Corporate Bond Dealers' Inventory Risk and FOMC*

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Abstract

Macroeconomic announcements increase trading activity, with potential consequences for liquidity. This paper studies the effect of FOMC announcements on the US corporate bond market liquidity. The releases do not seem to create adverse selection. We obtain the probability distribution of monetary policy outcomes from 30 day Fed funds Futures. Despite the low toxicity of the order flow, dealers increase the price for liquidity provision in the presence of monetary policy uncertainty and unexpected Fed rate changes. Trading costs decomposition reveals that inventory risk aversion drives the dealers' behaviour. We conclude that a dealership market falls short around macroeconomic announcements, even when adverse selection may be absent.

Keywords: corporate bond market, inventory risk, FOMC, Fed funds futures.

JEL Classification: G12, G14.

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1 Introduction

The impact of monetary policy announcements has been a focus of many recent studies in financial economics (e.g. Lucca and Moench, 2015, Hausman and Wongswan, 2011). In general, it has been shown that the policy has a significant impact on asset prices and their returns. As one of the key tools of policy makers is the setting of the short term interest rate, also known as the *funds rate*, monetary policy decisions have a direct influence on various financial instruments. Furthermore, the funds rate is often directly used to compute prices of several interest rate derivatives. It is, therefore, pertinent to understand whether markets participants incorporate the policy announcements into the prices effectively.

If a fraction of market participants possesses superior knowledge about a future value of an asset, trades should reveal this information to the market. Even when information at disposal of traders is the same, different interpretations of the same piece of news can trigger the exact effect as asymmetric information would (as in Fleming and Remolona, 1997). In equilibrium, the price sensitivity to an order flow depends on the prevailing level of information asymmetry. Kim and Verrecchia (1997) argue that it can be interpreted as the ability to infer a signal from the news. In this study we focus on transaction prices and test whether both buyers and sellers interpret the news in a similar fashion.

This paper examines the behaviour of bid and ask prices on the corporate bond market in the US around the Federal Open Market Committee (FOMC) meetings. The corporate bond market is a dealership market, which operates mainly via request for quotes. In this market, dealers have to face the bargaining power of a counterparty when providing liquidity. In addition, the bilateral nature of transactions decreases the diffusion and incorporation of an information flow. Given these characteristics, dealers are exposed to a consistent inventory risk around announcements of macroeconomic data.

Gürkaynak et al. (2007b) find that 30 day Federal funds futures provide superior information about future monetary policy. Building on this result we use the futures prices to study the corporate bond quotes behaviour during the FOMC meetings weeks.

The 30 day Federal funds futures were introduced in 1988 at the CBOT. They are interest rate contracts which cash settle at the average Federal funds rate over the contract month.

This paper contributes to the existing literature in two ways. Firstly, it is presented that bid and ask prices do not react symmetrically to the uncertainty about monetary policy expectations. Due to large inventory risk aversion, the dealers tend to decrease the bid prices before announcements. Moreover, the dealers also provide a discount at the ask in order to reduce their exposure to the unexpected monetary policy change. This effect is even more pronounced for counter-cyclical sectors, which can further translate to similar premiums as in the stock market. Secondly, our results support the hypothesis that there is a flow of information from the 30 day Fed funds futures market ahead of the monetary committee meetings. In particular, the dealers use prices and adjust bond spreads such that it is impossible to trade on this information in the corporate bond market. Our GMM model confirms that the market makers do not face large adverse selection costs around the FOMC meetings, but decrease their order processing costs in order to adjust their inventories accordingly. Our study is most closely related to Friewald and Nagler (2016)'s paper and our results in part confirm their findings. Nevertheless, in contrast to their arguments, we find that there is no premium at the FOMC if prices are accounted for trading costs. Furthermore, due to higher frequency data we demonstrate that the inventory effect is apparent only on the announcement days.

This paper is structured as follows. The next section reviews the literature in related fields of monetary policy and market microstructure. We describe our methodology and computation of most important explanatory variables in section 3. Summary statistics and the key results are presented in section 4 and section 5. Robustness checks are outlined in section 6, followed by conclusion in section 7. All tables and figures are displayed at the end in section 8 and section 9.

2 Literature review

Information quality

This paper primarily focuses on the effect of an information flow between different financial markets. Ross (1989) analyses the effects of information flow changes on asset prices and volatility in an arbitrage free economy. He documents a direct relation between an information flow and volatility. Moreover, the timing of uncertainty resolution is irrelevant for asset prices if the terminal pay-off is not affected. Kim and Verrecchia (1994) identify different components that drive price and volume around public announcements: the price reaction depends on the unexpected portion of information contained in the announcement, while volume depends on the magnitude of price reaction. Hence, it is also indirectly impacted by the surprise component. In addition, the authors argue that volume is subject to the heterogeneity of private signals variance, public signal variance and to the amount of pre-announcement information.

Admati (1985) develops a multi asset model, where he shows that one can asses the quality of information by looking at the performance of market participants. The author argues that either not fully informative prices and agents with superior information, or perfect news dissemination and informative prices can be observed. In addition, Vega (2006) argues that public announcements can be split into two categories. One that can create under-reaction and the other that increases market efficiency, the types are closely related to the arrival of uninformed or informed traders, respectively. In line with this argument, Chan (2003) discovers a momentum after news releases in stock prices and reversal if there are no significant news. These studies lay good fundamentals to empirically test whether dealers prefer to maintain uninformative prices or face the risk of trading with better informed market participants.

However, although the FED releases its announcements on a scheduled basis and future policy measures are easy to infer, traders are likely to have different beliefs on the effects of such policies and their trading is influenced by such views (Fleming and Remolona, 1997). As remarked in Green (2004), information asymmetries in the debt market do not arise from the lack of public information but from differences in the ability to process such releases. The adverse selection is a major determinant of trading costs in the Treasury bond market. Numerous other studies looked at price patterns around public announcements for different asset classes (e.g. Fleming and Remolona (1999), Andersen et al. (2003) or Flannery and Protopapadakis (2002)), yet to the best of our knowledge there is no study of the corporate bond market.

The corporate bond market is also affected by adverse selection (Kedia and Zhou, 2014). Nevertheless, mandatory reporting of corporate bond transactions mitigates these information asymmetries (Bessembinder and Maxwell, 2008). As informed traders have become more active in the more opaque credit default swap market the percolation of information is lower.

Order flow and information asymmetry

In the Cao et al. (2003) model the inventory risk compensation leads to a link between an order flow and prices even if the order flow is uninformed. On the other hand, Green (2004) argues that the hedging pressure initiated by more precise announcements lead to a greater information asymmetry. He adds that more influential releases should increase the informational role of trading, and it is related to both the announcement itself and the surprise component. Moreover, he documents that important information releases create short periods of uncertainty, which is in contrast to the general consensus that prices are less sensitive during periods of high liquidity (e.g. Brandt and Kavajecz (2004)). Green (2004) also highlights that, in the liquid Treasury market, 30 minutes before an announcement volume and volatility drop while the spread widens. Yet after the release the opposite happens.

Chae (2005) points out that theoretical models do not provide consistent predictions about volume around significant information releases. For example, in Kyle (1985) the volume should rise in line with the information asymmetry. However, if the liquidity traders are able to postpone their trading until uncertainty is resolved, the volume could decrease before an announcement and the price sensitivity to order flows could rise (Foster and Viswanathan, 1990). Thus, it is possible to observe increased trading activity after announcements. Lee et al. (1993) detect a similar pattern. They find that the spreads widen and order book depth falls before the announcements. Albeit they point out that spreads can be wider after significant news releases, the effect disappears if controlled for volume. This could further support the claim that dealers engage more in risk management practices before the FOMC meetings than after. Chae (2005) shows via a simple test, using abnormal turnover, that there is a drop in trading before scheduled earnings (and other corporate) announcements. The author also discovers asymmetric price sensitivity before and after a news release.

Monetary policy announcements

The discussion about FOMC meetings and, in particular, their importance for asset pricing has been initiated by the Bernanke and Kuttner (2005)'s seminal paper. The authors document a significant stock market reaction to unanticipated changes in the Fed funds rate. The announcements impact financial assets not only by setting the level of the short term rate, but also by signalling future policy. In particular, the policy statements affect long term rates (Gurkaynak et al., 2005). The transmission channel of the target rate change on the term premia is represented by yield oriented investors. Some financial institutions can "window dress" their balance sheets by purchasing high yield securities, hence when the short term rate is low they purchase longer term bonds and decrease the long end of the curve (Hanson and Stein, 2015). Compared to other central banks, the Federal Reserve decisions have a consistent impact on bond prices volatility (Andersson et al., 2010). Furthermore, the announcements have a positive effect on the stock market: prior to FOMC meetings we observe a positive drift in the level of S&P500 index. There is no similar reaction in either other macro announcements or other asset classes. This effect is fully compatible with neither political nor liquidity risk (Lucca and Moench, 2015).

Monetary policy alone is unlikely to affect credit risk, which is another principal risk factor in the fixed income markets. The Federal Reserve intervenes on this variable by its credit policy, such as the Term Auction Facility in 2007 (Price, 2012). A possible effect of monetary policy on credit risk can manifest through banks' increasing risk taking in presence of easier credit (Jiménez et al., 2014). On the other hand, Ehrmann and Fratzscher (2009) find that the cyclical and capital intensive sectors respond more significantly to policy shocks. In addition, the monetary policy affects the low debt firms in the most significant fashion. The authors use Tobin's q as a proxy for different industry characteristics and find that the effect could be the result of financial constraints. Firms with low level of debt cannot borrow more. Overall, the message is that both financial constraints and investment opportunities drive the monetary policy impact.

3 Methodology

3.1 Data sources

This analysis focuses on the determinants of the corporate bonds liquidity. To assess the trading costs, we rely on the audit trail of corporate bond transactions disseminated through TRACE. We use an enhanced version[1] of the dataset containing more information such as the side of the initiator, and uncensored trade volume. To avoid the diffusion of information about dealers' inventory, this version of the dataset is made available with a 18 month lag. Therefore, our sample contains all FOMC announcements from November 2004 (since when all corporate bonds transactions had to be reported) to December 2014. We apply the cleaning procedure outlined by Dick-Nielsen (2009) and Dick-Nielsen (2014) thus we remove double reported inter-dealer transactions by matching buy and sell sides by cusip, date, time and volume.

We obtain general information about corporate bonds such as date of issuance, maturity, industry sector and embedded options from Thomson Reuters. We also add the credit rating history from Mergent Fixed Income Securities Database. We assign integer numbers to these bond ratings (i.e., AAA=1, AA+=2, . . . , D=22). To gauge the expectations about the

[1]The enhanced version is distributed through WRDS. It is different from the academic version of TRACE - distributed directly by the FINRA.

future monetary policy, we use 30 day Fed funds futures transaction data, which is acquired from CME DataMine. Finally, the dates of the FOMC meetings and the new target rate are publicly disclosed through the website of the Federal Reserve Board.

