services **(f)** Travel & Leisure

(g) Construction & Materials **(h)** Banks **(i)** Technology

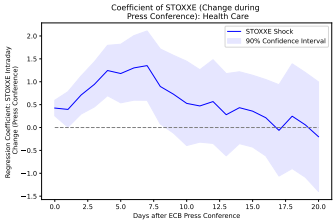
(j) Real Estate **(k)** Financial Services

Figure A.8: Univariate Regression: Effect of STOXXE Intraday Shock on Cyclical Stocks

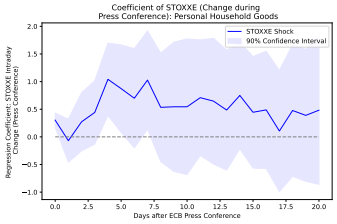
A.3.6 Univariate Regression: Defensive Stocks



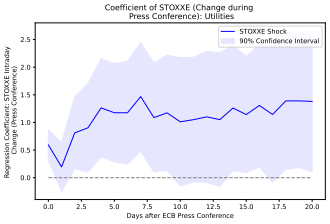
(a) Food & Beverages



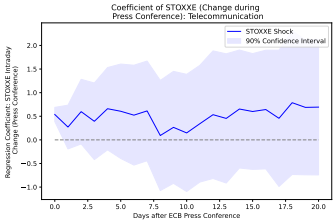
(b) Health Care



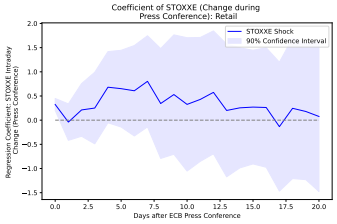
(c) Personal & Household Goods



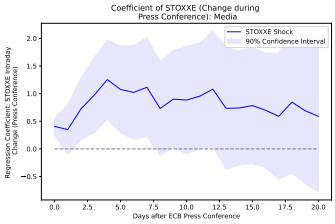
(d) Utilities



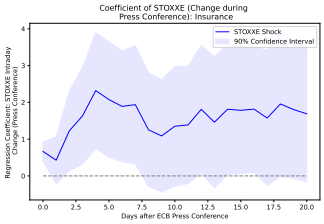
(e) Telecommunication



(f) Retail



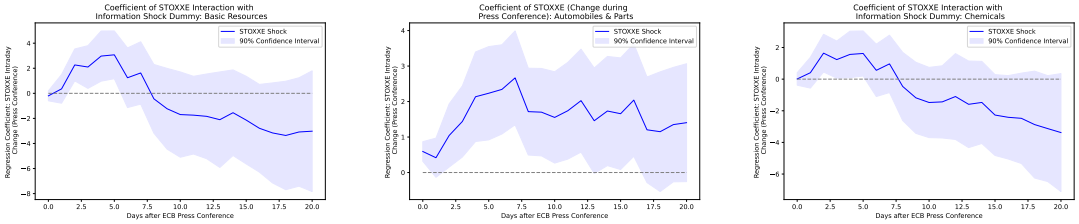
(g) Media



(h) Insurance

Figure A.9: Univariate Regression: Effect of STOXXE Intraday Shock on Defensive Stocks

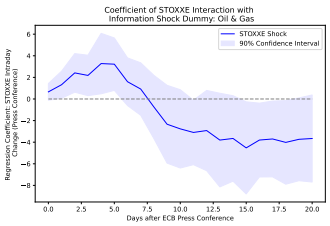
A.3.7 Information Shock Interaction Effect: Cyclical Stocks



