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Does Anyone Listen when Politicians Talk?
The Effect of Political Commentaries on Policy Rate Decisions and Expectations*

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Abstract

This paper investigates the effects of political commentaries on policy rate decisions and policy expectations in the United States and the euro area. The results suggest that political commentaries do influence policy rate expectations in both regions, even after controlling for macroeconomic releases and immediate interest rate expectations. The findings regarding the policy reaction functions reveal that market expectations are mostly rational. There is no evidence that the Federal Reserve responds to political commentaries that suggest rate hikes or easings. Meanwhile, the European Central Bank seems to have steered its policy in line with political commentaries that suggested further easings during the pre-crisis period, consistent with market expectations.

Keywords: central bank independence, market expectations, unconventional policy.

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1. Introduction

> *"It really helps an economy to have a strong and independent central bank. What I mean by that is a central bank that can make monetary policy decisions without being influenced by short-term political pressures."*
>
> Ben Bernanke, Federal Reserve Chairman
> Teacher Town Hall Meeting, August 12, 2012[1]

The issue of whether central banks and financial markets respond to political comments on the stance of monetary policy is critical for policymaking as well as for expectations formation. In fact, the effectiveness of policy depends on how well a central bank can guide market expectations (Woodford, 2001). A politically independent central bank has more credibility, which should increase its ability to guide expectations more effectively. If markets believe that the central bank's policy can be influenced by political populism, then politicians can influence expectations and the central bank's desired policy effect can be thwarted by changes in market expectations driven by political talk.

Although central banks are ostensibly independent, it is reasonable to assume that they may respond to political pressure. This possible susceptibility to political pressure has been a popular topic of investigation for many decades, for both the United States (for example, see Weise, 2012; Hellerstein, 2007; Havrilesky, 1995, 1988; Allen, 1986) and the euro area (for example, see Maier, 2002; Maier, Sturm, and de Haan, 2002; Maier and Bezoen, 2004).

A related and unexplored question is whether financial markets *believe* that monetary policy actions taken by the Federal Reserve or the European Central Bank (ECB) are influenced by political pressure. The degree to which markets believe that politicians can sway policy is important. If market participants expect the central bank to adjust monetary policy according to political remarks, we should see a revision to market expectations following political commentaries.

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[1] Ben Bernanke, (2012), "Conversation with the Chairman: A Teacher Town Hall Meeting," speech, Washington, August 12, www.federalreserve.gov/mediacenter/files/conversation-with-the-chairman-transcript-20120809.pdf.

In this paper, we attempt to provide an answer to this question, specifically during the recent crisis period. We investigate the response to political pressure of (i) central banks' policy reaction functions and (ii) market expectations related to future policy rates. We follow the methodology developed by Ehrmann and Fratzcher (2011) to construct dummy variables that quantify political commentaries, and we develop testable equations for policy reaction functions and market-perceived monetary policy rules that include these political commentaries. We split our sample into two periods, the pre-crisis (January 2, 2002 through July 31, 2007) and the crisis (August 1, 2007, through December 30, 2011) periods, to examine whether political commentaries during the crisis period had a different effect on market expectations and policy reaction functions.

Our findings suggest that political commentaries do influence policy rate expectations, even after controlling for macroeconomic releases and interest rate expectations of upcoming meetings. During the pre-crisis period, market participants expected the ECB to ease policy in response to expansionary political commentaries, which is supported by the policy reaction function in which the ECB seems to significantly respond to such commentaries. During the crisis, there is some weak evidence that financial markets expected the ECB to tighten its stance in response to political commentaries advocating tighter policy. In the United States, market participants are mostly unresponsive to political commentaries that suggest a rate hike or easing, which is consistent with our estimates of the Federal Reserve's reaction function. Nevertheless, some evidence suggests that market participants interpret neutral commentaries as future tightenings. We discuss the likely reasons for this behavior in our empirical analysis.

The paper proceeds as follows. Section 2 presents a review of the relevant literature. Section 3 describes the construction of the dummy variables that reflect our interpretation of political commentaries, which is key to our analysis. Section 4 presents the model and our empirical specifications. Section 5 discusses our findings. Section 6 concludes.

2. Background and Literature Review

Political pressure on monetary policy has been a topic of discussion for many years, following the seminal work of Havrilesky (1988, 1990, and 1995). More recent literature has recognized that central banks may implement time-inconsistent policies under political pressure, as politicians have different objectives than central bankers; in particular, they have higher inflation tolerance (for example, see Barro and Gordon, 1983; Kydland and Prescott, 1977). Along these lines, Ehrmann and Fratzscher (2011) find evidence that politicians in Europe prefer lower interest rates relative to the ECB. They focus on understanding the motivations behind political commentaries, identifying the factors behind the ECB and the politicians' differences in preferences. They do not, however, examine the effects of political pressure on the ECB or market expectations, which is the focus of our paper. A large literature has studied the Federal Reserve's experience over time.[2] Weise (2012) finds evidence of time-inconsistent policies and argues that the U.S. great inflation of the 1970s was caused, in part, by political pressure resulting in over-expansionary monetary policy. Examining FOMC minutes and transcripts, he finds the political environment led the Federal Reserve to prematurely abandon anti-inflationary monetary policy in 1970, 1973, and 1974. Froyen, Havrikesky, and Waud (1997) find that, in the United States, there are more calls for an easing of monetary policy than a tightening; however, for their entire 1959–91 sample, the Federal Reserve is more responsive to calls for tightening than easing.[3] Grier (1987) finds evidence of an election-cycle influence on money growth rates—specifically, quarterly money growth increases three years prior to an election and declines a year after the election—suggesting presidential political pressure on the Federal Reserve. Grier's

[2] Most of the literature focuses on presidential influence on monetary policy; however, Havrilesky (1995, p. 114) finds some evidence of congressional pressure.

[3] During the Martin regime (1959:4–1970:1), monetary policy was tighter than it would have been in the absence of political pressure. During the Burns regime (1970:2–1979:9), there were 57 easing signals and 24 tightening signals, but monetary policy did not respond significantly to these signals. During the Volcker regime (1979:10–1982:6), the Federal Reserve responded more to easing signals than it would have done in the absence of political pressure. During the Greenspan regime, there was no statistically significant response to political signaling.

results are supported by Hellerstein (2007), who finds that the FOMC is less likely to tighten monetary policy in the year before a presidential election compared with other times.

The period following 2008 is particularly important since our quantitative measure of political commentaries increases significantly following 2008. The increase in commentaries may reflect the extraordinary increase in unemployment, unconventional policy measures deployed by the Federal Reserve, and changes in regulatory policies and practices enacted by Congress and implemented by the Federal Reserve among other regulatory agencies.

Given recent events, it becomes even more interesting to study the issue of central banks' independence and the market's perception of central banks' independence, which is the focus of our paper.

3. Measuring Political Commentaries

We closely follow the methodology developed by Ehrmann and Fratzcher (2011) to construct dummy variables that quantify political commentaries.[4] Using the Factiva database, which contains a rich archive of newspaper articles and newswire reports, we mimic the search command described in Ehrmann and Fratzcher (2011) to search for statements that contain a reference to the "Federal Reserve" or "ECB" and the political authorities.[5] Each search result is carefully screened for relevance, and from these results, we categorize political calls for easing or tightening, or neutral comments on policy. For

[4] Indeed, for the first half of the sample for the euro area, Michael Ehrmann kindly provided us with the dummy variables they constructed for their analysis.

[5] The articles contain politicians' comments on monetary policy or the Federal Reserve, not comments by the Federal Reserve itself. An example of our search command for the United States for the pre-crisis period is "Federal Reserve, or Fed, or Greenspan" and "republican, or representative, or governor, or senator, or congressman, or congresswoman, or congressperson, or lawmaker, or Clinton, or Obama, or Bush, or Treasury, or Council of Economic Advisors." The search returned over 80,000 articles for each region. After being sorted based on relevance, the articles were assigned the code +1 for easing calls, -1 for tightening calls, and 0 for neutral comments. In the case of the ECB, we focused on English language papers (following Ehrmann and Fratzcher, 2011); however, many European papers are translated into English, so we also have search results for papers such as *Der Spiegal* and *Le Monde*.

example, from January 1, 2002, through August 31, 2007, 682 relevant articles were detected out of 70,000 articles about the ECB. However, only about 60 percent were coded as political commentaries (PCs).

