Expectations or surprises: what really moves the U.S. Treasury market?

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Abstract

The standard approach in asset pricing is to use information shocks to determine how markets react to news. We examine this paradigm empirically by decomposing high-frequency bond responses into *ex-ante* (expected) and *ex-post* (surprise) news components. Focusing on the effects of macro news on the U.S. Treasury market, we measure the aggregate response in various forms by considering returns, volatility and abnormal price jumps. Our analysis shows that the magnitude, direction and duration of reactions depend on the choice of measurement component that is either expectations or surprises. While bond returns barely react to news, volatility is closely linked to fundamentals (both ex-ante and ex-post). Ex-ante forecasts of investors generate significant jump (tail) clustering in the data, but we find no evidence for such effects with (ex-post) surprise measures. This suggests that considering ex-post surprises solely as proxy for shocks undermines the realized announcement impact, particularly for characterizing jump-type tail behavior in crisis periods. The news-implied reaction dispersion between expectations and shocks is sizable, related to trading volume and time-varying over the business cycle. Our findings provide relevant implications for macro-finance modeling and bond market microstructure.

Keywords: U.S. Treasury market, Volatility, Jumps, High-frequency data, Macroeconomic news announcements, Public information, Price discovery

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1. Introduction

Financial markets are steadily exposed to information shocks driven by macroeconomic uncertainty, monetary policy decisions and trading activity. For investors, the arrival of new public information is important, for instance, to design investment strategies (Brandt and Kavajecz, 2004), adjust portfolio choice/diversification (Aït-Sahalia and Hurd, 2016; Das and Uppal, 2004), and estimate risk premium associated with asset price fluctuations (Aït-Sahalia et al., 2012). From a monetary policy perspective, understanding news effects is of interest particularly for central bankers to manage expectations and reduce market volatility.[1]

Measuring market reaction to news is, however, empirically challenging. The main reason behind this challenge is that shocks are unobservable and hence the *true* impact is latent in practice (Bekaert et al., 2013). To deal with this difficulty, researchers often extract the *unexpected surprise* component of announcement releases and use the surprise news component as a proxy for information shocks (see e.g., Bartolini et al., 2008; Fleming and Remolona, 1997; Green, 2004 and Gurkaynak et al., 2005). For instance, Fleming and Remolona (1997) and Green (2004) link bond trading activity to public information arrivals and show that news surprises lead to large price impact and volatility. In a macro-finance framework, Gurkaynak et al. (2005) document that long-term forward rates vary with the unexpected/unanticipated surprises of macroeconomic and monetary policy data release. Following this line, Bartolini et al. (2008) and Lahaye et al. (2011) continue to adopt a similar surprise-based approach and investigate how stocks, bonds and exchange rates respond to announcement reports: the prevailing evidence suggests that what moves markets is (and should be) the *expost* (i.e., after-news) unexpected surprises.

In this paper, we question this conventional approach and empirically show that market response to expost news surprises is more limited than documented in the literature. This finding particularly supports the view of Rigobon and Sack (2008) such that market responses to news shocks are relatively small and this (puzzle) may be related to the measurement of (noisy) announcement effects. We propose an approach that provides a potential resolution to this puzzle. Focusing on the trading patterns of the U.S. Treasury market, where the role of public information is essential, we decompose market reaction into expectation and surprise component of news announcements.[2] Because news arrivals (either exante or expost) could be associated with different moments of

[1] See e.g., Dominguez (2003, 2006), who show that central banks intervene to markets in periods of high volatility, i.e., when news-driven market fluctuations are severe. In this direction, Fratzscher (2006) find evidence that central bank communication can manage the investors' expectations and calm disorderly market conditions. For a comprehensive survey on this literature, see Blinder et al. (2008).

[2] Public information plays a role for both long-term investors and short-term traders, see e.g., Berry and Howe (1992), Ederington and Lee (1993), Fleming and Remolona (1999), Green (2004), Fleming and Piazzesi (2005), Mizrach and Neely (2008), Li et al. (2009), Brogaard et al. (2014). Furthermore, compared to stocks, the potential effect of new public information on bonds is often less ambiguous in theory. As Fleming and Remolona (1997) argue, this is mainly because stock prices are exposed to both cash flow and discount rate effects. For instance, while positive news related to macro fundamental may decrease bond prices (through discount rate effect), reaction of stock prices depends on which affects dominates the other. For that reason, the release of public information could be more important for bond traders than for stock traders regardless of the investment horizon.

intraday data, we consider three forms of market impact: realized returns, price volatility and jumps where the latter represents sudden/abnormal changes in bond prices apart from return and volatility patterns.[3] Taken together, these three reaction quantities allow us to trace the speed, strength and direction of news effects tied to expectations versus surprises.

Our empirical analysis reveals that market responses are not only linked to expost (surprise) measures of information shocks, but also to exante market expectations of investors. Bond prices adjust to most macro news rather quickly and hence returns barely react to fundamentals. The gradual (dynamic) impact of GDP and Nonfarm Payroll reports, however, depends significantly on the choice of reaction measure: while *expected* exante component of GDP (Nonfarm Payroll) release decreases (increases) returns, unexpected surprise component increases (decreases) returns. Moreover, we show that FOMC decisions affect cumulative bond returns and jumps *only* through expectations rather than surprises. Although volatility is strongly linked to macroeconomic conditions, investors' expectations for FOMC announcements fail to impact volatility at the high-frequency.

At the intraday level, the decomposition of exante versus expost information particularly affects jump-type tail responses. For example, expectations and surprises move price jumps to different directions with different magnitudes. Compared to volatility and return reactions, exante (expected) macro fundamentals are more influential for generating jumps. When we consider subsequent (delayed) news adjustment process, surprises explain only 1% of the total jump variation, whereas regression R^2 rises to 13% with the expected component of announcements. Unlike expost surprise effects, bond jumps react to exante expectations gradually, providing indirect evidence of *private information* circulating within the Treasury market.[4] These results hold regardless of the jump tail either negative (downside) or positive (upside).

The remainder of the paper is organized as follows. The next section discusses the related literature. Section 3 describes the data and outlines the methodology relying on high-frequency response regressions. In Section 4, we present the empirical results and discuss the financial implications. Section 5 reports the findings of our robustness checks and Section 6 concludes.

2. Related literature

Our paper is closely related to the studies that investigate the news effects on bond returns and volatility.[5] For instance, Jones et al. (1998) and Balduzzi et al. (2001) show that bond returns adjust

[3]Separating jumps from time-varying diffusive volatility is important because jumps represent tail risk and market fear, which cannot be explained by diffusive risk. Risk premium is mostly associated with jumps rather than volatility (see Bollerslev and Todorov, 2011a,b and Maheu et al., 2013). Furthermore, As Drechsler and Yaron (2011) argue, jump reactions represent non-Gaussian innovations to fundamentals and thus help understand how agents' views vary with high level of economic uncertainty.

[4]Consistent with the volatility results of Fleming and Remolona (1999), jump persistence attributed to exante expectations may reflect residual disagreement among bond investors about how new information moves intraday prices. Such a potential heterogeneity may arise from traders' differences in opinions and views. See, e.g., Pasquariello and Vega (2007), who examine bond market responses to news shocks through a trading environment with information heterogeneity.

[5]See e.g., Jones et al. (1998); Balduzzi et al. (2001); De Goeij and Marquering (2006); Andersen et al. (2007).

to news surprises rather quickly.[6] Our results support this conclusion but also show that the effect of GDP, Nonfarm Payroll and FOMC announcements on intraday returns is delayed. The evidence for volatility impact, however, appears to be mixed in the literature. For Jones et al. (1998), announcement shocks generate short-lasting effects, whereas Balduzzi et al. (2001) document that intraday volatility remains elevated following the news surprises. Disentangling expectation-driven reactions from surprises offers a potential resolution. We find that volatility adjusts to FOMC decisions quickly, while the volatility effect of macro fundamentals continues to be significant about 20-25 minutes following the news events. In this line, De Goeij and Marquering (2006) use data on different maturities and find that monetary policy (macro fundamentals) affect only short term (long-term) volatility. We focus on long term bond volatility characteristics and extend this study by separating exante versus expost effects. Comparing return and volatility responses across global markets, Andersen et al. (2007) find that macro announcements are the most influential in the U.S. Treasury market. We confirm these results through volatility impact and extend by considering jump-type reactions that cannot be solely explained by time-varying volatility patterns.[7] Taken together, this allows us to investigate the different distributional characteristics of data linked to first (returns), second (volatility) and third moments (jumps).

Another strand of literature studies the interaction between news surprises and jumps in bond prices (see e.g., Dungey et al., 2009; Beber and Brandt, 2010; Lahaye et al., 2011; Jiang et al., 2011 and Dungey and Hvozdyk, 2012). For example, Beber and Brandt (2010) find that macro news increases bond jump activity through volatility. Revisiting news-jumps relationship, Dungey et al. (2009) show that jumps in the U.S. Treasury bond prices occur even in trading days without any news arrivals. Lahaye et al. (2011) confirm this finding, and Jiang et al. (2011) suggest that liquidity factors—rather than expost information shocks—drive jump-type market uncertainty. Our analysis is linked to this line of research in several respects. First, contrary to the analysis of Beber and Brandt (2010), we separate jump movements from volatility and examine news effects on these measures separately. Second, as in Dungey et al. (2009) and Lahaye et al. (2011), we show that the surprise component of new public information has limited power to explain jumps in the data. We argue that one reason behind this pattern is related to reaction measurement. Jump responses appear to be disconnected from macro shocks, when we use the expost surprise component of news announcements as a measurement proxy. The exante expected component of new information, however, explains a larger fraction of jump arrivals compared to expost surprise. Our approach could hence help resolve the jumps-news conflict: investors' expectations rather than surprises for

[6]From a microstructure perspective, the main mechanism behind market reaction relies on the price discovery process. The prior literature on the relation between price discovery and public information arrivals is extensive. See e.g., Fleming and Remolona (1999), Andersen et al. (2003), Brandt and Kavajecz (2004), Andersen et al. (2007), He et al. (2009), Jiang et al. (2011) and Man et al. (2013).

[7]To further explore system-wise information spillovers, Brenner et al. (2009) link unexpected news surprises to volatility comovements, documenting evidence for shock propagation within bond markets. Unlike Andersen et al. (2007), Beber and Brandt (2010) suggest that expost return and volatility dynamics vary with the business cycle: responses are stronger to bad (good) news in booms (recessions).

the economy generate jump-type abnormal price moves despite the role of market microstructure factors, such as trading activity and liquidity (Jiang et al., 2011).

The empirical analysis of the paper particularly extends the works of Evans (2011) and Dumitru and Urga (2016). Evans (2011) examines how macro announcements prompt jump arrivals in the U.S. futures market. The jump regressions of Evans (2011) reveal that macro news arrivals (i.e. dummies) and FOMC shocks/surprises barely influence intraday bond jumps. Relying on the same model specification, we run jump regressions by disentangling the effects of expectations from surprises. Our estimates for exante news components contrast sharply with those reported in Evans (2011). First, jumps are closely linked to macro fundamentals and the degree of connection appears to be stronger prior to the subprime mortgage crisis. Second, expectations for FOMC policy decision are significantly associated with jump clustering, decreasing prices (increasing yields) about 6-10 basis points (bps). The partial R^2 value of FOMC rate expectations reaches to 10%, which is statistically significant and larger than documented by Evans (2011) (as 5%). This result has also economic relevance: because expectations of market participants for the future economic outlook could largely diverge, trading activity reflects differences of opinion (Fleming and Remolona, 1997) rather than heterogeneity in receiving information (Bacchetta and Wincoop, 2006). Such dynamics in turn amplify persistent jump-type fluctuations at intraday trading frequencies. News surprises, however, tend to be short-lived and hence mitigate the impact of news arrivals. In this direction, Dumitru and Urga (2016) conclude that information asymmetry in price discovery varies with jump arrivals. Our work complements Dumitru and Urga (2016) in three aspects. First, we disentangle new effects into exante and expost factors, whereas Dumitru and Urga (2016) utilize only expost measures (release/surprise). As our empirical analysis details, this decomposition changes the direction, magnitude and variation of jump reactions. Second, the focus of Dumitru and Urga (2016) is on jump dynamics per se, while we characterize market reactions not only related to jumps but also in forms of returns and volatility. Third, Dumitru and Urga (2016) argue that longer maturities display different patterns compared to shorter maturities, and surprises fail to explain jumps for long horizons. In contrast, we find evidence in favor of news-driven jumps in long maturity bond prices. As Rigobon and Sack (2008) point out, analyzing how markets react to news could depend on the measurement of the information content. For jumps, expost information is incorporated fast and jump responses appear to be limited. Price jump impact linked to exante factors is, however, more persistent and hence fundamentals are perhaps more powerful to explain tail risk.

On the methodological front, our estimation approach directly builds on the response regressions developed by Andersen et al. (2003, 2007). We regress bond returns, volatility and jumps on expectation and surprise components of each macro announcement. To analyze the role of expectations versus surprises, we consider different forms of regressions, such as *sink* models (where all exante and expost factors appear together within the same multiple regression model) and decomposed models (where we investigate the exante and expost new components on markets separately). In parallel to Andersen et al. (2003, 2007), our news database consists of twenty-four U.S. macroeconomic news announcements. We augment the database by adding the expectated and surprise components of FOMC policy decisions. To measure exante impact, we use analysts' consensus forecasts and the range between highest-lowest expectations as a proxy for expectational dispersion. As is standard, our expost reaction proxies are the actual news releases and the unexpected surprise components of announcements. The latter represents consensus errors or news shocks.

Few studies have examined the potential limitation of using expost surprise measures (e.g., Conrad et al., 2013; Fleming and Piazzesi, 2005 and Gurkaynak et al., 2005). The standard term structure theory implies that the price impact of information shocks should be short-lived so that the expectations of investors for the future play no role in shaping yield curve. Gurkaynak et al. (2005) find evidence that refutes this prediction and document that surprise news components may suffer from measurements errors. To assess how markets react to FOMC decisions, Fleming and Piazzesi (2005) suggest tracking the shape of the yield curve instead of using *expost surprise* measures. Rigobon and Sack (2008) develop an econometric approach to account for the noise in measured expost data surprises directly. Our paper attempts to provide an alternative explanation by highlighting the importance of *exante expectations* when quantifying bond market reaction to news. Conrad et al. (2013) find that exante (expected) volatility raises future stock returns. Rather, we focus on bond market dynamics and study how exante news components move historical bond returns, volatility and jumps in prices.

3. Data and methodology

3.1. Bond data

We use 5-minute data for the 30-year U.S. Treasury bond futures traded on the Chicago Board of Trade (CBOT). We consider a sample that covers the periods from January 1, 2004 to December 31, 2010. Tickdata Inc. provides the transaction prices throughout the trading days and we consider closing prices in our empirical analysis. We follow Opschoorb et al. (2014) and start sampling from 8:30 EST until 15:00 EST, the last observation of the trading day t. These trading hours leave us $N = 78$ five-minute intervals for the all sample trading days in our database.

As is standard in the literature, we omit trading days with too many missing values or low trading activity (see e.g., Lahaye et al., 2011; Opschoorb et al., 2014). We removed fixed/irregular holidays, weekends and trading days for which there are more than 19 missing values at the 5-minute frequency (corresponding to more than one fourth of the data), and trading days with too many empty intervals and consecutive prices.[8] Appendix A presents the details of the data description and adjustment procedures.

To measure intraday volatility correctly, it is important to account for the (intraday) periodic effects caused by regular trading patterns, such as openings and closings of the major markets

[8]These holidays include the New Year (December 31−January 2), Martin Luther King Day, Washington's birthday or Presidents' Day, Good Friday, Easter Monday, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas (December 24−26).

(see e.g., Andersen and Bollerslev, 1997; Baillie and Bollerslev, 1991; Lahaye et al., 2011). We use the filtration method proposed by Erdemlioglu et al. (2015) to identify the period component of volatility. To implement the procedure, we first estimate intraday periodicity in the data and then remove periodicity from exchange rate returns by using the estimates. As Erdemlioglu et al. (2015) emphasize, this method is advantageous because it does not impose any structural restrictions on volatility estimators.[9]

3.2. Macroeconomic announcements

As in Opschoorb et al. (2014) and Andersen et al. (2003), our news database consists of twenty-four U.S. macroeconomic variables and the Fed funds rate determined by the FOMC committee. For each announcement type, we have data (estimates) on consensus forecasts (i.e., the median forecasts of analysts), the released actual figures of the macro variable (REL) and the lowest versus highest forecasts of analysts for each announcement (HIGH, LOW). We obtain the raw announcements data from the Econoday and the actual released figures are provided by the Haver Analytics. The data on median analysts forecasts are provided by Market News International and Thomson Financial. The announcement sample covers the periods January 1, 2004 to December, 2010.[10] Table 1 describes our macroeconomic news announcements data.

[Insert Table 1 here]

We classify the announcements in four categories: (1) real activity, (2) consumption and investment, (3) government, trade and prices, (4) indicators, indices and policy. For each category, the table reports the macro variable, time/frequency of the announcement, the number of news arrivals, mean and standard deviation. To ease comparison and interpretation, we standardize announcements in each category before conducting the estimations.

3.3. Exante and expost measures of news announcements

We measure the exante and expost components of news announcements in a rather tractable way. Using the announcement categories presented in Table 1, we derive three main proxies, namely, CON, RANGE and SURP:

- CON: the standardized median analysts' forecasts representing *exante* consensus market expectations towards macro fundamentals and monetary policy (i.e., the Federal (Fed) funds rate).
- RANGE: the standardized difference between the highest and lowest forecasts of analysts. This proxy tracks the *exante* dispersion in market expectations for the macro fundamentals.

