The Informativeness of Customer Order Flow following Macroeconomic Announcements: Evidence from Treasury Futures Markets

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Abstract

We study the effect of macroeconomic announcements on the 30 Year U.S. Treasury Bond futures. Virtually all trading in the 30 Year Treasury is concentrated in the futures (rather than the spot) market. Consistent with earlier studies, we find that (i) the announcement surprise has a significant contemporaneous effect on yields and (ii) customer order flow is significantly more informative on announcement days than on non-announcement days. Based on a unique feature of the data, we identify floor traders who execute customer trades but do not trade for their personal accounts (brokers) and floor traders who trade both for customers and their personal accounts in the same day (dual traders). We find that the customer order flow of dual traders is significantly more informative on announcement than on non-announcement days, but customer order flow of brokers is not. Moreover, dual traders make more profits from personal trading on announcement days compared to locals (i.e. floor traders who only trade for their personal accounts). Finally, we find that a dual trader's profits on announcement days is significantly and positive correlated with its own customer order flow, even after controlling for market volatility, the degree of competition for customer order flow, and the announcement surprise. We conclude that the aggregate customer order flow following macroeconomic announcements is informative and that this information is profitable to floor traders who observe the order flow. Our results are consistent with the idea that either some customers are better able to interpret public news, or that the correlated trades of uninformed customers result in the aggregate customer order flow being informative.

Keywords: U.S. Treasury Futures Market, Macroeconomic Announcements, Order Flow Informativeness

1. Introduction

Many researchers have studied the impact of macroeconomic announcements on returns and volatility in the market for US Treasuries. Ederington and Lee (1993, 1995) identify that macroeconomic announcements are responsible for most of the observed volatility patterns in a day. They show that though most of the price adjustment takes place in the first minute, volatility remains high for about fifteen minutes. Fleming and Remolona (1997) confirm the relation between Treasury prices and public news, and conclude that the largest price shocks in the bond market over the period August 1993 until August 1994 are all caused by macroeconomic news announcements. These articles, together with further analyses and extensions[1], all document a strong response of trading to public news announcements.

However, what is the process by which the information spreads through the market in the minutes after the announcement? Andersen, Bollerslev, Diebold, and Vega (2003) point out that order flow is a candidate mechanism: "It will be of interest ... to determine whether news affects exchange rates via order flow or instantaneously". At first sight, it may appear that new information from macroeconomic announcements should be impounded in the price immediately, and there is no role for order flow. However, as pointed out in Lyons (2001), the above statement is true only if: "(1) all information relevant for exchange rates is publicly known and (2) the mapping from that information to the prices is also publicly known." While it is safe to assume that the first holds, the second assumption may be strong. In many markets, there is hardly any consensus on the 'correct' model: different agents will have a different interpretation

[1] See for example Fleming and Remolona (1999), Balduzzi, Elton, and Green (2001) and Andersen, Bollerslev, Diebold, and Vega (2003, 2005).

of the news. Though it maybe obvious that a higher than expected unemployment figure is not good for the economy, the exact impact on prices is not immediately clear and indeed depends on risk-preferences and on how the news report is interpreted. Furthermore, different risk-preferences and endowments will make demand curves heterogeneous across agents. These considerations have lead researchers to examine the role of order flow following macroeconomic announcements.

The exchange rate literature has demonstrated that order flow is a significant determinant of spot exchange rate movements; moreover, order flow in the exchange rate markets may even predict macro fundamentals (Lyons, 2005). However, public news in the exchange rate market affects both future cash flows and the discount rate. In contrast, since cash flows from Treasury bonds are fixed, it is likely that, by examining the effect of macro news on Treasury bonds, we may be successful in isolating the effect of public news on discount rates.

Three recent papers examine the role of order flow around macroeconomic announcements in the U.S. Treasury market. Green (2004) finds that the order flow reveals information and that the level of information asymmetry in the interdealer market is raised by releases of macroeconomic news. Brandt and Kavajecz (2004) show that on non-announcement days order flow explains up to 26% of the day-to-day variation in yields. Pasquariello and Vega (2006) also find that order flow explains bond yield changes, where the portion that is explained depends on the dispersion of beliefs across informed traders.

We will focus on determining the causes of increased information asymmetry following releases of macroeconomic news. The literature has discussed two reasons why information asymmetry may be higher after a public news release. First, some market participants may be more capable of interpreting how the public news affects bond prices. Second, the order flow

may be informative even if individual traders have no special knowledge of the macro releases. As Lyons (2005) argues, trades may occur for purely allocative reasons, with the sum of these trades conveys new information about the macro-economy. When a large number of agents are trading for correlated reasons, the resulting order flow is informative to market makers.[2]

Previous studies on the impact of order flow on treasury yields use GOVPX data to analyze information asymmetry in the Treasury bond spot markets. However, since GOVPX data only contains inter-dealer trades, but not dealer-customer traders, these studies cannot directly identify whether customers are the source of informational asymmetry. This is because the increased asymmetry after an announcement could originate either from customers or from broker-dealers who are superior information processors and quickly trade on their information.

Using a detailed dataset of Treasury futures transactions, we are able to uniquely identify a floor trader, and also whether the trader bought or sold for outside customers or for his/her personal account. Thus, we can accurately measure customer order flow. Further, we can identify futures floor traders who trade both for customers and their personal accounts on the same day (*dual traders*), traders who only trade for themselves (*locals*), and brokers who only execute trades for customers (*brokers*). A key prediction is that, provided the customer order flow is informative, traders with access to customer order flow should have higher profits for their personal trades, compared to proprietary traders who do not have such access. By comparing the informativeness of the customer order flow of brokers and dual traders, and the trading profits of locals and dual traders, we can assess whether this is the case.

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[2] Note that the sum of allocational trades is not zero because, while all customers observe the same public signal, they rebalance their portfolios differently. Vayanos (2001) also study large institutional investors who trade for "allocational" reasons associated with risk-sharing, portfolio rebalancing, and liquidity, rather than for "informational" reasons.

We first analyze the price impact of customer order flow after incorporating announcement effects, following Green's (2004) generalization of the Madhavan, Richardson, and Roomans (1997) model. Specifically, we examine the informativeness of customer order flow on announcement versus non-announcement days, while distinguishing between the customer order flow of brokers and dual traders. Consistent with earlier studies, we find that customer order flow is more informative on announcement days. However, we also find that this increased informativeness is solely from the dual traders' customer order flow; the informativeness of brokers' order flow is not statistically different between announcement and non-announcement days.

Does observation of the customer order flow translate into additional trading profits for dual traders? We calculate trading profits, following Fishman and Longstaff (1992) and Locke, Sarkar, and Wu (1999) and others, for dual traders and locals on announcement and non-announcement days. We find a clear informational advantage from observing the customer order flow. First, dual traders' own account trades are more profitable even on non-announcement days and, further, their profit advantage is even higher on announcement days. This is particularly true in the first 15 minutes after announcements, when customer order flow is the most informative. Moreover, dual traders' profit advantage is greater for those announcements where the informativeness of dual traders' customer trades is higher (e.g. Nonfarm payroll).

Dual trader profits may be determined by a number of factors, including access to customer order flow, but also market volatility and the degree of competition for order flow. We find that a dual trader's profits are significantly and positively correlated with customer order flow, even after controlling for volatility, the degree of competition, and the announcement surprise. The association is greater in magnitude for the number of signed customer trades than for the number

of unsigned trades, consistent with informed customers trading on one side of the markets. Finally, the correlation is stronger for announcements where the dual trader's profit advantage and the informativeness of its customer trades is higher.

Taken together, our results strongly suggest that some customers have better information following macroeconomic news, perhaps because they process public news better. More important, we find that differential access to the customer order flow is profitable to traders who have such access. These effects hold for the full day but are magnified in the 15-minutes after announcements.

We study the market for the 30 year U.S. T-Bonds Futures trading on the Chicago Board Of Trade (CBOT). Our study of Treasury futures, as opposed to the spot, market provides some advantages. This is the most actively traded long-term interest contract in the world. Moreover, trading in Treasuries with a maturity of 30 years takes place almost solely on the futures market. In comparison, other maturities such as the 5 year Treasury security is divided between the spot and futures market (Fleming and Sarkar, 1998), in which case hedging of spot positions in the futures market can affect the results.

The rest of the paper is built up as follows. In section 2, we discuss in more detail why there can be information asymmetry in the case of public announcements and describe the reasons to expect that order flow is the mechanism with which news spreads through the market. In Section 3 we discuss our data and present descriptive statistics. Section 4 contains our analysis of customer order flow. Section 6 presents results on trading profits of locals and dual traders. In section 7, we examine the determinants of dual traders' profits. Section 8 concludes.

2. Information Heterogeneity around Announcements and Order Flow

To study the impact of order flow empirically Evans and Lyons (2002) develop a three round model. In the first round dealers trade with the public, in the second round dealers trade amongst themselves and in the third round the dealers again trade with the public. To study their model and the impact of order flow empirically, they regress daily returns of the spot exchange rate on the interest differential of the two countries and the interdealer order flow. They find that for DM/$ the R-squared value is 64% and for Yen/$ this is 46%, giving strong evidence that order flow does matter. Referring to these results, Lyons (2001, §7.1, p.188-189) gives three strategies for determining what drives the order flow. The first strategy is to disaggregate order flow such that it can become clear which type of order flow has the largest price impact. The second is to analyze whether order flow conveys more information on days with announcements relative to non-announcement days. The third is to disentangle the type of information, for example disentangling payoff from discount rate information.

The latter of the strategies is best explained by assuming that the price of an asset can be calculated as the discounted value of the expected payoff. Information that concerns the expectation of the payoff is called payoff information; all other information that affects the price is assumed to do this via the discount rate. An advantage of the Treasury market is, as Lyons (2001, p.30) explains, that in this case "payoffs take the form of coupons and principal (which are publicly known as long as the bond is default free)". So by studying U.S. Treasuries we are already implicitly taking the third strategy into account and are confident our public information affects the prices in all cases via the discount rate.

Lyons (2001, §9.3) implements the first strategy. He regresses monthly returns in the exchange rate market on aggregate customer order flow of one large bank and obtains an R2 of

about 15%. Disentangling the information further into unleveraged financial institutions, leveraged financial institutions and nonfinancial corporations produces a better fit of 27%. Though these estimates are difficult to compare with the above daily estimates they give some first evidence that the impact of order flow differs per market participant.

Green (2004) and Pasquariello and Vega (2006) are both articles that take the second strategy. Both compare the differential impact of order flow on days with announcements relative to days without announcements.