If there is more than one comment on any given day, the comments are aggregated as in Havrilesky (1988) to examine their total effect on central bank and financial market behavior. The aggregation of comments can be viewed as a proxy for mounting political pressure on the Federal Reserve or the ECB to which the central bank may have to respond.[6]

We classify each political commentary based on whether it suggests lower interest rates (PC_t^+) or higher interest rates (PC_t^-), or whether it is neutral (PC_t^0):

$$
\begin{aligned}
PC_t^+ &= \begin{cases} 1 & \textit{preference for lower rates} \\ 0 & \textit{otherwise} \end{cases} \\
PC_t^- &= \begin{cases} 1 & \textit{preference for higher rates} \\ 0 & \textit{otherwise} \end{cases} \\
PC_t^0 &= \begin{cases} 1 & \textit{no preference of a policy change} \\ 0 & \textit{otherwise} \end{cases}
\end{aligned}
\tag{1}
$$

The entire press announcement is read to ascertain the correct commentary context. We code political commentaries conservatively: If a comment is ambiguous, the comment is categorized as neutral. This conservatism is one possible explanation for why we find fewer political comments coded as "easing" or "tightening" in the pre-crisis period for the ECB compared to others. For example, "Sobles says ECB rate hike would help rein in inflationary expectations in Spain" and "German institutes call on ECB to raise rates" are coded as calls for tightening (PC^-) "France's Govt Welcomes ECB Shift Since Market Turmoil" and "Spain Solbes: ECB Policy Should Focus On CPI

[6] To capture political pressure, Havrilesky (1988) develops an index measuring policy signals from the Administration to the Federal Reserve, the Signals from the Administration to the Federal Reserve (SAFER) index. The index is constructed by adding the number of political statements obtained from speeches, news conferences, interviews, and other sources in a given month.

Expectations" are coded as neutral comments (PC^0)[7]; "France presses ECB against new rate hike" and "Frances Lagarde Urges ECB To Cut Rates For Investment Mkts" are coded as calls for easing (PC^+).

Neutral commentaries reflect those incidences where politicians agree with the central bank. In such occurrences, however, it is tricky to predict and test the significance of market response to neutral political commentaries. On the one hand, if market participants act on the signal in these commentaries, then we should not expect any change in market expectations. On the other hand, if market participants do not act on the signal, then we should still not see any significant reaction. Hence, there is observational equivalence between the two scenarios, and we cannot identify whether market participants respond to these political commentaries. For that reason, we avoid interpreting an insignificant coefficient associated with neutral political commentaries in our empirical analysis.

Table 1 shows the number of political commentaries for the subsamples we consider in the analysis. The upper panel shows the numbers for the United States, and the lower panel shows the numbers for the euro area. The last row in each panel shows the total number of commentaries before and during the crisis period in each category. Looking at the upper panel, we note that there were very few political commentaries during the pre-crisis period in the United States, limiting our ability to test the general effect of such commentaries on market expectations in a broad sense. The number of political commentaries are in line with other studies, including an earlier version of Nunes (2013), which updated Havrilesky's index of Signals from the Administration to the Federal Reserve (SAFER) to 2006.

The pre-crisis period from 2002 to 2007 broadly corresponds to the Chairmanship of Greenspan. Most comments complement Federal Reserve policy actions during this time and laud Alan Greenspan's policy vision. Overall, there are fewer comments during the Greenspan era, and our data are consistent with Havrilesky (1995, pp. 69–71).

[7] For the latter commentary, specifically, we cannot ascertain from the article whether inflationary expectations are high or low; hence, we classify it as neutral.

Havrilesky (1995) reports that Greenspan was well known for his aversion to the politicization of monetary policy. Under Presidents George H. W. Bush and Bill Clinton, Havrilesky finds a drop in political commentaries even when the economy was in recession in 1991 (when one typically sees commentaries increase).

For the crisis period, there is a noticeable increase in the number of political commentaries, particularly those that criticize the accommodative stance of monetary policy and suggest a tighter stance (PC^-), as shown by the crisis columns in the upper panel of table 1. Meanwhile, there is also a significant increase in the number of neutral commentaries that support the unprecedented unconventional policies adopted by the Federal Reserve to mitigate the financial crisis during that time. These unconventional policies resulted in a more-than-threefold increase in the size of the Federal Reserve's balance sheet. Political commentaries on these policies largely fell into two camps—those who criticized the Federal Reserve for undertaking them and those who supported the Federal Reserve's actions. Politicians who attacked the Federal Reserve did so on several fronts, including the media and the introduction of legislation to monitor Federal Reserve activities more closely, as discussed in section 2.

As shown in the lower panel of table 1, the number of political commentaries are generally much higher in the euro area, particularly for the period before the financial/sovereign debt crisis. The decline in the overall number of commentaries during the crisis compared with the previous period could perhaps reflect that there was more uncertainty regarding the status and the independence of the ECB in the earlier period when it was newly formed, but as the ECB established its status as an independent central bank, the number of political commentaries declined over time. During the crisis period, there were quite a few political commentaries that suggested easier monetary policy relative to few commentaries that suggested a tighter stance. The comments for an easing came from France, Ireland, and Portugal (not shown). The majority of the comments during the crisis period were either calls for easing or neutral comments defending ECB independence and the mandate on price stability. Very few comments called for a tightening in the euro area. The policy process for the ECB is more complex compared

with the Federal Reserve, as there are multiple sovereign states with potentially differing objectives. Officially, the ECB is required to consider only euro-wide economic conditions for policy setting.[8] However, without political unity in the euro area, it is possible to imagine that some central bankers will weigh national economic conditions above euro-area conditions, especially if those economic conditions diverge from the euro area (Dornbusch, Favero, and Giavazzi, 1998; De Grauwe, Dewachter, and Giavazzi, 1998; Heinemann and Huefner, 2004; Bouvet and King, 2013). Each country in the euro area has one vote and decisions are made by simple majority rule. As a result, smaller countries have a larger voice given their size in the monetary union, which can matter if inflation tolerance differs among participating countries (Berger and De Hann, 2002; Meade and Sheets, 2005). We do not weigh commentary on ECB policy by politicians in the euro area by nationality but rather take the approach that the ECB considers euro-area interests (Gerlach 2007).

Figure 1 provides the political commentaries from a time-series perspective. The upper panel shows the commentaries for the United States and the lower panel shows the commentaries for the euro area. Overall, we do not observe a different pattern in the intensity of political commentaries during election cycles (not shown), consistent with Havrilesky (1995, p. 204). The figure illustrates the contrasting pattern in the intensity of political commentaries between the United States and the euro area. In the United States, the number of political commentaries increases drastically with the crisis, while in the euro area, there was a decline in the number of political commentaries during the crisis period.[9] The rise in commentaries calling for a tightening were, in general, a response to the bank bailouts, Federal Reserve communications, and inflation concerns surrounding the quantitative easings. The other neutral commentaries during the 2009–10 period concern Chairman Bernanke's nomination and confirmation.

[8] Article 10 in the Protocol (No. 4) on the Statute of the European System of Central Banks and of the ECB.

[9] We should note that our sample ends before the ECB implemented more radical unconventional monetary policy actions, such as negative interest rates or quantitative easing. Such actions led to a rise in the number of PCs criticizing the ECB, similar to the U.S. experience.

4. The Model and Data

We assume that central banks—the Federal Reserve and the ECB in our empirical application—set their target policy rates, or more generally their monetary policy stance, following a standard Taylor rule:

$$r_\tau = r + \beta_\pi(\pi_\tau - \pi^*_\tau) + \beta_y(y_\tau - y^*_\tau) + u_\tau, \tag{2}$$

where (π-π*) is the deviation of the actual inflation rate (π) from an inflation target (π*) (that is, the price gap), (y-y*) is the deviation of the actual output growth rate (y) from the growth rate of potential GDP (y*) (that is, a measure of the output gap), and r_τ represents the target rate for the central bank at the end of the intermeeting period τ. In a framework similar to Hamilton, Pruitt, and Borger (2011), we consider the expectation of equation (2) conditional on information available to market participants as of day *t*—that is, Ω_t:

$$\begin{aligned} E(r_\tau \mid \Omega_t) = r + \beta_\pi E(\pi_\tau \mid \Omega_t) - \beta_\pi E(\pi^*_\tau \mid \Omega_t) + \\ + \beta_y E(y_\tau \mid \Omega_t) - \beta_y E(y^*_\tau \mid \Omega_t) + E(u_\tau \mid \Omega_t). \end{aligned} \tag{3}$$

Thus, the change in expectation between day *t*-1 and day *t* can be written as

$$\begin{aligned} &E(r_\tau \mid \Omega_t) - E(r_\tau \mid \Omega_{t-1}) = \\ &\quad \beta_\pi[E(\pi_\tau \mid \Omega_t) - E(\pi_\tau \mid \Omega_{t-1})] - \beta_\pi[E(\pi^*_\tau \mid \Omega_t) - E(\pi^*_\tau \mid \Omega_{t-1})] + \\ &\quad \beta_y[E(y_\tau \mid \Omega_t) - E(y_\tau \mid \Omega_{t-1})] - \beta_y[E(y^*_\tau \mid \Omega_t) - E(y^*_\tau \mid \Omega_{t-1})] + \\ &\quad E(u_\tau \mid \Omega_t) - E(u_\tau \mid \Omega_{t-1}). \end{aligned} \tag{4}$$

Assuming that inflation and output targets do not change on a day-to-day basis, the above equation simplifies to

$$\begin{aligned} &E(r_\tau \mid \Omega_t) - E(r_\tau \mid \Omega_{t-1}) = \\ &\quad \beta_\pi[E(\pi_\tau \mid \Omega_t) - E(\pi_\tau \mid \Omega_{t-1})] + \beta_y[E(y_\tau \mid \Omega_t) - E(y_\tau \mid \Omega_{t-1})] + \\ &\quad E(u_\tau \mid \Omega_t) - E(u_\tau \mid \Omega_{t-1}), \end{aligned} \tag{5}$$

which can be rewritten as

$$\Delta er_\tau = \beta_\pi \Delta S^\pi_t + \beta_y \Delta S^y_t + \varepsilon_t, \tag{6}$$

where $\Delta er_\tau = E(r_\tau \mid \Omega_t) - E(r_\tau \mid \Omega_{t-1})$ is the daily change in the market expected policy rate over term τ, and ΔS^π and ΔS^y are the changes in the expected level of inflation and real activity, respectively.