3.2 Empirical analysis

The empirical analysis aims to identify the effect of different FOMC announcement-related variables on the corporate bond market liquidity The first step is to compare different conditions offered by the market makers around the FOMC announcement. To do so, we construct a measure of price deviation: we take the difference between an executed price and a daily average price for each bond that has at least 5 trades on a given day with at least one buy and one sell. For each trade j in day t of bond i we define the deviation to be equal to:

$$\delta_{i,j,t} = 1/\bar{P}_{i,t}\left(P_{i,j,t} - \bar{P}_{i,t}\right) = 1/\bar{P}_{i,t}\left(P_{i,j,t} - \frac{1}{N_{i,t}}\Sigma_j P_{i,j,t}\right), \tag{1}$$

where P is the price of the security and N is the number of trades. Using this measure, we compute effective spreads under a regular assumption that mid price is the same for both quoted (which we do not observe) and executed prices. Our measure is very similar to round-trip costs as proposed by Chakravarty and Sarkar (2003) or Hong and Warga (2000). Therefore, for brevity, whenever we refer to bid or ask it means either an executed buy or sell price.

One of the determinants of the price offered by the dealers is return uncertainty (Ho and Stoll, 1981). Obviously, such ambiguity is high around interest rate moving events such as the FOMC announcements. To measure future monetary policy actions expectations and their uncertainty, we compute implied probabilities of the interest rate changes from the Federal funds futures. To do so, we follow the methodology outlined in the white papers of CME Group (2017) and in Geraty (2000).

The Fed funds future price at time t for the contract month (T_0 to T_1) is defined as:

$$FF(t, T_0, T_1) := 100 - 100 \times \mathbb{E}_t^{\mathbb{Q}}\left[\int_{T_0}^{T_1} r_s ds\right], \tag{2}$$

where $\mathbb{E}_t^{\mathbb{Q}}$ denotes the risk neutral expectation and $T_0 < T_1$. The buyer of the futures contract locks in the $FF(t, T_0, T_1)$ rate. At the end of the period the buyer receives the futures rate minus the realised average Fed funds rate r_{T_0,T_1}. Trivially, it follows that for $T_0 < t < T_1$ and

$t \to T_1$ the FF price becomes less dependent on the expectation part and more on the realised one - $\int_{T_0}^{t} r_s ds$.

Using the above definition we can obtain market expectations of the average rate over a contract month. This also means that each two FF reflect independent information about the Fed policy during a two month period. Under the assumption that a shift in the funds rate can happen only on the FOMC announcement day we can obtain future implied probabilities of such a change. To do so, one needs to consider two cases:

- No meeting in the following month: in this case, we can derive a measure of the expectation of the interest rate under the new policy from the future contract of the following month.

$$\begin{aligned} FFER(end) &= 100 - FF(t,\ \text{following month}), \\ ImpliedRate &= 100 - FF(t,\ \text{meeting month}), \\ FFER(start) &= \frac{N}{M}\left(ImpliedRate - \frac{N-M}{N} FFER(end)\right). \end{aligned} \tag{3}$$

- No meeting in the preceding month: in such situation, we can derive the interest rate expectation at the beginning of the period.

$$\begin{aligned} FFER(start) &= 100 - FF(t, \text{previous month}), \\ ImpliedRate &= 100 - FF(t, \text{meeting month}), \\ FFER(end) &= \frac{N}{N-M}\left(ImpliedRate - \frac{M}{N} FFER(start)\right), \end{aligned} \tag{4}$$

where FF is the futures contract price, $FFER(start)$ and $FFER(end)$ are the expected fed rates at the beginning and the end of the meeting month, respectively. $N = \#$ of days in the meeting month and $M =$ FOMC meeting day-1. It follows that risk neutral Expected Change $= FFER(end) - FFER(start)$ in both cases.

Since the Fed changes the overnight rate by multiples of a quarter percentage point, we compute the probabilities of policy change by assuming a binomial tree model. The two possible outcomes in this lattice are hike (ease) of at least 25 bps if the expected change is positive (negative), and no action. The probability of a monetary policy action is:

$$\mathbb{P}(\text{action}) := \min\{4 \times |\text{Expected change}|, 1\}. \tag{5}$$

It can be seen that $\mathbb{P}(\text{action}) \in [0,1]$ for any Expected Change value. With these implied probabilities we can compute a measure of future monetary policy uncertainty, which is simply the Bernoulli distribution's variance:

$$\text{Entropy} := \mathbb{P}(\text{action}) \times (1 - \mathbb{P}(\text{action})). \tag{6}$$

In the next step of our study, we employ the Glosten and Milgrom (1985)'s model. According to the model, ask (a_t) and bid (b_t) quotes at time t can be represented as follows:

$$a_t = \mu_{t-1} + \frac{\Pi\theta_{t-1}(1-\theta_{t-1})}{\Pi\theta_{t-1} + \frac{1}{2}(1-\Pi)}(V^H - V^L), \tag{7}$$

$$b_t = \mu_{t-1} - \frac{\Pi\theta_{t-1}(1-\theta_{t-1})}{\Pi(1-\theta_{t-1}) + \frac{1}{2}(1-\Pi)}(V^H - V^L), \tag{8}$$

where μ_{t-1} is the fundamental value of the asset, Π is the fraction of informed traders on the market. V^L and V^H correspond to possible final values of an asset - *low* and *high*, respectively. Lastly, θ_{t-1} is the probability of the future value being equal to V^H. In the case of the FOMC announcements we compute θ_{t-1} using the futures prices using the procedure described above. In terms of the last part of the equations 7 and 8, we compute the bond price difference given a jump in the short rate - r at the announcement:

$$V^H - V^L = \mathbb{E}_t^{\mathbb{Q}}\left[\exp\left(-\int_t^T (r_s + c_s)ds\right)\right] - \mathbb{E}_t^{\mathbb{Q}}\left[\exp\left(-\int_t^T (R_s + c_s)ds\right)\right], \tag{9}$$

where c_s is the credit spread at time s, $R_s = r_s + 0.0025m$ for $m \in \mathbb{Z}$ and $\mathbb{E}_t^{\mathbb{Q}}$ is the expectation under risk neutral measure at time t. m can be obtained from the futures prices and we define it as $m := \left\lceil |\text{Expected Change}/0.25| \right\rceil$. The equation holds also for $m < 0$. However, superscripts H and L change their position. We remove this problem by using the absolute value. The difference thus is equal to:

$$V^H - V^L = \mathbb{E}_t^{\mathbb{Q}}\left[\exp\left(-\int_t^T (r_s + c_s)ds\right)(1 - \exp(-0.0025m(T-t))\right], \tag{10}$$

while if we use $m < 0$ the last part becomes $(\exp(-0.0025m(T-t)) - 1)$. As expected the difference is always positive. The theoretical values for constant yields are plotted in Figure 3. This result suggests that, in addition to the bond's sensitivity to interest rate changes, we have to take into account the maturity and the level of interest rates.

We create $V^H - V^L$ variable by daily interpolating the risk free yield curve obtained from the H.15 release published by the Federal Reserve. Next, we match the bond maturity with an appropriate yield and add the Moody's Aaa credit spread value. Then we take the difference between the price of such a zero coupon bond and a theoretical value in case of $m = 1 \Rightarrow 25$ basis points jump in the risk free rate.

To link the variables related to the FOMC announcement with the conditions offered by dealers, we run separate regressions of the price deviation measure for buy and sell trades occurring in the two days before the meeting and the meeting day before the announcement time[2]:

$$\begin{aligned} deviation_{it} = \alpha &+ \beta_1 Entropy_t + \beta_2 ExpectedChange_t + \beta_3 logVolume_{it} + \beta_4 (V^H - V^L)_{it} \\ &+ \beta_5 logDealerVolume_{it} + \beta_6 logStaleness_{it} + \beta_7 SellFraction_{it} \\ &+ \beta_8 Maturity_{it} + \beta_9 Yield_{it} + \beta_{10} CreditSpread_{it} + \beta_{11} BondRating_{it} + \epsilon_{it}, \end{aligned} \tag{11}$$

and for trades occurring after the announcement time and in the following two days[3]:

$$\begin{aligned} deviation_{it} = \alpha &+ \beta_1 logVolume_{it} + \beta_2 (V^H - V^L)_{it} + \beta_3 logDealerVolume_{it} \\ &+ \beta_4 logStaleness_{it} + \beta_5 SellFraction_{it} + \beta_6 Maturity_{it} + \beta_7 Yield_{it} \\ &+ \beta_8 CreditSpread_{it} + \beta_9 BondRating_{it} + \beta_{10} AbsoluteSurprise_{it} + \epsilon_{it}. \end{aligned} \tag{12}$$

During the pre announcement period, the explanatory variables are: monetary policy expectation and uncertainty, the interest rate sensitivity of the security price, the time to maturity, the risk free rate, the credit spread and the bond rating. We control for the bargaining power of the initiator and market liquidity by including the volume of the transaction and the amount of each security traded in the inter-dealer market, respectively. We also include measures of order imbalance and price staleness. For trades after the event, the expectation and uncertainty variables are replaced with a measure of the unexpected movement of interest rates. A detailed description of these variables is reported in Table 16. To control for the heterogeneity across securities we include bond fixed effects. In addition, since the bond market order flow is correlated, and each announcement characteristics affect the whole cross section of securities, we cluster by the week around each FOMC meeting in all regressions.

[2] We define this time frame as the period before the meeting.
[3] We refer to this as the period after the meeting.

Building on the literature and to break down the effect of the FOMC announcements on bond liquidity, we further analyse bonds with embedded options, as well as bonds issued by companies in different sectors separately.

In the last part of our analysis, we estimate an extended microstructure GMM model based on Madhavan et al. (1997). We follow an approach similar to Green (2004). The model decomposes bid-ask spreads into compensation for liquidity provision (order processing costs) and adverse selection components. The latter measures price of information revealed by the order flow. The model also allows to quantify the premium related to the news announcement as well as to identify the cause of the change in trading costs around the FOMC statement releases.

4 Summary Statistics

The data used in this study is downloaded from the TRACE database and covers the US market corporate bond trades. We keep only bonds with both buy (from the dealer's perspective) and sell dealer-customer transactions on a particular day. Furthermore, we match those trades by CUSIP codes with single bond characteristics and delete all the entries which indicated maturity less than zero as well as all of those without a match in the bond characteristics file. The final sample thus totals 5,817,147 corporate bond trades with 2,453,991 buy (bid) and 3,363,156 sell (ask) transactions. The dataset consists of 71,250 different bonds, with an average number of about 82 trades per bond, with minimum and maximum equal to 2 and 19,247, respectively. The average bond maturity in our sample is about 8.5 years.

Since the study focuses on behaviour during the FOMC meeting weeks, the trades span weeks around all FOMC meetings from 8 Nov 2004 to 19 Dec 2014 (announcements between 10 Nov 2004 and 17 Dec 2014) which equals to 82 event weeks[4]. There are few occasions when a public holiday occurs during such a week. For these cases we use the data from preceding Friday or up to following Monday so that we work on a consistent five working day window. The average number of transactions during a meeting week is around 65,000 while minimum and maximum are approximately 28,500 and 105,000, respectively. However, before the end of 2008 the number of trades was below the average, yet after the Fed rate reached 0-0.25% it increased significantly (see Figure 1a). On the other hand, while volume increased over time, there is no such a jump in the quantity of trades during the low interest rates regime (Figure 1b). Both

[4]There was a single change of -75bps outside scheduled meetings on 21 January 2008.

trends suggest that an average deal size shrank during the period.