We want to shed more light on the subject of the informational role of order flow and find out what causes the increased information asymmetry. To do this we take a combination of the first and second strategy. We do not observe total aggregate order flow, but are able to accurately measure customer order flow and to distinguish traders that have access to customer order flow. A prediction of the above exchange rate literature is that traders with access to the customer order flow are better off (Lyons (2001, p.45)) and should have higher profits. Our analysis allows us to directly test this prediction.

3. Data

Our analysis focuses on the period starting in January 1994 and ending in December 1997. The sample period reflects the availability of the transactions data for the 30 year U.S. Treasury Bond or T-Bond futures. The data, which was provided by the Commodity Futures Trading Commission (CFTC), allows us to identify a group of futures floor traders able to observe customer trades. We study the 30-Year T-Bond futures because, of all Treasury futures, it has the largest share of the combined trading activity in the spot and futures markets. For example, while the share of the futures markets in total trading volume is 95% for the 30 year bond, it is

only 24% for the 5 year bond.[3] Below, we first describe the futures data and then discuss a broad selection of macroeconomic announcements that took place during our sample period.

A. Futures data

We study the 30 Year U.S. T-Bond futures listed on the Chicago Board of Trade (CBOT), which trade via the 'open outcry' method in which traders gather in a trading pit and communicate with one other by either shouting out orders or by using hand signals. Trading hours on this market are between 08:20 A.M. Eastern Standard Time (EST) and 15:00 P.M. EST. Our data has transaction records for all futures trades executed by individual floor traders in the T-Bond futures pit during the sample period. To protect trader privacy, the CFTC assigned a randomly selected number unique to each trader. In addition to the traders' identification, the data also reports the trade time, price, quantity, the trade direction (whether the trade was a buy or a sell) and the contract. Although traders report time in 15-minute brackets, the trade is timed to the nearest second using an exchange algorithm known as computerized trade reconstruction (CTR). As discussed in Manaster and Mann (1996), although the trade time is estimated, leading to some timing errors, it is likely to be accurate. This is because the timing of the trade is a critical element in the use of the audit trail data in internal (exchange) and external (CFTC enforcement) investigations of legal trading practices. CTR data for different contracts and sample periods has previously been used by Fishman and Longstaff (1992), Manaster and Mann (1996), Locke, Sarkar and Wu (1998), and others.

[3] These calculations are from Fleming and Sarkar (1998). They are based on data from 1993, and use 'on-the-run' securities (i.e. the most recently issued security in a maturity) in the spot market and the most nearby futures contracts.

The advantage of using the CTR data is that we are able to identify whether a floor trader executed a trade for her own account or for a customer. Unique to this data, the record specifies a classification of the customer types for each side of the trade. There are four customer type indicators (CTI), labeled 1 through 4. CTI1 trades are trades for personal accounts, CTI2 indicates trades executed for the account of the trader's clearing member, CTI3 indicates trades executed for the account of any other exchange member and, finally, CTI4 trades are trades on behalf of outside customers. We focus exclusively on CTI1 and CTI4 trades in this paper, which together represents the majority of all trading volume[4]. Fishman and Longstaff (1992), Manaster and Mann (1996), and Chakravarty and Li (2003) also exclude CTI2 and CTI3 trades from their analyses.

On any trading day there are four different 30 Year U.S. T-bonds futures listed, each with a different expiry month. We focus on the most active of these four contracts, which is the nearby contract. Note that there is not a one-to-one correspondence of the futures and spot instruments. The 30 Year T-bonds futures, for example, has as deliverable U.S. Treasury bonds that have a maturity of at least 15 years from the first day of the delivery month (see www.cbot.com for details). However, as Ederington and Lee (1993) point out, by taking the most nearby contracts there will be a strong link between the spot and futures market, making them almost substitutes.

We confine our analysis to regular trades, and eliminate spread trades (e.g. butterfly spread trades). Then, we carefully filter the date to eliminate reporting errors. First, we delete trades that occur at unusually low prices that occurred primarily on May 1997. Second, we use a filter to

[4] This fact is generally true. For example, the share of CTI1 and CTI 4 trades in all trades is about 85% for Soybean futures (Fishman and Longstaff, 1992) and about 87% for Chicago Mercantile Exchange (CME) futures contracts (Manaster and Mann, 1996).

omit trades where the prices are unusually high or low relative to neighboring trades, although they are not unusual relative to prices for trades occurring at other times of the day. We expect these trades to suffer from a serious timing error and remove them. Specifically, we delete trades for which the return increases (decreases) by at least 0.25% relative to the previous trade, and the subsequent trade return decreases (increases) by 0.25% or more. The combined effect of the filters is to eliminate about 1.44% of more than 43 million observations, so that our final sample includes 42,488,327 observations.

B. Macroeconomic announcements

[INSERT TABLE 1 ABOUT HERE]

The macroeconomic announcements are obtained from the International Money Market Services (MMS) database which records the announcement date, announcement time, the median value of forecasts and the first realized (or announced) figure. Table 1 shows that the majority of announcements occur at 8.30 A.M.; others occur mostly at 10A.M. We will focus on the effect of announcements that take place at 8:30 A.M. EST, since most important announcements occur at this time. To correct for potential data errors, we exclude the following days from the sample:

- days when either the realized value or the expectation are missing,
- days on which the Fed made an earlier than usual or an unexpected announcement
- the day on which the Durable Goods Orders figure was announced at 9:00 AM instead of 8:30 AM,
- two days on which the market closed at 11:00 (1994/4/1 and 1996/4/5), and
- four days on which the market closed for a part of the day (1994/9/14, 1996/8/26, 1997/2/26 and 1997/2/27).

[INSERT TABLE 2 ABOUT HERE]

We define a day to be an announcement day if there is at least one 8:30 announcement and no announcements at other times in the morning (i.e. no 9:15 and 10:00 announcement). A non-announcement day is a day on which there were no announcements in the morning. A similar definition was used by Fleming and Remolona (1999). Table 2 shows that we have roughly equal numbers of announcement and non-announcement days in any year, varying between 84 and 91 for non-announcement days and between 89 and 100 announcement days. We also report numbers for two subsets of announcement days: the important announcement types (Nonfarm Payroll Employment, CPI and PPI), which are roughly a quarter of all 8:30 AM announcement days, and the Nonfarm Payroll Employment announcements, which are roughly one-tenth of all 8:30 AM announcement days. These subsets of announcements have previously been found to have significant market impact (see Green (2004) and Fleming and Remolona (1999)). Table 2 also lists the 25 different announcement types and the frequency of each in the sample.

Following Balduzzi, Elton, and Green (2001) and Andersen, Bollerslev, Diebold, and Vega (2003), we assume that all the information that the announcement conveys can be summarized in one figure: the unexpected part of the announcement. For an announcement of type *k* and day *t*, the surprise $S_{k,t}$ is defined as:

$$S_{k,t} = \frac{R_{k,t} - M_{k,t}}{\sigma_k} \qquad (1)$$

where $R_{k,t}$ denotes the realized announcement (i.e. the first-reported number) and $M_{k,t}$ is the median of forecasts for announcement *k* on day *t*. The scaling parameter σ_k is the standard deviation of the announcement surprises for announcement type *k*; by scaling we can compare the announcement effect across types.

4. Identifying Floor Traders with Access to Customer Order Flow

A contribution of the paper is the ability to identify groups of futures floor traders with direct access to the customer order flow. These are floor traders who *only* execute CTI4 trades on a particular day—i.e. they execute trades on behalf of outside customers. In contrast, floor traders who *only* execute CTI1 trades on a particular day have no direct knowledge of customer trades; their trades are for personal account only. Last, but not least, are floor traders who, on a particular day, trade both for their own accounts and for customers. Following the literature (Fishman and Longstaff (1992), Locke et al (1999), and Chakravarty and Li (2003)), we refer to these floor traders as dual traders. In theory, if customer order flow is informative, dual traders may be able to use this information to earn additional trading revenues on their personal accounts. In this section, we discuss how we identify different groups of floor traders and then provide summary statistics about the activity of different floor traders on announcement and non-announcement days.

A. Types of Traders

For a floor trader, we define a particular day as a local, broker or dual day according to the proportion x of her own account trading (CTI1) volume relative to total (CTI1 plus CTI4) trading volume. A local day of a floor trader is defined as one where x is greater than 98% (x>98%). As discussed in Chang, Locke, and Mann (1994), the 2% filter is intended to allow for the possibility of error trading.[5] A broker day of a floor trader is one where x<2%, while a dual day

[5] As Chang et al (1994) state, "when a broker makes a mistake in executing a customer order, the trade is placed into an error account as a trade for the broker's personal account. The broker may then offset the error with trade for the error account. A value of 2% for this error trading seems reasonable from conversation with CFTC and exchange staff."

occurs if 2%<=*x*<=98%. We refer to a floor trader's CTI1 (CTI4) trades on a local (broker) day as local (broker) trades, and the CTI1 (CTI4) trades of a floor trader's dual day as dual/own (dual/cust) trades. For a particular day, we ignore the CTI4 trades of locals and the CTI1 trades of brokers. Therefore, total CIT1 trades is the sum of local and dual/own trades and total CTI4 trades is the sum of dual/cust and broker trades. These identification procedures follow those used previously by Locke et al (1999) and Chakravarty and Li (2003).

Over the four years in our sample, there are 3,382 floor traders and 1,005 trading days. If each trader were active every day, there would be almost 3.5 million trader days. In fact, traders are not active every day, so we have a total of 523,537 trader days. Moreover, as discussed further in section 3.1, we exclude certain days to arrive at our sample of announcement and non-announcement days. After omitting these days, there remains a total of 376,918 trader days.

B. Summary Statistics

[INSERT FIGURE 1 ABOUT HERE]

Panels a, b and c in Figure 1 show the volume (in units of 1,000 contracts), the bid-ask spread (in basis points) and volatility (in % per 15-minute intervals) for the 30 year T-Bond futures on announcement and non-announcement days during 1994 to 1997. All statistics shown are measured as aggregates over 15-minute intervals. The closed (open) circles indicate whether the difference between announcement and non-announcement days is significant at the 1% (5%) level.