Baseline equations (2) and (6) represent, respectively, the way central banks set their target rates and the way market participants revise their expectations of these policy rates based on macroeconomic data. To analyze the effect of political commentaries on the central banks' policy reaction functions and on market expectations of future policy rates, we augment these equations to include political commentary (PC) dummies. Other control variables are discussed in subsection c.

a. Detailed Specification of the Policy Reaction Functions

To check whether political commentaries have any significant effect on the policy reaction function, we derive an empirically testable counterpart of equation (2)—an ordered probit model that incorporates political commentaries into the reaction function.

The discrete nature of monetary policy decisions suggests the use of an ordered response model, similar in methodology to Hausman, Lo, and Mackinlay (1992). These studies normally analyze policy rate changes that typically occur in discrete increments of 25 basis points. The period that we analyze, however, includes much more than rate changes, as a number of unconventional monetary policy measures started to be implemented as of 2008 in both the United States and the euro area. Therefore, to analyze the policy reaction functions, we use a multivariate probit where the dependent policy variable is a dummy that takes the values $y_\tau = \{-1, 0, 1\}$ according to whether the policy is a tightening measure, neutral, or an easing measure, respectively. Because of the mixing of policy rate changes and unconventional monetary policy announcements, we focus on the sign of the policy changes rather than the size. The list of dates and measures for the period of unconventional policies follows Rogers, Scotti, and Wright (2014). The unconventional monetary policies include large-scale asset purchase (LSAP) announcements, as well as some Jackson Hole and other influential speeches in the United States, and speeches and announcements of new measures in the euro area, such as the

introduction of the fixed rate full allotment policy, of the six-month, one-year, and three-year longer-term refinancing operations (LTROs), and of the covered bond purchase program.

We set our time unit to be the time interval between two policy meetings. This interval generally corresponds to the pre-established meeting calendar, but occasionally policy measures are adopted during the intermeeting period between two regular meetings.[10]

It is easier to describe the model by indexing observations by event τ, representing policy meeting days, rather than days *t*, as policy rate changes only occur on particular dates. Consequently, $\tau = 1$ corresponds to the first policy meeting, $\tau = 2$ to the second, and $\tau = N$ to the last. Let r_τ denote the τ^{th} policy change and v_τ denote a vector of variables, namely inflation and output, observed during the period prior to the τ^{th} policy meeting that may have influenced the central bank's decision as to whether to ease or tighten policy. We hypothesize the existence of an unobserved latent variable, r_τ^*, such that

$$r_\tau^* = r + \beta_\pi(\pi_\tau - \pi_\tau^*) + \beta_y(y_\tau - y_\tau^*) + \varepsilon_\tau = v_\tau' B + \varepsilon_\tau \ , \tag{7}$$

where $\varepsilon_\tau / v_\tau \sim i.i.d.N(0,1)$. Then, the observed series of policy measures is related to the unobserved latent process as follows:

$$r_\tau = \begin{cases} -1 & if \quad r_\tau^* \in (-\infty, c_1] \\ 0 & if \quad r_\tau^* \in (c_1, c_2] \\ 1 & if \quad r_\tau^* \in [c_2, \infty), \end{cases} \tag{8}$$

where $c_1 < c_2 < c_2$.[11] Therefore, the probability to have an easing measure will be

[10] For the euro area, there are no policy changes in the "-1" category. For the United States, there is only one such change, which is the last interest rate cut in December 2008.

[11] Policy changes typically occur in discrete increments of 25 basis points in both regions. In particular, during our 2002–11 sample period, most of the policy changes fall into the following categories: $y_\tau = \{-1, -0.75, -0.50, -0.25, 0, 0.25\}$. A more traditional probit model, therefore, would define equation (8) as follows:

$$P(r_\tau = -1/v_\tau) = P(c_1 < v_\tau'\mathrm{B} + \varepsilon_\tau \le c_2) \tag{9}$$

or, if we denote the standard normal cumulative distribution by $\Phi(z)$,

$$\begin{aligned} P(y = -1/v_\tau) &= \Phi(c_1 - v_\tau'\mathrm{B}) \\ P(y = 0) &= \Phi(c_2 - v_\tau'\mathrm{B}) - \Phi(c_1 - v_\tau'\mathrm{B}) \\ P(y = 1/v_\tau) &= 1 - \Phi(c_2 - v_\tau'\mathrm{B}), \end{aligned} \tag{10}$$

from which the log-likelihood of the model can be trivially expressed and maximized by conventional procedures with respect to the parameters of interest.

We keep the idea of a simple Taylor rule framework in mind when we construct the explanatory variables included in the reaction function. We use the last observed value of the unemployment rate (y_τ) and the inflation rate (π_τ) as measures of the output gap and the price gap, respectively.[12] We add a volatility measure (vol_{t-1}) from the previous day to this baseline model to capture financial stress, especially during the crisis period. In addition, we add our main variable of interest, the political commentaries (PC^-, PC^0, PC^+). To check whether commentaries released closer to a policy meeting have a larger effect on the policy decision, we look at the 3-day and 10-day periods prior to a meeting, as well as the total number of political commentaries that were released over the entire intermeeting period.[13] Our underlying probit regression is of the type

$$\begin{cases} -1 & if \quad r_\tau^* \in (-\infty, c_1] \\ -0.75 & if \quad r_\tau^* \in (c_1, c_2] \\ \dots & \dots \quad \dots \\ 0.25 & if \quad r_\tau^* \in [c_6, \infty) \end{cases}$$

Our results for the euro area, for which there is no zero-lower-bound problem, are robust to this specification as well.

[12] To the extent that the inflation and output targets are constant over time, we can disregard them, as the probit is identified up to scale.

[13] In our empirical specification, we separate the effects of dovish and hawkish commentaries, which allows us to interpret the probabilities in a probit model in a straightforward way. Although there may not be any theoretical reason to make such a distinction, this general form allows us to test and confirm the presence of a symmetric response, if any. To the extent that the policy response is symmetric to positive and negative commentaries, the coefficient estimates associated with different political commentaries will not be significantly different from each other.

$$
\begin{aligned}
r_\tau^* = r &+ \beta_{1,PC-}\, PC^-(1-D_t) + \beta_{2,PC-}\, PC^-(D_t) + \beta_{1,PC+}\, PC^+(1-D_t) + \beta_{2,PC+}\, PC^+(D_t) \\
&+ \beta_{1,PC0}\, PC^0(1-D_t) + \beta_{2,PC0}\, PC^0(D_t) \\
&+ \beta_{\pi 1}\pi_\tau(1-D_t) + \beta_{\pi 2}\pi_\tau(D_t) + \beta_{y1}\, y_\tau(1-D_t) + \beta_{y2}\, y_\tau(D_t) \\
&+ \beta_{y1}\, vol_{t-1}(1-D_t) + \beta_{y2}\, vol_{t-1}(D_t) + \varepsilon_\tau ,
\end{aligned}
\tag{11}
$$

where π_τ and y_τ are the most recent inflation and unemployment rates, respectively, and PC^-, PC^0, and PC^+ are political commentaries that suggest rate hikes, confirm the existing policies, or recommend easings, respectively.[14] We control for the effect of the financial crisis by interacting each variable with a dummy variable D_t, which is equal to 1 starting in August 2007, so that effectively we study the coefficients during the pre-crisis and crisis periods.