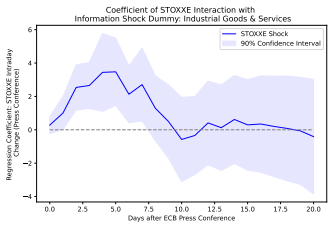
(a) Basic Resources

(b) Automobiles & Parts

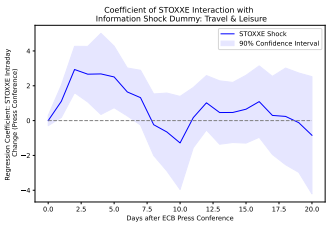
(c) Chemicals



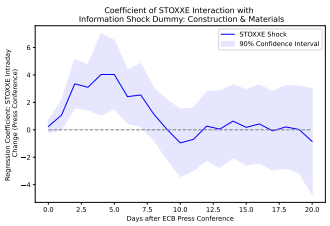
(d) Oil & Gas



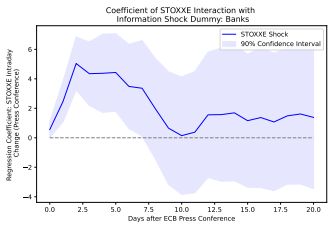
(e) Industrial Goods & Services



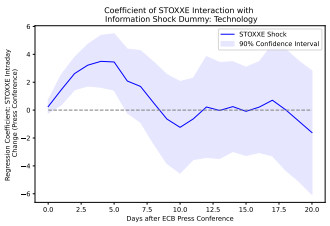
(f) Travel & Leisure



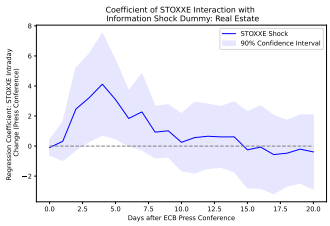
(g) Construction & Materials



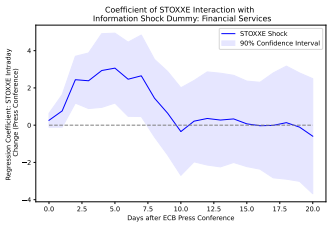
(h) Banks



(i) Technology



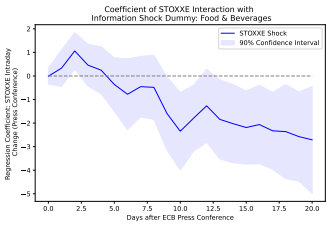
(j) Real Estate



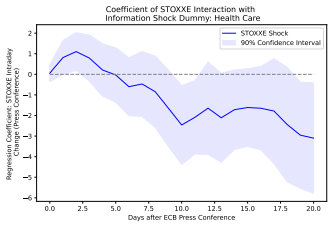
(k) Financial Services

Figure A.10: Information Shock Interaction Effect: Cyclical Stocks

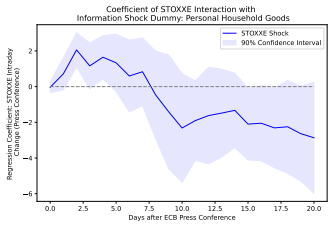
A.3.8 Information Shock Interaction Effect: Defensive Stocks