In order to compute the expected change in the federal funds rate, we download the daily 30 day Federal funds futures data from CME and compute the expected changes. The daily federal funds rate is a transaction-weighted rate and it is an important reference rate in the US. It is used in forming monetary policy decision as well as pricing interest rate products such as OIS. The federal funds market is an interbank OTC market for reserves held by Federal Reserve banks. The Federal funds futures are traded at the CBOT. They are interest rate contracts which cash settle at the average federal funds rate over the contract month. Neither there are up front costs of buying a contract nor the notional ($5 million) changes hands. The price is quoted as 100 minus the average overnight Federal funds rate for the delivery month.

During the period there were 15 up, 10 down and 59 no change movements in the federal funds rate. The policy shocks varied from −75bps to 25bps. As it can be seen in Figure 2, all up movements happened at the beginning of the period, while the drops around years 2007 and 2008. Expected changes on a day before each meeting obtained from the futures prices are also plotted in the figure.

Simple summary statistics unveil that there is a rise in the number of trades around the FOMC meetings with the peak on the day preceding the meeting (22.7% of all trades). On the other hand, the daily volume peaks on the day after the meeting (23.54%). Both metrics show a significant decline in market activity on -2 and +2 days from the meeting. Further analysis shows that the market dealers are buying more after the meeting, while other participants are more likely to buy before the monetary policy action announcement.

We compute spreads based on all trades available on a single day and, where possible, we also split each day into morning and afternoon sessions with the cut-off point set up at 2:15pm. The split is dictated by the timing of the Federal Reserve announcements. Additionally, both types of spreads are computed as volume-weighted and simple mean quantities. All four series were truncated at 0.5% and 99.5%. The summary statistics unveil similar pattern across the different measures of the spread. The most noticeable feature is that the value weighted spreads are in general lower than the standard ones, which is in line with the previous studies. Average spreads are equal to 103bps and 137bps in cases of the value weighted and standard full day measures, respectively.

Table 2 presents correlations between the variables used in our study. Most of them are lowly correlated. However, as expected there is high positive correlation between maturity, the risk free yield and $V^H - V^L$ (correlations between 0.3 and 0.5). While the credit spread is negatively correlated with the risk free rate and $V^H - V^L$ with correlations -0.47 and -0.23, respectively.

5 Results

In this section, we examine trading costs determinants for the whole sample of bonds. A higher volume of traded bonds around the FOMC meeting days can be linked to the flow of informed trading triggered by the expectations about future monetary policy, as predicted by Kim and Verrecchia (1994). We see instead that announcement related variables have little influence on the trading volume and on the order imbalance: Figure 1a and 1b show that these variables follow a path not influenced by Fed announcements. Moreover, the paltry R-squared of the regressions reported in Table 3 and Table 4 confirm the visual impression of the aforementioned figures.

In the first step, we analyse the behaviour of spreads before and after the announcement. Corporate bond dealers do not face a "toxic" order flow deriving from informed trading but rather confront traders with heterogeneous beliefs. Hence the FOMC announcement *per se* should not create a shock in the order flow that the dealers have to manage. At odds with these predictions, the dealers increase the price for liquidity provision before the announcement, in particular when the uncertainty about future monetary policy is high (see Table 5). In line with Glosten and Milgrom (1985), a shift from a situation where there is no uncertainty (Entropy $= 0 \Leftrightarrow \theta_{t-1} \in \{0, 1\}$) to a case where future monetary policy is perceived like a coin flip (Entropy $= 0.25 \Leftrightarrow \theta_{t-1} = 0.5$) causes the bid ask spread to widen by approximately 35 bps. The value difference $(V^H - V^L)$ indicates that the dealers account for a potential loss due to a jump in interest rates at any time.

Moreover, there is some evidence of the usefulness of the 30 day Fed funds futures as predictor of monetary policy as the coefficient of unexpected monetary policy (difference between futures implied rate and the actual rate) shocks is large and significant. After an announcement, the dealers respond to the surprise component by widening the bid-ask spread. This happens irrespectively of the unexpected shock direction. Comerton-Forde et al. (2010) unveil a similar pattern in equity markets. They point out that when dealers experience a revenue shock, they try to recover it by increasing the price for liquidity provision.

Consequently, we turn to deviation regressions where we can observe a more detailed dealers' response. We split the sample into four subcategories in order to study the behaviour of bids and asks during two periods separately. The findings are presented in Table 6. The regressions suggest that the uncertainty about interest rate changes and the future bond value affects bids more than asks. *Entropy* is both statistically and economically significant for both bid and ask prices. The effect of monetary uncertainty is approximately twice as large at bid (-60.94) than at ask (32.22). Additionally, the dealers do not change their sensitivity to $V^H - V^L$ on the buy side while they do not price it before the meetings on the sell side. This indicates that they are more likely to sell before the meeting in order to avoid holding the inventory over the announcement period.

Surprisingly, the expectation of an interest rate hike decreases the trading costs on the bid side. To explain this counter-intuitive behaviour, we look at the average price movements before the announcement: we can see in Table 7 that the average price is significantly lower when traders expect a rise in interest rates. Moreover, an unreported regression of the average relative price on the expected change suggests that price decrease of 10 bps per percentage point of expected positive jump. The increased liquidity on the bid side is likely to be caused by dealers competing to purchase securities at a distressed price. Moreover, it further supports our claim that market participants closely observe the monetary policy news and incorporate them into prices even before the FOMC announcement.

When considering the difference between high and low security value state, we can notice the more interest rate sensitive a security is, the lower the bid price posted by the dealers. The ask price is not affected by this variable: dealers are prone to reduce their inventory before the FOMC announcement and offer better conditions to players on the ask side. After the uncertainty is resolved, we can see that the bid price continues to be affected in the same way and that ask quotes are adjusted accordingly: without an imminent threat of a value shock to their inventory, dealers respond to interest rate sensitivity with a symmetric adjustment of both bid and ask prices.

Unsurprisingly, the interest rate sensitivity is reflected by credit ratings. As the yield of a AAA bond is predominantly determined by the risk free curve, a change in policy rates has a greater impact on such a bond compared to one with a larger credit spread. As a result, the dealers require higher compensation the better rating bond has. Conversely, when clients want to buy speculative securities, the dealers can infer positive idiosyncratic information. In fact, despite the higher risk of such securities, dealers charge relatively more to sell them. In addition, we can notice that the adjustment for credit rating does not change on the sell side after the announcement; therefore, it is likely to be related to issuer-specific information that can be released at any moment.

5.1 Embedded options

The prices of bonds with and without embedded options should react differently to changes in interest rates. As a substantial part of the bonds traded contain one or more embedded option, we test whether our results are not driven by the option components. In order to perform the tests, we obtain embedded options data from Thomson Reuters and we run the regressions separately for callable, convertible, putable, and no option bonds.

The liquidity of callable bonds behaves in a different way as compared to the general results (Table 8). Despite having a similar reaction to the monetary policy uncertainty, it moves in the opposite direction to the expected change and to the interest rates sensitivity. The bid price increases as observed in the whole sample, while the ask decreases in the anticipated adjustment. Overall, dealers' compensation is decreasing in the expected shift in policy rates. An explanation might lie in the option component of such bonds: a higher interest rate pushes the embedded call option out of the money, this translates into lower volatility of the optionality component of the price (Duffee, 1998). In general, the lower the security volatility, the higher its liquidity.

In terms of the interest rates sensitivity, we observe that bid prices do not respond to larger price sensitivity (unlike in our general results), but ask prices do. This might be an exacerbation of the dealers behaviour, who set ask prices to dispose the most sensitive assets. Lastly, the trading costs of callable bonds after the announcement are not affected by the securities' responsiveness.

Next we turn to bonds without options. Thanks to this separate analysis, we can identify which of the general results are driven by plain vanilla bonds, and those caused by callable bonds. These two categories represent most of the trades in our sample, therefore they are likely to be the main drivers of our general results.

First, we notice that the *Entropy* affects only the bid price of simple bonds. Hence, the general worsening of the trading cost presented in Table 6 is partly caused by callable bonds. It appears that the dealers require a compensation to sell callable bonds before the FOMC announcement. Before the meeting, prices of callable bonds might be distressed because higher entropy means an increase in the value of the embedded call option. Therefore, the dealers prefer to wait for an announcement when the uncertainty about future monetary policy is high.

Second, the expectations of higher interest rates increase the bid price for straight bonds, possibly because of the presence of depressed prices. However, we do not observe any liquidity improvements on the ask side. As in the case of callable bonds dealers do not want to sell at a distressed price in presence of uncertainty. Nevertheless, this case is (somewhat) different because the price is unlikely to revert after a hike in the interest rates. In summary, dealers prefer to wait until the last moment to realize losses.

Lastly, it can be noticed that the interest rates sensitivity affects bid and ask prices both before and after the announcement. We conclude that the non-significant coefficient for the ask price before the meeting is caused by dealers offering favourable ask price to eliminate the risk of holding callable bonds.

In terms of credit rating, the adjustment for callable bonds is lower in magnitude than in the case of straight bonds. A smaller shift translates into worse trading conditions on the buy side, and in favourable on the sell side for low-rated callable bonds. Such change suggests a larger inventory risk aversion for callable bonds. In fact, interest rate movements can affect the value of the embedded option of low rated firms, which issue these instruments to be exposed to favorable interest rate movements. In summary, the dealers fear changes in the value of callable bonds embedded options and idiosyncratic changes of the issuer credit quality for straight bonds.

We now turn to the analysis of convertible and putable bonds (Table 9). These securities represent a smaller fraction of trades compared to callables and plain vanilla bonds. The sensitivity of convertibles to the future monetary policy uncertainty moves in the same way as in the case of callable bonds. This result comes from the fact that around 40% of convertibles (accounting for about half of trades) are also callable: in fact, the measure of sensitivity to the entropy is smaller and noisier that the one for callables. The expectations of a rise in the interest rate increases the liquidity of convertibles. This behaviour is related to the raised moneyness of the conversion option, due to both a lower bond value and higher policy rates which is related to booming stock markets (Rigobon and Sack, 2003). The bond price will then become close to the price of the company equity which is traded on a more liquid market. Another surprising result is the low response of the ask price to interest rate sensitivity: unlike other securities, convertibles react neither before, nor after the news release. However, the dealers require higher compensation for buying this type of bonds before the announcement the lower bonds credit quality.

We observe that the entropy does not affect putable bonds liquidity. The presence of an embedded long put option insures the dealers' inventory against adverse interest rates movements. Given this insurance, dealers can perform their market making activity with lower risk and, therefore demand a lower compensation. Like other bonds with embedded options, the outlook of higher interest rates boosts their liquidity. In this case, an increased moneyness of the put option is the key driver and the bond price gets closer to the exercise trigger point. In addition, thanks to the put protection, the individual bond rating does not play a role when the dealers acquire such bonds.