[9] This is particularly the case for the choice of cutoff values in threshold power variations. For brevity, we do not detail the procedure here, yet it is available upon request.

[10] Due to data availability, the sample of LOW and HIGH measures (last two columns) starts from May 29, 2007.

- SURP: the standard proxy for unexpected information shocks representing news surprises. We extract the (expost) surprise component of announcements as the difference between released announcement value (REL) and its survey median expectation (CON), divided by the standard deviation of the difference.[11]

3.4. Response regressions for returns, volatility and jumps

To motivate our regression setup, let us first consider a standard linear model for a certain market reaction type. The general form of our response regressions is such that

$$REACTION_t = \beta_0 + \beta_1 NEWS_{1,t} + \beta_2 NEWS_{2,t} + \cdots + \beta_n NEWS_{n,t} + \epsilon_t, \tag{1}$$

where $REACTION_t$ denotes the reaction type as a dependent variable, β_0 is the drift term and β_1, $\beta_2, \ldots, \beta_n$ simply determine the degree of relationship between the reaction form and multiple news events ($NEWS_{1,t}$, $NEWS_{2,t}$, ..., $NEWS_{n,t}$) arriving at time t. Relying on this underlying model, we identify market reaction in several forms: (a) realized *returns* (i.e., price variation incurring intraday gain or loss), *volatility* (i.e., price fluctuations) as well as extreme swings generating *jumps* in bond prices. Each response type characterizes different bond market dynamics—as soon as the news arrives—and hence we consider all these three forms (as dependent variables) when studying expected versus surprised effects. Because we aim at measuring such reactions in continuous-time, we assume that the log-price $p(t)$ follows a jump-diffusion process such that

$$dp(t) = \mu(t)dt + \sigma(t)dW(t) + h(t)dq(t), \qquad t \geq 0, \tag{2}$$

where $dp(t)$ denotes the logarithmic price increment, $\mu(t)$ is a drift term, $\sigma(t)$ is a strictly positive and càdlàg (right-continuous with left limits) stochastic volatility process, and $W(t)$ is a standard Brownian motion. In Equation (2), $q(t)$ further denotes a jump process (e.g., Poisson process) and $h(t)$ denotes the jump sizes.[12]

Throughout, we further assume that $p(t)$ is observed at discrete points in time, and the continuously compounded ith intra-day return of a trading day t is hence given by $r_t \equiv p(t+i\Delta) - p(t+(i-1)\Delta)$ with $i = 1, ..., M$ and trading days $t = 1, ..., T$. Similar to those adopted in Andersen

[11] That is, the standardized surprise for announcement j, at time t, i, is $S^j_{t,i}$=$(R^j_{t,i}$-$E^j_{t,i})/\hat{\sigma}_j$, where $R^j_{t,i}$ is the released announcement figure j at time t,i, $E^j_{t,i}$ is its consensus market forecast and $\hat{\sigma}_j$ is the standard deviation of the difference. See e.g., Opschoorb et al. (2014), Menkveld et al. (2012), Lahaye et al. (2011), Pasquariello and Vega (2007), Andersen et al. (2003) and Balduzzi et al. (2001), who use consensus data and adopt this surprise measurement approach.

[12] In our analysis, we are particularly interested in detecting rare and large (i.e., finite-activity) jumps in the data based on the semimartingale given by Equation (2). Nevertheless, our robustness analysis (Section 5) reveals that the form of the jump component (i.e., Poisson type finite-activity versus generalized Lévy type infinite-activity) does not significantly change the parameter estimates.

et al. (2003, 2007), the specific forms of our response regressions then can be written as:

$$\textbf{Return responses:} \quad r_t^* = \beta_0 + \sum_{i=1}^{l} \beta_i r_{t-i}^* + \underbrace{\sum_{k=1}^{K}\sum_{j=0}^{J} \beta_{kj}^{(e)} E_{k,t-j}}_{\text{exante component}} + \underbrace{\sum_{k=1}^{K}\sum_{j=0}^{J} \beta_{kj}^{(s)} S_{k,t-j}}_{\text{expost component}} + \varepsilon_t \tag{3}$$

$$\textbf{Volatility responses:} \quad |r_t^*| = \beta_0 + \sum_{i=1}^{l} \beta_i |r_{t-i}^*| + \underbrace{\sum_{k=1}^{K}\sum_{j=0}^{J} \beta_{kj}^{(e)} |E_{k,t-j}|}_{\text{exante component}} + \underbrace{\sum_{k=1}^{K}\sum_{j=0}^{J} \beta_{kj}^{(s)} |S_{k,t-j}|}_{\text{expost component}} + \varepsilon_t \tag{4}$$

$$\textbf{Jump responses:} \quad |\kappa_t^*| = \beta_0 + \underbrace{\sum_{k=1}^{K}\sum_{j=0}^{J} \beta_{kj}^{(e)} |E_{k,t-j}|}_{\text{exante component}} + \underbrace{\sum_{k=1}^{K}\sum_{j=0}^{J} \beta_{kj}^{(s)} |S_{k,t-j}|}_{\text{expost component}} + \varepsilon_t, \tag{5}$$

where r_t^*, $|r_t^*|$ and $|\kappa_t^*|$ are the periodicity-filtered returns, proxy for spot volatility and price jumps in absolute terms (identified by Lee and Mykland, 2008 approach), respectively. In each regression model (from (3) to (5)), $\sum_{k=1}^{K}\sum_{j=0}^{J}\beta_{kj}^{(e)}|E_{k,t-j}|$ and $\sum_{k=1}^{K}\sum_{j=0}^{J}\beta_{kj}^{(s)}|S_{k,t-j}|$ are the exante and expost measures of K macro announcements with J-period lagged effects. For return and volatility responses, we further consider the l lagged values of the dependent variables (i.e., $\sum_{i=1}^{l}\beta_i r_{t-i}^*$ and $\sum_{i=1}^{l}\beta_i|r_{t-i}^*|$, respectively).

To highlight the potential intraday impact of new information on trading, we report in Tables 2 and 3 the largest negative and positive changes of the 30-year U.S. Treasury bond prices, respectively. Similar to the assessment of Fleming and Remolona (1997), we sort the largest negative and positive returns on our sample and then mark the associated news events (if any) corresponding to those largest price changes together.[13]

[Insert Tables 2 and 3 here]

The table indicates that the majority of the largest negative and positive price changes systematically occur within 5-minutes following the news announcement releases. For instance, if the scheduled macro news becomes public at 8:30 in the morning, we observe the sharp price change at 8:35 (third column in tables). The fourth column of Table 2 reflects that largest decreases in prices are related to the announcements of Nonfarm Payroll, Trade Balance and Unemployment Claims (corresponding the news types 4, 17 and 25) among other drivers, such as GDP and CPI. Moreover, while several most extreme movements also occur in days without any news events (e.g., November 29, 2004 and January, 20, 2009 in Table 2), this does not seem like a common feature in the data. Only seven largest negative and positive changes (out of twenty-five) occur on days when there is no scheduled news event.[14]

[13]Overall, we examine into the fifty largest positive and fifty largest negative price changes. This roughly captures the occurrences in far-extreme right tail and far-extreme left tail lower than 1% of observations. To ease exposition on the tables, we report only the first twenty-five of largest changes. The additional statistics are in line with those of the first twenty-five observations and available upon request.

[14]We further identify some news events that are not necessarily followed by largest negative or positive returns.

Largest negatives/positives exhibit similar patterns in terms of information-reaction match). One noticeable observation is that the largest decreases in price are associated with *positive* dispersion (i.e., release − consensus) whereas the largest increases in prices coincide with *negative* dispersion. This regularity holds for most of the largest changes and likely reflects the tail impact of negative versus positive surprises, respectively.

Tables 2 and 3 further reveal that some of the largest negative and positive price changes are the identified intraday jumps. It is, however, important to note that certain fraction of the largest changes are not necessarily associated with price jumps. One candidate explanation is that jumps are the large price changes after controlling volatility and periodic effects. Therefore, if volatility on announcement days is high, then the size of the price increment shrinks because we scale large prices with volatility and periodic patterns. Regardless, we notice five Lee and Mykland (2008) jumps out of twenty-five largest changes in bond prices.

Given these features in the bond data, we proceed by estimating our response regressions. We estimate the reaction coefficients using least squares based on various specifications with regard to components and impact timing. First, we investigate full responses and include both exante and expost components of announcements in our regressions (Section 4.1). Relying on our preliminary assessment, we next decompose bond responses into exante versus expost effects and examine the estimated coefficients separately in Sections 4.2 and 4.3. To better understand the information content embedded in exante versus expost news components, we further study the speed (duration) of news adjustment process, the role of 2007-2008 subprime financial crisis as well as the interaction effects (Sections 4.4−4.6). Finally, we complete our baseline analysis by characterizing the empirical link between trading activity and (exante- versus expost-implied) tail responses.

4. Results

4.1. High-frequency bond market reaction with exante and expost measures

We start by examining the joint impact of both exante and expost measures on bond market dynamics. We proceed to estimate an unrestricted model that contains the exante and expost information for each news announcement. To capture exante factors, we consider (median) consensus forecasts of investors as well as ranges between high and low forecasts (i.e., the dispersion in the expectations) for the macro variable. Our expost variables rely on surprises and represent news shocks as measured by the difference between expectations and released figures.[15] Given these information factors, we analyze three distinct type (or moment) of market reaction: returns, volatility and extreme price jumps.

[Insert Table 4 here]

[15]We conducted the standard diagnostic tests prior to the estimations. Utilizing the collinearity test, we noticed that the correlation between exante consensus forecasts and expost surprises is rather negligible, whereas there is high correlation between consensus forecasts and released announcements. To eliminate inference problems, we thus use only surprises conveying expost information.

Table 4 reports the regression results for the contemporaneous responses of bond returns. Several exante (consensus forecast) variables appear to be significant by generating positive impact (exante factors in [1]): GDP final, Consumer credit, Business inventories and Consumer price index (CPI). Among those exante forecast variables, bond returns react mostly to Inventories and Consumer credit (1.57 and 1.33 bps, respectively). Perhaps surprisingly, Inflation (via CPI) increases bond returns only by 0.13 bps, but decreases if we consider the forecast dispersion in inflation expectations (-0.09 bps in [2]) rather than forecast levels.

The second panel of Table 4 presents the bond return reactions to expost factors within the same full model (i.e., variables 26−50). The estimates deliver two interesting results. First, the variables that are significant at the exante level (variables 1, 3, 9, 15, 19) fail to explain the return variation at the expost level (variables 26, 28, 34, 40, 44). Second, bond returns now respond contemporaneously to various expost measures, including Construction spending, Factory orders and Government budget deficit. The table further indicates that the interest rate decisions of FOMC committee (variable 24) fail to move returns contemporaneously irrespective of the type of information (i.e., either exante or expost). More broadly, these estimation results indirectly support the market efficiency hypothesis such that expost news shocks are incorporated into prices quickly, which in turn is likely to trim realized return responses.

[Insert Table 5 here]

Having assessed the joint effects of exante and expost factors, we now turn to examine volatility reaction. Table 5 reports the news response coefficients for both exante and expost variables in the full model. The first noticeable feature is that the high-frequency response of bond volatility to news differs substantially from that of returns (e.g., exante factors panel in Tables 4−5). For instance, most macro announcements and FOMC rate decisions significantly impact intraday bond volatility, except a few real activity and consumption/investment-related variables. Focusing on the exante factors, we further notice that the variables increasing returns are no longer significant to affect volatility (e.g., variables 3, 9, 15). Nonfarm payroll, GDP advance, Trade balance and Unemployment claims are the key exante variables contributing to volatility (around 2 bps). Consistent with the results of Opschoorb et al. (2014) (for bonds) and Andersen et al. (2003) (for currencies), volatility tends to decline suddenly when the news is released (around 1 to 2 bps).[16] Unlike return responses, volatility reaction appears to be qualitatively similar with forecast range as an alternative exante measure (last three rows in [2]).

The table further indicates that the degree of volatility reaction depends also on whether or not the information component in the news is exante or expost. The two key factors revealing such evidence are FOMC policy rate decisions and Initial unemployment claims (variables 24 and 25, respectively). While (exante) market expectations towards FOMC rates cannot solely move the

[16]This evidence is perhaps in favor of the sudden *calming down* effect of information when market participants start interpreting the news. Our finding is broadly in line with the patterns identified in Andersen et al. (2007) (see e.g., page 265 in this study).

U.S. bond market volatility (in [1]), the expost market surprises significantly lower it (about 5 bps in [2]). When the news is, however, linked fundamentals (e.g., Employment claims), the evidence suggests that exante rather than expost information significantly impacts intraday volatility (2.7 bps and 0.7 bps, respectively). The difference in significance (exante versus expost) could be explained by the fact that market participants and bond traders are likely to wait for the released figure of FOMC committee to take positions. Therefore, the information embedded in surprises (via releases) contributes to volatility rather than expectations (through consensus forecasts). For macro fundamentals (e.g., Initial employment claims), volatility response seems to be stronger with exante measures: expectations rather than news surprises tend to move market volatility in this case.

[Insert Table 6 here]

As we discussed earlier, Return and volatility features capture bond market trading activity only partially. News events are typically associated with sudden (tail-type) market/trading reaction which in turn amplifies jumps in asset prices. Therefore, we now consider jumps as an alternative reaction type and investigate how price jumps react to exante and expost news components. Table 6 reports our jump regression results.

The results indicate that U.S. macroeconomic conditions significantly generate negative jumps in the bond market. Because jumps represent sudden/abrupt market movements, the magnitudes of responses are rather large varying between 1 to 11 bps. Perhaps more importantly, exante and expost variables contribute jump dynamics in different ways. For instance, the (exante) component of New home sales announcements creates negative jumps (by size of 10.1 bps), whereas the expost impact of the same variable on bond jumps is relatively marginal (i.e., 2.4 bps). Moreover, Consumer confidence index appears to be an important indicator when measured by exante information (9.8 bps). However, the coefficient estimate of the same variable is statistically insignificant to explain jump-type price adjustment at the expost level.

Another noteworthy pattern is related to the coefficients of FOMC rate decisions. As the upper panel of Table 6 indicates, forward-looking expectations for the Fed Funds rate lead to negative jumps in prices about 11 bps (upper panel in [1]). If we measure the jump reaction by expost surprise component instead, the effect of the variable appears to be smaller around 6 bps (lower panel in [2]). This suggests that jump response linked to FOMC decisions is stronger with exante market expectations than that with expost surprises.

4.2. Disentangling market responses into exante and expost information

In the previous section, we presented preliminary evidence that bond market responds to exante and expost information in distinct ways. Expectations (conveying exante information) significantly move bond prices, volatility and jumps even in the presence of surprise effects (conveying expost information). To delve this analysis further, we now split contemporaneous market reaction into exante and expost factors and examine (return, volatility and jump) effects separately.

[Insert Table 7 here]

Table 7 reports the estimated news response coefficients for returns 5-minutes following the announcements. Several features are worth mentioning. While consensus (exante) expectations for GDP figures (variable 3) significantly (at 5%) increase bond returns about 0.14 bps, expost reaction (through surprises) appears to be negative and statistically insignificant (last column [SURP]). This evidence is also pronounced with other exante factors including Consumer credit, Business inventories and Consumer prices. Furthermore, regardless of the choice of reaction factors (i.e., exante or expost), neither Nonfarm payrolls (variable 4) nor FOMC rates generate any sudden bond return variation. The middle panel of the table also indicates that exante range factors (i.e., high-low dispersion in consensus forecasts) are mostly insignificant except for inflation expectations (variable 19). More broadly, in terms of overall significance of exante and expost measures, R^2 values seem to be very low irrespective of the information content; consensus, range or surprise (lower panel of Table 7).

[Insert Table 8 here]

Relying on the same regression specifications (i.e., exante information [CON]-[RANGE] versus expost information [SURP]), we now turn to the analysis of instantaneous volatility responses. Table 8 reports the estimated coefficients for each model. The table allows us to make various types of result comparison. For instance, contrary to the return responses (Table 7), the reaction of intraday bond volatility to news is stronger. The volatility responses range between 2 to 4 bps (for significant factors) and R^2 values confirm these findings (around 11%).[17] We also notice that factors that are significant at the expost level fail to impact volatility with exante news. Only expost surprises rather than exante expectations for GDP figures tend to move bond volatility (lowering it by 4 bps). Another interesting finding emerges from the FOMC rate responses (variable 24): the contribution of rate expectations to bond volatility is rather limited (and insignificant), compared to surprise effects. In other words, investors are likely to wait for the actual released figure and hence volatility reaction becomes significant only at the expost level. Across three alternative models and all factors, the largest marginal response is attributable to interest rate surprises (5.1 bps). Nevertheless, investors' forward-looking expectations for Initial unemployment claims (as one key macro condition indicator) have more marginal power to decrease volatility (3 bps), compared to expost surprise impact (1.7 bps).

[Insert Table 9 here]

In addition to return and volatility response analysis, we examine how exante and expost factors influence jump-type extreme variation in bond prices. We provide the estimated jump response coefficients in Table 9. The striking evidence is that jump-type market reaction is substantially

[17] Of course, the dependent variables are not same hence direct comparison requires care.

larger than both return and volatility reactions (Panels [CON], [RANGE], [SURP]). The reaction size varies between 2 to 10 bps and all coefficients have negative sign: macroeconomic conditions generate sudden negative jumps in bond prices, implying sharp increase in yields within 5-minutes following the announcement release.