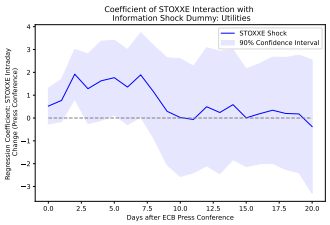
(a) Food & Beverages



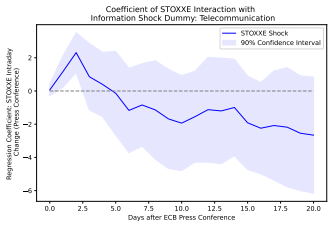
(b) Health Care



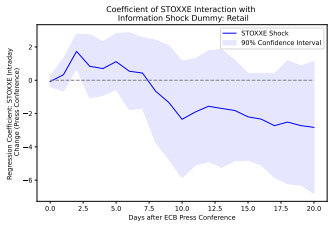
(c) Personal & Household Goods



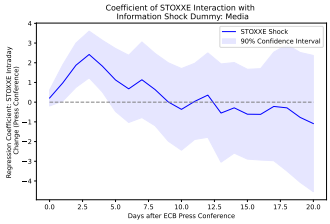
(d) Utilities



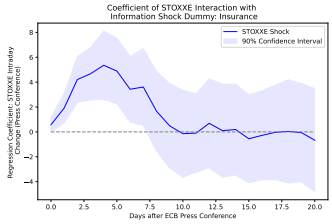
(e) Telecommunication



(f) Retail



(g) Media



(h) Insurance

Figure A.11: Information Shock Interaction Effect: Defensive Stocks

A.4 Summary Statistics of Trading Volume

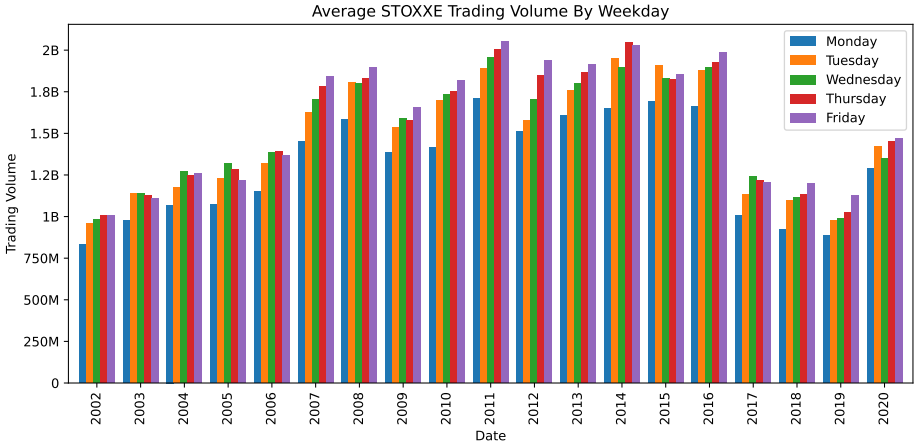


Figure A.12: Trading Volume of STOXXE by Weekday

	Volume (in EUR Mio.)							
	Count	Mean	Std.	Min.	25%	50%	75%	Max.
Date								
2002	260.0	958.61	280.54	4.7	805.74	938.22	1,112.41	1,920.92
2003	261.0	1,096.16	289.45	3.49	937.08	1,115.07	1,249.53	2,035.85
2004	262.0	1,203.68	325.67	34.78	1,039.16	1,189.52	1,375.74	2,315.45
2005	260.0	1,224.77	296.67	219.26	1,032.24	1,238.05	1,404.67	2,742.93
2006	260.0	1,323.49	316.79	366.7	1,160.35	1,299.33	1,476.16	2,434.32
2007	261.0	1,680.09	456.4	1.04	1,442.29	1,640.18	1,932.06	3,235.2
2008	262.0	1,782.49	594.36	72.36	1,476.7	1,736.25	1,996.3	4,500.58
2009	261.0	1,549.03	403.49	41.4	1,332.7	1,522.45	1,785.42	2,819.25
2010	261.0	1,683.01	642.16	25.32	1,323.14	1,535.5	1,943.29	4,616.69
2011	260.0	1,922.99	555.71	554.08	1,598.24	1,809.7	2,157.39	4,029.07
2012	261.0	1,715.46	499.58	9.72	1,433.55	1,696.75	1,980.83	3,799.4
2013	261.0	1,787.64	529.83	25.56	1,483.68	1,735.54	2,047.53	3,979.86
2014	261.0	1,913.88	622.05	18.13	1,492.61	1,846.31	2,278.49	4,374.24
2015	261.0	1,820.24	555.17	0.08	1,531.94	1,815.91	2,105.74	3,757.13
2016	261.0	1,870.28	699.63	218.34	1,428.13	1,765.96	2,194.59	6,982.98
2017	260.0	1,160.03	353.72	313.27	923.41	1,139.26	1,377.8	2,870.83
2018	261.0	1,090.72	326.16	2.9	908.47	1,070.52	1,246.36	2,355.51
2019	261.0	1,000.07	279.52	66.15	852.09	947.7	1,149.85	2,204.79
2020	130.0	1,412.87	602.98	118.52	978.63	1,275.42	1,697.76	3,742.82

Table A.6: Summary Statistics of STOXXE Trading Volume

Note: Sample ends in July 2020 together with the intraday data provided by Altavilla et al., 2019.

A.5 Key Metrics of Trading Strategies

In section 4.4 I describe how the momentum induced by intraday shocks can lead to significant excess returns, particularly in the wake of information shocks. However, these strategies can be significantly improved by better market timing. As the impact of positive and negative shocks both decrease over time, *Strategy A.1* that exits (or shorts) the market for $t + x$ days after a negative shock can avoid (profit from) negative returns following events with negative shocks. All strategies except for *Strategy A.2* assume that one exits the market at the end of the trading day on ECB announcement days.

Cumulative returns relative to the benchmark can be increased by more than 200 percentage points for a strategy that exits the market for 12 days after a negative shock. A strategy that shorts the market reaches its maximum cumulative return when it shorts the market for 13 days after a negative shock. For a simple strategy that exits the market after a negative intraday shock, the maximum drawdown can be reduced by more than 25 percentage points compared to the benchmark.

Strategy A.2 improves market timing by exiting the market immediately after the press conference. Similar to Figure 9, observing the intraday shock has superior information power relative to the simple daily return on ECB announcement days. Thus, performance of *Strategy A.2* with exact market timing is slightly better compared to strategies that exit only at the end of the day.