Panel (a) of Figure 1 shows that volume is higher in every 15-minute interval of announcement days compared to non-announcement days. In Panels (b) and (c), we show statistics for liquidity, as measured by the bid-ask spread, and volatility. To eliminate the bias caused by the bid ask bounce, we define volatility as the maximum of the standard deviations of

the customer buy and sell prices over the 15 minute interval, where the maximum is taken to avoid the difficulty of having no buy or sell orders in an interval. This definition of volatility was previously used by Manaster and Mann (1996). Consistent with previous literature (e.g. Locke et al, 1999), we define the bid-ask spread is the volume-weighted average of the customer buy price minus the volume-weighted average of the customer sell price in an interval. We find that, similar to volume, the volatility is higher for most of the announcement day compared to non-announcement days. In contrast, the bid-ask spread is significantly higher for announcements only in the event interval 08:30-08:45; thereafter, while the bid-ask spread remains higher, the difference with non-announcement days is only intermittently significant. This is consistent with Fleming and Remolona (1999), who find that the bid-ask spread reverts to normal levels earlier than volatility and volume do. In general, the decrease in liquidity and the increase in volatility are strongest in the 15-minutes after announcements, consistent with Green (2004).

[INSERT TABLE 3 ABOUT HERE]

Panel A of Table 3 shows, for the entire sample, statistics of liquidity, trading activity and volatility on announcement and non-announcement days, measured as averages over 5-minute intervals. Consistent with Figure 1, there is increased activity on announcement compared to non-announcement days; for example, the number of trades is 1.30 times higher and the number of active floor traders is 1.18 times higher on announcement days. The trade size is also higher on announcement days relative to non-announcement days. Finally, volatility and the bid-ask spread are, respectively, 1.18 and 1.14 times higher.

Is the relative importance of trades by different types of traders (local, broker and dual) different on announcement and non-announcement days? In Panel B of Table 3, we break down the liquidity and trading activity statistics by the type of trader. Considering trades for floor

traders' own accounts (CTI1 trades), most own account trading is by locals on both announcement and non-announcement days, with higher average volume, number of trades and number of active traders compared to dual traders. In contrast, a majority of customer trades (CTI4 trades) are executed by dual traders rather than brokers on both announcement and non-announcement days. However, all categories of floor traders (local, broker and dual) show similar percent increases in trading activity on announcement days, as shown in the last column of the table under the heading "*Ratio*". Thus, the relative importance of different trade types is similar for announcement and non-announcement days. Finally, the bid-ask spread for customers is higher for trades executed by dual traders, compared to brokers, on both announcement and non-announcement days. However, the increase in the bid-ask spread on announcement days is 27% for customers of brokers compared to 13% for dual traders.

[INSERT FIGURE 2 ABOUT HERE]

We have seen that announcement effects are strongest in the 15-minute period after the announcement. We now focus on the period 08:20-09:00 in order to examine more closely the intraday effects from announcements. We show in Figure 2 the patterns in volume, the bid-ask spread and volatility for each 5 minute interval around the 8:30 A.M. announcement time (the bold vertical line). The plots in the left (middle) column show the intraday pattern for announcement (non-announcement) days. The right column shows the ratio of the two (with a bold horizontal line at 1). The grey bars indicate the estimate, with 95% confidence bounds given by the lines above and below the top of each bar. Panel (a) of Figure 2 shows that, while the average volume in a 5-minute interval is lower in the 8:30-9:00 interval compared to the 8:20-8:30 interval on non-announcement days, the opposite is true on announcement days. Activity peaks in the 5-minutes just after announcements when volume, volatility and the bid-ask spread

are between 4 and 7 times higher than on non-announcement days, and the difference is significant[6]. Volume and volatility remain significantly higher on announcement days even at 9am, whereas the bid-ask spread is significantly higher for 10 minutes after announcements. Finally, we do not observe a "calm before the storm" effect as volume, volatility and the bid-ask spread are at normal levels in the 5-minutes prior to announcements .

Panel (b) of Figure 2 shows volume for different types of trades (local, broker and dual). Dual trading volume is further divided into the volume of trades for her own account and for customers. All trade types show significantly increased volume in the 8:30-9:00 interval on announcement days, relative to non-announcement days. The biggest increase in volume comes from customers of dual traders, which is about 5 times higher in the 5-minute interval following announcements, compared to non-announcement days. Customer trades by brokers and proprietary trading by locals are about 3 to 4 times higher in the same period.

The results for the period immediately after announcements are in contrast to those for the full day, as reported in Panel B of Table 3, which showed that the relative increase in volume is similar for different trade types. Thus, it appears that customer trading "leads" own-account trading; the increase in customer volume is greater right after announcements, while own-account trading volume increases later in time. One interpretation of this result is the "hot potato trading" effect, where outside order flow arrives in the pit through dealers who first accommodate the order flow against their own inventory and then diversify their inventory through intra-dealer trades in the pit. In the next section, we examine the informativeness of customer order flow by brokers and dual trades.

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[6] On non-announcement days, there appears to be a 15-minute cycle for the bid-ask spread, which may be caused by the 15 minute reporting window.

5. The Informativeness of Customer Order Flow

We have documented an increase in customer and own-account trading volume on announcement days. Further, the increase in customer trading volume is highest immediately after announcements, raising the possibility that this order flow is informative. In addition, there is a substantial increase in customer order flow through dual traders. It is of interest to examine whether, if aggregate customer order flow is indeed informative, customer order flow of dual traders and brokers are different in their informativeness. Such a distinction may arise if informed customers are more likely to trade with brokers rather than dual traders, or vice versa. If dual traders take advantage of customer information, then informed traders may execute orders through brokers. Alternatively, if dual traders have superior execution skills, informed traders may prefer dual traders.

We assess the informativeness of customer order flow using a modified version of Green's (2004) methodology. Specifically, we examine price changes of customer trades for announcements occurring at 8:30 AM. Let $p_{t,h}$ be 100 times the log of the last price in interval h, where h is a 5-minute interval. The first interval is h=0 and indicates the announcement interval 8:30 AM to 8:35 AM. Then $p_{t,h}$- $p_{t,h-1}$ is the return from interval h-1 to h. We estimate the following regression for customer trades of floor traders:

$$p_{t,h} - p_{t,h-1} = \alpha_a d_a + \alpha_n d_n + \beta_a d_a \omega_{t,h} + \beta_n d_n \omega_{t,h} + \sum_{k \varepsilon K} \gamma_{k,h} I_{k.t} S_{k,t} + \varepsilon_{t,h} \qquad (2)$$

where t=1, ..,T is a trading day, k=1,..,K is an announcement at 8:30 AM, d_a=1 for announcement days and is zero otherwise, d_n=1 for non-announcement days and is zero otherwise, $\omega_{t,h}$ is the customer order flow or the signed trading volume (positive for a buy and negative for a sell) summed over trades in interval h, $I_{k,t}$=1 in the event interval if there is a 8:30 AM announcement k on day t, and $S_{k,t}$ is the standardized announcement surprise as defined in

(1). The surprise term captures the effect of announcement surprises on price changes. Green (2004) incorporates a similar term in his regression of price change on order flow, and finds that, for procyclical indicators such as Housing Starts, the estimate is negative ($\gamma_{k,h}<0$), whereas for countercyclical indicators such as initial jobless claims, it is positive ($\gamma_{k,h}>0$). The equation is estimated using the Feasible Efficient GMM procedure, with the Newey-West estimator (using three lags) of the sample autocovariance matrix.

[INSERT FIGURE 3 ABOUT HERE]

Theory predicts that $\beta_a>0$ and $\beta_n>0$ if order flow is informative on announcement and non-announcement days, respectively. If the informativeness of order flow is higher on announcement than on non-announcement days, then we expect that $\beta_a > \beta_n$. We estimate (2) separately for each 15-minute interval of announcement and non-announcement days. Then, we plot estimates β_a and β_n in Figure 3. A closed (open) circle indicates that the estimate for announcement days is significantly higher than for non-announcement days at the 1% (5%) level. We find that the informativeness of customer order flow is significantly higher for the first 15 minutes after announcements, compared to non-announcement days. Thereafter, there is generally no significant difference between order flow informativeness on announcement and non-announcement days.

[INSERT TABLE 4 ABOUT HERE]

While Figure 3 shows that informativeness is not significantly different between announcement and non-announcement days, these results were based on separate regressions for each interval and so may lack statistical power. We now estimate (2) based on 5-minute intervals for the entire day. Panel A of Table 4 reports estimates of α_a, α_n, β_a and β_n for three sets of announcements: the set of all announcements, the set of important announcements (Nonfarm

Payroll, CPI, PPI) and Nonfarm Payroll only. Under the column heading "*All Floor Tr*", we report results for the case where (2) is estimated for all customer trades. Under the column heading "*Dual vs Broker*", we report results for the case where (2) is estimated separately for customer trades of brokers and dual traders. Below Panel A, we report results for hypotheses tests comparing informativeness on announcement and non-announcement days, and between dual traders and brokers, based on the GMM Criterion Function test.

Consider first the results in Panel A for all customer trades ("*All Floor Tr*"). We find that β_a and β_n are both significant and positive, indicating that customer order flow is informative on both announcement and non-announcement days. In addition, β_a is higher than β_n, and this difference is significant at the 1% level or less. Thus, customer order flow is more informative on announcement days. Comparing the different announcement subsets, we find that β_a is higher for the set of important announcements compared to the set of all announcements, and highest for Nonfarm Payroll announcements. The relative impact of the different announcements is consistent with previous results, such as Fleming and Remolona (1999) and Green (2004). The R-squared value is around 15%, indicating that the model explains a moderate portion of the variation in 5-minute returns.

Next, consider the results in Panel A for customer trades of brokers and dual traders separately ("*Dual vs Broker*"). For the set of all announcements, dual traders' customer order flow is significantly more informative then brokers' customer order flow on both announcement and non-announcement days. More interesting, the informativeness of dual traders' customer order flow is significantly higher on announcement days compared to non-announcement days. In contrast, we cannot reject the null that brokers' customer order flow is equally informative on announcement and non-announcement days. These results remain consistently true for the

different samples of announcements: dual traders' customer order flow is more informative on announcement days but brokers' customer order flow is not. This difference in informativeness is greatest for the Nonfarm Payroll Employment. Taken together, these results suggest that dual traders benefit from the information in customer order flow, and this benefit is larger on announcement days.

Panel B of Table 4 reports estimates of the announcement surprise coefficients. Since we expect the surprise to be incorporated into the prices quickly we have estimated the coefficients only for h=1 (the 8:30 AM to 8:35 AM interval)[7]. Out of 15 announcement types, the estimates of 9 announcements are negative and significant, with the Nonfarm Payroll Employment having by far the highest price impact followed by the PPI and CPI announcements. These results agree in ranking, sign and significance with Green (2004), who uses an almost identical set of announcements.[8] The ranking of announcement impacts also agrees with Andersen et al (2005).