We further compare jump responses to exante consensus forecasts ([CON]) and expost news surprises. While the direction of responses is similar across exante and expost factors, we observe differences in magnitudes. For example, exante reaction of Industrial production is lower than expost variation (2 bps versus 6 bps). However, Capacity utilization (variable 7) generates substantial downside jump reaction only when it is measured through exante consensus forecasts. While there are several variables generating same amount of exante and expost effect (e.g., Retail sales, Consumption, Business inventories), the level of jump responses depends on the information type (either exante or expost) for many others: Government budget deficit, Trade balance, Consumer confidence index and Initial unemployment claims. In both exante and expost models ([CON] and [SURP]), the main jump driver is the FOMC policy rate decisions (10 and 9 bps, respectively). Interestingly, although we use the same macro factors across models, adjusted R^2 estimate with the exante variables ([CON]) is larger than that induced by expost variables [SURP] (6% versus 3%).

4.3. Jump responses to pure announcement arrivals

As Andersen et al. (2003) argue, market reaction to new information could be linked to both news size and pure announcement arrival. Section 4.2 presents evidence that bond responses (return, volatility, jumps) depend on the size associated with exante and expost information. We now study the latter case by considering announcement dummies rather than size as predictors.

To proceed, we particularly focus on extreme (jump-type) reactions using disjoint exante and expost information. Our regression specification then mimic the jump regressions estimated by Evans (2011). In our analysis, we extend this study in two distinct ways. First, we directly use intraday jumps rather than proportional daily jumps. This allows us to pin down the exact location of abrupt price changes at high-frequency. Second and more importantly, we break down the information-driven reaction into exante and expost components. Our jump regression models (exante versus expost) are then given by

$$\textbf{(Exante) jump responses:} \quad |\kappa_t^*| = \beta_0 + \underbrace{\sum_{k=1}^{K} \beta_k^{(e)} |E_{k,t}^{(\text{dummy})}|}_{\text{exante component}} + \varepsilon_t \qquad (6)$$

$$\textbf{(Expost) jump responses:} \quad |\kappa_t^*| = \beta_0 + \underbrace{\sum_{k=1}^{K} \beta_k^{(s)} |S_{k,t}^{(\text{dummy})}|}_{\text{expost component}} + \varepsilon_t, \qquad (7)$$

where κ_t^* is the periodicity-filtered intraday jump detected at time t (through Lee and Mykland, 2008 approach), and $\sum_{k=1}^{K} \beta_k^{(e)} |E_{k,t}^{(\text{dummy})}|$ and $\sum_{k=1}^{K} \beta_k^{(s)} |S_{k,t}^{(\text{dummy})}|$ are the announcement dummies relying on exante and expost measures of macroeconomic conditions, respectively. While exante variables are the investors' forward-looking consensus forecasts, expost information (through news release) reflects news shocks.

[Insert Table 10 here]

Table 10 reports the jump response coefficients of information-adjusted Evans (2011) regressions. The results broadly support the main conclusions of the previous section. Both exante and expost factors significantly (at 1%) generate contemporaneous downside (negative) jumps in bond prices, as yields suddenly increase, when the announcement is released ([CON] and [SURP]). For all macroeconomic variables, the jump response to pure news arrival with expectations ([CON]) is larger than that with surprises ([SURP]). While the difference appears to be marginal in direct coefficient comparison, the exante model has larger adjusted R^2 than expost model (22% versus 17%, respectively). FOMC policy rate decisions (variable 24) are statistically significant at the 1% level, both exante and expost information components simultaneously sharp negative (positive) jumps in the U.S. bond prices (yields).

4.4. Speed of adjustment: contemporaneous and cumulative lagged responses

Up to now, we have only examined the *instantaneous* bond market reaction to exante and expost information arrivals. In line with the notion of market efficiency, this consideration is undoubtedly reliable under the assumption that macro news is incorporated into prices quickly. Prior research on price discovery and market microstructure studies, however, document that news adjustment process could be gradual for various reasons related to trading activity and liquidity (see, e.g., Andersen et al., 2003; Jiang et al., 2011; Lee and Mykland, 2012). In this direction, we now investigate cumulative lagged responses to assess how fast bond market processes new information.

[Insert Table 11 here]

For each response duration type (lagged versus contemporaneous), we estimate the full regression models that contain all macroeconomic variables. To ease interpretation, however, we follow the literature and provide in Table 11 only the estimated coefficients of key benchmark variables. These eight (out of twenty five) macro news factors are GDP final, Nonfarm payroll employment, Durable goods orders, Trade balance, CPI, Consumer confidence index, FOMC policy decisions and Initial unemployment claims.

We start by examining return responses (Panel A). In line with earlier studies on bond market (e.g., Fleming and Remolona, 1997, 1999), the estimated coefficients for contemporaneous reaction are mostly insignificant regardless of the information type exante or expost (upper left panel). Exceptionally, the exante impact of GDP on bond returns is significant at the 5% level (0.14 bps), whereas there is no significant expost effect of the same variable (-0.04 bps).

The right side of Panel A further reports the results when cumulative (lagged) effects are considered in regressions. The response coefficients reveal several notable features. The degree and direction of response with exante market expectations differ significantly from that with expost information surprises. For instance, consensus forecasts on GDP figure at the exante level lower bond returns *gradually* by 1.02 bps around 25−30 minutes, whereas expost surprises appear to increase returns by 1.92 bps within the same reaction window. The results indicate a similar pattern with Nonfarm Payroll and FOMC rate decisions. While cumulative exante reaction to Nonfarm payroll is relatively small and positive (0.30 bps), expost reaction embedded in the same variable is large and negative (-4.85 bps). If market reaction is measured by news surprises (as proxy for information shocks), the cumulative impact will diverge from what market participants expect and forecast at the exante level. More interestingly, we notice that the FOMC rate decisions have significant and persistent negative effects *only* with exante information: Fed rate hike pushes down prices (by 3.78 bps) which in turn generates increase in long-term yields. On the other hand, expost surprises fail to explain any variation in intraday bond returns. This result holds regardless of the choice of response duration either contemporaneous or delayed (1.27 bps versus 15.70 bps in Panel A, respectively).

We proceed to examine the lagged responses of intraday volatility to exante versus expost new components. Panel B of Table 11 reports the estimated reaction coefficients. The results indicate that almost all key variables are significant at the 1% level. Consumer confidence index, however, does not influence volatility at high-frequency regardless of (i) impact window (instantaneous or lagged) and (ii) information type (exante or expost). Interestingly, the impact of FOMC rate decisions is significantly negative only when we track volatility reaction through expost shocks (5.13 bps). Unlike macro news responses, volatility appears to adjust rather quickly to FOMC policy decisions. As the right side of Panel B reports, lagged (expost) FOMC coefficient is large (-7.95 bps) but insignificant. Comparing lagged impact with contemporaneous reaction, we further notice that the direction of effect changes for certain variables. While, for instance, Nonfarm payroll employment announcements push volatility down instantaneously by 3 bps, volatility rallies significantly by 8-9 bps and the effect continuous to be present about 25-30 minutes (lag significance in brackets). GDP final, Trade balance and Consumer price index are the other main macroeconomic indicators for which volatility response turns gradually from negative to positive.

We complete our baseline news adjustment analysis by investigating jump responses across exante and expost measures of macro factors (Panel C of Table 11). Compared to return and volatility responses, jump reactions are significantly more severe such that the average change in price jumps—due to macro news—remains between around 5-10 bps. Perhaps more importantly, several benchmark macro variables significantly impact bond jumps with lags only at the exante level rather than expost. These variables are GDP final, Trade balance and FOMC policy decisions. Moreover, the separation of exante versus expost news reactions further changes the direction of jump occurrences. While exante GDP expectations trigger jump-type sudden price reaction within 30 minutes (by 4.87 bps), investors' (expost) surprises towards GDP have no significant impact on bond market jump swings. Similarly, exante consensus forecasts on Nonfarm payroll employment continue to amplify downside jump reaction in the market (by 3.05 bps), whereas expost information surprises contribute to upside jumps (by 1.23 bps). The magnitude and direction of jump responses to exante information differs significantly from that linked to expost information. the estimated coefficients of Consumer confidence index support these findings.

The cumulative jump response of bonds to expost shocks is overall insignificant. With the significance probability of 0.395 (bottom side of Panel C), we cannot reject the hypothesis that there is one (5-minutes) lagged reaction. In sharp constrast, exante measures of macroeconomics conditions provide different conclusions: all macro variables generate gradual impact on intraday jumps with three significant lags (corresponding to 15-minutes response duration). The distinction between exante versus expost responses is also pronounced in R^2 values. The cumulative lagged impact of exante variables explains 13% of jump variation in bonds. The R^2, however, significantly drops to 1% when we measure cumulative responses by expost information shocks. Exante market expectations rather than surprises are associated with jumps, and evidence is stronger compared to return and volatility reactions.

[Insert Figure 1 here]

To visualize the jump patterns in Table 11, we now simply estimate the full models (for volatility and jump responses) first only with exante variables and then only with expost variables. We consider the full reactions including both contemporaneous and lagged effects. We extract the fitted values for jumps with exante and expost measures separately.

The upper left panel of Figure 1 illustrates the fitted values, that is, variation explained through exante variables (crosses) and through expost variables (circles). Consistent with the results presented in Table 11, we observe that the fitted reaction with expost information (i.e. surprises) appears to be lower than that with exante measures of macro factors over time. The differences in fits are particularly visible during the subprime mortgage crisis period 2008-2009. Investors' expectations trigger stronger jump reactions, whereas surprises tend to undermine the effects. Intuitively, if an investor uses surprises as proxy for information shocks, the estimated impact appears to be weaker, but in fact, exante measures reveal otherwise. The fit is relatively stronger with expectations compared to surprises.

The upper right panel of Figure 1 further displays the the difference between exante and expost regression fits in absolute terms. The figure exhibits a temporal deviation between two news components and the difference seems to be larger during post-crisis periods (corresponding to observations 1350-1500). the patterns evolve similarly when we consider the difference in levels without absolute terms.

We look closer to the data regularities during the post-crisis period (i.e., observations 1350-1500). We plot in lower-left panel of the figure the variation explained by exante variables (crosses) versus expost variables (circles). If exante and expost information contents are identical, then we expect the circles to match the cross lines. The noticeable pattern in the figure is, however, a strong divergence between fitted exante and expost values. Over the sample from November 2008 to June 2009, the fitted values with surprise measures are consistenly lower than that with exante market forecasts. The difference in absolute terms corresponds to 50-100 bps (lower right panel), which is quite substantial at the 5-minute intraday level.[18]

4.5. What did the subprime crisis change? Expectations versus surprises

In this section, we particularly assess the effect of 2007-2008 financial crisis on expectations-driven versus surprise-driven bond market responses. To achieve this objective, we split our full sample into two sub-periods; pre-crisis (2004-2007) and post-crisis (2007-2010). For brevity, we only discuss the main findings linked three forms of reaction types: returns, volatility and jumps.[19]

During the pre-crisis period, our results suggest that ex-post news shocks (surprises) instantaneously lower returns (increasing yields), whereas exante consensus forecasts do not have significant impact on bond returns. Following the crisis, expost and exante measures move bond returns differently, however. While exante factors, such as Consumer credit (9), Business inventories (15) and Consumer prices (19) tend to raise returns, the surprise (expost) components of those variables fail to explain any contemporaneous return variation. Interestingly, unlike the pre-crisis sample, expost FOMC rate surprises are no longer significant to affect bond returns throughout post-crisis period. For the volatility responses, we notice that the results remain qualitatively similar regardless of the sample period. Unlike return responses, reaction of volatility to FOMC rate decisions is insensitive to financial conditions. The variation explained by exante and expost factors appears to be higher in crisis period, compared to that in tranquil periods (i.e., %10 vs. 5%, respectively).

As we turn to jump responses, several findings are noteworthy. First, the marginal effects of exante measures tend to be higher than that of expost measures. The evidence is more pronounced particularly for macro indicators and indices (20-25), such as Housing starts, Unemployment claims and Consumer confidence index. The results also show that the strongest jump responses are attributed to ex-ante FOMC rate decisions (8%) and GDP (7%). During the crisis period, the total variation explained by macro factors decreases from 12% to 5%, however, reflecting a disconnection between macro news and jumps. We further estimate the jump regressions of Evans (2011) and find interestingly that the contribution of exante macro measures to explain bond jumps reaches to 25%.

[Insert Figure 2 here]

Given the evidence that jumps are mostly linked to exante information content, we now attempt to uncover the contribution of each macroeconomic indicator in explaining jump variation. To achieve this, we estimate our jump regressions using full sample, pre-crisis and post-crisis periods. Figure 2 shows the partial R^2 values explained by each news announcement.

[18] It is important to note that Figure 1 illustrates only the fitted rather than actual values. We are aware of the fact that there might be an exante over-reaction, which may turn to normal (as a correction) with the expost information. This pattern may arise, for instance, if the expost realized figure falls below exante expectations.

[19] All estimation results are available upon request.

The upper panel of Figure 2 displays that jump variation associated with (exante) market forecasts (solid line) departs significantly from that with expost reactions (dashed line). The evidence is pronounced for certain variables including Capacity utilization and New home sales. For all macroeconomic indicators (variables 20−25), exante information signals explain jumps more than do the expost news arrivals. The high-frequency market reaction to FOMC policy decisions, for instance, is stronger when we consider expectations rather than information shocks as drivers.

[Insert Figures 3 and 4 here]

Decomposing the sample into two periods reveals similar patterns, although the exante versus expost response differential appears to be more visible during the precrisis sample (middle panel). Across all macroeconomic announcements, partial R^2 values of the model with exante factors (solid line) are larger than that with expost factors (dashed line). While expectations and surprises towards real activity (variables 4−9) have similar explanatory power, one can observe the divergent patterns, especially for variables related to price indices, Consumer confidence and Housing starts. Figure 3 shows that these conclusions remain same for both upside (positive) and downside (negative) jump tails. Regardless of the information measure (i.e., exante versus expost), the relationship between macroeconomic conditions and jumps is likely to be stronger in precrisis period, relative to the postcrisis period (Figure 4).

[Insert Figure 5 here]

We finally examine the time-varying properties of jump reaction conditional on expectations and surprises. Figure 5 shows the estimated (full-model) jump responses (expected versus surprise components) on days of six benchmark announcements: GDP, CPI, Nonfarm payrolls, Consumer index, FOMC and Initial unemployment claims.[20]

The main feature of the figure is that expectations and surprises lead to different tail (i.e., extreme and sudden) market reaction. For instance, on the announcement days of GDP numbers, bond market responses to expected news components appear to be stronger than that generated by surprises (Panel A). Further, the magnitude of the effect is time-varying and asymmetric. Specifically, in normal periods (2004-2007) when GDP figure is released, expectations of investors for the economy amplify positive and significant jump reaction (around 10 bps), as opposed to limited surprise-induced impact (solid line). After the subprime crisis (last quarter of 2008), surprise effects are relatively muted, while expectations suggest larger downside (jump) responses (dotted line). Such response deviations between expectations and surprises are also present on CPI and Nonfarm payroll announcement days. On CPI announcement periods (middle figures of Panel A), investors expect consumer prices to increase around early 2009 due to low interest rate policy conducted by

[20] It is worth noting that the fitted jump responses can be considered as jump size "conditional" on information, that is, either on expectations or surprises.

the monetary authorities. While expectation-driven jump responses track this pattern (in line with actual news releases), shock-driven responses mitigate the realized effect.

Among all six benchmark factors, the largest difference between expectation and surprise effects occurs on FOMC announcement days (Panel B). For example, throughout the years 2006 and 2008, market expectations lead to negative price jumps (increasing yields), whereas surprises contribute to positive price jumps (decreasing yields). Exante and expost news effects thus reveal opposite financial implications. On the risk management perspective, if the news reaction measurement relies on the surprise component, then the downside market risk exposure of a fixed-income trader will look lower than that actually reflected by expectations. For policymakers, how markets react to public information is important for managing market uncertainty. Considering only surprises for such an assessment then may bias the policy implementation. In the next section, we attempt to propose an alternative regression specification by exploiting the information content in both expected and surprise measures.

4.6. An alternative specification: interaction news effects

Does the impact of information shocks vary with expectations? How does the market respond when expost surprises are linked to exante market forecasts or expectations? We answer these questions by testing for interactions between exante and expost measures of benchmark macro variables. We estimate our response regressions (for returns, volatility and jumps) with both main terms (exante and expost measures separately) and the interaction terms. The interest is related to the estimated coefficients of the interaction terms. A significant positive (negative) coefficient of the interaction variable implies that the shock response of the macro variable is larger (smaller) when it is expected by bond investors. In the absence of information spillover between exante versus expost (i.e., in case of insignificant coefficient), there is no linkage between expectations and surprises.

[Insert Table 12 here]

Table 12 reports the estimated coefficients of response regressions with interaction effects. The results indicate that market reactions are typically stronger with significant interaction terms (left panel), compared to main terms (i.e. when exante and expost components are separated). Moreover, the estimated coefficients of interaction terms are significantly larger than that of main terms for the same variables in regressions. This may suggest that considering expost surprises as a measure of reaction type is likely to undermine the potential realized market impact of macro conditions on bonds.

The estimates further reveal the presence of several distinct reaction patterns. For instance, supporting the previous results, high-frequency bond returns do not react substantially to benchmark macro factors, either at the exante or expost level. Interactions between (exante) expectations and (expost) surprises deliver quite similar results. FOMC rate decisions and Initial unemployment claims are the only two variables that are barely significant (at the 10% level). This evidence might reflect that realized intraday returns (or losses) of investors at the intraday horizons are barely driven by macro fundamentals: news is incorporated into price very quickly (quicker than 5-minutes) and hence high-frequency gains and losses appear to be independent from macro conditions in short (intraday) trading horizons.