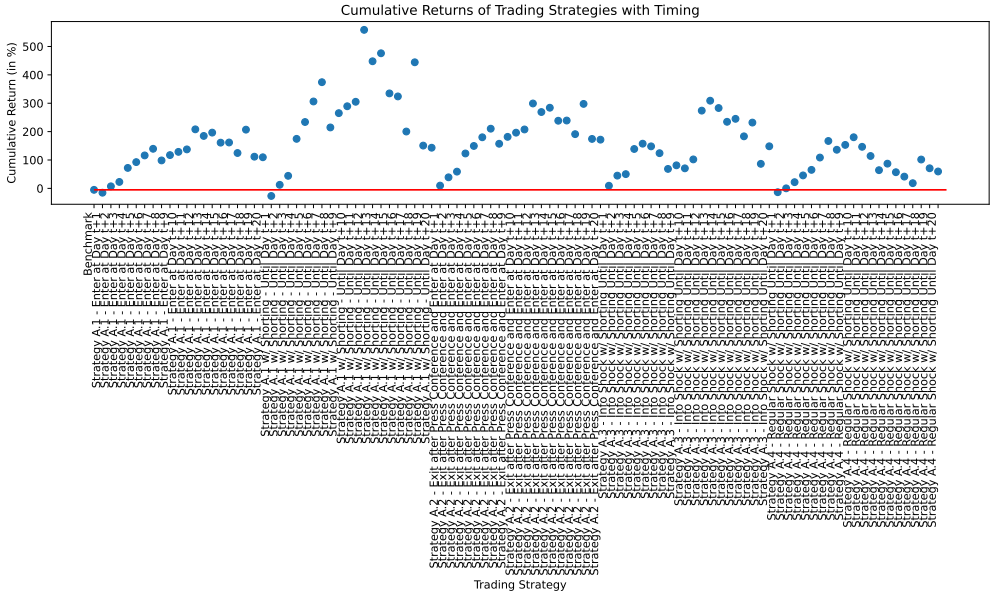


Figure A.13: Cumulative Returns of "Timing" Strategies

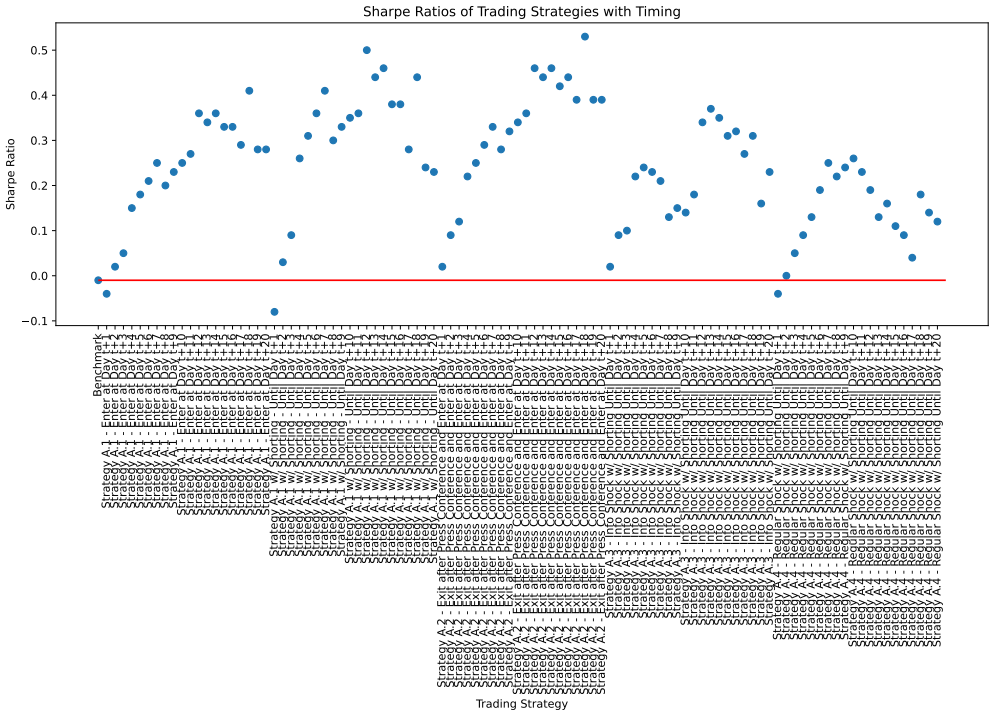


Figure A.14: Sharpe Ratios of "Timing" Strategies

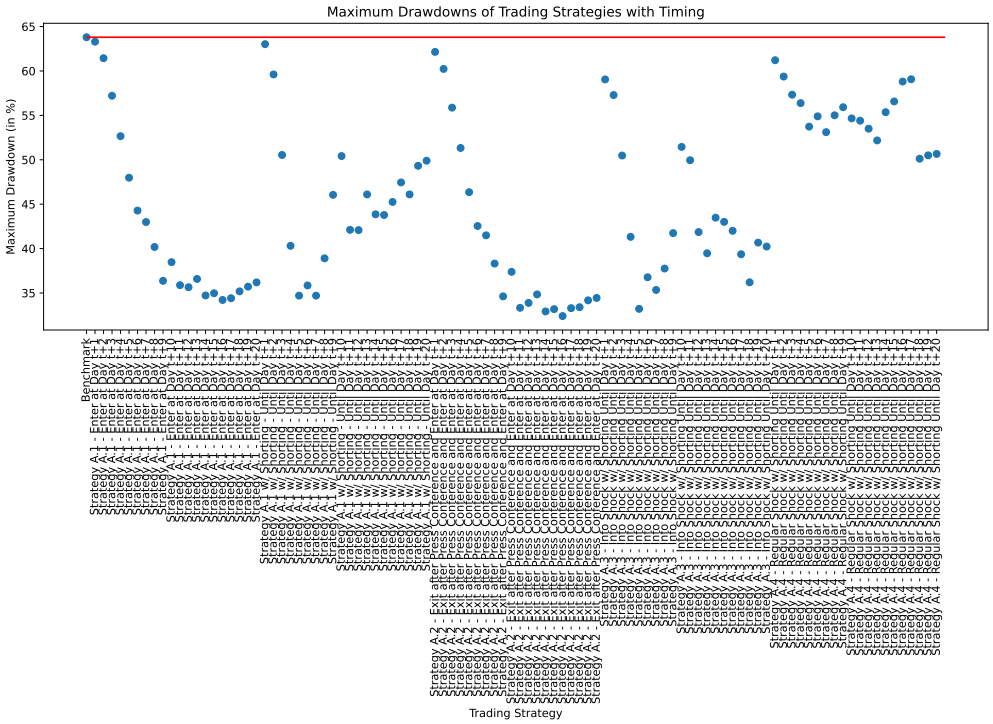


Figure A.15: Maximum Drawdowns of "Timing" Strategies

A.6 Monetary Policy Shocks from Factor Rotation

Monetary policy shocks are obtained from factor analysis following Altavilla et al. (2019). I estimate shocks by extracting latent factors from changes in the yield curve followed by a factor rotation to give these shocks an economic interpretation.