In this specification, if the central bank simply reacted to macroeconomic conditions and not to political commentaries that suggest easings or tightenings, we would expect $\beta_1 = \beta_2 = 0$ associated with PC^- and PC^+. However, we would obtain a similar result if politicians and the central bank agreed with the interpretation of macroeconomic information. In this case, we assume that the central bank is not influenced by the political commentaries but rather responding to macroeconomic conditions. In contrast, when macroeconomic conditions do not warrant a particular response from the central bank, and the central bank reacts to easing or tightening pressures from politicians, we would expect $\beta_1, \beta_2 \neq 0$.

b. Detailed Specification of the Policy Expectations Model

Our next objective is to test whether political commentaries have any significant effect on policy expectations. If market participants think that central banks respond to political pressures, then political commentaries should be significant in affecting market expectations. To test this argument, we consider the following empirical specification at the daily frequency, which is an augmentation of equation (6):

[14] The next subsection describes how these commentaries are constructed.

$$
\begin{aligned}
\Delta er_t^j = \alpha \; & + \beta_{11} PC_{Agg}^{+}(1-D_t) + \beta_{12} PC_{Agg}^{+}(D_t) + \beta_{21} PC_{Agg}^{-}(1-D_t) + \beta_{22} PC_{Agg}^{-}(D_t) \\
& + \beta_{31} PC_{Agg}^{0}(1-D_t) + \beta_{32}^{i} PC_{Agg}^{0}(D_t) + \beta_{41} \Delta S_t^{\text{Real Ind.}}(1-D_t) + \beta_{42}^{i} \Delta S_t^{\text{Real Ind.}}(D_t) \\
& + \beta_{51} \Delta_t^{Inf.Ind.}(1-D_t) + \beta_{52} \Delta S_t^{Inf.Ind}(D_t) + \beta_{61} S_t^{Policy}(1-D_t) + \beta_{62} S_t^{Policy}(D_t) \\
& + \beta_{71} vol_{t-1}(1-D_t) + \beta_{72} vol_{t-1}(D_t) + \varepsilon_t,
\end{aligned}
\tag{12}
$$

where Δer_t^j is the change in market expectations for the *j*-month overnight index swap (OIS) rate with *j* = 1,…, 24 or the change in government bond yields. PC_{Agg}^{+}, PC_{Agg}^{-}, and PC_{Agg}^{0} refer to indicator variables that aggregate the number of political commentaries over an n-day period prior to day *j*, so that $PC_{Agg}^{+} = \sum_{i=j-3}^{j} PC_{t-j}^{+}$, $PC_{Agg}^{-} = \sum_{i=j-3}^{j} PC_{t-j}^{-}$, and $PC_{Agg}^{0} = \sum_{i=j-3}^{j} PC_{t-j}^{0}$. $\Delta S_t^{\text{Real Ind}}$ is the change in the Scotti (2016) real activity surprise index, $\Delta S_t^{Inf.Ind}$ is the change in the surprise index for inflation data releases, and S_t^{Policy} is the surprise component of a policy rate change as explained in subsection c.

In more detail, our dependent variables are OIS rates, a daily measure of market participants' expected policy rate over the relevant term, and government bond yields. If political commentaries cause market participants to revise their expected path of the policy rate, then they should affect OIS rates.[15] One drawback of using OIS as a measure of market expectations is that much of the political commentary in the United States came during the crisis period and after the policy rate hit the ZLB (recall figure 1). The OIS rates only capture expectations of future policy rates, not expectations about further quantitative easing. To that end, we also use, as left-hand-side variables, changes in

[15] OIS are over-the-counter traded derivatives, namely interest rate swaps, in which the parties exchange at maturity the difference in interest between what would accrue over the life of the contract under the fixed-rate assumption and what would accrue from repeatedly rolling over an investment in the overnight market. The OIS rate can be viewed as a measure of the expected monetary policy rate over the relevant maturities (for example, see Taylor and Williams, 2009), as the floating leg is tied to a published index of a daily overnight rate reference, like the effective federal funds rate and the EONIA (euro overnight index average) rate. In fact, the OIS rate equals the average of the overnight interest rates expected until maturity and as such is indeed a measure of the expected monetary policy rate over the relevant maturities.

government bond yields to better reflect market expectations about quantitative easing policies once short-term rates hit very low levels.[16] In particular, we use OIS rates from one month to two years as well as 2- and 10-year government yields, though we only show a subset of these maturities. Figure 2 shows selected maturities of the U.S. and euro-area OIS rates that we have used in the empirical analysis.

We believe that implications of a political commentary may take a few days to be digested by market participants and incorporated into prices. For that reason, we look at the effect of a political commentary over a four-day interval from the day it was released (from day t to t-3). Unlike in the previous section, where we also investigated the response to aggregated political commentaries over the intermeeting period, we believe that market participants react more quickly to news and commentaries; hence, we limit our analysis to recent political commentaries.

The direction of the market response to political commentaries depends on market participants' perception. For example, if market participants think that central bankers steer policy in the same direction of political commentaries, then commentaries that suggest rate cuts (PC^+) should be associated with reductions in rate expectations ($\beta_{11}, \beta_{12} < 0$), while commentaries that suggest rate hikes (PC^-) should be associated with increases in rate expectations (that is, $\beta_{21}, \beta_{22} > 0$). In contrast, if market participants think that political commentaries cause central banks to steer policy in the opposite direction (that is, to have a contrarian response), then commentaries that suggest rate cuts (PC^+) may cause market participants to think that central banks will "toughen up" and increase rates in the future such that $\beta_{11}, \beta_{12} > 0$, whereas commentaries that suggest rate hikes (PC^-) may lead to policy easing ($\beta_{21}, \beta_{22} < 0$). A priori, we do not expect neutral commentaries to have an effect on market expectations because such commentaries merely confirm the status quo, and hence we would expect $\beta_{31} = \beta_{32} = 0$.

[16] Since 2008, the federal fund target rate has in fact been at the ZLB. The euro-area main refinancing operation rate also reached very low levels over the same period.

c. Other Variables Included in the Model

Other variables that we include in our empirical application are surprise measures of economic activity, inflation, and policy rates, as well as a measure to capture overall risk and uncertainty, particularly during the crisis. We use a real activity surprise index (Scotti, 2016) as a summary measure of recent economic data surprises about real activity variables. An increase in the value of the index tends to be associated with better-than-expected releases of real activity variables and therefore suggests that the economy is doing better than expected, compared with Bloomberg expectations. On a daily basis, the index is a measure of the weighted real-activity surprises that have occurred in the recent past.

To analyze the interaction between inflation expectations and monetary policy expectations, we use inflation surprise indexes for the United States and the euro area similar to the real activity surprise index previously described. These inflation surprise indexes reflect the effects of any relevant data release on inflation expectations on a continuous basis.[17]

The main advantages of including these surprise indexes are that they summarize a lot of relevant information about real activity and inflation, and they control for the fact that data releases on other macroeconomic variables and political commentaries may cause revisions to market expectations relative to real activity and inflation. In fact, to the extent that political commentaries affect market expectations of real activity and inflation captured by one of the key variables included in the indexes, their influence is incorporated in our index and hence in our specification. These two surprise indexes not only reflect the sensitivity of market expectations to economic developments, but they also control for the potential endogeneity between market expectations and political commentaries. [18] In the presence of these news release indexes, the coefficients on PCs

[17] For the United States, the inflation index includes the surprise components of the CPI, PPI finished goods, hourly compensation, and GDP deflatior releases. For the euro area, the inflation index includes the surprise components of the HICP flast estimate, HICP, PPI, and core CPI releases.
[18] To the extent that political commentaries respond to the same news releases that also affect expectations of future policy, there is room for endogeneity.

reflect the effect of political commentaries on market expectations *after* filtering out the effect of any news releases that affect political commentaries.

Policy rate surprises are measured as the difference between the federal funds target rate or the main refinancing operation rate and their respective Bloomberg expectations.[19] In principle, policy expectations could react to any developments affecting monetary policy decision making, including political commentaries. To the extent that markets expect central banks to respond to political commentaries and revise their expectations accordingly, PC dummies may become insignificant on the days of policy meetings. Thus, our results regarding the significance of political commentaries err on the conservative side.

We capture the overall uncertainty due to elevated risk factors for the United States with the VIX, the Chicago Board Options Exchange market volatility index; for the euro area, we use VSTOXX, the implied volatility on the Euro Stoxx 50 index. The implied volatilities are expected to capture the elevated risks during the crisis period due to an increase in overall uncertainty as well as general financial stresses that might have affected policy decisions in addition to poor macroeconomic performance.[20] We lag this variable by one day to avoid potential endogeneity between changes in policy expectations and risk factors.