Unlike return reactions, volatility and jump responses are quite large, especially when we consider interactions between exante and expost measures. Many fundamental macro variables explain the variation in intraday volatility and jumps. Volatility increases (2-5 bps) with the announcements of GDP, Nonfarm payroll employment, Trade balance and Consumer price index (the left column in Panel B). Despite the evidence with macro factors, surprises towards FOMC policy decisions, however, fail to explain intraday volatility when associated with expectations (i.e. interaction between exante FOMC and expost FOMC). The estimated interaction coefficient of the FOMC variable is positive (0.707), but it is not statistically different from zero. One reason behind this finding could be that investors typically pause to weigh the communication and public speech of central banks to adjust positions and expectations. Consequently, only released figures—neither expectations nor surprises—may contribute to the price discovery process.

Panel C of Table 12 shows that jump reactions are stronger than both volatility and return responses. The estimated coefficients of all interacted macro variables and the FOMC policy factor significantly generate jumps in bond prices (at the 1% level). As exante information interacts with expost surprises, the largest positive impact comes from the GDP final and the FOMC rate decisions (9 and 6 bps, respectively). For these two factors, news shocks (through main terms) lead to negative jumps, whereas the expectation-induced news shocks (through interaction terms) increase jump occurrences.

4.7. Trading activity, announcement timing and jump responses

In the previous sections, we focus on the effects of news events on returns and price uncertainty. Research on market microstructure also emphasizes the role of trading activity in identifying news effects. New information often prompts investors to revise expectations, changing trading volume and prices. Because volume and price uncertainty feed on each other (see e.g., Engle et al., 2012), such abnormal price swings convey information and impact trading process. In light of these features, we expect to observe an association between trading volume and estimated (news-induced) jump responses.[21] Figure 6 displays the volume of trades (i.e., the number of contracts) and the estimated jump responses on GDP announcement days over the sample.

[Insert Figure 6 here]

The upper panel of the figure suggests that trading activity varies over the business cycle and GDP expectations are positive before the credit crisis until 2007. Starting with early 2008,

[21] More specifically, our objective is to test for the evidence that there is a potential link between volume and tail-type market reaction (conditional on public information). A more comprehensive work—left for future research—may exploit such endogenous (lead-lag) dynamics in depth.

however, we notice that GDP expectations first decline, then increase around mid-2008 and fall again following the Lehman Brothers collapse in September 2008. From that period to the end of subprime crisis (June 2009), the market forecast for change in final GDP numbers remains negative and follows a downward trend. During this contraction period (and even after until 2010), trading volume continues to be relatively low and thus reflects the potential tightness in liquidity.

Further, the lower panel of Figure 6 illustrates the behavior of trading volume together with expectation- and surprise-induced jump responses. Sudden market reaction to expectations differs from surprise effects over time. The difference in effects is particularly large in the first quarters of 2009, when trading volume is low. Interestingly, surprise components almost never generate negative jumps and the magnitude of expost shocks is quite marginal on days of GDP news release. In contrast, expectation-induced jump reaction is negative and reveals strong downside market risk. These regularities may explain why low trading activity still persists after the crisis.

[Insert Figure 7 here]

Given the difference between exante and expost jump variation, it is perhaps possible to link trading volume to market reaction *dispersion* empirically. The dispersion (i.e., the difference between exante and expost reaction) may then simply reflect the market (tail) uncertainty conditional on economic conditions. That is,

$$RD_t = \widehat{jumps}_t^{exante} - \widehat{jumps}_t^{expost} \tag{8}$$

where RD_t is the reaction dispersion on time t when a specific news arrives (e.g., GDP), $\widehat{jumps}_t^{exante}$ and $\widehat{jumps}_t^{exante}$ denote the fitted jump reactions conditional on (exante) expectations and (expost) surprises, respectively. Intuitively, in periods when the dispersion is low, the price reaction associated with extreme events (tail fear) should be limited because anticipated expectations and unanticipated surprises are close to each other. Conversely, high levels of dispersion can be considered as a proxy for elevated market uncertainty.

Based on this conjecture, Figure 7 shows the evolution of trading volume and the dispersion of estimated jump responses linked expectations versus surprises. The patterns are intriguing in two aspects. First, the endogenous lead-and-lag relationship between volume and market uncertainty is noticeable, supporting the common view in the microstructure literature. Second, the dispersion is time-varying and counter-cyclical: it appears to be positive in normal periods (implying low risk fear) before 2006 (10-15 bps) and negative (implying high fear) in stress period after 2008 (20-25 basis points). During the period when the dispersion is large (i.e., in absolute terms), trading activity appears to be low until mid-2010. Given these results, dispersion proxy permits to track market uncertainty both at the macro level over the business cycle and micro level for the trading process.

5. Robustness checks

We assess the robustness of our main results in several respects. First, we regress returns and volatility on announcement dummies only. We, therefore, examine the reaction of return and volatility to pure announcement arrivals rather than magnitudes. Second, we consider an alternative identification test for intraday jumps. This alternative test relies on the approach of Lee and Hannig (2010) and locates large (finite-activity) jumps in the presence of any small (infinite-activity) jumps. Third, we estimate intraday volatility non-parametrically using the threshold power variation (TPV) approach of Bollerslev et al. (2013). Finally, we estimate our response regression on the interval—rather than trading day—basis. For brevity, we summarize and discuss only the main findings in this section.[22]

Return and volatility responses to announcement arrivals. For volatility reaction to news dummies, we find that the benchmark fundamentals, such as Nonfarm payroll, GDP final, CPI and Initial unemployment claims, are still statistically significant (see e.g., Table 8 for a direct comparison). Separating exante components from expost components does not affect the estimation results. One reason could be due to the fact that times of expectations and surprises often coincide with each other. We also notice that the FOMC decision dummies fail to result in any sudden volatility response regardless of the news component either expected or surprise. This finding may reflect the information differential between pure announcement timing and announcement magnitude. We further confirm this evidence by considering news releases (REL) as alternative expost reaction proxy. Still, the coefficient of the FOMC policy decisions remains insignificant, suggesting that FOMC announcement timings do not lead to strong market volatility reaction. The estimated RANGE component appears to be significant but only at the 5% level. For return regressions, the results with announcement dummies duplicate those reported in Table 7.

An alternative method for intraday jump identification. In our empirical analysis, we identify jump arrivals based on the test of Lee and Mykland (2008). This test well detects extreme changes in prices under the assumption that jumps have only finite-activity. In the presence of infinite-activity jumps, however, the Lee and Mykland (2008) test is likely to lose its detection power. To check the sensitivity of our results to the choice of the jump method and type, we utilize the big Lev́y jump test proposed by Lee and Hannig (2010).[23] To proceed, we first identify the jumps in the data using the Lee and Hannig (2010) test. Then, we run our jump regressions and examine the cumulative delayed reaction to news. We repeat this exercise for both expected and surprise news components, and compare the estimates directly with those reported in Panel C of Table 11.

We start by discussing the results for the exante reaction analysis. We confirm that the estimated coefficients of the jump regressions are still significant. For example, Lee and Hannig (2010)

[22]The estimations results and details are available upon request.

[23]For brevity, we do not provide the details of this test and refer the paper for the implementation.

test delivers an R^2 of 16%, which is slightly lower than that with the Lee and Mykland (2008) test (20%). This result is perhaps unsurprising given that the Lee and Hannig (2010) test is robust to small jumps that may not respond to news announcements. Examining the lag structure of the responses, we also notice that the magnitudes and signs of the total cumulative jumps responses remain same. For example, when we use the Lee and Hannig (2010) identification, the estimated cumulative jump response to FOMC rate expectations is around -8 bps and hence close to the baseline estimate with the Lee and Mykland (2008) test (-9 bps). The coefficients of the lag terms are significantly different from zero, suggesting evidence in favor of delayed response. Consistent with our baseline results with the Lee and Mykland (2008) test, jumps adjust to expectations gradually for several variables, including Nonfarm payroll, Trade balance, Consumer confidence and Initial unemployment claims. The coefficients are statistically significant up to 3 terms with p-value of 0.004 (versus 0.003 as reported in Table 11).

We finally turn to the results for surprise-induced reaction. In terms of significance, magnitude and sign, the estimated coefficients are quite similar to those reported in Table 11. The adjusted R^2 of the model is 2%, which is very close to the R^2 of the model with Lee and Mykland (2008) jumps (i.e., 1%). Recall that our baseline analysis reveals that surprise components do not generate jump clustering. Still, there is no evidence for such subsequent news effects. The surprises for most macro fundamentals and FOMC news announcements are not associated with jumps in bond prices. In contrast with the main results, the announcements of Durable good orders and Initial unemployment claims are now insignificant. The robustness analysis overall suggests that our findings are insensitive to the choice of jump identification test.

An alternative method for intraday volatility estimation. We turn to the estimation of spot volatility. We follow Bollerslev et al. (2013) and consider the threshold power variation (TPV) approach as an alternative estimator. Let $CV_{t,i}$ denote the diffusive spot volatility of the process given in (2) for the time i of a trading day t. Then,

$$CV_{t,i} = \left\{ i \in [0,T] : |r^*_{t,i}| < u \right\}, \tag{9}$$

where $u = \alpha\Delta^{\varpi}$ is the truncation threshold for Δ representing incremental change, and α (> 0) is expressed in units of standard deviations of the continuous part of the process for a constant $\varpi \in (0, 1/2)$. As in Bollerslev et al. (2013), we set the truncation thresholds $\alpha = 3$ and $\varpi = 0.47$.[24] Similar to our baseline analysis, we filter the intraday returns $r^*_{t,i}$ from periodic diurnal patterns before estimating the volatility regressions.

The results (unreported for brevity) indicate that the estimated coefficients of exante and expost news events on $CV_{t,i}$ are considerably close to baseline estimates i.e., when we measure volatility

[24] It is worth noting that the threshold α can be a larger fraction of the standard deviation, such as $\alpha = 4, 5, 6$. Nevertheless, because larger threshold values will force the CV estimator retain returns with larger sizes, the TPV estimates will be even closer to those coming from our baseline volatility estimator.

absolute returns.[25] For instance, in line with the results reported in Table 5, the estimated coefficients of GDP Advance and Preliminary are significantly negative. The other variables affecting volatility include Nonfarm Payroll Employment, Trade Balance, CPI, PPI and Initial Unemployment Claims. These variables typically decrease intraday volatility around 1-2 basis points within five-minutes following the news. Overall, the choice of intraday volatility estimator (i.e., either absolute returns or TPV approach) does not change the magnitudes, significance and signs of news effects.

Interval-based reaction regressions. In our baseline empirical analysis, we follow Lahaye et al. (2011) and estimate the reaction regressions (for returns/volatility/jumps) on trading days continuously over the sample. Alternatively, it is possible to estimate reaction regressions separately for each news event on (5-minute) time interval.[26] Each interval-based regression hence contains one single (explanatory) variable for intraday periods where we have the release (i.e., the independent variable), and corresponding reaction form (i.e., the dependent variable). We estimate these interval-based regression for several benchmark macroeconomic variables, including GDP, Nonfarm, CPI, Unemployment claims and FOMC. Because the number of exact *interval-to-interval* matches is rather limited for jumps, we carry out this type of robustness check for return and volatility patterns.[27] For both exante and expost components of news events, we examine the estimate coefficients and corresponding partial R^2 values.

The results indicate that the R^2 values change with the variable of interest. We further notice that return reactions remain qualitatively similar to our baseline findings. The estimated coefficients of volatility reactions, however, exhibit slightly different patterns. For instance, the impact of Nonfarm payrolls to volatility becomes statistically insignificant, while the partial R^2 of consensus (exante) CPI increases to 4%, compared to R^2 revealed by its surprise (expost) component (i.e., 1% and no significance). The R^2 of Unemployment claims becomes 3% with consensus factor, whereas R^2 is lower than 1% with the surprise component of Unemployment claims.

For return reactions, while most findings are consistent with the baseline results, R^2 values of several news events are mostly higher than that from multiple regressions. It is, however, important to note that the analysis in this case might suffer from small sample bias linked lower number of observations, especially for expost (surprise component) of some variables. We have substantial increase in R^2 of Nonfarm payroll (9% with expectations vs 20% with surprises). Perhaps surprisingly, while consensus FOMC explains 18% of return variation, this number decreases to 4%

[25] These results are available upon request.

[26] Before running each single-factor regression, we first check whether or not news times and quantities match correctly. For instance, if the news arrives at 8:30am, we examine the news effect one time stamp ahead (i.e., 8:35am) in order to avoid any problem related to reaction timing.

[27] See e.g., Lahaye et al. (2011), who show that probability of observing an intraday jump (condition on macroeconomic news events) is even lower than 1%, and likely to be driven by the limited number of exact news-jumps matches. To overcome this issue, Lahaye et al. (2011) estimate their models on *days* (rather than intervals) where there are both jumps and news announcements.

with surprise component (and the estimated coefficient becomes statistically insignificant). Neither consensus nor surprise components reveal evidence in favor of the effect of Initial unemployment claims. Therefore, the results reported on Table 9 are consistent with those in this robustness check.

6. Conclusions

Macro-finance theory implies that bond prices should react to information shocks and hence expectations of investors no longer move the yield curve. Studies on market microstructure and price discovery almost always rely on this prediction. The challenge arises, however, from measurement of shocks that are unobservable. To overcome this issue, researchers and practitioners utilize the surprise (i.e., after-release or expost) component of news announcements as an empirical proxy for shocks.

This paper outlines the limitation of surprise components as measures for news-effect analysis, and proposes an alternative framework. Using high-frequency (5-minute) data on 30-year U.S. Treasury bond, we examine the role of *exante* expectations versus *expost* surprises in explaining bond market responses to information arrivals. We find evidence that the response differential between exante and expost components is large, statistically significant and economically relevant. Unlike surprises, the expected news component (i) varies over the business cycle, (ii) reveals distinct patterns in crisis episodes, (iii) tracks announcement type/timing, and (iv) results in subsequent news adjustment process. This evidence is stronger particularly for jump-type tail movements, compared to return and volatility effects. The surprise measure still explains a fraction of bond volatility, but its explanatory power becomes dramatically weak to characterize detected jumps. Our results suggest linking surprises to expectations (observation-by-observation), which conveys more information to identify the strength, direction and variation of responses.

Another intriguing argument in prior research is that fundamentals and asset prices are often disconnected (e.g., Andersen et al., 2003, 2007). Our jump regression estimates indicate that the source of disconnection could be related to shock measurement. When we use the surprise news components as regressors, fitted price jumps fail to capture salient properties of market stress, such as time-variation in uncertainty. In contrast, jump reactions—conditional on expectations—exhibit counter-cyclical regularities that describe how investors perceive risk: low levels in normal periods and high levels in recessions. This finding may also explain why jumps are weakly associated with information shocks (see e.g., Jiang et al., 2011; Lahaye et al., 2011): expectations rather than surprises influence price jumps. We also document that price jumps adjust to expectations gradually. Consistent with the evidence in Fleming and Remolona (1999), this may reflect a potential disagreement (and/or private information) among investors about the implication of news for prices.

It is quite likely that expectations for the U.S. fundamentals and its monetary policy have cross-border global effects. Such linkages may occur, for instance, either within the same market (e.g., from U.S. to European bond market) or across asset classes (e.g., from bonds to currencies or stocks). Moreover, if expectations and surprises move markets differently with respect to magnitude and direction (when the news is announced), then one can design an active fixed-income trading strategy conditional on real-time expectations versus surprises. Compared to latter (surprise-based) approach, the former (expectation-induced) trading may produce less noise, more variation and smoother trend, which could in turn allow investors to locate profit quickly and accurately. In addition, the relatively strong relation between jumps and exante news measures can manifest itself in risk pricing. Option prices, for instance, reflect investors' expectations for the level of uncertainty about the future. Sharp and sudden changes in options prices thus indirectly represent compensation (or premia) that traders demand to protect against tail events. Therefore, jumps in option prices could be more responsive and sensitive to exante news factors than jumps in the underlying asset. Future research may explore these issues in depth and provide more insights on theoretical and empirical grounds.

Appendix

A. Data adjustment and cleaning

30-year US T-bond futures are traded on the Chicago Board of Trade (CBOT). The original time zone for the US bond futures is based on the Eastern time (EST), and we start sampling from 8:30 EST until 15:00 EST, the last observation of the trading day t. These trading hours leave us $N = 78$ five-minute intervals for the all sample trading days of 30-year U.S. T-bond futures.

When constructing our database, we take into account the day sessions as well as the trading at both pit and electronic platforms. We further excluded overnight sessions and we apply the automatic rolling method to the contracts. This method automatically determines the best times to roll of a continuous-time futures price series. The method first computes the daily volume of the both current-month and next-month contracts. Next, the current month contracts are rolled to the next-month contracts, when the volume of the new contracts exceeds the volume of the existing contracts. We select the contracts as front futures contracts. Those contracts are the contracts that are closest to maturity. The use of the front contracts helps us process all nearest contracts into a single continuous contract. The raw futures data is obtained as tick data. We create a database for 5-minute intervals by converting tick-by-tick data into intra-day 5-minute frequencies.