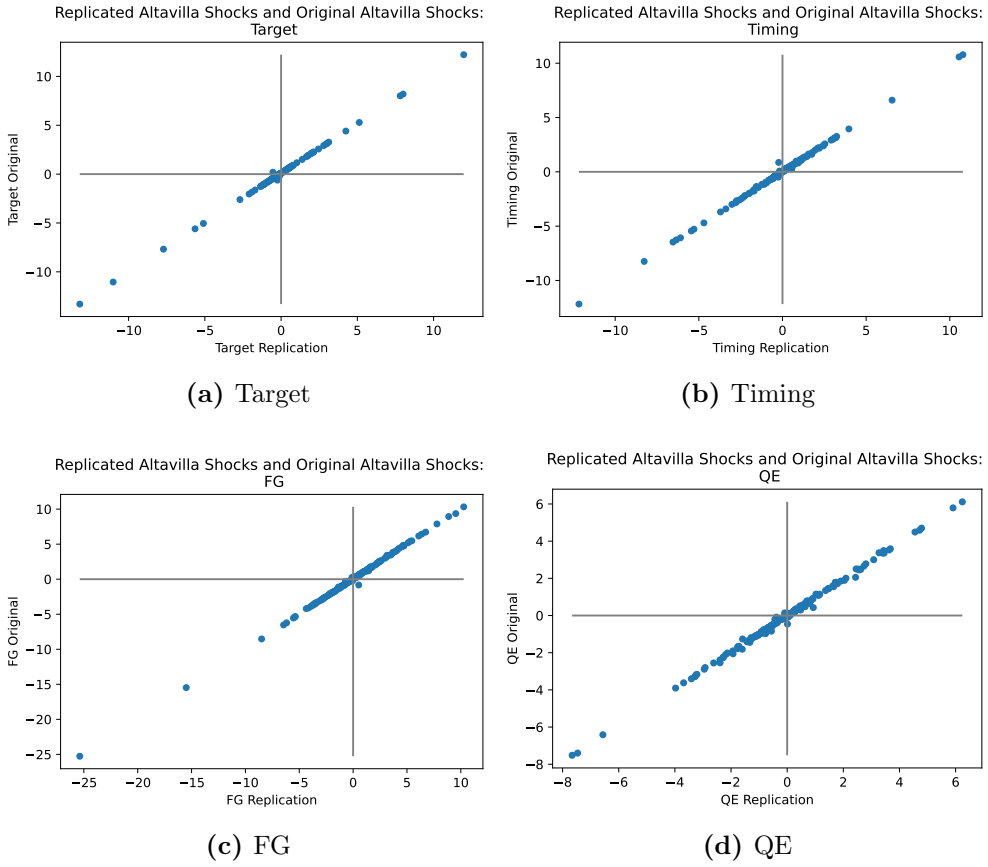
$$X^j = F^j \Lambda^j + \epsilon^j \tag{4}$$

In this setup, the yield changes are contained in X^j where j represents either the press release or the press conference. Rows correspond to policy events while each column contains the yield changes of different OIS rates. These yield changes are then to be explained by latent factors F and their factor loadings Λ. Consequently, fours factors are extracted.

These monetary policy factors are constructed in such a way that the first factor, the *Target Factor*, loads on the interest rate change in the press release window while the latter three shocks are extracted from yield changes during the press conference window. The *Timing Factor* captures short term yield changes during the press conferene, while the *FG Factor* loads on medium term yields. Finally, the *QE Factor* is constructed in such a way that it loads on long term yield changes while minimizing its variance prior to the quantitative easing period starting in 2014 as defined by the authors.

A.7 Replication of Altavilla et al. (2019)

The authors provide and update an Excel File that contains all relevant intraday changes for the time series used in their paper. This file is updated regularly and is called the "Euro Area Monetary Policy Event-Study Database" (EA-MPD). Additionally, the authors provide all code necessary to replicate their results. Using the provided Julia code I updated the monetary policy shocks and applied them to my analysis.



(a) Target **(b)** Timing

(c) FG **(d)** QE

Figure A.16: Replication of Altavilla et al. (2019) Shocks (2002-2018)

A.8 Textual Analysis

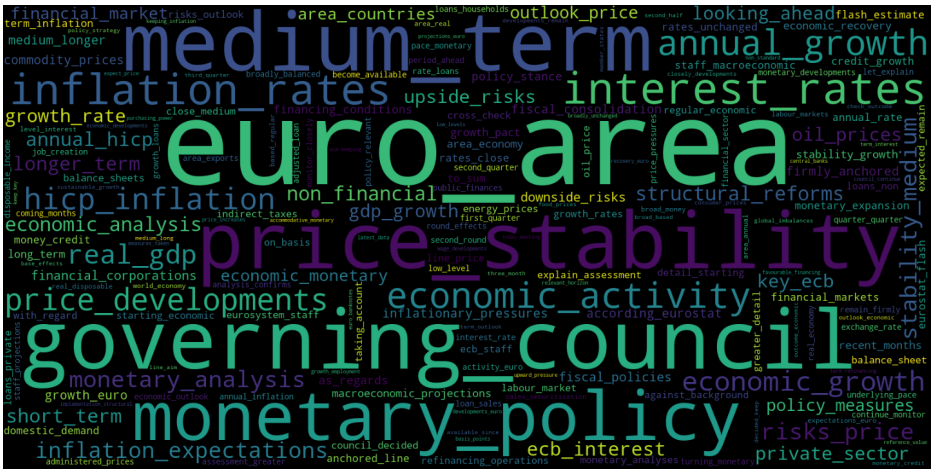


Figure A.17: Wordcloud of Bigrams from ECB Statements

A.8.1 Preparation of ECB Press Conference Statements

For the textual analysis of ECB Press Conference Statements the following steps have been performed:

1. Download all press conference transcripts from ECB website
2. Extract only the statements and exclude Q&A session
3. Tokenize the text, i.e. isolate individual words
4. Convert all words to lower case
5. Remove numbers and punctuation
6. Remove English stopwords (using the NLTK[11] stopwords package)
7. Remove all tokens that consist of only one letter

For my analysis in Section 4.3.2 I extract the most popular bigrams from all ECB statements. Before passing these bigrams to the next stage of my analysis, I remove all bigrams that do not contain a relevant meaning with respect to monetary policy or economic analysis. Among the bigrams that I remove are words such as "euro area", "governing council", "press conference", "end year", "first half", etc.