5. Results

This section presents the empirical results during the pre-crisis and crisis periods for the United States and the euro area for both specifications described in the previous section. We first empirically measure the response of policymakers to political commentaries, and then we estimate the market response to political commentaries. Combining these results allows us to investigate the rationality of market expectations. Specifically, if market participants expect interest rates to respond to political

[19] We use the median expectation from the survey and subtract it from the actual policy change to obtain the unanticipated component of the policy action.
[20] Our results are robust if we use the LIBOR-OIS spread (or EURIBOR-OIS spread) as the uncertainty measure (not shown).

commentaries in a particular way and the policymakers indeed steer the policy in that direction, we interpret it as evidence that expectations are rational. In contrast, if market participants expect interest rates to respond to political commentaries in a certain way but the policy is unresponsive (or responds in the opposite direction), we interpret it as evidence that expectations are irrational.

a. Results from the Policy Reaction Functions

Table 2 shows the results from the probit estimation for the United States. We estimate the specification for the period before the recent financial crisis (January 2, 2002, through August 9, 2007) as well the recent sample that covers the financial crisis and the European sovereign debt crisis (August 10, 2007, through December 30, 2011). Columns I–III show the results from the baseline Taylor rule specification. The first column shows the coefficient estimates for the period before the crisis, and the second column shows the estimates for the crisis period. The third column, "Δ," shows the p-values from the hypothesis test that checks whether the pre-crisis coefficients are statistically significantly different from their crisis counterparts. Accordingly, an increase in the unemployment rate significantly decreases the probability of a rate hike during the period prior to the crisis. In contrast, an increase in the inflation rate increases the probability of a rate hike, and it is significant for both periods. Columns IV–XII show the effect of the PC variables for alternative time windows.[21] We observe that political commentaries are generally not significant in affecting the policy decision across alternative specifications, supporting the independence of the Federal Reserve as highlighted by Chairman Bernanke's quote at the beginning of this paper, especially in the crisis period in which there were a good number of political commentaries. The only exception is the negative and significant coefficient associated with PC^- before the crisis, suggesting that the Federal Reserve was more likely to ease rates when there were

[21] Note that if there are no political commentaries during an n-day interval prior to a policy meeting, the regressions are run without that particular PC variable, which is shown by a blank cell in the table (such as column 4, rows 1–2 or column 7, row 3).

political commentaries that suggested further rate hikes. Nevertheless, because of the very few political commentaries over the pre-crisis period, we disregard this result. As indicated earlier, an insignificant response associated with neutral commentaries does not allow us to identify whether the Federal Reserve acts in accordance with these commentaries or ignores them. Although we do not observe a significant response to neutral commentaries for the 3-day and 10-day intervals, there is a positive and significant response for the neutral commentaries aggregated over the intermeeting period during the period before the crisis. This response suggests that neutral commentaries confirming Federal Reserve policies make the Federal Reserve more likely to consider a rate hike, although the evidence is not overwhelming.

Table 3 shows the policy reaction function for the euro area. Columns I–III show that while an increase in the unemployment rate decreases the probability of a rate hike before the crisis, the sensitivity of the ECB to this variable declines significantly during the crisis period, as shown in column III. Focusing on our main variables of interest, we observe that political commentaries suggesting further easing decrease the probability of a rate hike during the pre-crisis period. Furthermore, the effect of such commentaries increases if they are released closer to a meeting. For example, if a PC^{+} comes during the 3-day period prior to a meeting (column 4), then its effect is about twice as large as a PC^{+} that comes during the 10-day period (column 7) or at any time during the intermeeting period (column 10). Although there is a significant decline associated with commentaries that suggest tighter policy during the crisis period (PC^{-}), there are very few observations to reach a definite conclusion. For robustness, a similar exercise is conducted with the more traditional ordered probit for the euro area and the results are quantitatively similar (not shown).[22]

[22] Because the euro area is not at the ZLB, we can use a traditional probit where the target rate changes in 25 basis point increments. However, we believe that our approach dominates the traditional approach given the number of unconventional monetary policy announcements over the period.

b. Results for the Policy Expectation Models

Equation (12) is estimated separately at daily frequencies for the United States and the euro area, both before the recent financial crisis and for the recent sample that covers the financial crisis and the European sovereign debt crisis. We use interactive dummies to capture the periods before and after the crisis to see if the changing nature and intensity of political commentaries during the crisis period had any different effect on market expectations.

Table 4 shows the estimation results for 3-, 6-, and 12-month OIS rates, as well as the two-year Treasury rate for the United States. Although we estimated the regressions for the entire range of OIS rates from 1 to 24 months, we only show the results for 3, 6, and 12 months for brevity. Similarly, the results for the 10-year Treasury rate are also omitted for brevity. Results for the missing OIS frequencies and for the 10-year government rates are broadly consistent. PC^{+}_{Agg}, PC^{-}_{Agg}, and PC^{0}_{Agg} are the aggregated values of positive and negative commentaries during a four-day window including day *t* as well as the three days prior to time *t* to capture any lagged effects. Due to the rare occurrence of political commentaries in the United States during the pre-crisis period (recall table 1), we cannot draw general conclusions from these findings and therefore disregard the weak statistical significance of the commentaries for the 12-month OIS and the two-year Treasury rates during the pre-crisis period. Meanwhile, there is some evidence that political commentaries suggesting rate cuts (PC^{+}_{Agg}) are interpreted by market participants to generate an inverse response during the crisis period—a period for which we have a slightly larger number of political commentaries. This finding, although not very strong, suggests that expansionary commentaries during the crisis period made market participants think that the Federal Reserve would respond by toughening up its policy stance (contrarian response). These results are loosely consistent with conjectures in Ball (2012) that the Federal Reserve is reluctant to pursue a more accommodative stance, even if economic conditions warrant such a stance, because of political pressure.

Political commentaries suggesting rate hikes (PC^-) are mostly insignificant in affecting policy expectations over the sample. This finding highlights that the political commentaries about the Federal Reserve's actions during the crisis period (75 commentaries over the period) were largely ignored by market participants in forming their expectations.

An interesting response is detected with respect to neutral commentaries. Recall that we expected an insignificant response to neutral commentaries either when markets ignore them or act on them. Our results, however, suggest a positive and statistically significant response associated with neutral commentaries during the crisis period. The positive coefficient may indicate that neutral commentaries about overly easy policies adopted by the Federal Reserve may have boosted confidence in the success of monetary policy and hence the economic outlook, which may have led to an upward revision of policy expectations. An increase in inflation expectations is consistent with the increase in the size of the significance of the coefficient on PC^0 as we move to longer maturities. Market participants do not immediately expect sizable rate hikes, but they believe that such policies will be necessary with the improved inflation outlook in the future. This interpretation is also consistent with the policy reaction function in table 2, where there was no significant response to neutral commentaries during the crisis period.

Overall, these findings are broadly consistent with the policy reaction function results discussed earlier, supporting the rational expectations hypothesis as well as the independence of the Federal Reserve (table 2). Market participants actually seem to believe the Federal Reserve to be so independent that they even expect it to toughen up in response to commentaries that suggested further easing.

As for the control variables, market participants' responses to data releases are consistent with our expectations.[23] An increase in Scotti's real activity surprise index, suggesting macroeconomic data releases are stronger than expected, prompts market participants to revise up their expected interest rate path (in anticipation of tighter

[23] Because there is only one incident where the median interest rate surprise is not zero, we drop this variable from the specification for the pre-crisis period.

monetary policy). Similarly, a stronger-than-expected inflation number, as measured by the inflation surprise index, urges market participants to revise up their expectation of future policy rates and inflation for the longer maturities during the period before the crisis. Surprises regarding the current interest rate decision prompt market participants to revise their policy path across the entire spectrum of maturities. The sensitivity to such surprises increases significantly during the crisis period at the short end of the OIS maturities but decreases over the crisis for two-year rates.[24] The declining effect of policy surprises at the longer end of the yield curve is consistent with the "timing hypothesis" of Kuttner (2001) as also investigated in Demiralp and Jorda (2004).[25] Short-term policy expectations are also affected from changes in financial stresses and market uncertainty during the crisis period, where an increase in VIX is interpreted as future easing of monetary policy.

Table 5 shows the regression results for the euro area, for which we have abundant observations during the pre-crisis period. For the period prior to the crisis, we observe a negative and significant relationship between expansionary political commentaries (PC^{+}) and market expectations of interest rates for shorter maturities. A similar finding is obtained for the crisis period where commentaries suggesting a tighter policy stance have a positive and significant coefficient across different maturities. However, due to the small sample of contractionary political comments in the euro area (table 1) during the crisis period, this finding should be taken only as indicative. Both results suggest that market participants expect the ECB to respond to political commentaries by steering its policy in the direction of the advice. No significant market response is shown for the vast number of expansionary political commentaries for the crisis sample. When we compare this finding with the ECB policy reaction function, we observe a consistent story: The

[24] A more noticable decline is observed for the 10-year rate (not shown).

[25] The idea is that central banks typically change the policy rate in discrete increments of 25 basis points in the same direction, and the general trend of these changes is rarely reversed. Consequently, when we calculate the response of different maturities to the surprise component of a policy change, it is possible that the market timed the target change incorrectly but nevertheless anticipated that change sometime in the near future. Thus, the advancement or postponement of anticipated rate changes will have a smaller effect on term rates than actions that indicate a reversal in the policy stance.