5.2 Industry

Building on vast literature (e.g. Ehrmann and Fratzscher (2004) or Dedola and Lippi (2005)), we proceed to examine the difference in sensitivity of various industries to the FOMC policy. In order to do so, we split the sample into seven groups based on SIC codes and grouping described by Kenneth French five portfolios[5] adjusted by separating finance and utilities sectors from "other" due to their well documented sensitivity to interest rate movements (e.g. Sweeney and Warga (1986)).

Following the same procedure as before, we estimate the regressions on separate industry sub-samples ahead and after the announcement for buy and sell transactions. All results are displayed in tables 10, 11, 12 and 13. It can be seen that there is some dispersion in the price of uncertainty. The dealers are particularly averse to acquire Manufacturing, Utilities and Healthcare bonds before the meeting. Even more interestingly, the market makers perceive a possible change in bond value differently across sectors.

On the other hand, the examination of ask quotes reveals a substantially different behaviour. The dealers do not incorporate the interest rate uncertainty into their quoted prices. These results suggest that market makers prefer to sell the bonds irrespectively of the predicted outcome. Furthermore, the value difference variable is only significant for Financial, Consumer and Health industries. This phenomenon could indicate that the dealers prefer to sell bonds before instead of holding them through the news release period. They are not interested in potential distribution of the value, the inventory risk reduction plays a more important role at that point.

Next, we turn our analysis to the post-meeting period. The value difference variable is still

[5] Further information about the codes allocation can be found on http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/

significant across industries except Consumer products. Moreover, absolute surprise impacts all but Other sectors at the bid, while it is the most significant for this sector on the ask side. The total effect is the largest for Finance industry which is likely to be linked to the sector's sensitivity to the interest rate level.

5.3 Risk aversion

In the previous sections, we have documented an asymmetric response to the information from the futures markets. The results point towards abnormally large risk aversion of dealers ahead of the FOMC meetings. In order to measure what fraction of the spread is related to information asymmetry, we estimate a generalised version of a microstructure model which allows for autocorrelation in the order flow[6]. We include indicator functions in order to disentangle effects in time series: days with no news releases, the announcement day before and after 2:15pm, as well as in cross section: bid and ask transactions.

The GMM results confirm our previous hypothesis and are presented in the panel A of Table 14. It can be seen that the information about monetary policy is disseminated efficiently as the adverse selection coefficients are negative and the premium coefficient - γ is not statistically different from 0. Dealers only fear some information asymmetry from the buy orders just before the announcements when $\theta_{BA} = 0.16$. Moreover, despite higher adverse selection costs, the dealers reduce the liquidity provision costs significantly. This is in line with the previous results, we can see that the market makers do so in order to adjust their inventories before the news release and are also willing to forego a part of their profits. We conclude that the inventory risk aversion causes an asymmetric response to *Entropy*. In addition, it is likely to be the key factor influencing its lack of statistical significance at the ask.

Linear tests of estimated coefficients further corroborate panel data regressions. The cost fractions vary among periods and sides. All linear tests are significant at 1% (Panel B, Table 14). However, the total costs ($\theta + \phi$) are not statistically different for *Before* and *No Announcement* at the bid, and *Before* and *After* at the ask. This is why we do not observe a large difference in spreads ahead and after the releases within our sample.

We have also shown that ask is typically not affected by value difference before the announcement, we believe that the results from Table 6 can be linked to the shift of dealers' focus from bond price fluctuations to the possibility of trading with an informed trader. The liquidity

[6]See Appendix A for the details of the model and its estimation.

providers sharply decrease their order processing costs at both bid and ask but more so at the ask price (20 vs 8 cents). Interestingly, the costs surge immediately after the announcement by 13 and 1 cent above the *No Announcement* period levels for the ask and the bid side, respectively. Since the order processing costs fall significantly while adverse selection costs rise during the morning of the monetary policy news release it is likely that the variation translates to poor performance of $V^H - V^L$.

It can be also seen that the adverse selection coefficient is negative at the bid during all time periods. This means that the quoted prices are already adjusted for the possible information asymmetry and that the order flow should not carry any additional information.

In conclusion, these results attribute the cause of lower liquidity around the FOMC announcements to the inventory risk rather than adverse selection. However, it remains unclear why dealers display such risk aversion in presence of a non "toxic" order flow.

6 Robustness

To further corroborate our results, we perform an analysis using different measures of computed spreads. We find that our results do not change substantially and key findings stand for spreads calculated using transaction value or equal weights. The findings are also robust to spreads computed based on full day transactions versus those utilising morning and afternoon trades separately. In addition, following previous studies (e.g. Goldstein et al., 2006) we test whether our results change if we remove bonds with less than a year to maturity or those with less than $10 million at the issue and we find that our results are not affected by these assets.

Moreover, we created two other possible empirical counterparts of the value difference variable - Equation 9. The conclusions remain broadly the same even if we change the credit spread to Moody's Baa or employ the Gürkaynak et al. (2007a)'s yields.

Next we tested our findings of a popular measure of adverse selection: the PIN metric proposed by Easley et al. (2002)[7]. Our goal is to see whether the variables which are determined by the announcement affect the amount of information contained in the order flow.

The results of these regressions[8] suggest that none of the variables has a significant effect of the probability of informed trading. The only exceptions are the entropy and the Baa-Treasury

[7]The procedure of how we compute the variable is outlined in Appendix B.

[8]For the sake of brevity we do not report the output of this robustness check. The authors are available to provide it upon request.

credit spread. The remainder of this section provides some comments about the coherency of these results with those presented previously.

The negative relation between the PIN and the monetary policy uncertainty confirms the information spillover between the Fed fund futures and the corporate bond markets. We can see that when the futures market does not convey information, the corporate bonds traders are more likely to transact for liquidity reasons. This result is in line with dealers widening their spread in presence of uncertainty: since the information about future monetary policy is available to almost all market participants, dealers are less exposed to heterogeneous beliefs when the orientation of the Fed is clear. Therefore, they can quote a tight bid-ask spread around the asset value under the new policy regime. This result is very close to the Glosten and Milgrom (1985) prediction when all traders are informed.

The low explanatory power of the other announcement-related variables confirms the results of the GMM model discussed in the previous section. We notice that the fluctuations in the bid-ask spread are caused by the variation in order processing costs charged by the dealers, rather than by adverse selection. Neither the expected change of interest rates nor the surprise component affects the probability of informed trading. It can be confirmed that dealers set their quotes according to their inventory aversion and not as a response to the order flow toxicity.

Finally, the positive sign of the credit spread coefficient is likely to be a consequence of flights to quality: when the market price for default risk is high, traders are selling low quality bonds in favour of safer securities, the PIN metric is likely to capture such effects.

6.1 The financial crisis

We also test whether the 2007-2009 financial crisis drives our results. We investigate on the effect of the turmoil by creating expansion and recession periods dummy variables, as defined by the NBER. As a result we have one contraction period from December 2007 to June 2009. In addition, we split the remaining two expansion periods into two - one before and one after the recession. We run the regressions described by Equation 11 and 12 augmented with two dummy variables $XII07 - VI09$ and $XI04 - XI07$ which take value 1 during corresponding dates and 0 otherwise.

Table 15 reports regressions results. We observe that during the turmoil despite dealers offering worse conditions at buy both before and after the meetings - *Deviation* is 34bps and 33bps further down for the respective periods, *Entropy* is still both economically and statistically significant. While during the financial crisis interest rates were falling, there were several other documented issues during that time. Participants in this market faced trading frictions and limited access to funding (Dick-Nielsen et al., 2012). In addition, the default of a major corporate bond dealer caused illiquidity spillovers (Di Maggio et al., 2016). This further supports the inventory management strategies story. Moreover, the dummy variable $XI04 - XI07$ is significant at the sell before the announcement. This was a period of monetary tightening thus unsurprisingly dealers preferred to sell bonds before the news release in order to avoid potential losses due to an unexpected increase in the interest rates.

7 Conclusion

This paper has studied the effects of the FOMC announcements on the US corporate bond market liquidity. Since the decisions of the Fed affect bond prices, and market participants may have heterogeneous views about future monetary policy, corporate bond dealers have to set their bid and ask prices such that they compensate for this asymmetric information.

Despite the fact that FOMC decisions themselves do not trigger any toxic order flow, the dealers decrease liquidity provision in the presence of future monetary policy uncertainty. They display an inventory aversion and are willing to avoid carrying sensitive securities over the announcement period by selling them at a relative discount. In addition, the market makers try to recover losses caused by unexpected rate movements through an increase in the liquidity provision costs.

These general results are determined by the behaviour of different bond types. In particular, the embedded option moneyness of some bonds affects the price volatility and, in turn, its liquidity. While the underlying mechanism is different, we observe a direct relation between expected policy rates and the liquidity of bonds with embedded options. The industry of the issuer also influences the movements in the bond liquidity. The sensitivity of some sectors to the interest rate was well documented before. Further analysis is needed to fully understand the reason for such a variation in liquidity across industries.

In conclusion, the decomposition of the bid-ask spread into order processing cost and adverse selection reveals that the dealers set prices as an implementation of inventory management policies, rather than as a response to informed trading. The monetary policy announcements affect the behaviour of corporate bond liquidity providers. However, this reaction is not justified neither by adverse selection nor by imbalanced order flows. Moreover, corporate bond prices appear to incorporate the future monetary policy expectations as measured by the 30-day Fed rate futures. This result supports the claim that the dissemination of information is efficient in the case of monetary policy actions and the Fed fund futures play an important role in bid-ask formation. However, the dealership structure of the US corporate bond market proves to be inadequate to accommodate heterogeneous beliefs, even if the adverse selection is low.

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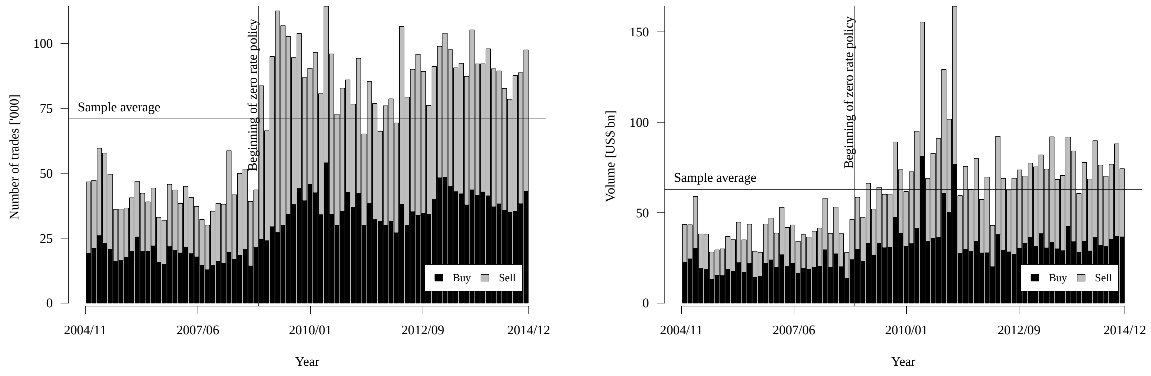
8 Figures

Figure 1: Trade quantity and volume of corporate bonds during FOMC meeting weeks 8 Nov 2004 - 19 Dec 2014.



(a) Trade quantity (b) Trade volume

Figure 2: Realised and Expected changes in Fed Funds Rate as of each FOMC announcement between 10 Nov 2004 - 17 Dec 2014.