[11] http://www.nltk.org/

A.8.2 Preparation of ECB Press Conference Q&A

For the textual analysis of ECB Q&As the following steps have been performed:

1. Download all press conference transcripts from ECB website in HTML
2. Extract only the Q&A session
3. Use HTML Tags to seprate Questions and Answers
4. Tokenize the text, i.e. isolate individual words
5. Convert all words to lower case
6. Remove numbers and punctuation
7. Remove English stopwords (using the NLTK[12] stopwords package)
8. Remove all tokens that consist of only one letter

My analysis of the ECB Press Conference's Q&A session is twofold: I analyze popular bigrams used during the Q&A session as well as the negativity of answers by the ECB President.

Popular Bigrams

For each meeting I analyze which bigrams identified in Section A.8.1 appear in questions by journalists and subsequent answers by the ECB President. If a bigram appears at least once per meeting, I set the dummy for the appearing bigram and that meeting to one. This is done for questions and answers separately. Finally, I divide the count of appearances by the total number of meetings and keep only those bigrams that appear in at least 10% of all meetings. Then I compare the share of appearance for each bigram for regular and information shock meetings. The ratio obtained from comparing regular and information shock meetings is then displayed in Figures 8 for questions and answers separately.

Answer Negativity

To calculate the sentiment in each response, i.e., the answer of the ECB President, I take each answer and count the number of negative words as collected in the Loughran and McDonald (2011) Dictionary. I account for negations that may appear prior to a negative word which may lead to that word having the opposite meaning. For each answer I then calculate the share of negative words relative to the total number of words. Finally, I calculate the standard deviation of negativity for each meeting.

[12] http://www.nltk.org/

A.9 Further Empirical Results

The regression results on the following pages contain additional robustness checks of the main specification. Tables A.7 and A.8 show that using a univariate regression with a dummy for positive intraday shocks, only intraday equity shocks seem to carry informational content for future cumulative returns. The same notion is supported by Tables A.7 and A.11 where the univariate regression is conducted using the actual intraday shocks of STOXXE and OIS2Y rates. Finally, Table A.11 shows the regression results for the entire time series of cumulative returns for up to 20 days. Table A.12 serves as a robustness check which demonstrates that the results are not changed when additional monetary policy shocks such as those by Altavilla et al. (2019) are included in the analysis.

	(1) t0	(2) tp1	(3) tp2	(4) tp3	(5) tp4	(6) tp5	(7) tp6	(8) tp7	(9) tp8	(10) tp10	(11) tp12	(12) tp14	(13) tp16	(14) tp18	(15) tp20
STOXXE Direction	14.70***	12.55	27.50*	41.93**	59.08***	66.87***	69.49***	68.63***	61.97**	71.44***	89.67***	86.31***	99.66***	116.30***	100.59***
	(2.82)	(1.05)	(1.83)	(2.52)	(3.07)	(3.20)	(3.03)	(2.75)	(2.51)	(2.64)	(3.03)	(2.83)	(3.14)	(3.31)	(2.71)
Constant	-7.16	2.97	-1.67	1.65	-8.66	-10.64	-16.12	-24.82	-14.28	-12.51	-18.23	-15.97	11.58	12.13	25.62
	(-1.37)	(0.25)	(-0.11)	(0.10)	(-0.45)	(-0.51)	(-0.70)	(-0.99)	(-0.58)	(-0.46)	(-0.62)	(-0.52)	(0.36)	(0.35)	(0.69)
Observations	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190
R^2	0.04	0.01	0.02	0.03	0.04	0.05	0.04	0.04	0.03	0.03	0.04	0.04	0.04	0.05	0.04
F	7.97	1.11	3.37	6.35	9.42	10.23	9.18	7.57	6.30	6.96	9.21	8.02	9.83	10.97	7.35

The t-stats (in parentheses) are based on White heteroscedasticity-consistent standard errors.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.7: STOXXE Directional Shock (2002-2020)

	(1) t0	(2) tp1	(3) tp2	(4) tp3	(5) tp4	(6) tp5	(7) tp6	(8) tp7	(9) tp8	(10) tp10	(11) tp12	(12) tp14	(13) tp16	(14) tp18	(15) tp20
OIS 2Y Direction	2.70	16.66	26.64*	23.48	26.72	27.86	15.68	6.24	0.33	-5.83	14.24	15.78	25.20	21.21	18.96
	(0.50)	(1.41)	(1.76)	(1.42)	(1.33)	(1.29)	(0.65)	(0.24)	(0.01)	(-0.20)	(0.46)	(0.49)	(0.75)	(0.58)	(0.50)
Constant	-9.49*	1.73	-4.90	-4.17	-17.21	-20.44	-27.00	-36.06	-24.70	-24.85	-32.59	-29.68	-3.88	-6.34	9.68
	(-1.75)	(0.15)	(-0.32)	(-0.25)	(-0.86)	(-0.95)	(-1.12)	(-1.40)	(-0.96)	(-0.87)	(-1.05)	(-0.92)	(-0.12)	(-0.17)	(0.25)
Observations	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190
R^2	0.00	0.01	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.25	1.99	3.10	2.01	1.76	1.67	0.43	0.06	0.00	0.04	0.21	0.24	0.56	0.33	0.25