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Table 1: Summary statistics for U.S. macroeconomic news announcements

Variable	Time	Freq.	CON			REL			LOW			HIGH		
Real Activity			Obs.	Mean	Std.dev.	Obs.	Mean	Std.dev.	Obs.	Mean	Std.dev.	Obs.	Mean	Std.dev.
1. GDP advance	8:30	Q	28	2.03	2.54	28	1.81	2.44	14	-0.47	3.03	14	1.54	2.32
2. GDP preliminary	8:30	Q	28	1.92	2.66	28	1.91	2.75	15	0.33	3.10	15	1.12	2.80
3. GDP final	8:30	Q	28	1.93	2.82	28	1.91	2.71	16	0.53	3.15	16	0.89	3.11
4. Nonfarm payrolls empl.	8:30	M	72	1.56	23.75	74	-0.07	23.85	41	-19.45	26.91	38	-3.48	25.51
5. Retail sales	8:30	M	74	0.23	0.78	80	0.20	1.02	42	-0.53	1.02	42	0.69	0.70
6. Industrial production	9:15	M	74	0.18	0.51	77	0.10	0.77	39	-0.59	0.86	42	0.47	0.58
7. Capacity utilization	9:15	M	80	77.57	4.20	81	77.55	4.17	43	75.13	4.79	43	76.10	4.60
8. Personal income	8:30	M	76	0.29	0.57	73	0.37	0.65	38	-0.10	0.45	40	0.52	0.35
9. Consumer credit	15:00	M	76	2.76	5.33	80	2.02	8.17	41	-4.27	7.02	41	4.20	5.99
Consumption and Investment														
10. Personal consumption exp.	8:30	M	73	0.35	0.36	71	0.34	0.45	37	-0.06	0.52	39	0.56	0.32
11. New home sales	10:00	M	78	784.94	371.84	80	790.71	385.40	44	465.43	185.78	44	523.18	200.81
12. Durable goods orders	8:30	M	74	0.34	1.69	75	-0.13	3.42	41	-2.01	2.50	40	2.51	1.92
13. Construction spending	10:00	M	74	-0.15	0.64	75	-0.02	0.86	42	-1.35	0.91	38	0.20	0.69
14. Factory orders	10:00	M	79	0.14	1.84	81	0.04	2.07	38	-1.46	2.18	40	1.30	1.35
15. Business inventories	10:00	M	74	0.23	0.49	76	0.21	0.61	40	-0.32	0.78	39	0.46	0.47
Government, Trade and Prices														
16. Government budget deficit	14:00	M	75	-58.55	75.95	79	-56.33	82.70	38	-110.66	81.56	38	-67.19	74.52
17. Trade balance	8:30	M	81	-52.11	11.53	81	-51.92	11.81	42	-49.82	12.40	42	-43.84	12.34
18. Producer price index	8:30	M	75	0.23	0.62	78	0.31	1.01	38	-0.45	0.95	43	0.77	0.72
19. Consumer price index	8:30	M	80	0.22	0.33	76	0.22	0.43	40	-0.09	0.47	43	0.36	0.29
Indicators, Indices and Policy														
20. Consumer confidence index	10:00	M	84	79.98	25.19	84	79.79	26.19	45	65.63	21.53	45	65.63	21.53
21. NAPM index	10:00	M	82	53.93	7.59	82	55.08	9.00	44	47.38	8.90	44	53.30	7.77
22. Housing starts	8:30	M	83	1.33	0.60	83	1.33	0.62	42	0.74	0.28	42	0.83	0.30
23. Index of leading indicators	10:00	M	78	0.14	0.42	82	0.11	0.50	41	-0.24	0.48	38	0.54	0.40
24. FOMC rate decisions	14:15	FV	39	3.28	1.61	40	3.42	1.54	-	-	-	-	-	-
25. Initial unemployment claims	8:30	W	349	392.17	96.48	352	392.37	97.34	183	434.87	93.58	183	466.58	105.36

Notes: The table reports the descriptive statistics for the scheduled U.S. news announcements. The news arrival time and its frequency vary with the announcement type (second and third columns). CON: Consensus measure, i.e., the median of analyst forecasts; REL: Releases (real-time) news announcement without revision; LOW: Lowest analyst forecasts for the announcements; HIGH: Highest analyst forecasts for the announcements. Q: Quarterly; M: Monthly; W: Weekly; FV: Frequency varies. For announcement type (4.), the values are divided by ($\times 10^5$) to ease exposition. The sample covers the periods January 1, 2004 to December 30, 2010. Due to data availability, the sample of LOW and HIGH measures (last two columns) starts from May 29, 2007.

Table 4: Unrestricted (kitchen sink) contemporaneous return responses

	[1]			[2]		
Announcements	Coeff.	t-prob	sign	Coeff.	t-prob	sign
Constant	0.028	0.138		0.034.7	0.306	
Exante Factors						
1. GDP advance	-0.150	0.079	(−)	0.074	0.569	
2. GDP preliminary	-0.060	0.221		-0.005	0.972	
3. GDP final	0.168	0.041	(+)	0.021	0.749	
4. Nonfarm payroll employment	0.047	0.287		0.071	0.216	
5. Retail sales	0.009	0.750		0.096	0.157	
6. Industrial production	-0.327	0.767		0.018	0.984	
7. Capacity utilization	0.390	0.685		0.093	0.918	
8. Personal income	0.012	0.564		0.023	0.591	
9. Consumer credit	1.331	0.029	(+)	0.247	0.782	
10. Personal consumption exp.	-0.075	0.215		0.050	0.480	
11. New home sales	-0.169	0.805		0.192	0.787	
12. Durable goods orders	0.035	0.636		-0.007	0.895	
13. Construction spending	0.071	0.917		-0.628	0.615	
14. Factory orders	-0.522	0.359		-0.186	0.831	
15. Business inventories	1.568	0.082	(+)	-0.548	0.573	
16. Government budget deficit	-0.875	0.370		-1.179	0.397	
17. Trade balance	-0.007	0.808		-0.037	0.555	
18. Producer price index	-0.045	0.233		-0.015	0.853	
19. Consumer price index	0.125	0.052	(+)	-0.087	0.080	(−)
20. Consumer confidence index	-0.259	0.750		-0.148	0.909	
21. NAPM index	0.876	0.384		-1.076	0.328	
22. Housing starts	0.024	0.516		-0.078	0.093	(−)
23. Index of leading indicators	-0.503	0.602		1.728	0.124	
24. FOMC rate decisions	-0.452	0.750				
25. Initial unemployment claims	0.015	0.440		-0.009	0.740	
Expost Factors						
26. GDP advance	0.013	0.832		0.021	0.889	
27. GDP preliminary	-0.010	0.895		0.008	0.968	
28. GDP final	0.058	0.629		0.040	0.818	
29. Nonfarm payroll employment	0.028	0.375		-0.020	0.735	
30. Retail sales	0.002	0.956		0.009	0.895	
31. Industrial production	-0.573	0.558		-0.879	0.504	
32. Capacity utilization	0.099	0.597		-1.029	0.912	
33. Personal income	0.040	0.121		0.024	0.548	
34. Consumer credit	0.233	0.640		-0.053	0.948	
35. Personal consumption exp.	-0.028	0.523		-0.124	0.469	
36. New home sales	0.176	0.695		-1.379	0.636	
37. Durable goods orders	-0.118	0.194		-0.219	0.110	
38. Construction spending	-1.656	0.022	(−)	-1.929	0.051	(−)
39. Factory orders	1.160	0.088	(+)	1.519	0.172	
40. Business inventories	0.808	0.419		0.871	0.522	
41. Government budget deficit	1.276	0.058	(+)	0.946	0.188	
42. Trade balance	-0.017	0.544		-0.029	0.402	
43. Producer price index	0.012	0.780		0.004	0.946	
44. Consumer price index	-0.120	0.224		-0.091	0.436	
45. Consumer confidence index	-0.021	0.980		0.061	0.958	
46. NAPM index	0.251	0.760		0.753	0.484	

47. Housing starts	-0.037	0.191		-0.045	0.527	
48. Index of leading indicators	-1.744	0.100		-2.179	0.168	
49. FOMC rate decisions	-0.977	0.741		-2.534	0.661	
50. Initial unemployment claims	0.020	0.163		0.029	0.497	
Obs.		133426			69678	
F-stat [prob]		5.7	[0.000]		2.7	[0.000]
LL [Adj. R^2]		786024	0.0019		397997	0.0013

Notes: The table reports the regression results of the unrestricted (kitchen-sink) model for returns. We estimate the model by combining all standardized exante and expost factors (first column). The model specification is given by Equation (3) in the main text. Here, we consider only contemporaneous responses (thus we set $J = 0$). That is,

$$r_t^* = \beta_0 + \sum_{i=1}^{l} \beta_i r_{t-i}^* + \underbrace{\sum_{k=1}^{K} \beta_k^{(e)} E_{k,t}}_{\text{exante component}} + \underbrace{\sum_{k=1}^{K} \beta_k^{(s)} S_{k,t}}_{\text{expost component}} + \varepsilon_t,$$

where the dependent variable is 5-minute (periodicity-filtered) log-returns. Table 1 provides the description of exante and expost independent variables. Expost variables are surprises, whereas exante variables are consensus forecasts (Model [1]) and forecast ranges representing dispersion in expectations (Model [2]). The table reports the estimated coefficients in basis points (second column), probabilities of values (third column), and the sign of the statistically significant coefficients (fourth column). The standard errors of the coefficients are robust to heteroscedasticity and auto-correlation. The table further displays the number of observations (*Obs.*), F-statistics of the models as well as their likelihood ratios (LL) and adjusted R^2 values (in square brackets). The sample covers the periods January 1, 2004 to December 30, 2010 for Model [1], and May 29, 2007 to December 30, 2010 for Model [2].

Table 2: Largest negative price changes and news announcements for the 30-year U.S. Treasury bond

Price change	News Date	Time	News type	Return	Volatility	Jumps	Sign^{disp}
-0.0439	2009-01-05	8:35	13	-0.0087	0.0087	-0.0439	(+)
-0.0234	2004-04-02	8:35	4*	-0.0046	0.0046		(+)
-0.0218	2008-09-19	8:35		-0.0043	0.0043		
-0.0185	2005-07-05	8:35	14	-0.0037	0.0037	-0.0185	(−)
-0.0180	2009-01-16	8:35	19*	-0.0035	0.0035		(+)
-0.0174	2004-04-13	8:35	5*	-0.0034	0.0034	-0.0174	(+)
-0.0165	2007-12-12	8:35	17*	-0.0033	0.0033		(−)
-0.0162	2009-01-20	8:35		-0.0032	0.0032		
-0.0153	2009-02-19	8:35	18*	-0.0030	0.0030		(+)
-0.0151	2008-03-25	8:35	20	-0.0030	0.0030		(−)
-0.0147	2009-06-01	8:35	8*	-0.0029	0.0029		(+)
-0.0146	2009-01-21	8:35		-0.0029	0.0029		
-0.0136	2010-12-01	8:35	13*	-0.0027	0.0027		(+)
-0.0136	2004-11-29	8:35		-0.0027	0.0027	-0.0136	
-0.0134	2004-05-07	8:35	4*	-0.0026	0.0026		(+)
-0.0133	2010-09-03	8:35	4*	-0.0026	0.0026		(+)
-0.0132	2008-12-10	8:35	16	-0.0026	0.0026		(+)
-0.0129	2010-05-10	8:35		-0.0025	0.0025		
-0.0125	2009-03-18	13:35	19	-0.0157	0.0157		(+)
-0.0118	2010-12-07	8:35	9	-0.0023	0.0023		(+)
-0.0116	2010-05-27	8:35	2*	-0.0023	0.0023		(+)
-0.0112	2006-10-10	8:35		-0.0022	0.0022	-0.0112	
-0.0111	2009-03-04	8:35		-0.0022	0.0022		
-0.0108	2004-11-05	8:35	4*	-0.0021	0.0021		(+)
-0.0107	2007-07-05	8:35	25*	-0.0021	0.0021		(+)

Notes: The table reports the largest negative price changes by 5-minute interval for the 30-year U.S. Treasury bond together with the associated (if any) news announcements. The table provides the largest price changes (first column), the trading dates of these largest changes (second column), time of the change (third column), and the type of the news (fourth column). * denotes the news announcement type that coincides with the largest price change. The sample covers the periods January 1, 2004 to December 30, 2010. The news announcements without the (*) superscript are released on the same date of the corresponding change, but they do not occur at the same 5-minute interval. Blank-left news types imply that there is no news event on that date. For these rows, the largest price changes are, therefore, not associated with news events. In the last four columns, the table further reports the periodicity-filtered intraday returns, volatility and detected jumps (if any) along with the dispersion sign (i.e., actual news release minus consensus forecasts. See Table 1 for the number labels of the announcement types given in the fourth column. The sample covers the periods January 1, 2004 to December 30, 2010.

Table 3: Largest positive price changes and news announcements for the 30-year U.S. Treasury bond

Price change	News Date	Time	News type	Return	Volatility	Jumps	Sign^{disp}
0.0337	2009-03-18	13:20	19	0.0411	0.0411	0.0337	(+)
0.0221	2004-03-05	8:35	4*	0.0044	0.0044	0.0221	(−)
0.0220	2008-11-25	8:35	2*	0.0043	0.0043		(−)
0.0182	2008-11-14	8:35	5*	0.0036	0.0036		(−)
0.0179	2008-12-01	8:35	13	0.0035	0.0035		(−)
0.0174	2009-02-17	8:35		0.0034	0.0034		
0.0173	2004-01-09	8:35	4*	0.0034	0.0034		(−)
0.0168	2004-08-06	8:35	4*	0.0033	0.0033		(−)
0.0162	2004-10-12	8:35		0.0032	0.0032	0.0162	
0.0149	2008-09-16	8:35	19*	0.0029	0.0029		(−)
0.0148	2008-12-17	8:35		0.0029	0.0029		
0.0145	2008-10-01	8:35	13	0.0029	0.0029		(+)
0.0142	2009-03-18	13:30	19	0.0175	0.0175		(+)
0.0140	2009-03-05	8:35	25*	0.0028	0.0028		(−)
0.0139	2008-01-03	8:35	25*	0.0027	0.0027		(−)
0.0139	2008-11-20	8:35	25*	0.0027	0.0027		(+)
0.0139	2004-06-15	8:35	15*	0.0027	0.0027		(+)
0.0138	2008-09-15	8:35	6	0.0027	0.0027		(−)
0.0135	2010-11-29	8:35		0.0027	0.0027	0.0135	
0.0132	2010-01-12	8:35	17*	0.0026	0.0026		(−)
0.0130	2010-06-04	8:35	4*	0.0026	0.0026		(−)
0.0128	2008-01-23	8:35		0.0025	0.0025		
0.0125	2004-07-06	8:35		0.0025	0.0025	0.0125	
0.0119	2004-12-03	8:35	4*	0.0023	0.0023		(−)
0.0115	2008-10-24	8:35		0.0023	0.0023		

Notes: The table reports the largest positive price changes by 5-minute interval for the 30-year U.S. Treasury bond together with the associated (if any) news announcements. The table provides the largest price changes (first column), the trading dates of these largest changes (second column), time of the change (third column), and the type of the news (fourth column). * denotes the news announcement type that coincides with the largest price change. The sample covers the periods January 1, 2004 to December 30, 2010. The news announcements without the (*) superscript are released on the same date of the corresponding change, but they do not occur at the same 5-minute interval. Blank-left news types imply that there is no news event on that date. For these rows, the largest price changes are, therefore, not associated with news events. In the last four columns, the table further reports the periodicity-filtered intraday returns, volatility and detected jumps (if any) along with the dispersion sign (i.e., actual news release minus consensus forecasts. See Table 1 for the number labels of the announcement types given in the fourth column. The sample covers the periods January 1, 2004 to December 30, 2010.