ECB indeed seems to react to commentaries that advocate lower future policy rates during the period before the crisis (table 3).

Looking at the control variables, we observe no significant response to surprises about real activity as captured by Scotti's surprise index. The inflation index becomes significant during the crisis period. Because market participants correctly anticipated all interest rate changes before the crisis period, we do not have an interest rate surprise variable estimated for the pre-crisis sample. Nevertheless, interest rate surprises are significant during the crisis period. Market response to elevated risk and uncertainty, as captured by the coefficient on VSTOXX, is significant for the entire sample.[26]

c. Robustness Analysis

As a robustness check, we aggregate positive and negative political commentaries to capture the effect of net hawkishness by the politicians where $PC_{Agg}^{Net} = PC_{Agg}^{-} - PC_{Agg}^{+}$. This aggregation allows for a higher number of political commentary dummies to support our results, but it does not separate the responses to individual political commentaries and ignores neutral commentaries. Tables 6 and 7 show the results from these regressions. Although there is no net effect of political commentaries on market rates for the United States, net hawkishness does yield a significant market response for the entire sample for the euro area. The response is more pronounced for the shorter maturities for the crisis period, but it affects both short- and longer-term expectations for the pre-crisis period.

As another robustness check, table 8 breaks the crisis period into the period before the ZLB that covers August 2007 through November 2008 and the ZLB period that covers December 2008 through December 2011. One can argue that mixing policy decisions while the rates are positive with quantitative easing decisions may be problematic because it assumes they exist on the same space and are comparable. To address this concern, we treat the ZLB period separately, allowing for a different response during this period. Table 8 suggests that the perverse response that we had detected in table 4 with respect

[26] For robustness, these results were replicated with 2- and 10-year German and U.S. bonds and results were broadly consistent.

to PC^+ is present also during the ZLB period. The insignificant coefficients for the early crisis period should be interpreted with a grain of salt, however, because there are very few political commentaries during this time, as shown in table 1.

We also consider several robustness checks for the estimates of the policy reaction functions. It is plausible to assume that politicians respond to forecasts of economic activity, which help them predict the central bank's actions and comment on these anticipated central bank moves. If this is the case, there is potential endogeneity between political commentaries and policy actions. To control for this forward looking bias, we include changes in five-year swap rates as a proxy for longer-term inflation outlook. The swap rates are not only insignificant in our probit regressions but they do not affect the rest of the coefficient estimates either (not shown).

As another robustness check for the reaction functions, we investigate whether commentaries with opposite content in a given time frame yield a milder response on behalf of central banks. Numerous political commentaries that uniformly suggest a rate hike before a policy meeting may be treated differently, relative to the alternative case of several offsetting commentaries in the same period that suggest a rate hike or a rate cut. In the second scenario, in fact, the central bank may be less eager to respond to political pressures. While it is interesting to test this hypothesis empirically, the presence of very few such instances challenges reliable estimation.

6. Conclusion

This paper investigates whether financial markets as well as central banks respond to political commentaries on the stance of monetary policy. One unexplored question in the political influence on central banking is whether financial markets believe that Federal Reserve or ECB policies are affected by political pressures. Our findings suggest that political commentaries do influence policy rate expectations in the euro area and the United States, even after controlling for macroeconomic releases and interest rate expectations. When we compare these findings with the policy reaction functions of the

Federal Reserve and the ECB, we conclude that market participants generally form their expectations in a rational manner.

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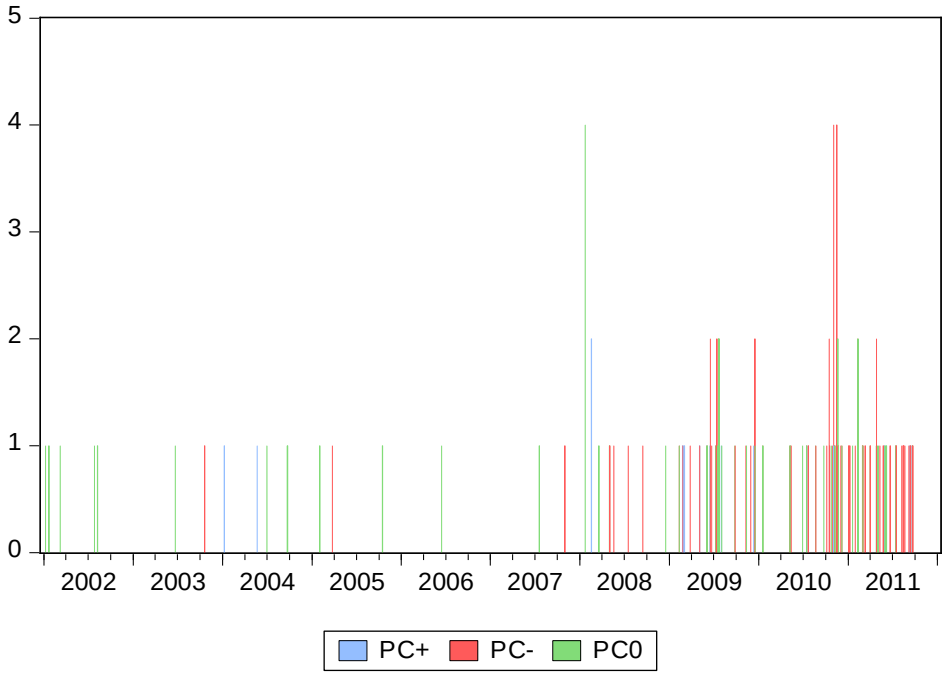
Figure 1