Since Figure 3 shows that announcement effects on the order flow is highest in the first 15-minutes, we now focus more narrowly on the period 8:30 AM to 8:45 AM. We estimate (2) for 5-minute intervals h==1, 2, 3, where h=1 is the event interval from 8:30 AM to 8:35 AM, and h=3 indicates the interval from 8:40 AM to 8:45 AM. These results, which are in Panel C of Table 4, are qualitatively similar to those for the full day. Customer order flow is more informative on announcement than on non-announcement days and, further, this increase in informativeness is solely from that part of the order flow due to dual traders' customers; there is

[7] We also estimated the equation with a separate surprise coefficient for every interval, and indeed the great majority of all significant estimates were in the first interval.

[8] The differences are that Green (2004) splits the Employment report into Unemployment and Nonfarm Payroll Employment (we only study the latter), that the Trade Balance is combined with the Import and Exports figure (we only study the Trade Balance, which is a function of the other two) and we also study GDP announcements (which are quarterly), Personal Income, Personal Consumption Expenditure and Business inventories.

no increase in informativeness of brokers' customer order flow. Quantitatively, however, the announcement effects are stronger in the first 15-minutes than in the full day, consistent with Figure 3. Accordingly, the informativeness of dual traders' customer order flow, relative to brokers' customer order flow, is also substantially higher in the first 15-minutes (e.g. up to 3 times higher for Nonfarm Payroll Employment). These conclusions generally hold for the different samples of announcements. The R-squared value is consistently between 35% and 39%, indicating that the model explains a large portion of the variation in returns in the first 15 minutes after announcements.

Our results show that the informativeness of customer order flow increases on announcement days, but only for dual traders. Since dual traders also trade for their own accounts, they can use their knowledge of customer trades to profit on their personal trades. In the next section, we estimate dual traders' profits from their personal trades on announcement and non-announcement days.

6. Trading Profits of Floor Traders

Customers may trade after an announcement either to rebalance their portfolios and/or because they are able to interpret news better. In the latter case, the order flow reflects the superior information processing skills of customers. We have seen previously that dual traders' customer order flow is highly informative, especially on announcement days. Dual traders may have an advantage over locals since they can observe the trades of their customers, and this advantage may translate into higher trading profits. Thus, the profitability of dual traders' personal trades, relative to personal trades of locals (who only trade on personal account and do not execute trades for customers), may indicate the value from observing customer order flow.

To analyze whether dual traders can benefit from the information that is possibly contained in customer order flow, we calculate trading profits following the methodology in Fishman and Longstaff (1992): for each trader the value of purchases is subtracted from the value of sales, and any remaining imbalance is valued at a reference price. Profits are calculated for floor traders active in the measurement interval (i.e. either the event interval 8:30 to 8:45 or the full day). The aggregate profit $\Pi_{k,t}$ for floor trader k in day t is defined as:

$$\prod_{k,t} = \sum_{j=1}^{N^s_{k,t}} q^s_{j,k,t} P^s_{j,k,t} - \sum_{j=1}^{N^b_{k,t}} q^b_{j,k,t} P^b_{j,k,t} + \left(\sum_{j=1}^{N^b_{k,t}} q^b_{j,k,t} - \sum_{j=1}^{N^s_{k,t}} q^s_{j,k,t} \right) Rf_t \qquad (3)$$

where $N_{k,t}{}^b$ ($N_{k,t}{}^s$) is the total number of buy (sell) trades in day t by trader k, $q^b{}_{j,k,t}$ ($q^b{}_{j,k,t}$) is the buy (sell) quantity or number of contracts for trade j, $P^b{}_{j,k,t}$ ($P^b{}_{j,k,t}$) is the buy (sell) quantity or number of contracts for trade j. Rf_t is the reference price in day t; in accordance with the literature, it is assumed to be the last price in the measurement interval. Thus, when calculating profits for the full day, Rf_t is the end-of-day settlement price; [9] when calculating profits for the 8:30 to 8:45 interval, Rf_t is the last price in the 8:30 to 8:45 interval.

Aggregate profits are a function of total trading volume, which is far higher for locals when compared to the own account trading volume of dual traders. To adjust for this, we estimate the per contract profits, which is obtained by dividing a floor trader's aggregate profits by the number of round-trip contracts executed on that day. Specifically, we obtain profits per round trip contract as follows:

$$\pi_{k,t} = \frac{\prod_{k,t}}{\max(\sum_j q^b_{j,k,t}, \sum_j q^s_{j,k,t})} \qquad (4)$$

[9] The valuation of end-of-day inventory assumes that traders do not carry inventory between days.

[INSERT TABLE 5 ABOUT HERE]

Panel A of Table 5 shows the per contract profits for own account trades of locals and dual traders for the full day. In all cases, mean profits are different from the median profits, indicating that the distribution of profits is skewed. Therefore, our conclusions will be based on the median profits; specifically, we use the Wilcoxon *z*-statistic for comparison of median profits. An * (**) indicates that median profits are different between announcement and non-announcement days at the 5% (1%) level or less. An *x* (*xx*) indicates that median profits are different between dual traders and locals at the 5% (1%) level or less. We observe that, for both local and dual traders, the median trading profits are positive and higher on announcement compared to non-announcement days. More important, dual trader profits are higher than that of locals' profits on both announcement and non-announcement days. Dual traders' profits are higher by about $2.60 per contract on both non-announcement days and all announcement days. These conclusions remain true for the two sub-samples of announcements. Dual trader profits are higher than that of locals' by $3.30 for the set of important announcements, and $3.40 for the Nonfarm payroll Employment announcements.

Earlier, we found that dual traders' customer order flow is informative, and more so on announcement than on announcement days. Further, informativeness is highest for Nonfarm payroll, followed by the set of important announcements and then the set of all announcements. We now find that dual traders' profits, relative to that of locals, are correlated with the informativeness of customer order flow: dual traders have higher relative profits for precisely those announcements where customer order flow is more informative. These results are consistent with the hypothesis that dual traders profit from the informativeness of their customer

order flow. Alternatively, the additional profits for dual traders relative to locals may constitute compensation for providing additional liquidity to customers on days with higher volatility.

If dual traders are providing additional liquidity to customers on announcement days, then customers of dual trades may be expected to have higher trading costs relative to brokers on such days. To estimate customer trading costs, we calculate per contract trading profits (which may be interpreted as a bid-ask spread) of brokers' and dual traders' customer trades. Note that, while the profits may be interpreted as trading costs for the "aggregate" of customers who trade with the broker or dual trader, they do not constitute the average trading cost of a customer. The reason is that we only observe customer trades per trader; multiple customers can be linked to one trader and one customer can also trade via multiple traders.[10]

The results for profits of customer trades for the full day are in Panel A of Table 5. We observe that median trading profits on customer trades are negative, consistent with the interpretation that these are trading costs for customers. Further, customers of brokers and dual traders have higher trading costs on announcement days, consistent with higher trading profits for own-account trades on such days. Comparing customer profits of dual traders and brokers, we observe that customers lose more money with dual traders, consistent with the higher bid-ask spread for dual traders' customer trades, compared to those of brokers' (see Table 3). It appears that, although dual traders' customers are more informed, they lose more money than brokers' customers. Why, then, do these customers stay with dual traders? One possibility is that these

[10] If customers have valuable information, they may behave strategically (e.g. by splitting the order between multiple traders). As discussed recently in the *Wall Street Journal*, January 24 2006, "Hedge funds add twist to 'prime' brokerages," many hedge funds have several prime brokerages, not only to obtain better terms and rates but also due to "... fear that their information could be used improperly".

customers are risk-averse and dual traders are better able to smooth profits. Indeed, we observe from Panel A of Table 5 that the standard deviation of customer profits is lower on announcement days for dual traders' customers, compared to broker customers. Another possibility is that dual traders' customers receive some unobserved benefits, such as lower commissions (Fishman and Longstaff, 1992) or better execution.

Panel B of Table 5 shows own-account and customer profits for the first 15 minutes after announcements. These results are qualitatively similar to those in Panel A. For all announcement samples, profits are higher on announcement days and, further, dual traders have higher median profits compared to locals, especially on announcement days. Turning to customer profits, we find again that dual traders' customers consistently lose more money; however, as before, the standard deviation of customer profits is also lower for dual traders' customers. Consistent with the increased informativeness of customer order flow in the first 15 minutes after announcements, compared to the full day, we find that the *difference* in dual trader and local profits is also greater at this time. For example, for all announcements, dual trader profits are $6.10 higher than local profits, whereas this difference was only $2.60 for the full day.

We conclude that trading for own account is more profitable on announcement days, and customer order flow may be the source of these additional profits. This conclusion is based on the evidence that dual traders' profits from own account trading are higher than that of locals, especially on announcement days. An alternative interpretation of increased own account trading profits on announcement days is that they constitute additional compensation to dual traders for providing liquidity to customers on announcement versus non-announcement days; the cost of such liquidity is greater due to the increased trading and higher volatility on announcement days.

In the next section, we examine the determinants of dual trader profits---in particular, its association with customer trades and volatility.

7. Determinants of Dual Trader Profits

Dual traders play a variety of roles in the futures markets. As brokers, they provide execution services to their customers. As proprietary traders, they may speculate on short-term price trends in the markets (similar to locals), or they may provide liquidity to customer trades, or they may take advantage of the information content of their customer order flow. In this section, we take a closer look at the cross-sectional determinants of dual trader profits, and attempt to evaluate the relative importance of the different motives for their trading. Accordingly, we estimate the following regression for the 8:30 to 8:45 interval on announcement days for the sample of all announcements:

$$\pi_{k,t} = \alpha + \beta_c C_{k,t} + \beta_\sigma \sigma_t + \beta_n N_t + \sum_{l \varepsilon L} \gamma_l I_{l,t} |S_{l,t}| + \varepsilon_{k,t} \qquad (5)$$

where $\pi_{k,t}$ is the profit of dual trader k on announcement day t, $C_{k,t}$ is a measure of the dual trader's access to its customer order flow, σ_t is the market volatility (estimated using the method described in Section 4), and $S_{l,t}$ is the standardized surprise for announcement type l. N_t is the number of dual traders per customer trade, which is a measure of the competition for customer order flow; the normalization by the number of customer trades is necessary because more dual traders are likely to be active when more customers are trading.

If access to its customer order flow is profitable for dual traders, then we expect $\beta_c>0$: dual trader's profits increase when its access to customer order flow increases. We further expect that $\beta_\sigma>0$ for two reasons: increased volatility may lead to increased cost of supplying liquidity to customers, which requires greater compensation to dual traders in their capacity as market

makers; alternatively, increased volatility may be an outcome of greater information flows. Finally, increased competition is likely to reduce dual trader profits, ceteris paribus, and so expect that $\beta_n<0$.