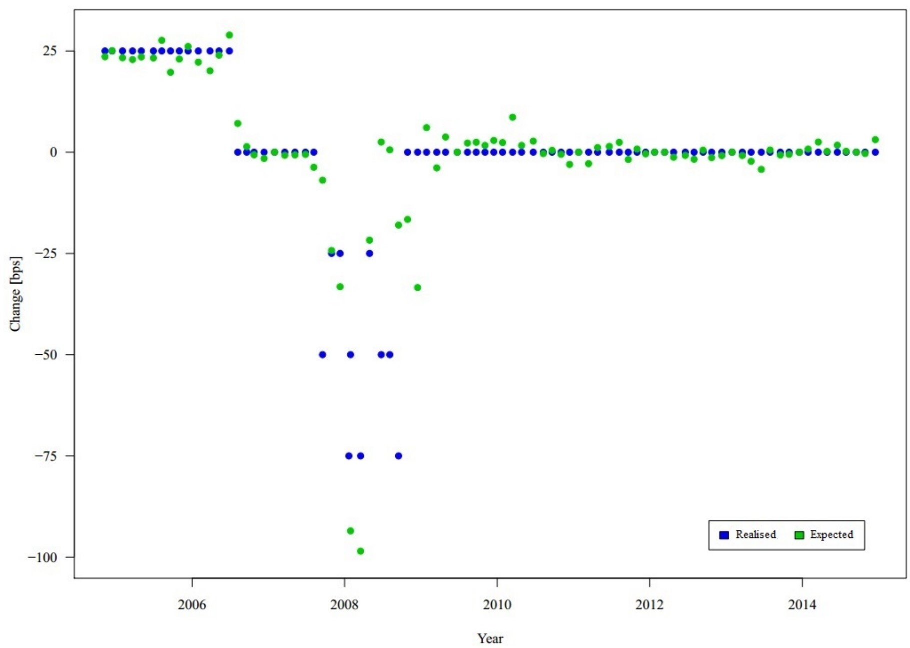
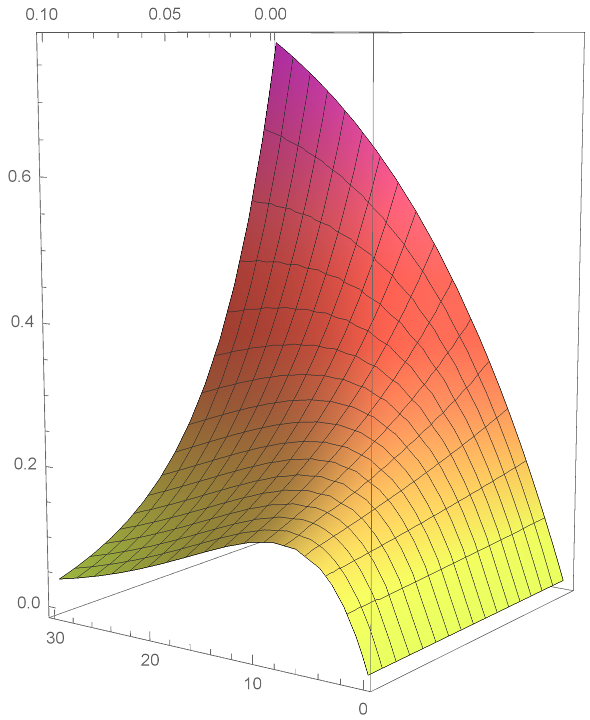


Figure 3: Difference between V^H and V^L of a corporate bond for maturities 0 to 30 years and a constant yield between 0 and 10%.



9 Tables

Table 1: Summary statistics.
The table presents summary statistics of variables used in this study sampled at a daily frequency. We summarize descriptive statistics for the *Entropy*, value difference, deviation from the mid price, trading volume, dealer transactions volume, time to maturity, expected move in monetary policy, absolute policy surprise, credit rating, fraction of sell trades, trade staleness and the probability of informed trading. Further variable descriptions are presented in Table 16. We report across all bonds the means, standard deviations, minimum and maximum values. The sample is based on the US transaction data of corporate bonds from TRACE, provided by WRDS for the period during FOMC weeks from 8 Nov 2004 until 19 Dec 2014 - 5,817,147 observations. The unit of each variable is reported in brackets.

Statistic	Mean	St. Dev.	Min	Max
Entropy[bps]	2.9	4.9	0	25
$V^H - V^L$ [%]	0.88	0.39	0	10.11
Bid/Ask deviation [bps]	−0.09	98.81	−351	321
Volume [USD m]	0.886	8.949	0	5,000
log Dealer Volume [log USD]	11.23	5.26	0	23.43
Maturity [Years]	8.531	8.962	0	100.025
Expected Change [bps]	−0.1	11.1	−103.7	28.9
Surprise Level [bps]	−0.3	8.2	−57	43.5
Spread VW [bps]	100	130	−140	840
Risk free rate [%]	2.4	1.5	0	5.5
Credit Spread	4.94	1.71	0	9.32
Sell Fraction	0.46	0.288	0	1
log Staleness [log USD]	-14.84	3.53	-23.65	-0.69
PIN	0.292	0.02	0.242	0.388

Table 2: Correlations.

The table reports correlations between variables. The sample is based on the US transaction data of corporate bonds from TRACE, provided by WRDS for the period during FOMC weeks from 8 Nov 2004 until 19 Dec 2014 - 5,817,147 observations. The correlations between bid/ask deviation are computed on the respective part of the dataset separately.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Entropy	1													
2. $V^H - V^L$	-0.06	1												
3. Bid/Ask deviation	-.06/.02	-.10/.05	1											
4. log Volume	-0.02	0.02	.22/-.21	1										
5. log Dealer Volume	0.03	-0.03	-.07/.02	-0.18	1									
6. Maturity	-0.02	0.30	-.14/.10	0.02	-0.09	1								
7. Expected Change	0.06	-0.01	.03/.00	0.00	-0.02	-0.00	1							
8. Surprise Level	0.02	0.02	.02/-.02	-0.00	0.01	0.00	-0.00	1						
9. Spread VW	0.07	0.10	-.53/.39	-0.26	0.05	0.20	-0.04	-0.03	1					
10. Risk free rate	0.03	0.35	-.13/.11	0.01	-0.07	0.49	0.09	-0.06	0.16	1				
11. Credit Spread	0.18	-0.23	-.09/.01	-0.06	0.08	-0.03	-0.07	0.05	0.12	-0.47	1			
12. Sell Fraction	-0.01	-0.02	-.10/.12	0.02	0.00	-0.02	0.01	-0.01	-0.01	-0.00	-0.02	1		
13. log Staleness	-0.01	0.03	-.02/-.01	-0.01	-0.60	0.07	0.01	-0.00	0.07	0.01	-0.00	-0.08	1	
14. PIN	-0.07	-0.09	-.03/-.01	-0.03	0.03	-0.01	-0.00	0.04	0.04	-0.38	0.54	-0.02	0.01	1

Table 3: Volume regressions.
The table presents fixed effects panel data regressions results, where *Volume* is the dependent variable measured in billions of dollars. All t-statistics in brackets are based on robust clustered by the FOMC meeting weeks standard errors. The sample is based on the US corporate bonds transaction data from TRACE, provided by WRDS for the period during FOMC weeks from 8 Nov 2004 until 19 Dec 2014 - 838,882 observations averaged daily for each cusip. All reported regressions are estimated with bond fixed effects. $*, **, ***$ denote significance at 10%, 5% and 1%, respectively.

	Volume [bn]				
Horizon = −2	14.2	14.0	15.0	13.4	14.5
	(1.54)	(1.51)	(1.44)	(1.43)	(1.37)
Horizon = −1	38.4	38.2	39.4	37.6	38.8
	(4.51)***	(4.48)***	(4.03)***	(4.32)***	(3.92)***
Horizon = 0	30.2	30.1	30.8	29.7	30.5
	(4.12)***	(4.10)***	(4.02)***	(4.02)***	(3.95)***
Horizon = 1	37.8	37.8	37.8	37.8	37.8
	(3.83)***	(3.82)***	(3.82)***	(3.83)***	(3.83)***
ExpectedChange	1.18	2.26	2.88	0.54	1.18
	(0.12)	(0.23)	(0.28)	(0.05)	(0.11)
max_surprise	3.36	3.53	4.04	3.34	3.87
	(0.21)	(0.22)	(0.26)	(0.21)	(0.25)
SurpriseLevel		21.4	21.4		
		(1.04)	(1.04)		
Entropy			-21.6		-22.7
			(0.35)		(0.37)
Absolute Surprise				-16.7	-17.1
				(0.70)	(0.72)
Constant	78.4	78.6	78.6	79.2	79.2
	(12.86)***	(12.88)***	(12.89)***	(12.62)***	(12.64)***
F statistic	4.9	4.5	3.9	4.3	3.8
Adjusted R-squared	0.00	0.00	0.00	0.00	0.00

Table 4: Imbalance regressions.
The table presents fixed effects panel data regressions results, where *Imbalance* is the dependent variable measured as the normal quantile of the fraction of sell volume. All t-statistics in brackets are based on robust clustered by the FOMC meeting weeks standard errors. The sample is based on the US corporate bonds transaction data of from TRACE, provided by WRDS for the period during FOMC weeks from 8 Nov 2004 until 19 Dec 2014 - 838,882 observations averaged daily for each cusip. All reported regressions are estimated with bond fixed effects. $*, **, ***$ denote significance at 10%, 5% and 1%, respectively.

	Imbalance				
Horizon $= -2$	-0.02	-0.02	-0.04	-0.02	-0.03
	(1.86)*	(1.82)*	(2.58)**	(1.20)	(2.04)**
Horizon $= -1$	-0.04	-0.04	-0.05	-0.03	-0.05
	(3.13)***	(3.09)***	(3.85)***	(2.38)**	(3.25)***
Horizon $= 0$	-0.03	-0.03	-0.04	-0.03	-0.04
	(3.10)***	(3.07)***	(3.83)***	(2.58)**	(3.39)***
Horizon $= 1$	-0.03	-0.03	-0.03	-0.03	-0.03
	(2.67)***	(2.66)***	(2.65)***	(2.67)***	(2.67)***
ExpectedChange	-0.00	-0.00	-0.01	0.01	-0.00
	(0.06)	(0.14)	(0.39)	(0.17)	(0.10)
max_surprise	-0.04	-0.04	-0.05	-0.04	-0.05
	(1.42)	(1.43)	(1.64)	(1.40)	(1.61)
SurpriseLevel		-0.05	-0.05		
		(1.38)	(1.35)		
Entropy			0.28		0.29
			(2.77)***		(2.85)***
Absolute Surprise				0.18	0.18
				(6.61)***	(6.71)***
Constant	-4.41	-4.42	-4.42	-4.42	-4.42
	(544.92)***	(543.13)***	(542.03)***	(529.20)***	(528.29)***
F statistic	2.9	2.9	3.3	9.6	8.9
Adjusted R-squared	0.00	0.00	0.00	0.00	0.00

Table 5: Spread regressions.