The t-stats (in parentheses) are based on White heteroscedasticity-consistent standard errors.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.8: OIS 2Y Directional Shock (2002-2020)

	(1) t0	(2) tp1	(3) tp2	(4) tp3	(5) tp4	(6) tp5	(7) tp6	(8) tp7	(9) tp8	(10) tp10	(11) tp12	(12) tp14	(13) tp16	(14) tp18	(15) tp20
STOXXE	0.53***	0.25	0.83**	1.06**	1.62***	1.50***	1.43**	1.58**	1.02	0.95	1.26*	1.18*	1.19*	1.25	1.11
	(4.83)	(0.90)	(2.07)	(2.29)	(2.93)	(2.68)	(2.49)	(2.58)	(1.64)	(1.37)	(1.75)	(1.75)	(1.76)	(1.53)	(1.35)
Constant	-4.13	3.47	2.40	5.67	-1.64	-6.21	-12.86	-19.81	-14.06	-14.55	-20.18	-18.16	7.26	5.62	20.30
	(-0.83)	(0.28)	(0.17)	(0.35)	(-0.09)	(-0.30)	(-0.56)	(-0.80)	(-0.56)	(-0.54)	(-0.67)	(-0.58)	(0.22)	(0.16)	(0.55)
Observations	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190
R^2	0.15	0.01	0.05	0.07	0.10	0.08	0.06	0.06	0.03	0.02	0.03	0.02	0.02	0.02	0.01
F	23.32	0.81	4.28	5.22	8.60	7.17	6.18	6.67	2.69	1.89	3.05	3.05	3.10	2.34	1.82

The t-stats (in parentheses) are based on White heteroscedasticity-consistent standard errors.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.9: STOXXE Shock (2002-2020)

	(1) t0	(2) tp1	(3) tp2	(4) tp3	(5) tp4	(6) tp5	(7) tp6	(8) tp7	(9) tp8	(10) tp10	(11) tp12	(12) tp14	(13) tp16	(14) tp18	(15) tp20
OIS 2Y	1.29	2.55	5.67	5.70	9.67	9.98	10.20	4.02	5.99	4.70	5.77	3.29	7.66	4.97	2.31
	(0.86)	(0.79)	(1.07)	(1.08)	(1.21)	(1.41)	(1.41)	(0.60)	(0.81)	(0.52)	(0.58)	(0.35)	(0.66)	(0.42)	(0.21)
Constant	-9.34*	1.45	-4.99	-4.09	-16.38	-19.60	-25.47	-35.46	-23.34	-23.46	-32.01	-29.75	-3.44	-6.31	9.21
	(-1.73)	(0.12)	(-0.33)	(-0.25)	(-0.82)	(-0.92)	(-1.07)	(-1.38)	(-0.91)	(-0.82)	(-1.03)	(-0.93)	(-0.10)	(-0.17)	(0.24)
Observations	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190
R^2	0.01	0.00	0.01	0.01	0.02	0.02	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
F	0.75	0.62	1.15	1.16	1.47	2.00	1.98	0.36	0.65	0.27	0.34	0.12	0.44	0.18	0.04

The t-stats (in parentheses) are based on White heteroscedasticity-consistent standard errors.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.10: OIS 2Y Shock (2002-2020)

	(1) t0	(2) tp1	(3) tp2	(4) tp3	(5) tp4	(6) tp5	(7) tp6	(8) tp7	(9) tp8	(10) tp10	(11) tp12	(12) tp14	(13) tp16	(14) tp18	(15) tp20
STOXXE	0.43***	-0.27	-0.30	-0.04	0.19	0.12	0.57	0.75	0.44	0.51	0.51	0.43	0.36	0.39	0.73
	(3.51)	(-0.79)	(-0.69)	(-0.07)	(0.32)	(0.18)	(0.74)	(0.91)	(0.54)	(0.56)	(0.55)	(0.49)	(0.46)	(0.48)	(0.88)
OIS 2Y	1.15	-2.31	-4.61	-4.86	-6.26	-5.78	-0.59	-3.68	-3.85	-10.81	-12.09	-14.68	-13.61	-18.05	-14.44
	(0.89)	(-0.63)	(-1.11)	(-0.85)	(-0.94)	(-0.85)	(-0.07)	(-0.40)	(-0.34)	(-1.07)	(-1.17)	(-1.59)	(-1.13)	(-1.42)	(-1.11)
Information Shock × STOXXE	0.27	1.18**	2.57***	2.34***	2.65***	2.55***	1.44	1.63	0.44	-1.19	-0.43	-0.52	-0.66	-0.97	-1.76
	(0.99)	(2.10)	(3.70)	(3.04)	(2.69)	(2.76)	(1.38)	(1.36)	(0.33)	(-0.76)	(-0.28)	(-0.36)	(-0.47)	(-0.53)	(-0.93)
Information Shock × OIS 2Y	0.34	3.90	8.92	12.49	26.33	26.29*	22.27	13.01	26.30	54.32***	55.38***	56.00***	66.00***	73.21***	62.83**
	(0.09)	(0.49)	(0.62)	(0.97)	(1.52)	(1.79)	(1.31)	(0.87)	(1.60)	(2.66)	(2.71)	(2.86)	(2.73)	(2.66)	(2.55)
Constant	-3.20	5.79	7.69	11.44	7.90	3.30	-4.62	-14.73	-7.52	-5.60	-10.06	-8.87	19.33	17.64	29.37
	(-0.65)	(0.47)	(0.57)	(0.72)	(0.47)	(0.17)	(-0.21)	(-0.60)	(-0.30)	(-0.21)	(-0.34)	(-0.29)	(0.62)	(0.50)	(0.79)
Observations	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190
R^2	0.17	0.05	0.16	0.16	0.22	0.18	0.11	0.08	0.05	0.08	0.08	0.07	0.09	0.08	0.06
F	6.88	1.44	9.24	6.91	7.29	5.71	3.10	2.58	1.47	2.48	2.67	3.09	2.35	2.36	2.42