Table 5: Unrestricted (kitchen sink) contemporaneous volatility responses

	[1]			[2]		
Announcements	Coeff.	*t*-prob	sign	Coeff.	*t*-prob	sign
Constant	2.050	0.000	(+)	2.701	0.000	(+)
Exante Factors						
1. GDP advance	-2.358	0.000	(−)	-1.786	0.007	(−)
2. GDP preliminary	-2.286	0.001	(−)	-3.956	0.000	(−)
3. GDP final	-0.324	0.770		-0.890	0.035	(−)
4. Nonfarm payroll employment	-1.968	0.000	(−)	-2.867	0.000	(−)
5. Retail sales	-0.877	0.010	(−)	-1.506	0.023	(−)
6. Industrial production	0.724	0.366		1.204	0.191	
7. Capacity utilization	0.193	0.822		-1.937	0.176	
8. Personal income	-0.351	0.215		-2.082	0.001	(−)
9. Consumer credit	0.295	0.539		-0.291	0.711	
10. Personal consumption exp.	-1.665	0.000	(−)	-1.368	0.004	(−)
11. New home sales	-0.103	0.825		-1.721	0.016	(−)
12. Durable goods orders	-1.167	0.003	(−)	-0.283	0.698	
13. Construction spending	0.675	0.259		0.996	0.061	(+)
14. Factory orders	-0.550	0.256		-1.029	0.100	
15. Business inventories	0.770	0.417		-0.202	0.757	
16. Government budget deficit	0.981	0.162		0.773	0.269	
17. Trade balance	-2.173	0.000	(−)	-2.277	0.036	(−)
18. Producer price index	-1.160	0.001	(−)	-0.966	0.157	
19. Consumer price index	-1.045	0.093	(−)	-2.562	0.000	(−)
20. Consumer confidence index	0.572	0.382		0.675	0.528	
21. NAPM index	0.410	0.586		-0.201	0.795	
22. Housing starts	-2.031	0.000	(−)	-1.246	0.002	(−)
23. Index of leading indicators	0.208	0.747		-0.933	0.374	
24. FOMC rate decisions	-0.329	0.621				
25. Initial unemployment claims	-2.667	0.000	(−)	-1.287	0.009	(−)
Expost Factors						
26. GDP advance	-2.019	0.000	(−)	-3.408	0.000	(−)
27. GDP preliminary	-0.736	0.299		-0.366	0.602	
28. GDP final	-2.755	0.000	(−)	-4.302	0.000	(−)
29. Nonfarm payroll employment	-2.098	0.000	(−)	-2.891	0.000	(−)
30. Retail sales	-1.695	0.001	(−)	-1.802	0.002	(−)
31. Industrial production	-0.271	0.583		-0.485	0.563	
32. Capacity utilization	-0.311	0.001	(−)	12.134	0.286	
33. Personal income	-1.006	0.003	(−)	-0.177	0.799	
34. Consumer credit	-0.744	0.108		-0.671	0.328	
35. Personal consumption exp.	-1.086	0.008	(−)	-2.073	0.052	(−)
36. New home sales	0.023	0.920		2.381	0.181	
37. Durable goods orders	-1.985	0.001	(−)	-4.052	0.000	(−)
38. Construction spending	-0.982	0.175		-0.857	0.269	
39. Factory orders	0.089	0.875		0.872	0.257	
40. Business inventories	-0.291	0.748		-0.022	0.982	
41. Government budget deficit	-0.251	0.476		-0.221	0.584	
42. Trade balance	-0.766	0.143		-1.426	0.033	(−)
43. Producer price index	-1.537	0.000	(−)	-2.218	0.000	(−)
44. Consumer price index	-1.976	0.000	(−)	-1.659	0.006	(−)
45. Consumer confidence index	0.247	0.706		0.307	0.683	
46. NAPM index	-0.108	0.894		-1.012	0.260	

47. Housing starts	-0.477	0.112		-2.496	0.009	(−)
48. Index of leading indicators	0.778	0.300		1.873	0.075	(+)
49. FOMC rate decisions	-4.925	0.000	(−)	-6.256	0.000	(−)
50. Initial unemployment claims	-0.694	0.001	(−)	-4.362	0.000	(−)
Obs.		133426			69678	
F-stat [prob]		315.3	[0.000]		141.3	[0.000]
LL [Adj. R^2]		832334	[0.115]		423292	[0.098]

Notes: The table reports the regression results of the unrestricted (kitchen-sink) model for volatility. We estimate the model by combining all standardized exante and expost factors (first column). The model specification is given by Equation (4) in the main text. Here, we consider only contemporaneous responses (thus $J = 0$). That is,

$$|r_t^*| = \beta_0 + \sum_{i=1}^{l} \beta_i |r_{t-i}^*| + \underbrace{\sum_{k=1}^{K} \beta_k^{(e)} |E_{k,t}|}_{\text{exante component}} + \underbrace{\sum_{k=1}^{K} \beta_k^{(s)} |S_{k,t}|}_{\text{expost component}} + \varepsilon_t,$$

where the dependent variable is 5-minute (periodicity-filtered) absolute log-returns. Table 1 provides the description of exante and expost independent variables. Expost variables are absolute surprises, whereas exante variables are absolute consensus forecasts (Model [1]) and forecast ranges representing dispersion in expectations (Model [2]). The table reports the estimated coefficients in basis points (second column), probabilities of values (third column), and the sign of the statistically significant coefficients (fourth column). The standard errors of the coefficients are robust to heteroscedasticity and auto-correlation. The table further displays the number of observations (*Obs.*), F-statistics of the models as well as their likelihood ratios (LL) and adjusted R^2 values (in square brackets). The sample covers the periods January 1, 2004 to December 30, 2010 for Model [1], and May 29, 2007 to December 30, 2010 for Model [2].

Table 6: Unrestricted (kitchen sink) contemporaneous jump responses

	[1]			[2]		
Announcements	Coeff.	t-prob	sign	Coeff.	t-prob	sign
Constant	13.067	0.000	(+)	13.017	0.000	(+)
Exante Factors						
1. GDP advance	-4.039	0.062	(−)	-5.624	0.008	(−)
2. GDP preliminary	-4.972	0.001	(−)	-5.789	0.029	(−)
3. GDP final	-0.742	0.798		-3.843	0.004	(−)
4. Nonfarm payroll employment	-5.587	0.000	(−)	-6.481	0.000	(−)
5. Retail sales	-2.984	0.002	(−)	-3.339	0.042	(−)
6. Industrial production	-1.133	0.208		-1.072	0.430	
7. Capacity utilization	-7.945	0.000	(−)	-5.469	0.025	(−)
8. Personal income	-2.310	0.010	(−)	-5.903	0.000	(−)
9. Consumer credit	-7.292	0.000	(−)	-6.418	0.000	(−)
10. Personal consumption exp.	-2.865	0.113		-1.873	0.196	
11. New home sales	-10.590	0.000	(−)	-5.721	0.000	(−)
12. Durable goods orders	-4.721	0.000	(−)	-3.125	0.062	(−)
13. Construction spending	-7.760	0.000	(−)	-4.837	0.015	(−)
14. Factory orders	-6.215	0.000	(−)	-7.108	0.000	(−)
15. Business inventories	-4.800	0.000	(−)	-5.342	0.002	(−)
16. Government budget deficit	-8.993	0.000	(−)	-7.797	0.000	(−)
17. Trade balance	-7.322	0.000	(−)	-3.388	0.062	(−)
18. Producer price index	-1.699	0.016	(−)	-2.241	0.139	
19. Consumer price index	-1.869	0.276		-5.141	0.004	(−)
20. Consumer confidence index	-9.777	0.000	(−)	-6.241	0.000	(−)
21. NAPM index	-6.123	0.000	(−)	-6.931	0.000	(−)
22. Housing starts	-7.339	0.000	(−)	-3.982	0.002	(−)
23. Index of leading indicators	-7.805	0.000	(−)	-7.595	0.001	(−)
24. FOMC rate decisions	-11.587	0.000	(−)			
25. Initial unemployment claims	-7.030	0.000	(−)	-2.413	0.041	(−)
Expost Factors						
26. GDP advance	-6.826	0.000	(−)	-5.610	0.031	(−)
27. GDP preliminary	-4.094	0.036	(−)	-4.023	0.067	(−)
28. GDP final	-8.078	0.000	(−)	-8.575	0.000	(−)
29. Nonfarm payroll employment	-6.393	0.000	(−)	-6.391	0.000	(−)
30. Retail sales	-5.238	0.001	(−)	-4.769	0.001	(−)
31. Industrial production	-4.597	0.001	(−)	0.852	0.626	
32. Capacity utilization	-0.951	0.015	(−)	-60.736	0.000	(−)
33. Personal income	-3.723	0.001	(−)	-1.054	0.572	
34. Consumer credit	-5.772	0.000	(−)	-6.083	0.000	(−)
35. Personal consumption exp.	-4.420	0.001	(−)	-4.903	0.034	(−)
36. New home sales	-2.367	0.000	(−)	-23.790	0.000	(−)
37. Durable goods orders	-4.878	0.000	(−)	-6.677	0.000	(−)
38. Construction spending	-4.995	0.000	(−)	-7.325	0.000	(−)
39. Factory orders	-5.897	0.000	(−)	-4.774	0.000	(−)
40. Business inventories	-7.554	0.000	(−)	-7.308	0.000	(−)
41. Government budget deficit	-3.787	0.001	(−)	-2.006	0.310	
42. Trade balance	-2.851	0.034	(−)	-5.571	0.000	(−)
43. Producer price index	-5.722	0.000	(−)	-5.186	0.003	(−)
44. Consumer price index	-7.141	0.000	(−)	-4.659	0.001	(−)
45. Consumer confidence index	-1.226	0.249		-4.699	0.000	(−)
46. NAPM index	-5.196	0.000	(−)	-7.201	0.000	(−)

47. Housing starts	-1.717	0.044	(−)	-6.010	0.012	(−)
48. Index of leading indicators	-5.636	0.000	(−)	-4.441	0.008	(−)
49. FOMC rate decisions	-6.199	0.080	(−)	-17.998	0.000	(−)
50. Initial unemployment claims	-2.438	0.002	(−)	-10.242	0.000	(−)
Obs.		1949			992	
F-stat [prob]		4.5	[0.000]		1.8	[0.001]
LL [Adj. R^2]		9513.77	[0.083]		4719.2	[0.038]

Notes: The table reports the regression results of the unrestricted (kitchen-sink) model for jumps. We estimate the model by combining all standardized exante and expost factors (first column). The model specification is given by Equation (5) in the main text. As in Tables 4 and 5, we consider only contemporaneous responses (thus $J = 0$). That is,

$$|\kappa_t^*| = \beta_0 + \underbrace{\sum_{k=1}^{K} \beta_k^{(e)} |E_{k,t}|}_{\text{exante component}} + \underbrace{\sum_{k=1}^{K} \beta_k^{(s)} |S_{k,t}|}_{\text{expost component}} + \varepsilon_t,$$

where the dependent variable is 5-minute (periodicity-filtered) absolute jumps (identified by using Lee and Mykland, 2008 approach). Table 1 provides the description of exante and expost independent variables. Expost variables are absolute surprises, whereas exante variables are absolute consensus forecasts (Model [1]) and forecast ranges representing dispersion in expectations (Model [2]). The table reports the estimated coefficients in basis points (second column), probabilities of values (third column), and the sign of the statistically significant coefficients (fourth column). The standard errors of the coefficients are robust to heteroscedasticity and auto-correlation. The table further displays the number of observations (*Obs.*), F-statistics of the models as well as their likelihood ratios (LL) and adjusted R^2 values (in square brackets). The sample covers the periods January 1, 2004 to December 30, 2010 for Model [1], and May 29, 2007 to December 30, 2010 for Model [2].

Table 7: Decomposition of exante and expost news effects on returns

Announcements	[CON] Coeff.	t-prob	[RANGE] Coeff.	t-prob	[SURP] Coeff.	t-prob
Constant	0.028	(0.138)	0.031	(0.309)	0.028	(0.138)
1. GDP advance	-0.154	(0.116)	0.075	(0.599)	0.058	(0.543)
2. GDP preliminary	-0.062	(0.204)	-0.007	(0.914)	-0.021	(0.759)
3. GDP final	0.144	(0.041)	0.022	(0.707)	-0.042	(0.685)
4. Nonfarm payroll employment	0.044	(0.325)	0.071	(0.209)	0.021	(0.518)
5. Retail sales	0.011	(0.693)	0.095	(0.163)	0.007	(0.864)
6. Industrial production	-0.501	(0.641)	-0.185	(0.834)	-0.694	(0.468)
7. Capacity utilization	0.461	(0.629)	0.295	(0.764)	0.116	(0.522)
8. Personal income	0.013	(0.563)	0.032	(0.422)	0.039	(0.181)
9. Consumer credit	1.326	(0.029)	0.249	(0.777)	0.207	(0.697)
10. Personal consumption exp.	-0.082	(0.211)	0.061	(0.457)	-0.037	(0.432)
11. New home sales	-0.159	(0.817)	0.193	(0.792)	0.157	(0.730)
12. Durable goods orders	-0.002	(0.976)	0.027	(0.667)	-0.112	(0.138)
13. Construction spending	0.410	(0.544)	-0.641	(0.591)	-1.667	(0.019)
14. Factory orders	-0.453	(0.420)	-0.772	(0.362)	1.105	(0.099)
15. Business inventories	1.785	(0.050)	-0.830	(0.437)	1.278	(0.219)
16. Government budget deficit	-0.754	(0.442)	-1.693	(0.204)	1.195	(0.064)
17. Trade balance	-0.008	(0.779)	-0.040	(0.534)	-0.014	(0.602)
18. Producer price index	-0.039	(0.287)	-0.015	(0.872)	-0.022	(0.597)
19. Consumer price index	0.070	(0.069)	-0.083	(0.078)	-0.069	(0.385)
20. Consumer confidence index	-0.249	(0.758)	-0.169	(0.895)	-0.051	(0.951)
21. NAPM index	0.858	(0.395)	-1.315	(0.204)	0.296	(0.720)
22. Housing starts	0.022	(0.536)	-0.065	(0.139)	-0.029	(0.293)
23. Index of leading indicators	-0.777	(0.402)	1.142	(0.345)	-1.847	(0.068)
24. FOMC rate decisions	-0.519	(0.718)			-1.273	(0.689)
25. Initial unemployment claims	0.015	(0.449)	-0.007	(0.790)	0.023	(0.154)
Obs.	133426		69678		133426	
F-stat [prob]	9.9	[0.000]	4.7	[0.000]	10.0	[0.000]
LL [Adj. R^2]	786017	[0.002]	397993	[0.002]	786019	[0.002]

Notes: The table reports the regressions results for returns with exante and expost factors. We disentangle contemporaneous returns responses into exante and expost information measures. We consider only contemporaneous responses. The dependent variable is 5-minute (periodicity-filtered) log-returns. [CON]: model with (exante) consensus forecasts of each variable, [RANGE]: model with (exante) forecast dispersion of each variable, [SURP]: model with (expost) news surprises of each variable. All measures are standardized. For each model, the table reports the estimated coefficients (in basis points) and the probabilities of values. The standard errors of the coefficients are robust to heteroscedasticity and auto-correlation. The table further displays the number of observations (*Obs.*), F-statistics of the models as well as their likelihood ratios (LL) and adjusted R^2 values (in square brackets). The sample covers the periods January 1, 2004 to December 30, 2010 for [CON] and [SURP], and May 29, 2007 to December 30, 2010 for [RANGE].

Table 8: Decomposition of exante and expost news effects on volatility

	[CON]		[RANGE]		[SURP]	
Announcements	Coeff.	t-prob	Coeff.	t-prob	Coeff.	t-prob
Constant	2.046	(0.000)	2.697	(0.000)	2.047	(0.000)
1. GDP advance	-3.806	(0.000)	-4.707	(0.000)	-4.011	(0.000)
2. GDP preliminary	-2.745	(0.000)	-4.483	(0.000)	-3.375	(0.000)
3. GDP final	-1.482	(0.171)	-2.721	(0.002)	-4.029	(0.000)
4. Nonfarm payroll employment	-3.301	(0.000)	-4.432	(0.000)	-3.432	(0.000)
5. Retail sales	-2.022	(0.000)	-2.442	(0.015)	-2.736	(0.000)
6. Industrial production	0.616	(0.429)	0.675	(0.402)	0.238	(0.469)
7. Capacity utilization	0.109	(0.895)	-0.772	(0.419)	-0.375	(0.000)
8. Personal income	-0.537	(0.177)	-2.701	(0.000)	-1.552	(0.000)
9. Consumer credit	-0.213	(0.591)	-0.792	(0.217)	-0.546	(0.157)
10. Personal consumption exp.	-2.321	(0.000)	-2.116	(0.000)	-1.900	(0.000)
11. New home sales	-0.081	(0.855)	-1.241	(0.046)	-0.007	(0.977)
12. Durable goods orders	-2.558	(0.000)	-2.871	(0.000)	-3.310	(0.000)
13. Construction spending	-0.028	(0.953)	0.608	(0.227)	-0.506	(0.358)
14. Factory orders	-0.495	(0.138)	-0.358	(0.483)	-0.250	(0.528)
15. Business inventories	0.574	(0.430)	-0.211	(0.767)	0.226	(0.733)
16. Government budget deficit	0.918	(0.178)	0.627	(0.254)	0.002	(0.997)
17. Trade balance	-2.712	(0.000)	-3.681	(0.000)	-2.614	(0.000)
18. Producer price index	-2.031	(0.000)	-1.968	(0.020)	-2.506	(0.000)
19. Consumer price index	-2.178	(0.000)	-3.488	(0.000)	-3.140	(0.000)
20. Consumer confidence index	0.744	(0.106)	0.925	(0.266)	0.665	(0.149)
21. NAPM index	0.357	(0.528)	-0.677	(0.249)	0.139	(0.819)
22. Housing starts	-2.515	(0.000)	-2.723	(0.000)	-2.303	(0.000)
23. Index of leading indicators	0.598	(0.285)	0.283	(0.735)	0.917	(0.151)
24. FOMC rate decisions	-0.665	(0.315)			-5.131	(0.000)
25. Initial unemployment claims	-3.029	(0.000)	-2.696	(0.000)	-1.728	(0.004)
Obs.	133426		69678		133426	
F-stat [prob]	575.8	[0.000]	259.9	[0.000]	572	[0.000]
LL [Adj. R^2]	832302	[0.114]	423250	[0.097]	832253	[0.114]

Notes: The table reports the regressions results for volatility with exante and expost factors. We disentangle contemporaneous volatility responses into exante and expost information measures. We consider only contemporaneous responses. The dependent variable is absolute 5-minute (periodicity-filtered) log-returns. [CON]: model with (exante) consensus forecasts of each variable, [RANGE]: model with (exante) forecast dispersion of each variable, [SURP]: model with (expost) news surprises of each variable. All measures are standardized and the independent variables (both exante and expost) are in absolute values. For each model, the table reports the estimated coefficients (in basis points) and the probabilities of values. The standard errors of the coefficients are robust to heteroscedasticity and auto-correlation. The table further displays the number of observations (*Obs.*), F-statistics of the models as well as their likelihood ratios (LL) and adjusted R^2 values (in square brackets). The sample covers the periods January 1, 2004 to December 30, 2010 for [CON] and [SURP], and May 29, 2007 to December 30, 2010 for [RANGE].