Regressions before and after the announcement of value weighted spread based on RHS variables from Equation 11 and Equation 12. All t-statistics in brackets are based on robust clustered by the FOMC meeting weeks standard errors. The sample is based on the US transaction data of corporate bonds from TRACE, provided by WRDS for the period during FOMC weeks from 8 Nov 2004 until 19 Dec 2014. All reported regressions are estimated with bond fixed effects and control variables. $*, **, ***$ denote significance at 10%, 5% and 1%, respectively.

	Before	After
	Spread [bps]	
Entropy	139.07	
	(2.98)***	
ExpectedChange	-67.54	
	(4.29)***	
$V^H - V^L$ [%]	18.43	25.16
	(4.45)***	(5.90)***
Maturity	7.95	7.06
	(5.34)***	(4.93)***
Yield [%]	5.30	2.12
	(2.37)**	(0.86)
Credit Spread [%]	17.02	16.84
	(10.20)***	(8.82)***
Bond Rating	4.00	4.24
	(5.12)***	(6.98)***
Absolute Surprise		135.34
		(2.63)**
Constant	12.67	15.09
	(0.99)	(0.95)
F statistic	252.7	129.6
Adjusted R-squared	0.11	0.10
N	2,991,049	2,782,502

Table 6: Deviation regressions.
Regressions before and after the announcement of deviation and split between sides as per Equation 11 and Equation 12. All t-statistics in brackets are based on robust clustered by the FOMC meeting weeks standard errors. The sample is based on the US transaction data of corporate bonds from TRACE, provided by WRDS for the period during FOMC weeks from 8 Nov 2004 until 19 Dec 2014. All reported regressions are estimated with bond fixed effects and control variables. $*, **, ***$ denote significance at 10%, 5% and 1%, respectively.

	Before		After	
	Bid	Ask	Bid	Ask
Entropy	-60.94	32.22		
	(2.30)**	(2.05)**		
ExpectedChange	45.09	-6.87		
	(6.58)***	(1.57)		
$V^H - V^L$ [%]	-11.09	3.66	-11.69	7.99
	(4.73)***	(1.52)	(5.38)***	(3.79)***
Maturity	-8.56	0.01	-7.40	0.59
	(10.89)***	(0.02)	(7.95)***	(1.46)
Yield [%]	-2.18	4.18	-1.55	2.13
	(1.68)*	(5.45)***	(0.97)	(2.66)***
Credit Spread [%]	-11.84	2.99	-11.14	3.15
	(10.02)***	(5.22)***	(8.95)***	(5.25)***
Bond Rating	2.05	4.30	1.75	4.21
	(5.50)***	(16.60)***	(4.36)***	(16.41)***
Absolute Surprise			-59.68	42.65
			(3.59)***	(2.20)**
Constant	-4.49	57.57	-14.25	51.52
	(0.47)	(10.42)***	(1.46)	(8.36)***
F statistic	106.0	242.6	86.5	296.0
Adjusted R-squared	0.11	0.05	0.09	0.05
N	1,252,620	1,738,429	1,189,452	1,593,050

Table 7: Average price and policy expectations.
Comparison of the average relative price in presence of expectation of interest rate hike or ease. The standard errors of the mean are reported in parenthesis. The t-test is based on the alternative hypothesis that the average price in presence of hike expectations is lower than in presence of ease expectations. $*, **, ***$ denote significance at 10%, 5% and 1%, respectively.

Horizon	-2	-1	0
Hike	1	1.000	1.001
		(0.013)	(0.015)
Ease	1	1.001	1.002
		(0.075)	(0.022)
t-stat		-1.401*	-5.353***

Table 8: No embedded option and callable bonds regressions.

The table presents fixed effects panel data regressions results, where *deviation* is the dependent variable measured in basis points. Some explanatory variables are not reported the table. All t-statistics in brackets are based on robust clustered by the FOMC meeting weeks standard errors. The sample is based on the US transaction data of corporate bonds from TRACE, provided by WRDS for the period during FOMC weeks from 8 Nov 2004 until 19 Dec 2014. All reported regressions are estimated with bond fixed effects and control variables. $*, **, ***$ denote significance at 10%, 5% and 1%, respectively.

	Before				After			
	Bid Callable	Bid No Option	Ask Callable	Ask No Option	Bid Callable	Bid No Option	Ask Callable	Ask No Option
Entropy	-33.94	-51.09	58.24	22.07				
	(1.55)	(2.08)**	(3.30)***	(1.36)				
Expected Change	19.35	52.94	-16.86	-5.29				
	(3.06)***	(8.46)***	(4.53)***	(1.08)				
$V^H - V^L$ [%]	0.55	-13.25	-14.14	10.98	-0.10	-12.75	-4.83	16.44
	(0.12)	(6.01)***	(3.56)***	(4.03)***	(0.04)	(6.09)***	(1.19)	(6.14)***
Maturity [years]	-11.67	-6.18	2.21	-1.18	-10.48	-6.05	2.35	-0.30
	(11.40)***	(8.50)***	(3.41)***	(2.35)**	(11.57)***	(5.91)***	(3.08)***	(0.65)
Yield [%]	3.47	-4.43	4.45	4.52	4.61	-3.53	3.26	2.13
	(2.68)***	(3.41)***	(4.14)***	(5.37)***	(3.21)***	(1.94)*	(3.34)***	(2.41)**
Credit Spread [%]	-8.03	-14.29	2.68	3.56	-6.86	-13.11	3.52	3.33
	(7.46)***	(12.22)***	(2.53)**	(6.12)***	(7.72)***	(9.63)***	(2.98)***	(5.36)***
Bond Rating	1.53	2.04	3.31	4.73	1.96	1.53	3.10	4.67
	(3.53)***	(4.18)***	(6.88)***	(16.62)***	(5.31)***	(2.93)***	(7.16)***	(15.28)***
Absolute Surprise					-20.70	-69.05	38.89	44.64
					(2.52)**	(3.20)***	(5.08)***	(1.93)*
Constant	-204.09	-351.22	326.75	97.64	-86.71	-206.24	175.10	-6.46
	(4.33)***	(6.27)***	(6.42)***	(2.86)***	(1.50)	(3.19)***	(4.39)***	(0.16)
F statistic	76.3	85.4	150.9	272.2	86.1	69.9	237.8	255.8
Adjusted R-squared	0.08	0.14	0.05	0.05	0.07	0.11	0.05	0.05
N	296,309	914,563	403,882	1,288,760	279,195	867,629	375,911	1,171,971

Table 9: Convertible and putable bonds regressions.
The table presents fixed effects panel data regressions results, where *deviation* is the dependent variable measured in basis points. Some explanatory variables are not reported the table. All t-statistics in brackets are based on robust clustered by the FOMC meeting weeks standard errors. The sample is based on the US transaction data of corporate bonds from TRACE, provided by WRDS for the period during FOMC weeks from 8 Nov 2004 until 19 Dec 2014. All reported regressions are estimated with bond fixed effects and control variables. $*, **, ***$ denote significance at 10%, 5% and 1%, respectively.

	Before				After			
	Bid Convertible	Bid Putable	Ask Convertible	Ask Putable	Bid Convertible	Bid Putable	Ask Convertible	Ask Putable
Entropy	14.03	8.03	28.60	8.22				
	(0.65)	(0.41)	(1.43)	(0.37)				
Expected Change	12.99	12.76	-16.87	-12.58				
	(3.05)***	(3.28)***	(3.77)***	(3.47)***				
$V^H - V^L$ [%]	-3.53	-4.88	-1.09	-2.37	-2.82	-3.75	0.69	0.22
	(5.48)***	(7.16)***	(1.28)	(2.77)***	(4.59)***	(4.51)***	(0.79)	(0.22)
Maturity [years]	-3.53	-4.88	-1.09	-2.37	-2.82	-3.75	0.69	0.22
	(5.48)***	(7.16)***	(1.28)	(2.77)***	(4.59)***	(4.51)***	(0.79)	(0.22)
Yield [%]	-0.40	-6.37	5.11	12.72	-1.64	-2.54	1.92	6.91
	(0.31)	(2.66)***	(3.84)***	(5.33)***	(1.37)	(1.04)	(1.36)	(2.28)**
Credit Spread [%]	-6.57	-11.57	7.04	12.06	-6.80	-6.81	5.98	9.73
	(8.00)***	(7.57)***	(8.07)***	(7.19)***	(8.95)***	(4.58)***	(5.46)***	(6.40)***
Bond Rating	-1.43	0.12	2.93	4.41	-0.90	0.47	3.09	5.18
	(2.91)***	(0.14)	(5.24)***	(5.62)***	(1.46)	(0.47)	(4.49)***	(4.04)***
Absolute Surprise					-6.06	-9.49	30.93	28.05
					(0.59)	(1.03)	(3.02)***	(3.22)***
Constant	-373.60	-196.82	231.61	276.65	-290.62	-141.95	109.75	-7.77
	(6.72)***	(2.76)***	(3.34)***	(3.29)***	(4.55)***	(2.20)**	(2.19)**	(0.09)
F statistic	68.4	71.1	56.8	42.9	66.4	57.0	75.1	52.4
Adjusted R-squared	0.17	0.18	0.06	0.06	0.15	0.15	0.06	0.05
N	74,847	35,478	71,598	32,667	78,288	37,288	72,424	33,741

Table 10: Bid transactions before FOMC split by industry.
The table presents fixed effects panel data regressions results for the bid trades that occurred before the monetary policy announcement. *Deviation* is the dependent variable measured in basis points. All bonds with embedded options are removed from this analysis. Some explanatory variables are not reported in the table. All t-statistics in brackets are based on robust clustered by the FOMC meeting weeks standard errors. The sample is based on the US transaction data of corporate bonds from TRACE, provided by WRDS for the period during FOMC weeks from 8 Nov 2004 until 19 Dec 2014. All reported regressions are estimated with bond fixed effects and control variables. $*, **, ***$ denote significance at 10%, 5% and 1%, respectively.

	Bid before announcement						
Sector	Finance	Consumer	Manufacturing	Utilities	HiTec	Health	Other
Entropy	-58.02	-69.67	-101.30	-71.89	-57.55	-93.60	-66.54
	(2.07)**	(2.05)**	(2.12)**	(1.93)*	(2.00)**	(2.43)**	(2.03)**
ExpectedChange	58.83	57.16	48.52	52.18	58.87	40.11	32.96
	(9.90)***	(6.06)***	(4.99)***	(3.48)***	(5.04)***	(4.36)***	(3.40)***
$V^H - V^L$ [%]	-18.82	6.96	-18.62	-16.33	-19.28	-3.97	-33.86
	(5.68)***	(1.45)	(5.06)***	(3.46)***	(4.49)***	(1.03)	(4.78)***
Maturity	-5.78	-10.58	-7.27	-6.04	-6.34	-5.22	-3.01
	(6.29)***	(11.98)***	(5.88)***	(5.55)***	(5.85)***	(4.91)***	(3.02)***
Yield [%]	-6.56	-3.65	-2.60	-1.95	-2.06	-5.31	-4.27
	(3.88)***	(2.14)**	(1.11)	(1.13)	(1.39)	(3.05)***	(2.56)**
Credit Spread [%]	-14.55	-13.15	-15.11	-11.51	-8.90	-8.33	-14.72
	(10.31)***	(11.48)***	(8.06)***	(7.73)***	(6.39)***	(7.22)***	(13.37)***
Bond Rating	1.26	3.39	4.30	4.83	2.95	-0.47	2.75
	(2.75)***	(2.97)***	(3.62)***	(3.10)***	(4.55)***	(0.70)	(1.71)*
Constant	16.50	-21.16	32.34	-53.04	-0.31	4.50	-42.40
	(1.67)*	(1.34)	(1.78)*	(3.07)***	(0.03)	(0.46)	(2.35)**
F statistic	67.1	79.5	74.5	45.0	54.7	33.7	47.9
Adjusted R-squared	0.14	0.14	0.17	0.14	0.11	0.16	0.09
N	521,887	102,557	109,777	23,464	95,931	26,024	34,923

Table 11: Ask transactions before FOMC split by industry.