The t-stats (in parentheses) are based on White heteroscedasticity-consistent standard errors.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.11: Information Shock (2002-2020)

	(1) t0	(2) tp1	(3) tp2	(4) tp3	(5) tp4	(6) tp5	(7) tp6	(8) tp7	(9) tp8	(10) tp10	(11) tp12	(12) tp14	(13) tp16	(14) tp18	(15) tp20
STOXXE	0.40***	-0.25	-0.39	-0.13	0.06	0.07	0.56	0.78	0.50	0.54	0.59	0.49	0.34	0.37	0.79
	(3.13)	(-0.74)	(-1.14)	(-0.32)	(0.13)	(0.13)	(0.84)	(1.04)	(0.74)	(0.67)	(0.68)	(0.56)	(0.47)	(0.53)	(1.09)
OIS 2Y	-2.33	13.52	-13.17	-19.05	-32.38	-50.44	-41.57	-47.33	-39.54	-79.82	-124.38*	-72.59	-47.25	-3.10	1.99
	(-0.18)	(0.44)	(-0.37)	(-0.53)	(-0.66)	(-1.13)	(-0.76)	(-0.81)	(-0.66)	(-1.23)	(-1.82)	(-0.87)	(-0.51)	(-0.03)	(0.02)
Information Shock × STOXXE	0.39	1.24*	2.98***	2.89***	3.26***	3.12***	1.98*	2.05	1.01	-0.56	0.29	0.11	0.10	-0.24	-0.98
	(1.37)	(1.95)	(4.56)	(4.01)	(3.49)	(3.22)	(1.83)	(1.61)	(0.84)	(-0.40)	(0.20)	(0.07)	(0.07)	(-0.14)	(-0.60)
Information Shock × OIS 2Y	-0.27	2.95	7.08	10.19	24.13	24.72*	20.72	12.45	24.45	53.24***	54.64***	53.22***	61.75**	67.74**	56.94**
	(-0.08)	(0.36)	(0.54)	(0.86)	(1.52)	(1.69)	(1.18)	(0.81)	(1.56)	(2.62)	(2.68)	(2.67)	(2.54)	(2.48)	(2.37)
Target	1.43	4.49	4.01	8.31	6.39	18.11*	22.24*	18.84	30.46***	31.58**	51.37***	48.94***	41.38**	34.66**	46.65***
	(0.41)	(0.74)	(0.46)	(0.98)	(0.49)	(1.72)	(1.86)	(1.55)	(2.74)	(2.48)	(4.64)	(3.78)	(2.35)	(2.46)	(3.35)
Timing	7.41	-18.84	14.87	17.99	34.87	47.51	39.39	36.26	24.34	63.49	109.03	64.10	45.73	-8.53	-19.25
	(0.58)	(-0.60)	(0.39)	(0.47)	(0.65)	(0.99)	(0.66)	(0.59)	(0.40)	(0.90)	(1.50)	(0.74)	(0.46)	(-0.08)	(-0.19)
FG	1.81	-14.59	6.20	12.90	22.79	42.96	40.93	46.25	39.55	70.10	110.87	52.40	26.43	-18.92	-16.98
	(0.15)	(-0.48)	(0.18)	(0.36)	(0.46)	(0.99)	(0.81)	(0.84)	(0.71)	(1.13)	(1.65)	(0.64)	(0.29)	(-0.20)	(-0.18)
QE	-4.30	-7.55	-18.73**	-25.30***	-24.19*	-13.11	-11.93	-8.13	-15.85	-6.84	10.73	4.56	-12.40	-29.87	-32.10
	(-1.14)	(-0.66)	(-2.16)	(-2.91)	(-1.92)	(-1.21)	(-0.87)	(-0.53)	(-0.97)	(-0.43)	(0.62)	(0.22)	(-0.54)	(-1.30)	(-1.43)
Constant	-4.00	10.20	6.19	9.08	2.33	-6.52	-13.27	-24.04	-14.03	-20.74	-35.78	-21.65	12.57	23.33	36.32
	(-0.66)	(0.65)	(0.35)	(0.50)	(0.11)	(-0.29)	(-0.50)	(-0.88)	(-0.50)	(-0.63)	(-1.03)	(-0.56)	(0.31)	(0.53)	(0.82)
Observations	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190
R^2	0.21	0.06	0.20	0.23	0.28	0.23	0.15	0.11	0.12	0.13	0.17	0.14	0.14	0.12	0.11
F	3.67	0.86	5.48	6.36	6.10	3.93	2.25	1.97	2.52	3.00	4.72	3.51	2.61	3.12	4.61

The t-stats (in parentheses) are based on White heteroscedasticity-consistent standard errors.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.12: Information and Altavilla Shocks (2002-2020)