[INSERT TABLE 6 ABOUT HERE]

Table 6 shows the results from estimating (5) for different proxies of a dual trader's access to customer order flow $C_{k,t}$. In models 2 and 4, the proxy is the number of dual trader *k*'s customer trades or volume on day *t*; in models 3 and 5, the proxy is the number of the dual trader's signed customer trades or volume. The number of customer trades, rather than volume, may be more informative if trade size is not an indicator of how much information a customer has. Finally, results for signed trades or volume may be different from those using the unsigned variables if informative trades are mostly on one side of the market. For example, if customers have positive information, then we may expect buyer initiated trades to be more informative than seller initiated trades.

Consider the results from estimating (5), as reported in Table 6. In column (1), we include the number of customer trades while omitting the controls, and find that it is significantly positive, consistent with the idea that access to customer order flow is a significant determinant of dual trader profits. The intercept is $16.50, which is the mean value of dual trader profits in Panel B of Table 5; this result is to be expected because all the variables in the regression are demeaned. In the column labeled (1'), we include both the number of customer trades and the control variables. We find that the estimate of the number of customer trades remain positive and significant, although its magnitude is reduced by about half, compared to model (1), while the control variables have the expected signs, i.e. dual trader profits are significantly increasing in volatility and significantly decreasing in the degree of competition. Finally, in the column

labeled (1"), we include day dummies to control for *all* deterministic time series variations (including those of the control variables) and, therefore, only explore the cross-section. The results are essentially unchanged from those of model (1'): the coefficient estimate of the number of customer trades is highly significant with a magnitude similar to what we obtained in model (1').

In the columns labeled (2), (2') and (2") in Table 6, we use the number of signed customer trades as a proxy for the dual trader's access to customer order flow. As with model (1), we present three variations of the model: without (model 2') and with (model 2") the control variables, and with the day dummies (model 2"). We find that the results are qualitatively similar to those using the unsigned customer trades: dual trader profits are positively and significantly related to the number of signed customer trades, even after controlling for volatility, competition and the announcement surprise. Quantitatively, the magnitude of the estimated coefficient on signed trades is about 3.5 times greater than that of the unsigned trades, consistent with the idea that informed customers mostly trade on one side of the market.

In the columns labeled (3), (3') and (3") in Table 6, we use the customer trading volume as a proxy for the dual trader's access to customer order flow; and in the columns labeled (4), (4') and (4") in Table 6, we use the signed customer trading volume. In contrast to the number of trades, we find that although these variables are positive and significant when they are included without the controls, they are no longer significant after including the control variables. However, the control variables continue to have the expected signs. These results imply that the trade size is not informative to dual traders on announcement days, which may indicate that large trades are uninformative allocational trades uncorrelated with net customer order flow.

Alternatively, the result may indicate strategic behavior by informed customers who break up their trades and allocate them to different brokers.

In contrast to the above results, we find that the number of customer trades is not significantly related to dual trader profits on non-announcement days (these results are not reported, but are available from the authors). Instead, volatility is the main determinant of dual trader profits. Similarly, dual trader profits are also unrelated to the number of customer trades in that part of announcements days remaining after 8:45. This is consistent with the evidence from Figure 3 that, after 8:45, customer order flow is not significantly more informative on announcement days relative to non-announcement days.

Overall, the results in this section provide strong support for the idea that, on announcement days, access to customer order flow is an important and significant determinant of dual trader profits, even after controlling for other determinants of profits such as volatility, competition for order flow and the announcement surprise.

8. Conclusion

We study the effect of public announcements on trading in the 30 Year U.S. T-bonds Futures from 1994 to 1997. Our dataset allows us to identify customer and non-customer order flow, and identify three types of floor traders that are common to the futures market: those who trade exclusively for their personal accounts (locals), those who trade both for customers and themselves on the same day (dual traders) and those who only execute customer trades (brokers). These features of the data allow us to test the prediction of Lyons (2001) that traders who can see customer order flow have an advantage over traders who can not observe this.

We find evidence supportive of Lyons' (2001) prediction. We show that the customer order flow of dual traders is more informative than that of brokers, especially on announcement days.

Further, dual traders make more trading profits than locals, especially on announcement days. The relative informativeness of dual traders' customer order flow is most pronounced in the first 15 minutes after announcements, and their profit advantage over locals is also most pronounced at this time. Finally, dual trader profits are significantly and positively related to customer order flow, even after controlling for market volatility, the degree of competition for customer order flow, and the announcement surprise.

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Table 1: Macroeconomic Announcements

This table describes scheduled macroeconomic announcements from 1994 to 1997. The data is from the International Money Market Services (MMS), except for the Housing Starts announcement dates which are from the Bureau of the Census (www.census.gov) and FOMC announcement dates which are from Fleming and Piazzesi (2005).

			Number of Announcements					
		Time (EST)	1994	1995	1996	1997	Total	Remarks
				Quarterly				
1	GDP Advance	08:30 A.M.	4	4	4	4	16	
2	GDP Preliminary	08:30 A.M.	4	3	4	4	15	Mar-96 missing
3	GDP Final	08:30 A.M.	4	3	5	4	16	
				Monthly				
	Real Activity							
4	Nonfarm Payroll Employment	08:30 A.M.	12	12	12	12	48	
5	Retail Sales	08:30 A.M.	12	12	12	12	48	
6	Industrial Production	09:15 A.M.	12	12	12	12	48	
7	Capacity Utilization	09:15 A.M.	12	12	12	12	48	
8	Personal Income	08:30 A.M.	12	10	13	12	47	Jan-96 missing
9	Consumer Credit	03:00 P.M.	0	0	7	12	19	
	Consumption							
10	Personal Consumption Expenditure	08:30 A.M.	12	10	12	12	46	Jan&Mar-96 missing
11	New Home Sales	10:00 A.M.	12	11	13	12	48	
	Investment							
12	Durable Goods Orders	08:30 A.M.	12	11	13	12	48	At 10:00 A.M. if same day GDP; Mar-96 missing; Jul-96 at 09:00
13	Construction Spending	10:00 A.M.	12	12	12	12	48	
14	Factory Orders	10:00 A.M.	12	12	12	12	48	
15	Business Inventories	10:00 A.M.	12	12	12	12	48	At 08:30 A.M. in 1997
	Government Purchases							
16	Government Budget	02:00 P.M.	12	12	12	12	48	Jan-96 missing
	Net Exports							
17	Trade Balance	08:30 A.M.	12	11	13	12	48	
	Prices							
18	Producer Price Index	08:30 A.M.	12	12	12	12	48	
19	Consumer Price Index	08:30 A.M.	12	12	12	12	48	
	Forward Looking							
20	Consumer Confidence Index	10:00 A.M.	12	12	12	12	48	
21	NAPM Index	10:00 A.M.	12	12	12	12	48	
22	Housing Starts	08:30 A.M.	12	12	12	12	48	
23	Index of Leading Indicators	08:30 A.M.	12	11	13	12	48	
				Six-Week				
	FOMC							
24	Target Federal Funds Rate	02:15 P.M.	9	8	8	8	33	Around 02:15 P.M.; no Expectations; 1994/02/04 was 11:15 announcement; 1994/04/18 was an unexpected announcement at 10:06; 1994/08/16 was at 01:17 and 1996/03/26 was at 11:39
				Weekly				
25	Initial Unemployment Claims	08:30 A.M.	52	52	52	53	209	

Table 2: Sample of Announcement and Non-announcement days

This table shows the number of announcement and non-announcement days in our sample, and the frequency of each announcement. The announcement days are days on which there is an 08:30 A.M. announcement and no other announcement in the morning (ie no 09:15 and 10:00 announcements). Non-announcement days are days on which there are no announcements at all in the morning. There are three groups of announcement days: the first group contains all 08:30 A.M. announcements, the second group consists of the important announcement types (Nonfarm Payroll Employment, CPI and PPI), and the third group contains only the Nonfarm Payroll Employment announcements. We exclude days when either the realized value or the expectation are missing, days on which the FED made an earlier than usual or an unexpected announcement, the day on which the Durable Goods Orders figure was announced at 09:00, two days on which the market closed at 11:00 (1994/4/1 and 1996/4/5) and four days on which the market closed for a part of the day (1994/9/14, 1996/8/26, 1997/2/26 and 1997/2/27).

Sample	1994	1995	1996	1997	Total
All Trading Days	253	250	252	250	1,005
Non-announcement days	84	91	88	87	350
All announcement days	98	90	89	100	377
Days with Nonf. Payroll Emp., CPI and PPI Ann's	27	26	25	27	105
Nonfarm Payroll Emp. Announcements	9	8	7	10	34

Frequency of Announcement Types

No.	Description	1994	1995	1996	1997	Total
1	GDP Advance	3	4	1	4	12
2	GDP Preliminary	3	1	1	2	7
3	GDP Final	3	0	5	2	10
4	Nonfarm Payroll Employment	9	8	7	10	34
5	Retail Sales	9	11	9	12	41
8	Personal Income	5	3	5	4	17
10	Personal Consumption Expenditure	5	3	5	4	17
12	Durable Goods Orders	11	11	8	7	37
15	Business Inventories	0	0	0	7	7
17	Net Exports	12	10	11	11	44
18	Producer Price Index	11	11	11	10	43
19	Consumer Price Index	7	7	7	7	28
22	Housing Starts	11	9	10	9	39
23	Index of Leading Indicators	5	2	6	6	19
25	Initial Unemployment Claims	40	37	36	43	156

Table 3: Liquidity and Volatility on Ann and Non-ann Days, by Type of Trades

In Panel A, we show the average trading volume, number of transactions, trade size, number of active traders, bid-ask spread and volatility per 5 minute interval for the 30 year Treasury Bond futures listed on the Chicago Board of Trade (CBOT) on both announcement and non-announcement days. In Panel B, the average trading volume, number of transactions, trade size, number of active traders and bid-ask spread per 5 minute interval is shown for different trader types. We define an announcement day as a day on which there is an 08:30 A.M. announcement and no other announcement in the morning. Non-announcement days are days on which there are no announcements at all in the morning. We define a floor trader to be a Local (Broker) on a day if the proportion of volume for her own account, as a ratio of total (own+customer) volume, is greater than 98% (smaller than 2%). A floor trader is a Dual Trader on a day if this proportion is greater than or equal to 2% but less than or equal to 98%. The table reports the average volume, average number of transactions, the average volume per transaction (*Trade Size*), the average spread (in basis points), the average volatility (in % per 5 minutes) and the average number of traders active. Volatility is the maximum of the standard deviations of the customer buy and sell prices. The bid-ask spread is the volume-weighted average of the customer buy price minus the volume-weighted average of the customer sell price in an interval. The sample period is from 1994 to 1997.