Political Commentaries in the United States



Political Commentaries in the Euro Area

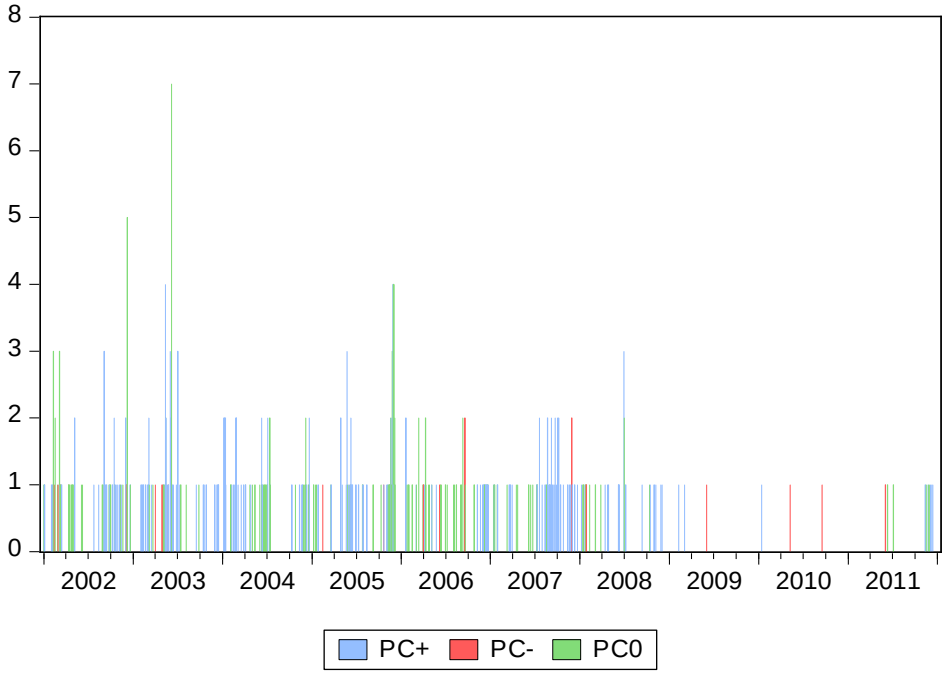


Figure 2: OIS rates in the United States and the Euro Area

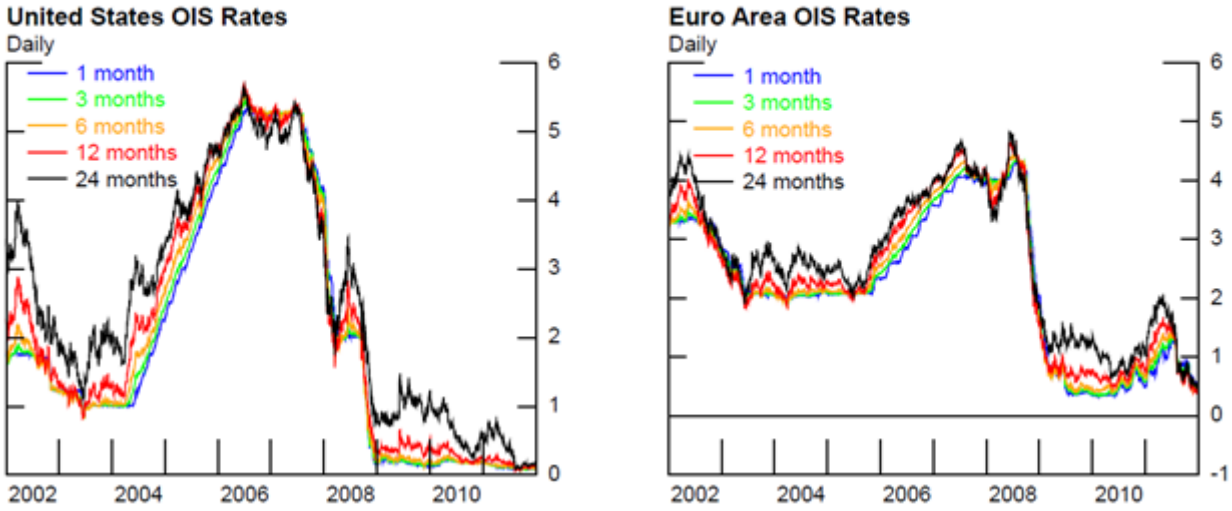


Table 1: Number of Political Commentaries in the Two Regions

United States

Number of *PC*s on a given day	PC_t^+		PC_t^0		PC_t^-	
	Pre-Crisis	Crisis	Pre-Crisis	Crisis	Pre-Crisis	Crisis
1	2	14	13	39	2	51
2	--	1	--	4	--	8
3	--	--	--	--	--	--
4	--	--	--	1	--	2
Total number of PCs	2	16	13	44	2	75

Euro Area

Number of *PC*s on a given day	PC_t^+		PC_t^0		PC_t^-	
	Pre-Crisis	Crisis	Pre-Crisis	Crisis	Pre-Crisis	Crisis
1	114	46	96	17	13	6
2	19	6	9	1	1	1
3	5	1	3	--	--	--
4	2	--	2	--	--	--
5	--	--	1	--	--	--
6	--	--	--	--	--	--
7	--	--	1	--	--	--
Total number of PCs	171	61	102	18	15	8

Pre-crisis sample covers the period from January 2, 2002, through July 31, 2007.
Post-crisis sample covers the period from August 1, 2007, through December 30, 2011.

Table 2: Probit Results for the United States

		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.
		Pre-crisis	Crisis	Δ	Pre-crisis	Crisis	Δ	Pre-crisis	Crisis	Δ	Pre-crisis	Crisis	Δ
1.	PC^{+}_{Agg} (3-day window)	--	--		--	0.77		--	--		--	--	
						1.01							
2.	PC^{-}_{Agg} (3-day window)	--	--		--	-0.41		--	--		--	--	
						0.54							
3.	PC^{0}_{Agg} (3-day window)	--	--		-0.16	-0.02	0.92	--			--	--	
					1.13	0.83							
4.	PC^{+}_{Agg} (10-day window)	--	--		--	--		--	0.05		--	--	
									0.57				
5.	PC^{-}_{Agg} (10-day window)	--	--		--	--		-0.72**	-0.17	0.03	--	--	
								0.19	0.17				
6.	PC^{0}_{Agg} (10-day window)	--	--		--	--		-0.18	-0.31	0.87	--	--	
								0.71	0.22				
7.	PC^{+}_{Agg} (total)	--	--		--	--		--	--		-0.30	-0.29	0.98
											0.67	0.24	
8.	PC^{-}_{Agg} (total)	--	--		--	--		--	--		0.46	0.01	0.52
											0.71	0.09	
9.	PC^{0}_{Agg} (total)	--	--		--	--		--	--		0.74**	-0.02	0.03
											0.33	0.13	
10.	Δ unemployment rate $_t$	-2.85**	-1.19	0.26	-2.57**	1.42	0.02	-2.59**	0.99	0.03	-3.18**	1.49	0.00
		1.07	0.93		0.87	1.36		0.87	1.38		1.02	1.32	
11.	Δ inflation rate $_t$	0.74**	0.31*	0.22	0.93**	-0.16	0.03	0.94**	-0.03	0.03	1.03**	0.00	0.02
		0.32	0.17		0.33	0.34		0.34	0.23		0.36	0.20	
12.	VIX $_{t-1}$	--	--		-0.04**	-0.08**	0.00	-0.04**	-0.07**	0.03	-0.05**	-0.07**	0.07
					0.02	0.02		0.02	0.02		0.02	0.02	
13.	Pseudo R^2			0.07			0.29			0.30			0.31
14.	LR statistic			13.12			53.69			55.99			58.31
15.	Number of Obs.			100			99			99			99

Standard errors are reported under coefficient estimates. **/* indicates significance at 95/90 percent level of confidence, respectively. Cells highlighted in grey are indicative of significant variables with too few observations to draw a valid conclusion.

Table 3: Probit Results for the Euro Area

		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.
		Pre-crisis	Crisis	Δ	Pre-crisis	Crisis	Δ	Pre-crisis	Crisis	Δ	Pre-crisis	Crisis	Δ
1.	PC^{+}_{Agg} (3-day window)	--	--		-0.33**	0.10	0.22	--	--		--	--	
					0.13	0.32							
2.	PC^{-}_{Agg} (3-day window)	--	--		0.23	-8.07**	0.00	--	--		--	--	
					0.72	0.41							
3.	PC^{0}_{Agg} (3-day window)	--	--		0.20	0.79	0.44	--	--		--	--	
					0.16	0.76							
4.	PC^{+}_{Agg} (10-day window)	--	--		--	--		-0.17**	-0.11	0.69	--	--	
								0.07	0.14				
5.	PC^{-}_{Agg} (10-day window)	--	--		--	--		-0.37	-0.17	0.70	--	--	
								0.36	0.36				
6.	PC^{0}_{Agg} (10-day window)	--	--		--	--		0.08	0.34	0.59	--	--	
								0.08	0.48				
7.	PC^{+}_{Agg} (total)	--	--		--	--		--	--		-0.13**	-0.01	0.69
											0.04	0.10	
8.	PC^{-}_{Agg} (total)	--	--		--	--		--	--		0.07	0.06	0.69
											0.32	0.32	
9.	PC^{0}_{Agg} (total)	--	--		--	--		--	--		0.04	0.22	0.59
											0.05	0.30	
10.	Δ unemployment rate $_t$	-7.38**	-2.75**	0.06	-5.14**	0.76	0.05	-5.17**	0.15	0.07	-5.82**	0.24	0.08
		1.98	1.33		2.36	1.52		2.35	1.52		2.12	1.55	
11.	Δ inflation rate $_t$	0.09	0.75	0.45	-0.15	0.33	0.49	0.26	0.44	0.80	-0.04	0.41	0.80
		0.74	0.50		0.49	0.47		0.48	0.52		0.50	0.53	
12.	VSTOXX $_{t-1}$	--	--		-0.03**	-0.07**	0.00	-0.03**	-0.07**	0.00	-0.03	-0.07	0.00
					0.01	0.01		0.01	0.01		0.01	0.01	
13.	Pseudo R^2			0.12			0.30			0.27			0.28
14.	LR statistic			23.45			58.13			52.26			54.07
15.	Number of Obs.			126			125			125			125

Standard errors are reported under coefficient estimates. **/* indicates significance at 99/95/90 percent level of confidence, respectively. Cells highlighted in grey are indicative of significant variables with too few observations to draw a valid conclusion.

Table 4: Policy Expectation Regression Results for the United States

		3-month OIS			6-month OIS			12-month OIS			2-year Bond		
		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.
		Pre-crisis	Crisis	Δ	Pre-crisis	Crisis	Δ	Pre-crisis	Crisis	Δ	Pre-crisis	Crisis	Δ
1.	PC^{+}_{Agg}	0.03	0.35**	0.13	-0.53	0.38*	0.04	-1.39*	0.77**	0.01	-2.98**	0.83	0.00
		0.13	0.17		0.38	0.22		0.74	0.38		1.13	0.67	
2.	PC^{-}_{Agg}	-0.18	0.01	0.59	-0.19	0.01	0.72	-0.75	-0.07	0.16	-1.07	-0.20	0.33
		0.35	0.06		0.55	0.08		0.47	0.13		0.87	0.19	
3.	PC^{0}_{Agg}	0.26	0.15*	0.65	0.59*	0.25*	0.35	0.70	0.56**	0.84	0.22	1.01**	0.40
		0.23	0.09		0.34	0.14		0.60	0.26		0.88	0.33	
4.	Δ Real Activity Surp. Index	0.01**	0.01**	0.58	0.03**	0.02**	0.19	0.07**	0.03**	0.02	0.09**	0.04**	0.01
		0.00	0.01		0.01	0.01		0.01	0.01		0.01	0.02	
5.	Δ Inflation Surprise Index	0.00	0.01	0.16	0.01**	0.01	0.63	0.01**	0.01	0.94	0.01	0.02**	0.68
		0.00	0.01		0.00	0.01		0.01	0.01		0.01	0.01	
6.	Interest Surprise	0.71**	1.11**	0.00	0.66**	1.17**	0.00	0.83**	1.13**	0.15	1.09**	0.64*	0.24
		0.04	0.07		0.06	0.13		0.08	0.19		0.12	0.37	
7.	VIX_{t-1}	0.0001	-0.0002**	0.00	0.0002	-0.0002**	0.00	0.0003*	-0.0001	0.00	0.0007**	0.0001	0.00
		0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00	
8.	R^2			0.19			0.14			0.10			0.04
9.	Number of Obs.			2173			2173			2173			2173

Newey-West heteroskedasticity consistent errors are reported. **/* indicates significance at 95/90 percent level of confidence, respectively. The regressions include a constant term (not shown). Cells highlighted in grey are indicative of significant variables with too few observations to draw a valid conclusion.