Table 9: Decomposition of exante and expost news effects on jumps

Announcements	[CON] Coeff.	t-prob	[RANGE] Coeff.	t-prob	[SURP] Coeff.	t-prob
Constant	10.885	(0.000)	9.671	(0.000)	8.687	(0.000)
1. GDP advance	-7.444	(0.000)	-7.796	(0.000)	-6.950	(0.000)
2. GDP preliminary	-6.343	(0.000)	-6.835	(0.000)	-6.766	(0.000)
3. GDP final	-3.367	(0.188)	-5.666	(0.001)	-7.555	(0.000)
4. Nonfarm payroll employment	-8.044	(0.000)	-7.400	(0.000)	-6.762	(0.000)
5. Retail sales	-5.427	(0.000)	-4.363	(0.017)	-5.563	(0.000)
6. Industrial production	-2.284	(0.008)	0.740	(0.579)	-6.392	(0.000)
7. Capacity utilization	-7.671	(0.000)	-8.873	(0.000)	-0.218	(0.702)
8. Personal income	-2.521	(0.025)	-5.940	(0.000)	-3.416	(0.001)
9. Consumer credit	-9.371	(0.000)	-8.172	(0.000)	-7.033	(0.000)
10. Personal consumption exp.	-4.510	(0.009)	-2.586	(0.011)	-4.169	(0.000)
11. New home sales	-9.462	(0.000)	-7.768	(0.000)	-3.730	(0.008)
12. Durable goods orders	-6.770	(0.000)	-5.715	(0.000)	-6.260	(0.000)
13. Construction spending	-9.462	(0.000)	-6.246	(0.014)	-6.916	(0.000)
14. Factory orders	-8.119	(0.000)	-7.991	(0.000)	-6.552	(0.000)
15. Business inventories	-7.848	(0.000)	-7.209	(0.000)	-7.172	(0.000)
16. Government budget deficit	-8.316	(0.000)	-6.816	(0.000)	-4.041	(0.002)
17. Trade balance	-7.772	(0.000)	-6.132	(0.000)	-5.839	(0.000)
18. Producer price index	-4.157	(0.000)	-3.340	(0.024)	-5.078	(0.000)
19. Consumer price index	-5.150	(0.000)	-5.733	(0.000)	-6.392	(0.000)
20. Consumer confidence index	-9.066	(0.000)	-7.446	(0.000)	-6.246	(0.000)
21. NAPM index	-7.601	(0.000)	-7.696	(0.000)	-5.736	(0.000)
22. Housing starts	-7.543	(0.000)	-5.608	(0.000)	-5.200	(0.000)
23. Index of leading indicators	-8.843	(0.000)	-7.776	(0.000)	-7.125	(0.000)
24. FOMC rate decisions	-10.006	(0.000)			-9.144	(0.000)
25. Initial unemployment claims	-6.926	(0.000)	-4.335	(0.004)	-3.438	(0.010)
Obs.	1949		992		1949	
F-stat [prob]	6.5	[0.000]	2.1	[0.002]	3.9	[0.000]
LL [Adj. R^2]	9483	[0.066]	4700	[0.026]	9452	[0.036]

Notes: The table reports the regressions results for jumps with exante and expost factors. We disentangle contemporaneous jump responses into exante and expost information measures. We consider only contemporaneous responses. The dependent variable is absolute 5-minute (periodicity-filtered) jumps (identified by using Lee and Mykland, 2008 approach). [CON]: model with (exante) consensus forecasts of each variable, [RANGE]: model with (exante) forecast dispersion of each variable, [SURP]: model with (expost) news surprises of each variable. All independent variables (exante and expost) are in absolute values. For each model, the table reports the estimated coefficients (in basis points) and the probabilities of values. The standard errors of the coefficients are robust to heteroscedasticity and auto-correlation. The table further displays the number of observations (*Obs.*), F-statistics of the models as well as their likelihood ratios (LL) and adjusted R^2 values (in square brackets). The sample covers the periods January 1, 2004 to December 30, 2010 for [CON] and [SURP], and May 29, 2007 to December 30, 2010 for [RANGE].

Table 10: Evans (2011) jump regressions with exante and expost factors

Announcements	[CON] Coeff.	t-prob	[SURP] Coeff.	t-prob
Constant	0.0022	(0.000)	0.0019	(0.000)
1. GDP advance	-0.0019	(0.000)	-0.0016	(0.000)
2. GDP preliminary	-0.0016	(0.000)	-0.0014	(0.000)
3. GDP final	-0.0014	(0.000)	-0.0014	(0.000)
4. Nonfarm payroll employment	-0.0021	(0.000)	-0.0018	(0.000)
5. Retail sales	-0.0015	(0.000)	-0.0013	(0.000)
6. Industrial production	0.0000	(0.000)	-0.0012	(0.000)
7. Capacity utilization	-0.0022	(0.000)	-0.0008	(0.001)
8. Personal income	-0.0014	(0.006)	-0.0012	(0.000)
9. Consumer credit	-0.0022	(0.000)	-0.0019	(0.000)
10. Personal consumption exp.	-0.0004	(0.472)	-0.0004	(0.034)
11. New home sales	-0.0020	(0.000)	-0.0017	(0.000)
12. Durable goods orders	-0.0017	(0.000)	-0.0014	(0.000)
13. Construction spending	-0.0022	(0.000)	-0.0019	(0.000)
14. Factory orders	-0.0021	(0.000)	-0.0018	(0.000)
15. Business inventories	-0.0021	(0.000)	-0.0018	(0.000)
16. Government budget deficit	-0.0022	(0.000)	-0.0019	(0.000)
17. Trade balance	-0.0016	(0.000)	-0.0014	(0.000)
18. Producer price index	-0.0011	(0.000)	-0.0009	(0.000)
19. Consumer price index	-0.0014	(0.000)	-0.0012	(0.000)
20. Consumer confidence index	-0.0018	(0.000)	-0.0016	(0.000)
21. NAPM index	-0.0019	(0.000)	-0.0016	(0.000)
22. Housing starts	-0.0014	(0.000)	-0.0013	(0.000)
23. Index of leading indicators	-0.0022	(0.000)	-0.0019	(0.000)
24. FOMC rate decisions	-0.0022	(0.000)	-0.0019	(0.000)
25. Initial unemployment claims	-0.0015	(0.000)	-0.0013	(0.000)
Obs.	1949		1949	
F-stat [prob]	22.7	[0.000]	17.5	[0.000]
LL [Adj. R^2]	9655	[0.217]	9602	[0.174]

Notes: The table reports the results of Evans (2011) jump regressions with (exante) consensus forecasts ([CON] and (expost) news surprises ([SURP]). All measures are standardized and the model specifications are given by Equations (6) and (7) in the main text. We consider only contemporaneous responses (thus $J = 0$). For each model, we regress absolute intraday jumps to exante and expost news dummies. [CON]: model with (exante) consensus forecast dummies of each variable, [SURP]: model with (expost) news surprise dummies of each variable.The standard errors of the coefficients are robust to heteroscedasticity and auto-correlation. The table further displays the number of observations (*Obs.*), F-statistics of the models as well as their likelihood ratios (LL) and adjusted R^2 values (in square brackets). The sample covers the periods January 1, 2004 to December 30, 2010.

Table 11: Contemporaneous and cumulative lagged responses: exante versus expost components

Panel A. Return responses	**Contemporaneous**				**Cumulative**			
	Exante		Expost		Exante		Expost	
3. GDP final	0.144**	(+)	-0.042	(−)	-1.020**	(−)	1.920*	(+)
4. Nonfarm payroll employment	0.044	(+)	0.021	(+)	0.296***	(+)	-4.850***	(−)
12. Durable goods orders	-0.002	(−)	-0.112	(−)	0.795	(+)	0.638	(+)
17. Trade balance	-0.008	(−)	-0.014	(−)	-0.814	(−)	-4.990***	(−)
19. Consumer price index	0.070*	(+)	-0.069	(−)	0.273	(+)	-1.710*	(−)
20. Consumer confidence index	-0.249	(−)	-0.051	(−)	-1.400	(−)	1.280	(+)
24. FOMC rate decisions	-0.519	(−)	-1.273	(−)	-3.770**	(−)	-15.700	(−)
25. Initial unemployment claims	0.015	(+)	0.023	(+)	-0.846	(−)	1.740	(+)
lag significance	·		·		5 [0.020]		4 [0.011]	
Adj. R^2	0.002		0.002		0.004		0.004	

Panel B. Volatility responses	**Contemporaneous**				**Cumulative**			
	Exante		Expost		Exante		Expost	
3. GDP final	-1.482	(−)	-4.029***	(−)	1.500*	(+)	0.326***	(+)
4. Nonfarm payroll employment	-3.301***	(−)	-3.432***	(−)	8.270***	(+)	9.790***	(+)
12. Durable goods orders	-2.558***	(−)	-3.310***	(−)	-2.350***	(−)	-2.700***	(−)
17. Trade balance	-2.712***	(−)	-2.614***	(−)	0.992***	(+)	1.170***	(+)
19. Consumer price index	-2.178***	(−)	-3.140***	(−)	2.670***	(+)	4.700***	(+)
20. Consumer confidence index	0.744	(+)	0.665	(+)	-0.529	(−)	0.251	(+)
24. FOMC rate decisions	-0.665	(−)	-5.131***	(−)	-0.340	(−)	-7.950	(−)
25. Initial unemployment claims	-3.029***	(−)	-1.728***	(−)	0.849***	(+)	-0.219***	(−)
lag significance	·		·		5 [0.000]		5 [0.000]	
Adj. R^2	0.114		0.114		0.117		0.117	

Panel C. Jump responses	**Contemporaneous**				**Cumulative**			
	Exante		Expost		Exante		Expost	
3. GDP final	-3.367	(−)	-7.555***	(−)	4.870**	(+)	-14.100	(−)
4. Nonfarm payroll employment	-8.044***	(−)	-6.762***	(−)	-3.050***	(−)	1.230**	(+)
12. Durable goods orders	-6.770***	(−)	-6.260***	(−)	-11.000**	(−)	-6.060**	(−)
17. Trade balance	-7.772***	(−)	-5.839***	(−)	-10.500***	(−)	-10.300	(−)
19. Consumer price index	-5.150***	(−)	-6.392***	(−)	-8.540	(−)	2.760	(+)
20. Consumer confidence index	-9.066***	(−)	-6.246***	(−)	-1.660***	(−)	2.610***	(+)
24. FOMC rate decisions	-10.006***	(−)	-9.144***	(−)	-9.500**	(−)	-16.400	(−)
25. Initial unemployment claims	-6.926***	(−)	-3.438***	(−)	-6.500***	(−)	-6.020**	(−)
lag significance	·		·		3 [0.003]		0 [0.395]	
Adj. R^2	0.066		0.036		0.133		0.015	

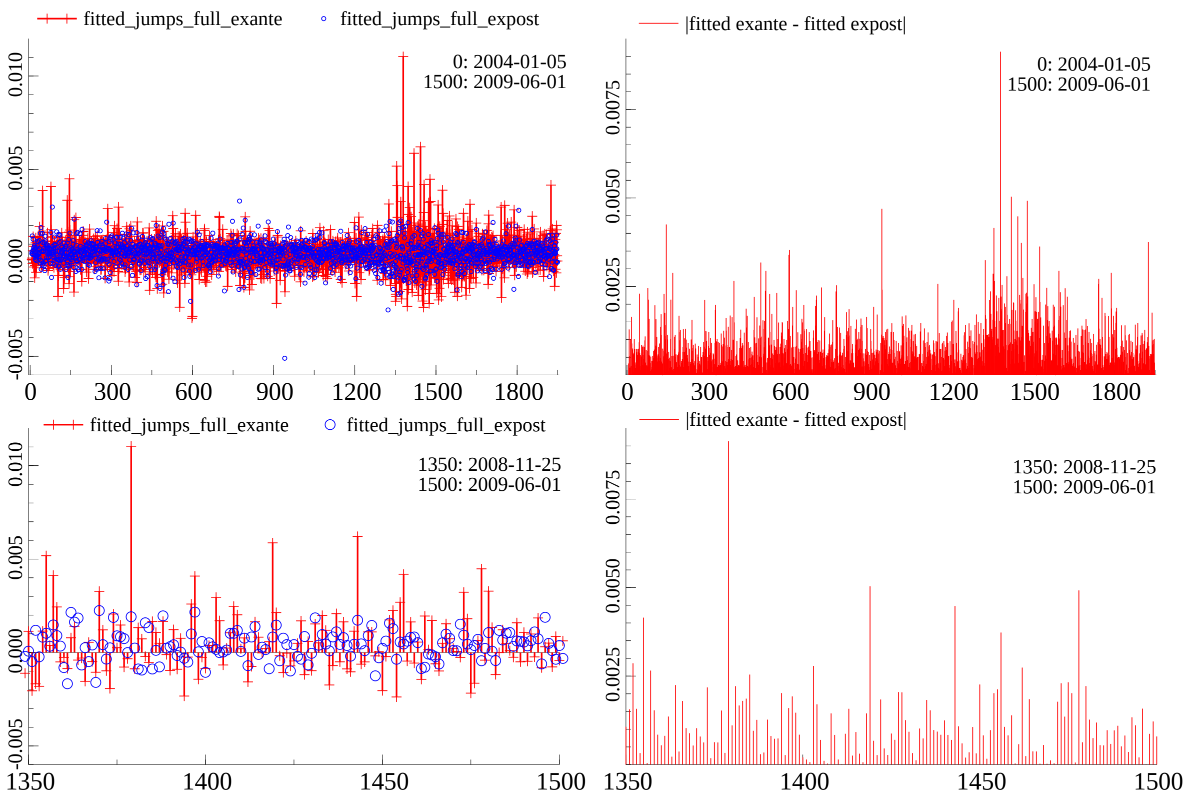
Notes: The table reports the estimates of the contemporaneous and cumulative (lagged) response of U.S. Treasury bond to news (exante versus expost). Panel A: return response coefficients, Panel B: volatility response coefficients, Panel C: jump response coefficients. For each category, we estimate the full model (with all news announcements (25 variables), but report only the coefficients of the benchmark indicators as in Andersen et al. (2003). The model specifications are given by Equations (3)−(5) (from Panels A to C) in the main text. The standard errors of coefficients are robust to heteroscedasticity and auto-correlation. *, **, and *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively. Each panel in the table further reports the maximum number of lags, their significance (in square brackets) and adjusted R^2 values (last row). The sample covers the periods January 1, 2004 to December 30, 2010.

Table 12: Response regressions with interaction news effects

Panel A. Return responses	Main terms				Interaction terms	
	Exante		Expost		Exante x Expost	
3. GDP final	0.227**	(+)	0.078	(+)	-0.075	(−)
4. Nonfarm payroll employment	0.044	(+)	0.029	(+)	0.036	(+)
12. Durable goods orders	0.065	(+)	-0.109	(−)	0.114	(+)
17. Trade balance	-0.006	(−)	-0.019	(−)	0.013	(+)
19. Consumer price index	0.109**	(+)	-0.111	(−)	-0.017	(−)
20. Consumer confidence index	-0.197	(−)	-0.055	(−)	-0.166	(−)
24. FOMC rate decisions	-0.051	(−)	2.005	(+)	6.371*	(+)
25. Initial unemployment claims	0.023	(+)	0.009	(+)	0.055*	(+)
Panel B. Volatility responses	**Main terms**				**Interaction terms**	
	Exante		Expost		Exante x Expost	
3. GDP final	-3.100***	(−)	-5.571***	(−)	5.773***	(+)
4. Nonfarm payroll employment	-2.800***	(−)	-3.330***	(−)	1.971***	(+)
12. Durable goods orders	-1.934***	(−)	-2.896***	(−)	1.506	(+)
17. Trade balance	-3.387***	(−)	-2.574***	(−)	3.396***	(+)
19. Consumer price index	-3.713***	(−)	-2.765***	(−)	2.101***	(+)
20. Consumer confidence index	0.393	(+)	-0.271	(−)	0.689	(+)
24. FOMC rate decisions	-0.371	(−)	-5.256***	(−)	0.707	(+)
25. Initial unemployment claims	-3.488***	(−)	-0.706***	(−)	0.608*	(+)
Panel C. Jump responses	**Main terms**				**Interaction terms**	
	Exante		Expost		Exante x Expost	
3. GDP final	-4.584***	(−)	-9.014***	(−)	9.238***	(+)
4. Nonfarm payroll employment	-4.936***	(−)	-6.262***	(−)	4.384***	(+)
12. Durable goods orders	-4.807***	(−)	-5.515***	(−)	4.661***	(+)
17. Trade balance	-6.039***	(−)	-4.647***	(−)	5.756***	(+)
19. Consumer price index	-6.166***	(−)	-5.518***	(−)	3.939***	(+)
20. Consumer confidence index	-6.837***	(−)	-4.963***	(−)	4.585***	(+)
24. FOMC rate decisions	-6.773***	(−)	-6.337***	(−)	6.243***	(+)
25. Initial unemployment claims	-5.729***	(−)	-1.501**	(−)	2.122***	(+)

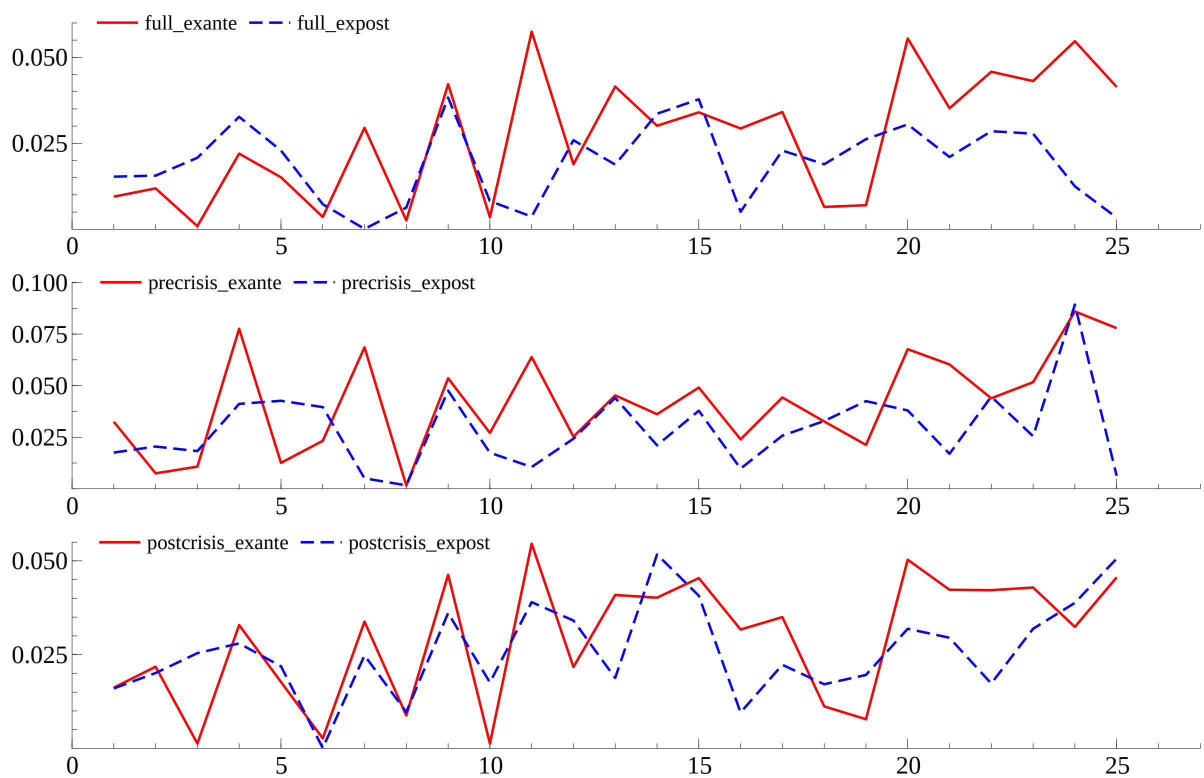
Notes: The table reports the results of the regressions with interaction effects. Panel A: return response coefficients, Panel B: volatility response coefficients, Panel C: jump response coefficients. For each category, the independent variables are the benchmark macro factors provided in the first column. "Exante x Expost" (right panels) is the interaction term of each variable, calculated as the simple observation-by-observation product of exante and expost measures. The standard errors of coefficients are robust to heteroscedasticity and auto-correlation. *, **, and *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively. The sample covers the periods January 1, 2004 to December 30, 2010.