Panel A: Overall (5min avg)

	Ann Days	Non-ann Days	Ratio
Volume (in #contracts)	7,912.7	5,591.0	1.42
#Transactions	595.9	458.2	1.30
Trade size	12.4	11.6	1.07
#Traders Active	172.9	146.0	1.18
Bid-Ask Spread (in bps)	64.2	56.4	1.14
Volatility (in % per 5min)	5.5	4.6	1.20

Table 3 (continued), Panel B:
Breakdown according to Trader Type (5min avg)

	Ann Days	Non-ann Days	Ratio
Own Account (CTI 1)			
Volume	5,203.8	3,691.2	1.41
From Local	4,515.7	3,141.9	1.44
From Dual Trader	688.1	549.3	1.25
#Transactions	450.3	345.9	1.30
From Local	353.3	264.0	1.34
From Dual Trader	96.9	81.8	1.18
Trade Size	10.9	10.2	1.07
From Local	12.0	11.3	1.06
From Dual Trader	6.9	6.5	1.07
#Traders Active	138.3	116.8	1.18
As a Local	98.3	81.4	1.21
As a Dual Trader	40.0	35.4	1.13
For Customer (CTI 4)			
Volume	2,708.9	1,899.8	1.43
Through Dual Trader	2,092.9	1,460.7	1.43
Through Broker	616.0	439.1	1.40
#Transactions	145.7	112.3	1.30
Through Dual Trader	117.4	90.9	1.29
Through Broker	28.2	21.4	1.32
Trade Size	17.5	16.1	1.09
Through Dual Trader	16.8	15.2	1.11
Through Broker	20.6	19.6	1.05
#Traders Active	50.9	42.4	1.20
As a Dual Trader	41.3	34.5	1.20
As a Broker	9.6	7.9	1.21
Bid-Ask Spread (in bps)	64.2	56.4	1.14
Through Dual Trader	66.8	59.0	1.13
Through Broker	43.0	34.1	1.26

Table 4: Informativeness of Customer Order Flow: Full Day and 15 minutes after Announcement

The table reports results from estimating the following regressions:

$$p_{t,h} - p_{t,h-1} = \alpha_{\mathrm{a}}\mathrm{d}_{\mathrm{a}} + \alpha_{\mathrm{n}}\mathrm{d}_{\mathrm{n}} + \beta_{\mathrm{a}}\mathrm{d}_{\mathrm{a}}\omega_{t,h} + \beta_{\mathrm{n}}\mathrm{d}_{\mathrm{n}}\omega_{t,h} + \sum_{k\in K}\gamma_{k,h}I_{k,t=a,h=1}S_{k,t} + \varepsilon_{t,h}, \qquad \text{(All Floor Traders)}$$

$$p_{t,h} - p_{t,h-1} = \alpha_{\mathrm{a}}\mathrm{d}_{\mathrm{a}} + \alpha_{\mathrm{n}}\mathrm{d}_{\mathrm{n}} + \beta^{\mathrm{d}}_{\mathrm{a}}\mathrm{d}_{\mathrm{a}}\omega^{\mathrm{d}}_{t,h} + \beta^{\mathrm{b}}_{\mathrm{a}}\mathrm{d}_{\mathrm{a}}\omega^{\mathrm{b}}_{t,h} + \beta^{\mathrm{d}}_{\mathrm{n}}\mathrm{d}_{\mathrm{n}}\omega^{\mathrm{d}}_{t,h} + \beta^{\mathrm{b}}_{\mathrm{n}}\mathrm{d}_{\mathrm{n}}\omega^{\mathrm{b}}_{t,h} + \sum_{k\in K}\gamma_{k,h}I_{k,t=a,h=1}S_{k,t} + \varepsilon_{t,h}, \qquad \text{(Dual vs Broker)}$$

where $h = 1, 2, \ldots$ is a 5-minute trading interval, $t = 1, \ldots, T$ is a trading day, $k \in K$ is one of K announcements at 8:30 AM. The interval $h = 0$ indicates the period 8:25 AM to 8:30 AM, $h = 1$ indicates the period 8:30 AM to 8:35 AM, etcetera. $p_{t,h}$ is 100 times the log of the last price in interval h, $\mathrm{d_a}$ is a dummy that is one for the selected sample of announcement days and zero else and $\mathrm{d_n}$ a dummy for non-announcement days, $I_{k,t=a,h=1} = 1$ in interval $h = 1$ if there is an 8:30 AM announcement k on day t, and $S_{k,t}$ is the standardized announcement surprise. The $\omega_{t,h}$ variables denote the customer order flow (*OF*) or the signed trading volume (positive for a buy and negative for a sell) summed over trades in interval h, where $\omega^{\mathrm{d}}_{t,h}$ denotes the customer order flow through dual traders, $\omega^{\mathrm{b}}_{t,h}$ through brokers and $\omega_{t,h}$ the combined customer order flow (thus $\omega_{t,h} = \omega^{\mathrm{d}}_{t,h} + \omega^{\mathrm{b}}_{t,h}$). We define a floor trader to be a Local (Broker) on a day if the proportion of volume for her own account, as a ratio of total (own+customer) volume, is greater than 98% (smaller than 2%). A floor trader is a Dual Trader on a day if this proportion is greater than or equal to 2% but less than or equal to 98%. For each announcement sample, the regression is estimated for all customer trades (shown under the column heading *All Floor Tr*) and for brokers or dual traders separately (shown under the column heading *Dual vs Broker*). There are three announcement samples: all announcements (indicated by column heading *All Ann & Non-ann days*), Nonfarm payroll employment, CPI and PPI announcements (indicated by column heading *Nonfarm, CPI, PPI Ann & Non-ann days*) and Nonfarm payroll announcements (indicated by column heading *Nonfarm Ann & Non-ann days*). The equation is estimated using the Feasible Efficient GMM procedure, with the Newey-West estimator (using three lags) of the sample autocovariance matrix. The t-values are reported below the estimates; an asterisk (*) denotes significance at the 5% level or less and two asterisks (**) denote signficance at the 1% level or less. Panel A reports the estimates of the Intercept (Int) and order flow (OF) variables estimated for the full day after 8:30 based on 5-minute intervals and shows test statistics for several Criterion Function Tests on the order flow parameters. Panel B gives the suprise coefficients for the All Floor Traders and Dual vs Broker model with the sample of all announcement and the non-announcement days (for the other samples the estimates are similar). Panel C resembles Panel A, but shows estimates of the model for 15 minutes after the announcement time (based on 5-minute intervals, i.e. $h = 1, 2, 3$).

Panel A: Customer Order Flow (OF): Full Day

				All Ann & Non-ann days		Nonfarm, CPI, PPI Ann & Non-ann days		Nonfarm Ann & Non-ann days	
				All Floor Tr	Dual vs Broker	All Floor Tr	Dual vs Broker	All Floor Tr	Dual vs Broker
OF	Ann	All Floor Tr	β_{a}	0.0347** (35)		0.0366** (18)		0.0391** (10)	
		Dual	$\beta^{\mathrm{d}}_{\mathrm{a}}$		0.037** (32.6)		0.0399** (16.1)		0.0443** (9)
		Broker	$\beta^{\mathrm{b}}_{\mathrm{a}}$		0.0268** (14.3)		0.0256** (6.91)		0.0219** (3.31)
OF	Non	All Floor Tr	β_{n}	0.0304** (33.9)		0.0304** (33.9)		0.0304** (33.9)	
		Dual	$\beta^{\mathrm{d}}_{\mathrm{n}}$		0.032** (31.4)		0.032** (31.4)		0.032** (31.4)
		Broker	$\beta^{\mathrm{b}}_{\mathrm{n}}$		0.025** (16.7)		0.025** (16.7)		0.025** (16.7)
Int	Ann		α_{a}	-0.0000659 (-0.201)	-0.0000665 (-0.203)	-0.00121 (-1.52)	-0.00121 (-1.53)	-0.00207 (-1.1)	-0.0021 (-1.12)
	Non		α_{n}	0.000245 (0.924)	0.000258 (0.976)	0.000245 (0.924)	0.000258 (0.976)	0.000245 (0.924)	0.000258 (0.976)
#obs	Total			55,482	55,482	34,734	34,734	29,268	29,268
	Ann			28,686	28,686	7,938	7,938	2,472	2,472
	Non			26,796	26,796	26,796	26,796	26,796	26,796
R^2				0.165	0.167	0.168	0.171	0.154	0.157

Table 4, Panel A: Customer Order Flow (OF): Full Day (continued)

		All Ann & Non-ann days		Nonfarm, CPI, PPI Ann & Non-ann days		Nonfarm Ann & Non-ann days	
		All Floor Tr	Dual vs Broker	All Floor Tr	Dual vs Broker	All Floor Tr	Dual vs Broker
Tests on OF	$\beta_a = \beta_n$	0.0014^{**} 10.2		0.00554^{**} 7.7		0.031^{*} 4.65	
	$\beta_a^d = \beta_n^d$		0.0011^{**} 10.6		0.00324^{**} 8.67		0.0142^{*} 6.01
	$\beta_a^b = \beta_n^b$		0.445 0.583		0.882 0.022		0.65 0.205
	$\beta_a^d = \beta_a^b$		0.00000269^{**} 22		0.00191^{**} 9.64		0.0109^{*} 6.49
	$\beta_n^d = \beta_n^b$		0.0000472^{**} 16.6		0.0000472^{**} 16.6		0.0000472^{**} 16.6

Panel B: Announcement Surprise

Announcement type		All Floor Traders		Dual vs Broker	
		Surprise Coefficient	t-value	Surprise Coefficient	t-value
1	GDP Advance	-0.097^{*}	-2.38	-0.0946^{*}	-2.37
2	GDP Preliminary	-0.214	-1.79	-0.213	-1.81
3	GDP Final	0.0255	1.42	0.0272	1.55
4	Nonfarm Payroll Emp.	-0.482^{**}	-3.1	-0.483^{**}	-3.12
5	Retail Sales	-0.111^{**}	-2.89	-0.112^{**}	-2.96
8	Personal Income	-0.011	-0.507	-0.0119	-0.541
10	Pers. Consumption Exp.	-0.000754	-0.0301	-0.000754	-0.0301
12	Dur. Goods Orders	-0.112^{**}	-4.2	-0.111^{**}	-4.16
15	Business Inventories	-0.0891^{*}	-2.09	-0.0902^{*}	-2.14
17	Net Exports	-0.00151	-0.109	-0.000293	-0.0222
18	Producer Price Index	-0.18^{**}	-4.57	-0.181^{**}	-4.62
19	Consumer Price Index	-0.131^{**}	-2.74	-0.131^{**}	-2.81
22	Housing Starts	-0.11^{**}	-5.67	-0.11^{**}	-5.78
23	Index of Leading Ind.	-0.0188	-0.683	-0.0176	-0.644
25	Init. Unemployment Cl.	0.0463^{**}	3.69	0.0457^{**}	3.64