The table presents fixed effects panel data regressions results for the ask trades that occurred before the monetary policy announcement. *Deviation* is the dependent variable measured in basis points. All bonds with embedded options are removed from this analysis. Some explanatory variables are not reported in the table. All t-statistics in brackets are based on robust clustered by the FOMC meeting weeks standard errors. The sample is based on the US transaction data of corporate bonds from TRACE, provided by WRDS for the period during FOMC weeks from 8 Nov 2004 until 19 Dec 2014. All reported regressions are estimated with bond fixed effects and control variables. $*, **, ***$ denote significance at 10%, 5% and 1%, respectively.

	Ask before announcement						
Sector	Finance	Consumer	Manufacturing	Utilities	HiTec	Health	Other
Entropy	31.25	11.23	-9.87	42.39	24.64	-8.33	64.36
	(1.54)	(0.65)	(0.52)	(1.77)*	(2.64)***	(0.50)	(1.81)*
ExpectedChange	-7.27	6.29	12.67	-19.42	-12.58	2.13	-23.94
	(1.04)	(1.09)	(2.26)**	(2.94)***	(3.03)***	(0.43)	(3.67)***
$V^H - V^L$ [%]	17.99	6.02	-1.32	3.12	1.64	10.21	8.25
	(5.40)***	(1.49)	(0.30)	(0.84)	(0.46)	(2.28)**	(1.39)
Maturity [years]	-1.86	1.54	-0.31	-2.06	-1.37	0.44	-1.24
	(2.81)***	(1.83)*	(0.37)	(2.70)***	(2.52)**	(0.47)	(0.99)
Yield [%]	4.58	1.53	4.60	5.32	6.64	3.20	6.22
	(4.60)***	(1.21)	(3.64)***	(3.55)***	(8.26)***	(2.16)**	(3.49)***
Credit Spread [%]	4.32	0.84	1.50	1.80	3.60	3.58	5.37
	(6.72)***	(1.16)	(1.82)*	(2.17)**	(6.55)***	(4.63)***	(4.05)***
Bond Rating	4.02	7.15	3.55	7.86	3.97	2.70	7.18
	(9.71)***	(12.04)***	(4.77)***	(4.32)***	(5.91)***	(5.55)***	(7.50)***
Constant	46.04	63.78	91.25	29.95	65.26	36.91	5.03
	(7.80)***	(5.91)***	(5.82)***	(1.46)	(6.16)***	(4.08)***	(0.39)
F statistic	223.9	68.5	94.9	51.8	128.9	38.9	63.1
Adjusted R-squared	0.05	0.06	0.04	0.05	0.05	0.06	0.06
N	743,263	133,327	163,313	30,382	135,242	33,125	50,108

Table 12: Bid transactions after FOMC split by industry.

The table presents fixed effects panel data regressions results for the bid trades that occurred after the monetary policy announcement. *Deviation* is the dependent variable measured in basis points. All bonds with embedded options are removed from this analysis. Some explanatory variables are not reported in the table. All t-statistics in brackets are based on robust clustered by the FOMC meeting weeks standard errors. The sample is based on the US transaction data of corporate bonds from TRACE, provided by WRDS for the period during FOMC weeks from 8 Nov 2004 until 19 Dec 2014. All reported regressions are estimated with bond fixed effects and control variables. $*, **, ***$ denote significance at 10%, 5% and 1%, respectively.

	Bid after announcement						
Sector	Finance	Consumer	Manufacturing	Utilities	HiTec	Health	Other
$V^H - V^L$ [%]	-18.99	2.57	-12.19	-19.78	-13.07	-5.90	-40.35
	(5.64)***	(0.53)	(3.07)***	(4.96)***	(2.87)***	(1.63)	(6.26)***
Maturity [years]	-5.33	-8.58	-6.49	-4.59	-4.74	-3.86	-2.70
	(4.55)***	(8.16)***	(4.43)***	(3.99)***	(3.89)***	(3.35)***	(2.36)**
Yield [%]	-4.25	-4.14	-4.49	-4.55	-4.35	-6.79	-3.60
	(1.88)*	(2.00)**	(1.67)*	(2.56)**	(2.69)***	(2.83)***	(1.78)*
Credit Spread [%]	-13.27	-12.18	-14.96	-12.44	-8.88	-7.71	-14.74
	(8.78)***	(7.64)***	(7.54)***	(8.51)***	(5.54)***	(4.57)***	(8.90)***
Bond Rating	0.88	2.48	2.95	5.27	2.69	-1.74	1.71
	(1.68)*	(2.12)**	(2.32)**	(3.13)***	(4.68)***	(2.35)**	(1.21)
Absolute Surprise	-81.64	-70.24	-66.24	-55.19	-65.73	-39.39	-14.76
	(3.43)***	(6.44)***	(2.26)**	(3.88)***	(4.35)***	(3.06)***	(1.16)
Constant	11.10	-29.21	32.07	-54.09	-30.69	-6.33	-39.80
	(1.08)	(1.60)	(1.74)*	(2.71)***	(2.45)**	(0.52)	(2.18)**
F statistic	59.5	72.1	68.5	50.4	55.9	33.4	85.4
Adjusted R-squared	0.11	0.12	0.15	0.13	0.10	0.12	0.09
N	498,139	100,013	101,087	21,408	89,370	23,834	33,778

Table 13: Ask transactions after FOMC split by industry.
The table presents fixed effects panel data regressions results for the ask trades that occurred after the monetary policy announcement. *Deviation* is the dependent variable measured in basis points. All bonds with embedded options are removed from this analysis. Some explanatory variables are not reported in the table. All t-statistics in brackets are based on robust clustered by the FOMC meeting weeks standard errors. The sample is based on the US transaction data of corporate bonds from TRACE, provided by WRDS for the period during FOMC weeks from 8 Nov 2004 until 19 Dec 2014. All reported regressions are estimated with bond fixed effects and control variables. $*, **, ***$ denote significance at 10%, 5% and 1%, respectively.

	Ask after announcement						
Sector	Finance	Consumer	Manufacturing	Utilities	HiTec	Health	Other
$V^H - V^L$ [%]	20.45	9.69	5.41	12.18	10.20	14.74	14.30
	(6.08)***	(2.32)**	(1.27)	(3.77)***	(2.82)***	(3.57)***	(2.57)**
Maturity [years]	-0.92	2.36	1.38	-1.10	-0.73	2.47	-1.33
	(1.48)	(3.27)***	(1.83)*	(1.38)	(1.18)	(2.89)***	(1.37)
Yield [%]	1.96	0.03	-0.49	3.29	3.83	-0.77	4.23
	(1.69)*	(0.03)	(0.37)	(2.56)**	(3.73)***	(0.58)	(2.21)**
Credit Spread [%]	3.96	1.44	1.41	4.29	3.48	3.96	4.90
	(5.56)***	(1.76)*	(2.13)**	(6.55)***	(4.79)***	(6.65)***	(4.97)***
Bond Rating	3.36	8.61	3.55	10.22	4.67	3.55	6.55
	(8.68)***	(15.02)***	(3.66)***	(5.46)***	(9.65)***	(5.13)***	(6.43)***
Absolute Surprise	50.27	10.63	26.47	13.36	31.77	13.43	99.61
	(1.83)*	(0.85)	(1.47)	(1.89)*	(2.40)**	(1.25)	(2.33)**
Constant	47.69	35.87	69.02	-3.84	49.09	20.98	13.59
	(6.97)***	(3.00)***	(6.10)***	(0.22)	(5.62)***	(2.29)**	(1.07)
F statistic	161.8	93.0	70.6	39.1	86.7	78.6	55.6
Adjusted R-squared	0.05	0.07	0.04	0.05	0.05	0.06	0.06
N	681,849	124,429	144,419	27,749	118,300	29,627	45,598

Table 14: GMM model estimates.
The table presents GMM results from the model fit to transaction price changes between 11:00 and 17:00 during the period of FOMC weeks from 8 Nov 2004 until 19 Dec 2014 based on the US transaction data of corporate bonds from TRACE, provided by WRDS - 5,414,855 observations. The model is estimated using Equation A.1. Indicator variables are fitted to account for *no announcement* - N, *before* - B and *after* - A, and for bid and ask sides - B and A (from the dealer's perspective), respectively. All t statistics in brackets are based on robust weight matrix and clustered by the FOMC meeting weeks. $*, **, ***$ denote significance at 10%, 5% and 1%, respectively.

		A: GMM			
No Announcement		Before		After	
Autocorrelation of trades					
ρ_{NA}	0.68	ρ_{BA}	0.79	ρ_{AA}	0.38
	(68.91)***		(101.60)***		(23.86)***
ρ_{NB}	0.26	ρ_{BB}	0.49	ρ_{AB}	0.01
	(28.26)***		(60.92)***		(0.77)
Order processing cost					
ϕ_{NA}	0.47	ϕ_{BA}	0.27	ϕ_{AA}	0.60
	(38.81)***		(9.03)***		(25.24)***
ϕ_{NB}	0.71	ϕ_{BB}	0.63	ϕ_{AB}	0.72
	(16.23)***		(21.36)***		(22.47)***
Adverse selection					
θ_{NA}	-0.02	θ_{BA}	0.16	θ_{AA}	-0.11
	(1.57)		(6.45)***		(8.21)***
θ_{NB}	-0.11	θ_{BB}	-0.06	θ_{AB}	-0.12
	(6.75)***		(4.02)***		(17.12)***
γ	0.04				
	(0.54)				
		B: Tests			
Time periods					
$\rho_{NB} = \rho_{BB} = \rho_{AB}$			$\chi^2_2 = 5699.04$***		
$\rho_{NA} = \rho_{BA} = \rho_{AA}$			$\chi^2_2 = 1760.11$***		
$\phi_{NB} = \phi_{BB} = \phi_{AB}$			$\chi^2_2 = 111.87$***		
$\phi_{NA} = \phi_{BA} = \phi_{AA}$			$\chi^2_2 = 217.75$***		
$\theta_{NB} = \theta_{BB} = \theta_{AB}$			$\chi^2_2 = 226.34$***		
$\theta_{NA} = \theta_{BA} = \theta_{AA}$			$\chi^2_2 = 317.86$***		
Transaction side					
$\rho_{NB} = \rho_{NA}$	$\chi^2_1 = 1005.58$***	$\rho_{BB} = \rho_{BA}$	$\chi^2_1 = 659.70$***		
$\rho_{AB} = \rho_{AA}$	$\chi^2_1 = 410.36$***				
$\phi_{NB} = \phi_{NA}$	$\chi^2_1 = 28.66$***	$\phi_{BB} = \phi_{BA}$	$\chi^2_1 = 60.04$***		
$\phi_{AB} = \phi_{AA}$	$\chi^2_1 = 15.09$***				
$\theta_{NB} = \theta_{NA}$	$\chi^2_1 = 26.29$***	$\theta_{BB} = \theta_{BA}$	$\chi^2_1 = 47.31$***		
$\theta_{AB} = \theta_{AA}$	$\chi^2_1 = 0.34$				

Table 15: Deviation regressions with recession and expansion dummies.
Regressions before and after the announcement of deviation and split between sides as per Equation 11 and Equation 12. The recession period is defined by NBER: *XII07-VI09* corresponds to all meetings between December 2007 and June 2009 - contraction. The variable takes value 1 during that period and 0 otherwise. *XI04-XI07* takes value 1 from November 2004 until November 2007 and 0 otherwise. All t-statistics in brackets are based on robust clustered by the FOMC meeting weeks standard errors. The sample is based on the US transaction data of corporate bonds from TRACE, provided by WRDS for the period during FOMC weeks from 8 Nov 2004 until 19 Dec 2014. All reported regressions are estimated with bond fixed effects and control variables. $*, **, ***$ denote significance at 10%, 5% and 1%, respectively.