Table 5: Policy Expectation Regression Results for the Euro Area

		3-month OIS			6-month OIS			12-month OIS			2year Bond		
		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.
		Pre-crisis	Crisis	Δ	Pre-crisis	Crisis	Δ	Pre-crisis	Crisis	Δ	Pre-crisis	Crisis	Δ
1.	PC^{+}_{Agg}	-0.14**	-0.10	0.69	-0.12**	-0.15	0.75	-0.13	-0.16	0.89	-0.18	0.01	0.47
		0.04	0.08		0.05	0.10		0.09	0.16		0.12	0.24	
2.	PC^{-}_{Agg}	0.03	0.77**	0.06	-0.11	0.70*	0.08	-0.32	0.85	0.08	-0.14	1.78**	0.03
		0.16	0.36		0.21	0.42		0.36	0.58		0.47	0.76	
3.	PC^{0}_{Agg}	-0.01	0.30	0.21	-0.07	0.23	0.35	-0.11	0.00	0.83	-0.11	-0.22	0.86
		0.04	0.24		0.05	0.32		0.07	0.49		0.10	0.67	
4.	Δ Real Activity Surp. Index	0.00	0.00	0.40	0.00	0.00	0.94	-0.01	0.00	0.40	-0.01	0.00	0.65
		0.00	0.00		0.00	0.00		0.01	0.01		0.01	0.01	
5.	Δ Inflation Surprise Index	0.00	0.004**	0.04	0.00	0.004**	0.04	0.00	0.007**	0.02	0.00	0.007**	0.12
		0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00	
6.	Interest Surprise		0.438**			0.359**			0.205**			0.053**	
			0.01			0.01			0.01			0.01	
7.	VIX_{t-1}	-0.0006**	-0.0006**	0.76	-0.0005**	-0.0005**	0.64	-0.0003*	-0.0004**	0.17	0.0002	-0.0001	0.02
		0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00	
8.	R^2			0.09			0.06			0.03			0.01
9.	Number of Obs.			2200			2200			2200			2200

Newey-West heteroskedasticity consistent errors are reported. **/* indicates significance at 95/90 percent level of confidence, respectively. The regressions include a constant term (not shown). Cells highlighted in grey are indicative of significant variables with too few observations to draw a valid conclusion.

Table 6: Policy Expectation Regression Results for the United States (Net Effect)

		3-month OIS		6-month OIS		12-month OIS		2-year Bond	
		I.	II.	III.	IV.	V.	VI.	VII.	VIII.
		Pre-crisis	Crisis	Pre-crisis	Crisis	Pre-crisis	Crisis	Pre-crisis	Crisis
1.	PC^{Net}_{Agg}	-0.10	0.03	0.20	0.06	0.39	0.05	1.08	0.05
		0.18	0.06	0.38	0.07	0.67	0.11	1.18	0.17
2.	Δ Real Activity Surp. Index	0.01**	0.01**	0.03**	0.02**	0.07**	0.03**	0.09**	0.04**
		0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
3.	Δ Inflation Surprise Index	0.00	0.01	0.01**	0.01	0.01**	0.01	0.01	0.02**
		0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.01
4.	Interest Surprise	0.72**	1.11**	0.69**	1.17**	0.87**	1.13**	1.11**	0.65*
		0.04	0.07	0.06	0.13	0.07	0.19	0.10	0.37
5.	VIX_{t-1}	0.0001	-0.0002**	0.0001	-0.0002**	0.0003	-0.0001	0.0005*	0.0001
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.	R^2		0.19		0.14		0.10		0.05
7.	Number of Obs.		2173		2173		2173		2173

Newey-West heteroskedasticity consistent errors are reported. **/* indicates significance at 95/90 percent level of confidence, respectively. The regressions include a constant term (not shown). Cells highlighted in grey are indicative of significant variables with too few observations to draw a valid conclusion.

Table 7: Policy Expectation Regression Results for the Euro Area (Net Effect)

		3-month OIS		6-month OIS		12-month OIS		2-year Bond	
		I.	II.	III.	IV.	V.	VI.	VII.	VIII.
		Pre-crisis	Crisis	Pre-crisis	Crisis	Pre-crisis	Crisis	Pre-crisis	Crisis
1.	PC^{Net}_{Agg}	0.14**	0.14*	0.13**	0.18*	0.15*	0.21	0.21*	0.15
		0.04	0.08	0.06	0.10	0.09	0.16	0.12	0.25
2.	Δ Real Activity Surp. Index	0.00	0.00	0.00	0.00	-0.01	0.00	-0.01	0.00
		0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
3.	Δ Inflation Surprise Index	0.00	0.004**	0.00	0.004**	0.00	0.01**	0.00	0.01**
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.	Interest Surprise		0.44**		0.36**		0.21**		0.06**
			0.01		0.01		0.01		0.01
5.	VIX_{t-1}	-0.0006**	-0.0006**	-0.00053**	-0.0005**	-0.00032*	-0.0004**	0.000126	-0.0001
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.	R^2		0.09		0.06		0.03		0.01
7.	Number of Obs.		2200		2200		2203		2203

Newey-West heteroskedasticity consistent errors are reported. **/* indicates significance at 95/90 percent level of confidence, respectively. The regressions include a constant term (not shown). Cells highlighted in grey are indicative of significant variables with too few observations to draw a valid conclusion.

Table 8: Policy Expectation Regression Results for the United States with the Zero Lower Bound

		3-month OIS			6-month OIS			12-month OIS			2-year Bond		
		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.
		Pre-crisis	Early Crisis	ZLB	Pre-crisis	Early Crisis	ZLB	Pre-crisis	Early Crisis	ZLB	Pre-crisis	Early Crisis	ZLB
1.	PC^{+}_{Agg}	-0.01	-0.08	0.16*	-1.43**	0.12	0.67*	-1.43**	0.12	0.67*	-3.00**	-1.29	1.03
		0.13	0.48	0.09	0.74	1.31	0.37	0.74	1.31	0.37	1.13	1.11	0.72
2.	PC^{-}_{Agg}	-0.19	-0.25	-0.05*	-0.76	0.30	-0.09	-0.76	0.30	-0.09	-1.08	-0.63	-0.20
		0.37	0.84	0.03	0.47	2.00	0.07	0.47	2.00	0.07	0.87	3.04	0.14
3.	PC^{0}_{Agg}	0.25	0.58	0.02	0.69	1.76**	0.28*	0.69	1.76**	0.28*	0.21	2.14**	0.71**
		0.23	0.39	0.04	0.60	0.73	0.15	0.60	0.73	0.15	0.88	0.86	0.27
4.	Δ Real Activity Surp. Index	0.01**	0.03	0.01**	0.07**	0.04	0.02**	0.07**	0.04	0.02**	0.09**	0.04	0.04**
		0.00	0.02	0.00	0.01	0.04	0.01	0.01	0.04	0.01	0.01	0.05	0.02
5.	Δ Inflation Surprise Index	0.0005	0.0174	0.0027*	0.0110**	0.0180	0.0034	0.0110**	0.0180	0.0034	0.0114	0.0266*	0.0079
		0.00	0.01	0.00	0.01	0.02	0.00	0.01	0.02	0.00	0.01	0.01	0.01
6.	Interest Surprise	0.70**	1.02**	1.54**	0.83**	1.02**	1.68**	0.83**	1.02**	1.68**	1.09**	0.56	0.95**
		0.04	0.09	0.02	0.08	0.21	0.04	0.08	0.21	0.04	0.12	0.42	0.07
7.	VIX_{t-1}	0.0002	-0.0004**	0.0000	0.0005**	-0.0002**	0.0001	0.0005**	-0.0002**	0.0001	0.0007**	0.0000	0.0003*
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.	R^2			0.23			0.17			0.11			0.06
9.	Number of Obs.			2173			2173			2173			2173

Newey-West heteroskedasticity consistent errors are reported. **/* indicates significance at 95/90 percent level of confidence, respectively. The regressions include a constant term (not shown). Cells highlighted in grey are indicative of significant variables with too few observations to draw a valid conclusion.