Table 4 (continued), Panel C: Customer Order Flow (OF): 15 minutes after Announcement

				All Ann & Non-ann days		Nonfarm, CPI, PPI Ann & Non-ann days		Nonfarm Ann & Non-ann days	
				All Floor Tr	Dual vs Broker	All Floor Tr	Dual vs Broker	All Floor Tr	Dual vs Broker
OF	Ann	All Floor Tr	β_a	0.0493** 10.4		0.0544** 6.06		0.0571** 3.77	
		Dual	β_a^d		0.0562** 10		0.065** 5.7		0.0762** 3.6
		Broker	β_a^b		0.0238* 2.53		0.0209 1.27		-0.0197 -0.494
OF	Non	All Floor Tr	β_n	0.0256** 9.67		0.0256** 9.67		0.0256** 9.67	
		Dual	β_n^d		0.0265** 8.92		0.0265** 8.92		0.0265** 8.92
		Broker	β_n^b		0.023** 4.77		0.023** 4.77		0.023** 4.77
Int	Ann		α_a	-0.0118** -2.75	-0.0119** -2.79	-0.0364** -2.69	-0.0367** -2.72	-0.0974** -3.26	-0.0931** -3.23
	Non		α_n	0.00334* 2.32	0.00345* 2.34	0.00334* 2.32	0.00345* 2.34	0.00334* 2.32	0.00345* 2.34
#obs	Total			2,181	2,181	1,365	1,365	1,152	1,152
	Ann			1,131	1,131	315	315	102	102
	Non			1,050	1,050	1,050	1,050	1,050	1,050
R^2				0.366	0.375	0.354	0.366	0.369	0.396
Tests on OF	$\beta_a = \beta_n$			0.0000131** 19		0.00208** 9.47		0.041* 4.18	
	$\beta_a^d = \beta_n^d$				0.00000279** 22		0.00111** 10.6		0.0202* 5.39
	$\beta_a^b = \beta_n^b$				0.94 0.00563		0.9 0.0158		0.288 1.13
	$\beta_a^d = \beta_a^b$				0.00359** 8.48		0.0343* 4.48		0.0628 3.46
	$\beta_n^d = \beta_n^b$				0.511 0.432		0.511 0.432		0.511 0.432

Table 5: Trading Profits per Round Trip, by Trader Type

The table reports trading profits per round trip contract for each type of trader (broker, dual and local) in the 30 Year Treasury Bond futures listed on the Chicago Board of Trade (CBOT) from 1994 to 1997. We define a floor trader to be a Local (Broker) on a day if the proportion of volume for her own account, as a ratio of total (own+customer) volume, is greater than 98% (smaller than 2%). A floor trader is a Dual Trader on a day if this proportion is greater than or equal to 2% but less than or equal to 98%. For dual traders, trading profits are calculated separately for customer trades and trades for their own accounts. The trading profits are calculated for each floor trader and each day (referred to as a Trader Day) by subtracting the value of purchases from the value of sales, with any remaining inventory assumed to be valued at the end-of-day settlement price (in Panel A), or the last price before 8:45 (in Panel B). The trading profits per round trip are obtained by dividing aggregate trading profits by the maximum of buy and sell quantity for each floor trader per day. The trading profits are calculated for all floor traders active on the particular day (in Panel A), or in the 8:30-8:45 interval (Panel B), for announcement and non-announcement days. On announcement days, the trading profits are calculated separately for three groups of announcements: all announcements (indicated by the row index *All Announcement Days*), Nonfarm payroll employment, CPI and PPI announcements (indicated by row index *Nonfarm, CPI, PPI*) and Nonfarm payroll announcements only (indicated by row index *Nonfarm Payroll Emp.*). In Panel A we show the mean, standard deviation (*St Dev*) and the three quartiles (*1st Q*, *Median* and *3rd Q*) of the trading profits (with the number of trader days in each group in the column *#Tr. days*) as calculated for the full day, Panel B reports the same statistics for the 8:30-8:45 interval. An asterisk ($*$) denotes a significant difference for announcement days from non-announcement days at the 5% level, two asterisks at the 1% level or less. An x indicates a significant difference between the local's (broker's) and dual trader's CTI1 (CTI4) median trading profits (based on a Wilcoxon ranksum test) at the 5% level, xx at the 1% level or less.

Panel A: Trading Profits per Round Trip: Full Day

	#Tr. days	Mean	St Dev	1st Q	Median	3rd Q
Own Account (CTI 1)						
Local						
Non-announcement Days	96,198	5.3	108.8	-4.9	5.2^{xx}	16.0
All Announcement Days	111,242	5.8	125.7	-3.8	$6.1^{**,xx}$	17.2
Nonfarm, CPI, PPI	32,618	7.4	140.8	-3.7	$7.1^{**,xx}$	20.1
Nonfarm Payroll Emp.	10,650	10.0	172.1	-4.5	$8.3^{**,xx}$	24.4
Dual Trader						
Non-announcement Days	52,386	6.4	63.6	-3.8	7.8^{xx}	19.5
All Announcement Days	58,998	8.4	73.9	-2.9	$8.7^{**,xx}$	21.3
Nonfarm, CPI, PPI	16,981	11.8	82.5	-2.3	$10.4^{**,xx}$	24.9
Nonfarm Payroll Emp.	5,545	14.6	106.0	-3.0	$11.7^{**,xx}$	29.9
For Customer (CTI 4)						
Dual Trader						
Non-announcement Days	52,386	-4.5	186.4	-85.1	-3.4	76.1
All Announcement Days	58,998	-11.5	219.2	-100.3	-7.8^{**}	82.5
Nonfarm, CPI, PPI	16,981	-17.6	236.0	-123.3	$-14.2^{**,xx}$	91.5
Nonfarm Payroll Emp.	5,545	-30.6	285.5	-161.7	$-25.0^{**,xx}$	107.6
Broker						
Non-announcement Days	25,469	-1.5	276.4	-118.0	0.0	111.9
All Announcement Days	30,094	-8.6	334.3	-142.7	-1.3^{**}	125.0
Nonfarm, CPI, PPI	9,291	-3.3	361.7	-156.3	-0.3^{xx}	156.3
Nonfarm Payroll Emp.	3,242	-2.5	439.4	-187.6	-0.4^{xx}	187.5

Table 5 (continued), Panel B: Trading Profits per Round Trip: 15 minutes after Announcement

	#Tr. days	Mean	St Dev	1st Q	Median	3rd Q
Own Account (CTI 1)						
Local						
Non-announcement Days	64,713	2.5	38.2	-13.5	0.0^{xx}	20.8
All Announcement Days	83,516	8.4	67.4	-13.2	$7.8^{**,xx}$	31.2
Nonfarm, CPI, PPI	25,301	17.0	93.0	-12.1	$14.8^{**,xx}$	43.9
Nonfarm Payroll Emp.	8,242	26.7	117.8	-11.1	$23.7^{**,xx}$	62.5
Dual Trader						
Non-announcement Days	17,181	4.6	46.7	-15.6	2.2^{xx}	31.2
All Announcement Days	26,474	16.5	99.0	-13.4	$13.9^{**,xx}$	40.5
Nonfarm, CPI, PPI	8,381	29.6	142.2	-14.2	$22.8^{**,xx}$	62.5
Nonfarm Payroll Emp.	2,709	49.0	199.1	-12.5	$31.3^{**,xx}$	101.6
For Customer (CTI 4)						
Dual Trader						
Non-announcement Days	17,181	-3.0	65.1	-32.5	0.0^{x}	31.3
All Announcement Days	26,474	-12.6	129.5	-67.7	$-7.3^{**,xx}$	49.0
Nonfarm, CPI, PPI	8,381	-22.7	175.8	-104.2	-17.5^{**}	63.5
Nonfarm Payroll Emp.	2,709	-35.0	225.0	-147.1	-25.8^{**}	87.3
Broker						
Non-announcement Days	6,567	-1.3	70.2	-31.3	0.0^{x}	31.3
All Announcement Days	9,034	-7.3	143.3	-62.5	$0.0^{**,xx}$	58.0
Nonfarm, CPI, PPI	2,843	-14.9	200.3	-101.7	-11.3^{**}	73.9
Nonfarm Payroll Emp.	970	-23.2	250.9	-145.4	-19.3^{**}	94.1

Table 6: Dual's Trading Profits on Announcement Days

The table reports results from estimating the following regression:

$$\pi^{\mathrm{d,a}}_{k,t} = \alpha + \beta_{\mathrm{C}}\mathrm{C}_{k,t} + \beta_{\sigma}\sigma_t + \beta_{N^{\mathrm{d}}}N^{\mathrm{d}}_t + \sum_{l\in L}\gamma_l I_{l,t}|S_{l,t}| + \epsilon_{k,t},$$

where $\pi^{\mathrm{d,a}}_{k,t}$ is the trading profit per round trip for dual trader k on announcement day t in the 8:30-8:45 interval. A floor trader is a Dual Trader on a day if the proportion of volume for her own account, as a ratio of total (own+customer) volume, is greater than or equal to 2% but less than or equal to 98%. The variable $\mathrm{C}_{k,t}$ represents one of four measures for the dual trader's access to customer order flow. Let $D^c_{j,k,t}$ denote the direction (+1 for buy, -1 for sell) of trade j for trader k on day t. Then the four measures are: the number of trades of dual k on day t that come from customers $\sum_j |D^c_{j,k,t}|$ (model (1)), the absolute summed signed number of trades $|\sum_j D^c_{j,k,t}|$ (model (2)), the total quantity of dual k on day t that comes from customers $\sum_j Q^c_{j,k,t}$ (model (3)) and the absolute summed signed quantity $|\sum_j D^c_{j,k,t}Q^c_{j,k,t}|$ (model (4)). The control variables on day t are the market volatility σ_t (estimated as the maximum of the standard deviations of the customer buy and sell prices) and the number of active duals per customer trade N^{d}_t (a proxy for competition). The indicator variable $I_{l,t} = 1$ if there is an 8:30 AM announcement l on day t, and $|S_{l,t}|$ is the absolute standardized announcement surprise. All regressors are demeaned to let the constant represent the average trading profit per round trip in the 8:30-8:45 interval of a dual on an announcement day. The equation is estimated using OLS, the t-values are reported below the estimates; an asterisk (*) denotes significance at the 5% level or less and two asterisks (**) denote signficance at the 1% level or less.