Figure 1: Fitted values from jump regressions using exante versus expost news measures



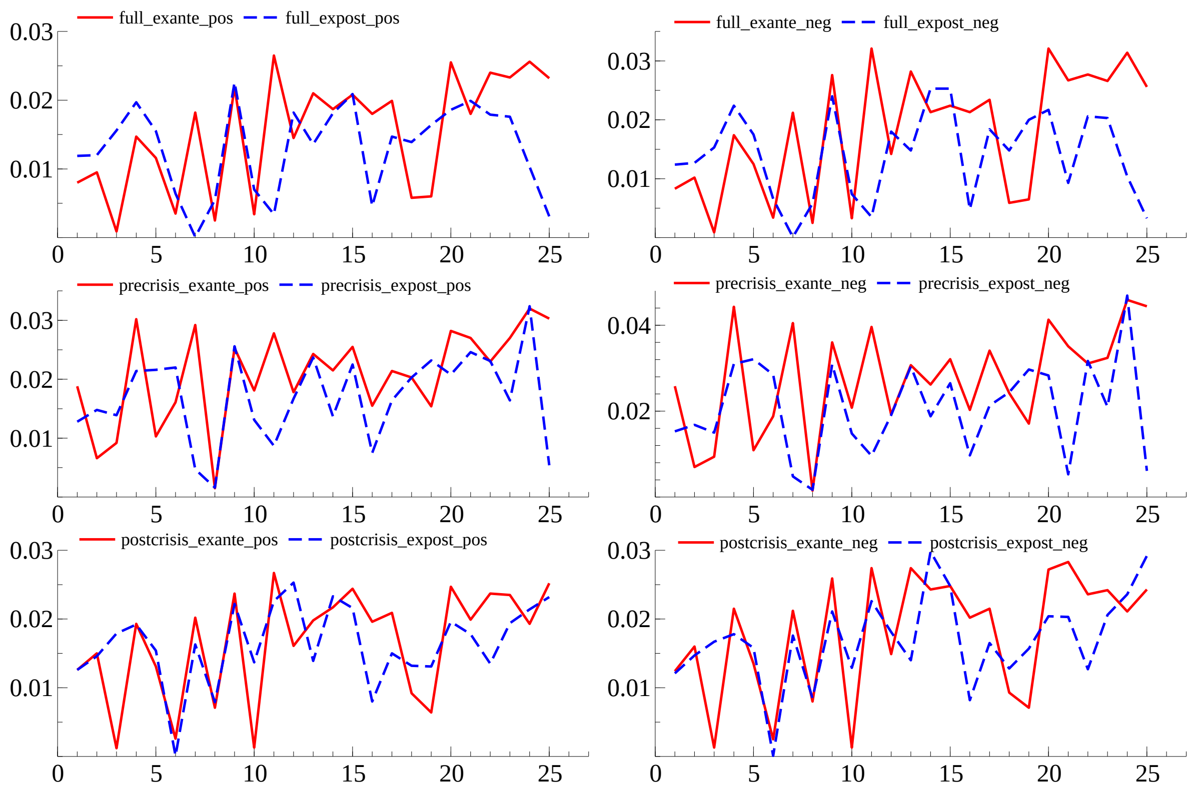
Notes: The figure illustrates the fitted values from unrestricted jump regressions for exante versus expost components of announcements (see e.g., Table 11). We consider both contemporaneous and cumulative (lagged) effects of variables on identified jumps. The sample covers the periods January 1, 2004 to December 30, 2010.

Figure 2: Contribution of each news announcement on total jump reaction



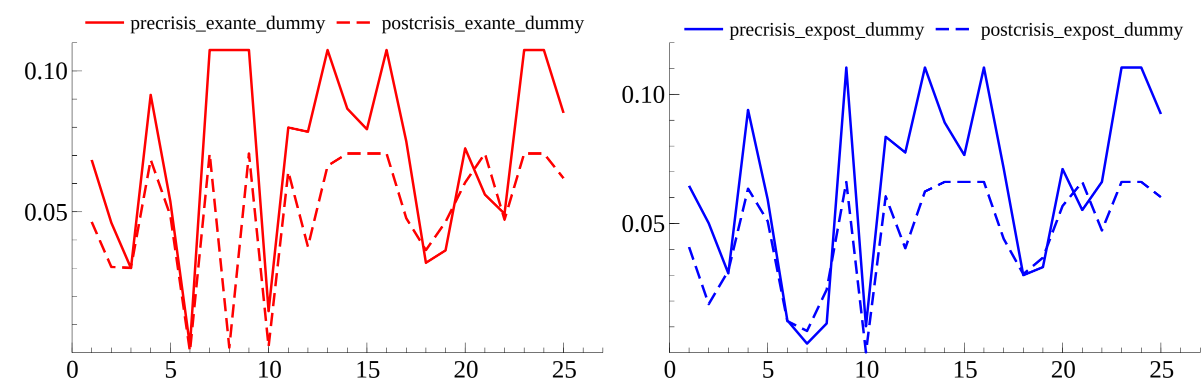
Notes: The figure displays the partial R^2 values generated by each news announcement. The X-axis denotes the announcement type (25 in total), and the Y-axis is the partial R^2 of the corresponding variable. The upper panel relies on the full sample results (2004-2010), whereas the estimates in the middle (lower) panel are for the precrisis (postcrisis) period. In each panel, solid and dashed lines provide the R^2 values attributed to exante and expost measures, respectively. Exante factors are based on the consensus forecasts, while the expost factors are the news surprises. All measures are standardized.

Figure 3: Contribution of each news announcement on total jump reaction: downside versus upside risk



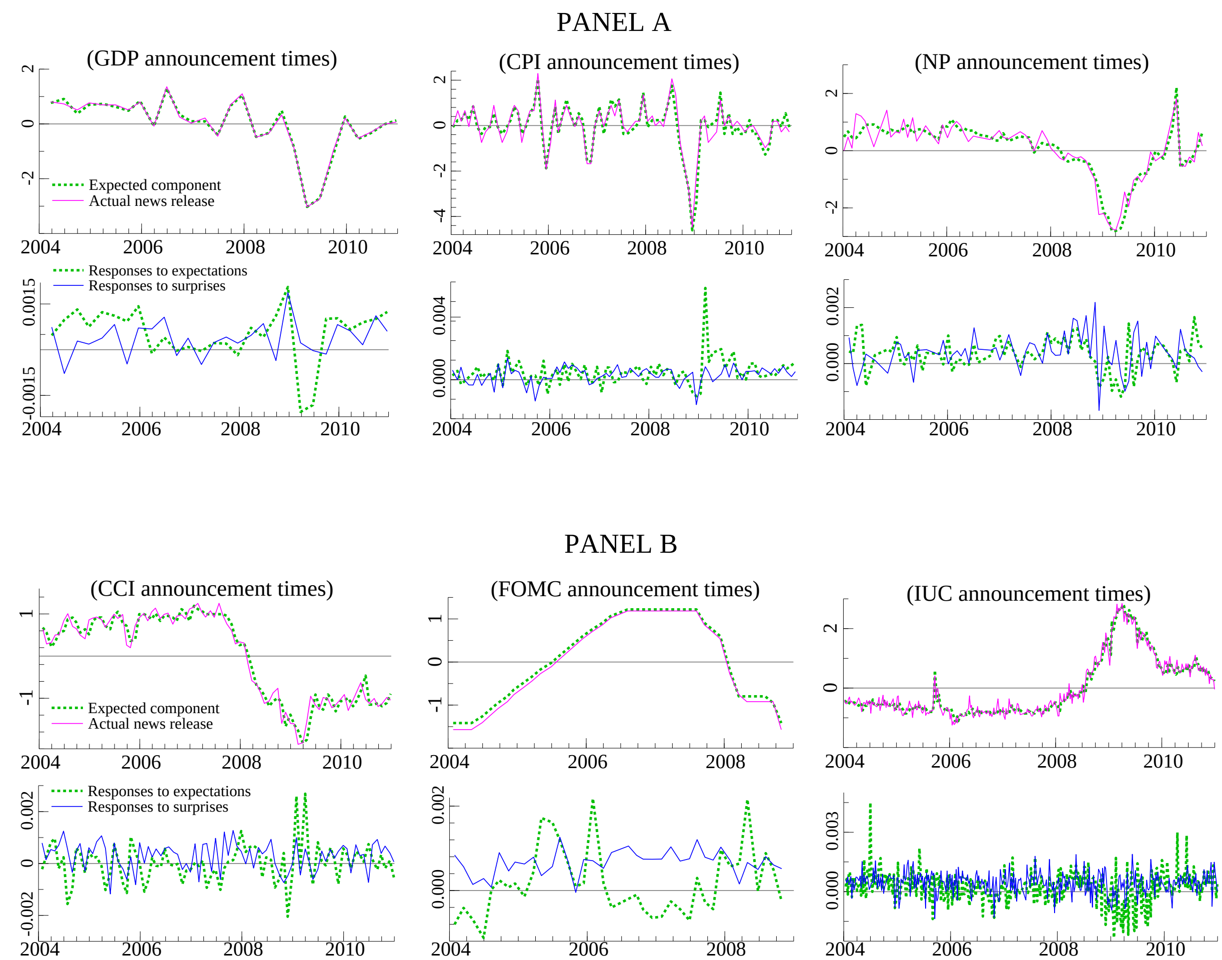
Notes: The figure illustrates partial R^2 values generated by each news announcement. The X-axis denotes the announcement type (25 in total), and the Y-axis is the partial R^2 of the corresponding variable. Left panels: positive intraday jumps (representing upside risk position). Right panels: negative intraday jumps (representing downside risk position). In each panel, solid and dashed lines provide the R^2 values attributed to exante and expost measures, respectively.

Figure 4: Jump responses before and after the subprime crisis: exante versus expost information



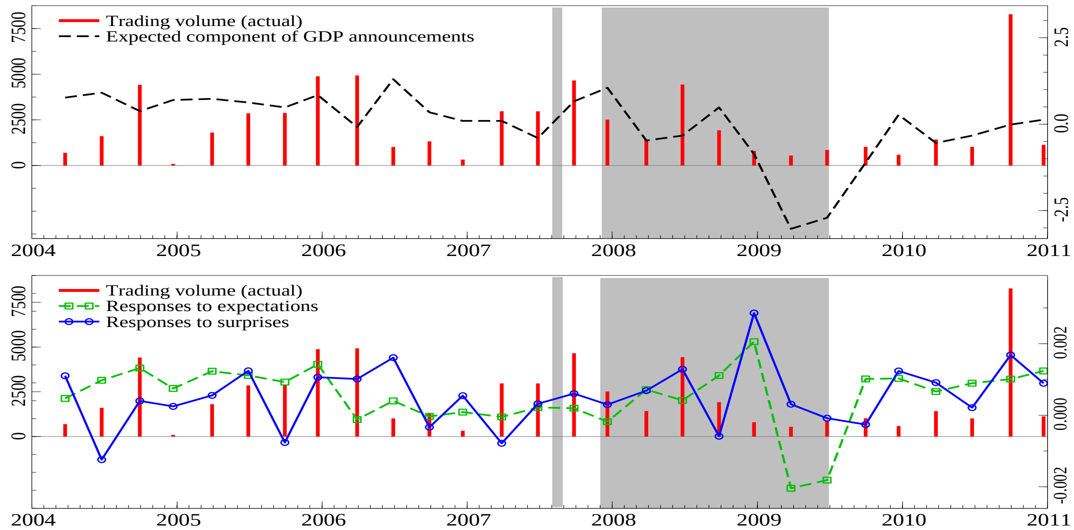
Notes: The figure illustrates partial R^2 values generated by each news announcement dummy. The X-axis denotes the announcement type (25 in total), and the Y-axis is the partial R^2 of the corresponding variable. Left (right) panel: jump responses to exante (expost) news dummies before and after the crisis. Solid and dashed lines represent the precrisis and postcrisis periods, respectively. In each estimation, the model specification relies on the jump regressions of Evans (2011). The postcrisis period spans from July 1, 2007 to December 30, 2010 based on the financial crisis time line published by the Federal Reserve Bank of St. Louis (see https://www.stlouisfed.org/financial-crisis/full-timeline).

Figure 5: Time-varying jump responses to expected and surprise component of announcements



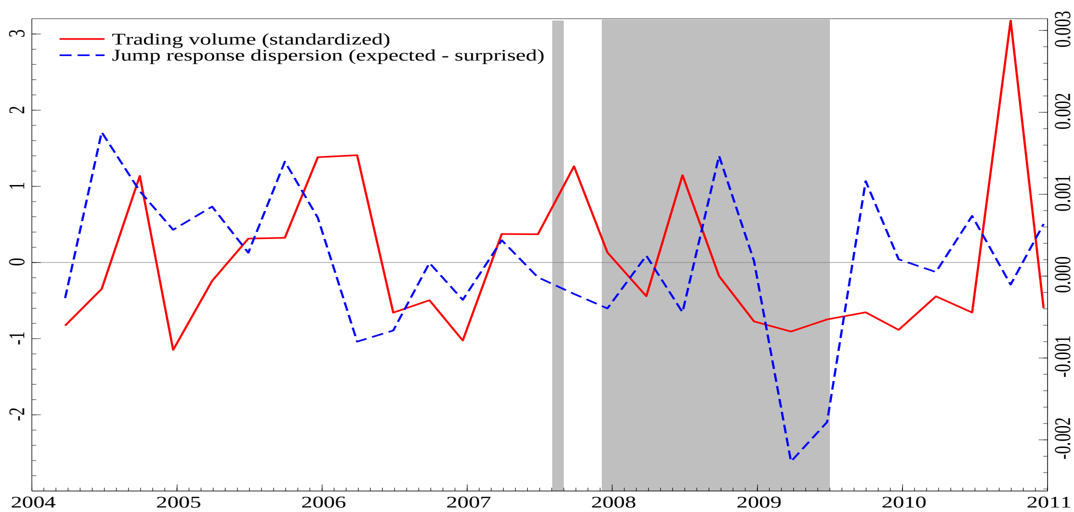
Notes: The figure displays the fitted jump responses over time on days of benchmark announcement days. Upper panels (in A and B): standardized median consensus analysts' forecasts for the announcement (dotted lines), and actual released number (solid lines). Lower panels (in A and B): fitted jump sizes conditional on expectations (dotted lines) and on surprises (solid lines). The announcements consist of GDP (Gross domestic product), CPI (Consumer price index), NP (Nonfarm payroll employment), CCI (Consumer confidence index), FOMC (Federal Open Market Committee), and IUC (Initial unemployment claims). We obtain the fitted values from the unrestricted jump regressions (see Table 11 for details). The sample covers the periods January 1, 2004 to December 30, 2010.

Figure 6: Trading volume and fitted (news-induced) jump responses around GDP announcements



Notes: Trading volume and conditional jumps responses on GDP announcement days. Upper panel: The actual volume of trades (solid line) and standardized median consensus analysts' forecasts for the GDP announcements (dashed line). Lower panel: the fitted jump responses to expected and surprise news measures (dashed and solid lines, respectively). The first and second shaded areas represent the BNP crisis (August 2007) and the NBER-defined recession period (December 2007 − June 2009), respectively. We obtain the fitted values from the unrestricted jump regressions (see Table 11 for details). The sample covers the periods January 1, 2004 to December 30, 2010.

Figure 7: Trading volume and jump response dispersion (exante − expost)



Notes: Standardized trading volume and the dispersion of fitted jump responses between expectations and surprises. The figure illustrates the evolution of trading volume (solid line) and the difference between expectation- and surprise-driven jump responses on GDP announcements days (dashed line). Figure 6 details the sample period and estimation scheme.