	Before		After	
	Buy	Sell	Buy	Sell
Entropy	-51.94	28.05		
	(2.78)***	(1.50)		
ExpectedChange	28.54	0.37		
	(4.10)***	(0.05)		
$V^H - V^L$ [%]	-10.21	12.89	-9.21	16.94
	(5.43)***	(5.67)***	(4.39)***	(6.90)***
Maturity	-5.20	0.15	-5.31	0.31
	(6.23)***	(0.22)	(5.17)***	(0.49)
Yield [%]	-2.74	5.28	-3.26	2.54
	(1.95)*	(5.66)***	(1.81)*	(2.68)***
Credit Spread [%]	-11.05	2.00	-9.21	2.69
	(8.23)***	(1.28)	(6.71)***	(2.50)**
Bond Rating	1.95	4.58	1.50	4.60
	(3.91)***	(16.69)***	(2.74)***	(14.67)***
Absolute Surprise			-24.36	40.23
			(1.12)	(1.79)*
XII07-VI09	-34.46	-4.31	-32.92	-1.56
	(6.90)***	(1.06)	(6.46)***	(0.48)
XI04-XI07	-15.13	-20.09	-2.08	-9.87
	(1.59)	(2.50)**	(0.21)	(1.42)
Constant	-17.61	51.17	-24.11	44.91
	(1.86)*	(7.93)***	(2.87)***	(7.28)***
F statistic	107.5	216.2	98.7	242.5
Adjusted R-squared	0.14	0.05	0.12	0.05
N	914,563	1,288,760	867,629	1,171,971

Table 16: Description of Regression Variables and Data Sources.
This table presents the variable names, definition and data source of the explanatory variables used in Equation 11 and Equation 12.

	Variable	Description	Data Source
1	Expected Change	Change in fed funds rate obtained from 30-day Fed Funds futures prices	CME DataMine
2	Entropy	Uncertainty about expected change	Own calculation
3	Credit Spread	Moody's Seasoned Baa Corporate Bond Yield Relative to Yield on 10-Year Treasury Constant Maturity	FRED Economic Data
4	Maturity	Maturity of the bond	Thomson Reuters
5	Value difference	Theoretical bond price difference in case of a 25bps jump in the level of interest rates. Expressed in %	Own calculation
6	Yield	Risk free rate adjusted by the maturity of a bond.	Fed H.15 series
7	Absolute Surprise	Absolute value of a difference between last expected change and actual FOMC decision	Own calculation
8	Max Surprise	Maximum of the differences between the expected change and the two possible outcomes of the binomial tree.	Own calculation
9	Staleness	Opposite of the weighted sum of the volume of the 5 previous trading days. For each bond i, $Staleness_{i,t} = -\sum_{j=0}^{5} Volume_{i,t-j} * 2^{-j}$	TRACE
10	Deviation	Distance from the theoretical mid price on a given day. Expressed in bps.	TRACE
11	Spread	Difference between Buy and Sell prices computed using either a full day or morning/afternoon transactions. Expressed in bps.	TRACE
12	Sell fraction	Sell trades volume divided by all trades volume in a given day.	TRACE
13	Bond Rating	Last observed bond's credit rating. If there are more ratings available the lowest is used.	Mergent

A GMM Model

Our estimation method follows Green (2004). However, we have adjusted the time indicator functions to incorporate the characteristics of the OTC market. We have allowed for longer time periods before and after the announcements as search time is significantly longer due to lower liquidity of corporate bonds as compared to the Treasury market depicted by Greene. Additionally, we were able to split the sample in separate conditions for both buy (bid) and sell (ask) transactions:

$$\begin{aligned}
p_t - p_{t-1} = {} & (\phi_{NB} + \theta_{NB}) I_{NB,t} x_t + (\phi_{BB} + \theta_{BB}) I_{BB,t} x_t + (\phi_{AB} + \theta_{AB}) I_{AB,t} x_t \\
& + (\phi_{NA} + \theta_{NA}) I_{NA,t} x_t + (\phi_{BA} + \theta_{BA}) I_{BA,t} x_t + (\phi_{AA} + \theta_{AA}) I_{AA,t} x_t \\
& - (\phi_{NB} + \rho_{NB}\theta_{NB}) I_{NB,t-1} x_{t-1} - (\phi_{BB} + \rho_{BB}\theta_{BB}) I_{BB,t-1} x_{t-1} \\
& - (\phi_{AB} + \rho_{AB}\theta_{AB}) I_{AB,t-1} x_{t-1} - (\phi_{NA} + \rho_{NA}\theta_{NA}) I_{NA,t-1} x_{t-1} \\
& - (\phi_{BA} + \rho_{BA}\theta_{BA}) I_{BA,t-1} x_{t-1} - (\phi_{AA} + \rho_{AA}\theta_{AA}) I_{AA,t-1} x_{t-1} + \gamma S_t + \varepsilon_t,
\end{aligned} \tag{A.1}$$

where p_t is a bond price at time t, $x_t = 1$ if a trade is a buy and $x_t = -1$ for a sell. Moreover, $I_{Ni,t} = 1$ if the transactions take place during days $\{-2, -1, 1, 2\}$ for i side - B or A and 0 otherwise. The indicators $I_{Bi,t}$ and $I_{Ai,t}$ are equal to 1 for the period before and after the announcement on the day 0, respectively. Using the following equations

$$\begin{aligned}
v_t = {} & x_t - \rho_{NB} I_{NB,t-1} x_{t-1} - \rho_{BB} I_{BB,t-1} x_{t-1} \rho_{AB} I_{AB,t-1} x_{t-1} \\
& - \rho_{NA} I_{NA,t-1} x_{t-1} - \rho_{BA} I_{BA,t-1} x_{t-1} - \rho_{AA} I_{AA,t-1} x_{t-1}
\end{aligned} \tag{A.2}$$

and

$$\begin{aligned}
u_t = {} & p_t - p_{t-1} - (\phi_{NB} + \theta_{NB}) I_{NB,t} x_t - (\phi_{BB} + \theta_{BB}) I_{BB,t} x_t - (\phi_{AB} + \theta_{AB}) I_{AB,t} x_t \\
& - (\phi_{NA} + \theta_{NA}) I_{NA,t} x_t - (\phi_{BA} + \theta_{BA}) I_{BA,t} x_t - (\phi_{AA} + \theta_{AA}) I_{AA,t} x_t \\
& + (\phi_{NB} + \rho_{NB}\theta_{NB}) I_{NB,t-1} x_{t-1} + (\phi_{BB} + \rho_{BB}\theta_{BB}) I_{BB,t-1} x_{t-1} \\
& + (\phi_{AB} + \rho_{AB}\theta_{AB}) I_{AB,t-1} x_{t-1} + (\phi_{NA} + \rho_{NA}\theta_{NA}) I_{NA,t-1} x_{t-1} \\
& + (\phi_{BA} + \rho_{BA}\theta_{BA}) I_{BA,t-1} x_{t-1} + (\phi_{AA} + \rho_{AA}\theta_{AA}) I_{AA,t-1} x_{t-1} - \gamma S_t
\end{aligned} \tag{A.3}$$

we can obtain an exactly identified parameter vector. Equation A.1 implies the following moment conditions:

$$\mathbb{E} = \begin{bmatrix} v_t I_{ij,t-1} x_{t-1} \\ u_t \\ u_t I_{ij,t} x_t \\ u_t I_{ij,t-1} x_{t-1} \\ u_t S_t \end{bmatrix} = 0, \tag{A.4}$$

for $i \in \{N, B, A\}$ and $j \in \{B, A\}$.

B PIN

The PIN variable is based on the Easley and O'hara (1992)'s model and it was proposed by Easley et al. (2002). There are three types of market participants: uniformed traders, informed traders and market makers. We have that orders arrive according to a Poisson distribution with a rate of λ. Next, it is assumed that a signal can be bad with probability $\delta > 0$ and good with $1 - \delta > 0$. The private information is captured by $0 < \alpha < 1$, which can be interpreted as an arrival rate of informed traders. Lastly, it is assumed that informed traders profit at the cost of the dealers and that the market makers expect a fraction of informed transactions to be equal $0 < \mu < 1$.

In order to compute PIN we begin with a daily likelihood:

$$L(\Theta|B_t, S_t) = \alpha(1-\delta)e^{-(2\lambda+\mu)}\frac{(\lambda+\mu)^{B_t}\lambda^{S_t}}{B_t!S_t!} + \alpha\delta e^{-(2\lambda+\mu)}\frac{\lambda^{B_t}(\lambda+\mu)^{S_t}}{B_t!S_t!} + (1-\alpha)\delta e^{-2\lambda}\frac{\lambda^{B_t+S_t}}{B_t!S_t!}, \tag{B.1}$$

where B_t and S_t are the numbers of buy and sell orders on a day t. Next we estimate the set of parameters $\Theta = \{\lambda, \delta, \alpha, \mu\}$ by maximizing the log likelihood function under the assumption of independent evolution of trades across days and the history of order flow $\mathcal{F} = \{B_t, S_t\}_{t=1}^{T}$:

$$l(\Theta|\mathcal{F}) = \sum_{t=1}^{T} \log\left(L(\Theta|B_t, S_t)\right). \tag{B.2}$$

In the empirical analysis we set $T = 25$ in order to avoid estimating the parameter values over two adjacent FOMC meeting periods. Therefore it is necessary to use a full TRACE sample spanning over the study period. We obtain the parameter set Θ for each bond separately and define

$$PIN := \frac{\hat{\alpha}\hat{\mu}}{\hat{\alpha}\hat{\mu} + 2\hat{\lambda}}. \tag{B.3}$$

Lastly, we take a simple average of all PIN values on a day t to use it as a market wide probability of informed trading.