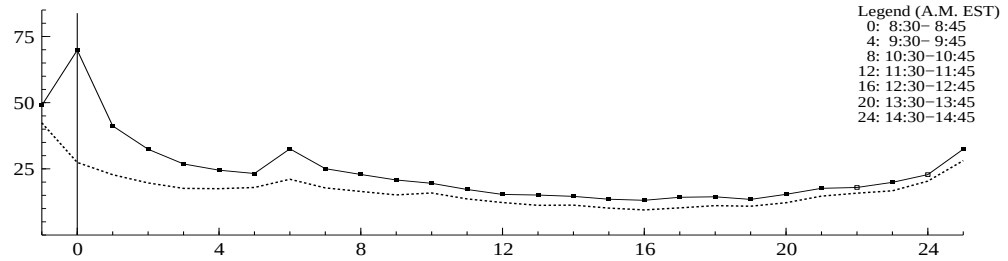
Dependent Variable: Dual's Trading Profits per Round Trip in the 8:30-8:45 interval on Ann Days

	(1)	(1')	(1")	(2)	(2')	(2")	(3)	(3')	(3")	(4)	(4')	(4")
Trades												
$\sum_j \lvert D^c_{j,k,t}\rvert$	0.582**	0.232**	0.211**									
	9.81	3.64	3.3									
Signed Trades												
$\lvert\sum_j D^c_{j,k,t}\rvert$				1.13**	0.727**	0.726**						
				9.89	6.25	6.23						
Quantity												
$\sum_j Q^c_{j,k,t}$							0.00358**	-0.00158	-0.00159			
							2.6	-1.13	-1.13			
Signed Quantity												
$\lvert\sum_j D^c_{j,k,t}Q^c_{j,k,t}\rvert$										0.00668*	-0.00129	-0.00143
										2.3	-0.442	-0.488
Constant	16.5**	16.5**		16.5**	16.5**		16.5**	16.5**		16.5**	16.5**	
	27.2	27.3		27.2	27.4		27.1	27.3		27.1	27.3	
Controls												
Volatility		23.1**			22.8**			24.2**			24.2**	
		7.16			7.08			7.54			7.52	
# Duals per Cust Trade		-36.3*			-37.1*			-50.3**			-48.8**	
		-2.28			-2.37			-3.21			-3.13	
Surprise Incl?		**yes**			**yes**			**yes**			**yes**	
Day Dummy Incl?			**yes**			**yes**			**yes**			**yes**
#Observations	26,474	26,474	26,474	26,474	26,474	26,474	26,474	26,474	26,474	26,474	26,474	26,474
R^2	0.004	0.017	0.039	0.004	0.018	0.040	0.000	0.016	0.039	0.000	0.016	0.039

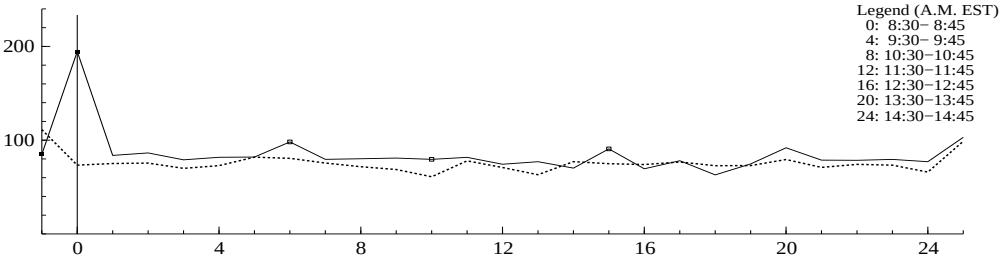
Figure 1: Intraday Patterns (15-minute intervals)

In these figures the full intraday pattern of volume (Panel (a)), bid-ask spread (b) and volatility (c) is shown, based on 15 minute intervals. The solid (dashed) lines show the intraday pattern for announcement (non-announcement) days, the solid vertical line represents the 8:30 announcement interval. An open (closed) circle indicates significant difference between announcement and non-announcement days at the 5% (1%) level. The volume is measured in 1,000 contracts, volatility in % per 15 minutes and bid-ask spread in basis points.

(a) Volume (in 1,000 contracts)



(b) Bid-Ask Spread (in bps)



(c) Volatility (in % per 15min)

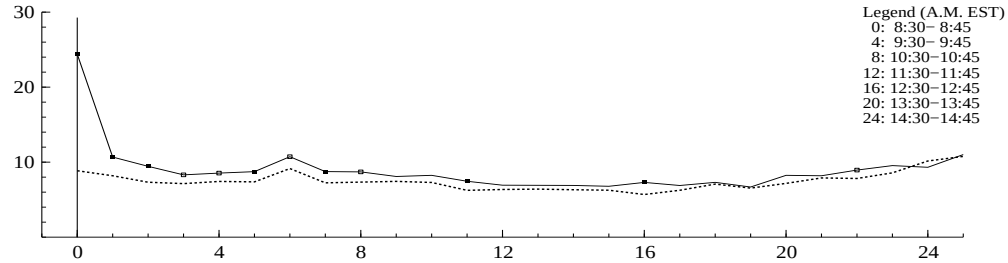
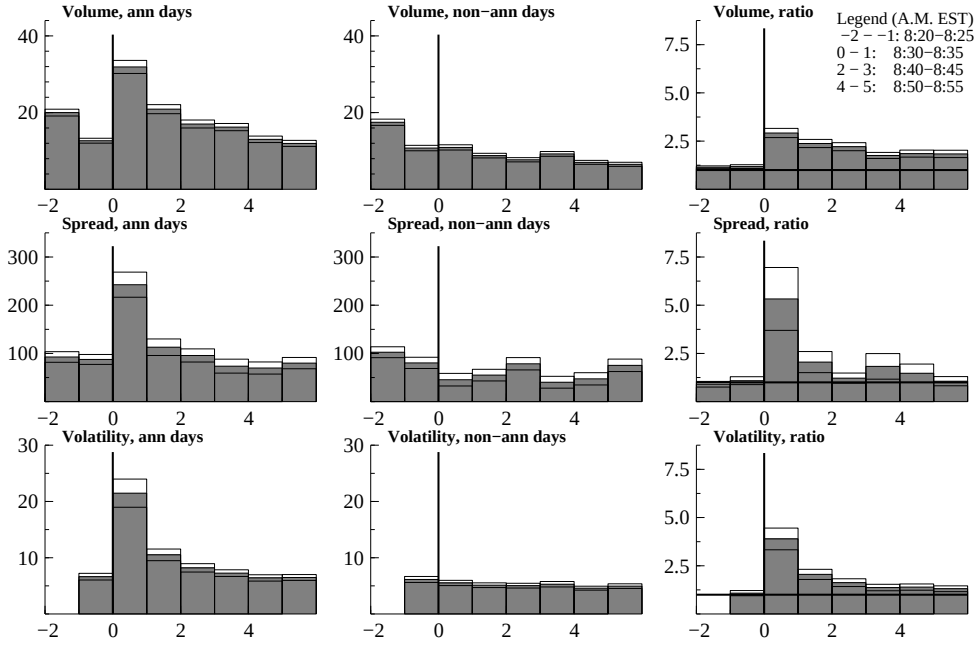


Figure 2: Patterns around announcement interval

Panel (a) shows the patterns in volume (in 1,000 contracts), bid-ask spread (in basis points) and volatility (in %) for each 5 minute interval around the 8:30 A.M. announcement time (the bold vertical line). The plots in the left (middle) column show the intraday pattern for announcement (non-announcement) days. The right column shows the ratio of the two (with a bold horizontal line at 1). The grey bars indicate the estimate, with the 95% confidence bounds given by the lines above and below the top of each bar. Panel (b) shows the volume for three types of trades: local, dual and broker trades. Dual trading volume is further divided into the volume of trades for her own account and for customers.

(a) Overview: volume (total), spread and volatility



(b) Volume per group

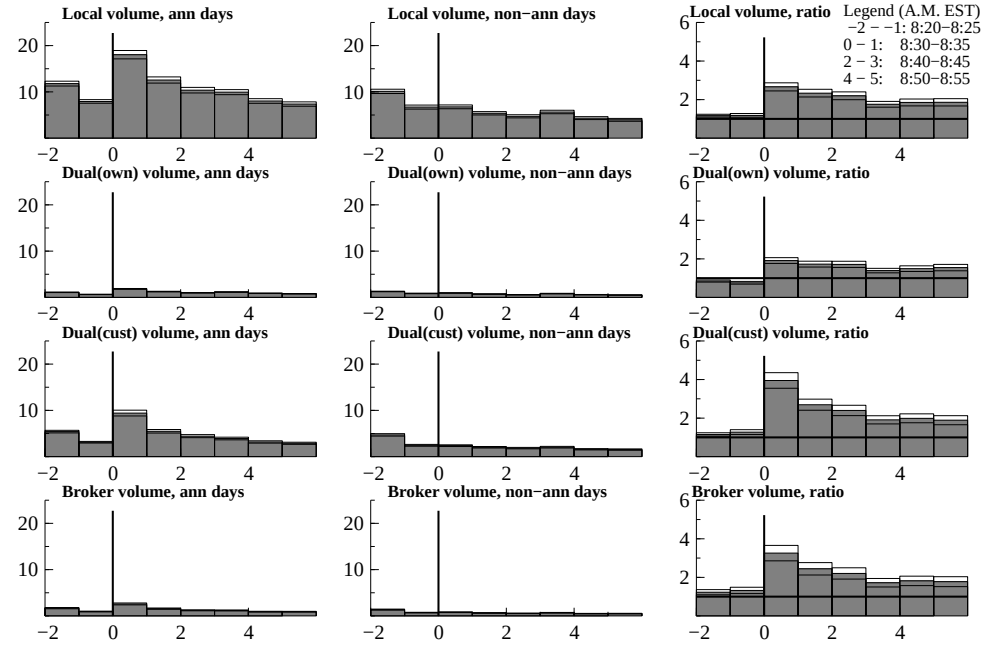


Figure 3: Intraday Pattern of Price Impact of Customer Order Flow (15-minute intervals)

In this figure the full intraday pattern of the price impact of customer order flow is shown, based on 15 minute intervals. The solid (dashed) lines show the intraday pattern for announcement (non-announcement) days, the solid vertical line represents the 8:30 announcement interval. An open (closed) circle indicates significant difference between announcement and non-announcement days at the 5% (1%) level.