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

Albert J. Menkveld

Vrije Universiteit Amsterdam
De Boelelaan 1105
1081 HV Amsterdam, Netherlands
Phone: +31 20 598 6130
Fax: +31 20 598 6020
ajmenkveld@feweb.vu.nl

Asani Sarkar

Federal Reserve Bank of New York
33 Liberty Street
NY 10045, New York, USA
Phone: +1 212 720 8943
Fax: +1 212 720 1582
asani.Sarkar@ny.frb.org

Michel van der Wel

Tinbergen Institute and Vrije Universiteit, Amsterdam
De Boelelaan 1105
1081 HV Amsterdam, Netherlands
Phone: +31 20 598 8626
Fax: +31 20 598 6020
mwel@feweb.vu.nl

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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 positively 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 may be 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 (Evans and 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 Evans and Lyons (2005) argue, 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 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 studies 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 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 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. Additional tests rule out the possibility that dual traders are better skilled than locals and that skills, rather than customer information, are the source of dual trader profits.

The decision of informed customers to execute trades through dual traders is an apparent puzzle given the higher trading costs of such trades, compared to brokers' customer trades. We have shown that, in practice, it is difficult for most customers to freely choose their brokers. And, for those customers who may do so, there may be additional economic benefits to offset the higher bid-ask spreads associated with trading through dual traders.

We study the market for 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 note are divided between the spot and futures market (Fleming and Sarkar, 1999), 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 by which news spreads through the market. In Section 3 we discuss our data and in section 4 we present descriptive statistics. Section 5 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 9 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 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 about 85% for the 30 year bond,

it is less than 20% 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 Time (ET) and 15:00 P.M. ET. 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 (1999), who use data from 1993 for 'on-the-run' securities (i.e. the most recently issued security in a maturity) in the spot market and for the most nearby futures contracts. The authors use GOVPX data for the spot market to obtain trading volume for the spot market. Since GOVPX covers a small part of the 5-year bond market and an even smaller part of the 30-year bond market, we adjust these numbers using GOVPX coverage ratios, as reported in Fleming (2003).

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 data 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 APPENDIX A 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. Appendix A 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. ET, 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 A.M. instead of 8:30 A.M.,
- 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 1 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 1 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 A.M. announcement days, and the Nonfarm Payroll Employment announcements, which are roughly one-tenth of all 8:30 A.M. announcement days. These subsets of announcements have previously been found to have significant market impact (see Green (2004) and Fleming and Remolona (1999)). Table 1 also lists the 15 different announcements that take place at 8:30 A.M. 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 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 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 CTI1 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*B*, 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 dollars) and volatility (in %, scaled to represent the full day figure) for the 30 year T-Bond futures on announcement and non-announcement days during 1994 to 1997. Consistent with the previous literature (e.g. Locke et al, 1999), we define the bid-ask spread as the volume-weighted average of the customer buy price minus the volume-weighted average of the customer

[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."

sell price in an interval. 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). 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. As shown in Panel (c), the volatility is also higher for most of the announcement day compared to non-announcement days. In contrast, Panel (b) indicates that 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 2 ABOUT HERE]

Panel A of Table 2 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. Finally, the trade size,

volatility and the bid-ask spread are, respectively, 1.07, 1.21 and 1.14 times higher on announcement days relative to non-announcement days.

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 2, 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 26% 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 statistically significant. [6] Volume and volatility remain significantly higher on announcement days even at 9 A.M., 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 4 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 2 to 3 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-

[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.

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.

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 A.M.. 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 A.M. to 8:35 A.M.. 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:

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

where t=1, ..,T is a trading day, k=1,..,K is an announcement at 8:30 A.M., 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 A.M. 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 3 ABOUT HERE]

The results underlying Figure 3 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 3 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 of Table 3 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 3 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 A.M. to 8:35 A.M. 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).

[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.

Since Figure 3 shows that announcement effects on order flow are highest in the first 15-minutes after the announcement, we now focus more narrowly on the period 8:30 A.M. to 8:45 A.M.. We estimate (2) for 5-minute intervals h==1, 2, 3, where h=1 is the event interval from 8:30 A.M. to 8:35 A.M., and h=3 indicates the interval from 8:40 A.M. to 8:45 A.M.. These results, which are in Panel C of Table 3, 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 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. 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. Proprietary 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. Since dual traders observe the trades of their customers while locals only observe the aggregate order flow, dual traders have an informational advantage that may translate into higher trading profits. Dual traders may profit from their information by mimicking or piggybacking on their informed customer trades, as shown by Fishman and Longstaff (1992) and Sarkar (1995).[9] 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:

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

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

[9] Dual traders may wish to trade ahead or frontrun their informed customer trades, but frontrunning is illegal in U.S. futures markets.

profits for the full day, Rf_t is the end-of-day settlement price; [10] 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:

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

[INSERT TABLE 4 ABOUT HERE]

Panel A of Table 4 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

[10] The valuation of end-of-day inventory assumes that traders do not carry inventory between days, an assumption that is largely validated by the data.

remain true for the two sub-samples of announcements. Dual trader profits are higher than those 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 non-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.

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:

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

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 5 ABOUT HERE]

Table 5 shows the results from estimating (5) for different proxies of a dual trader's access to customer order flow $C_{k,t}$. In models 1 and 3, the proxy is the number of dual trader k's

customer trades or volume on day t; in models 2 and 4, 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.[11] 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.

For each model m=1, 2, 3, 4, we present results for regressing the dual trader's profits on 3 sets of explanatory variables: a constant and $C_{k,t}$ (column heading m), a constant, $C_{k,t}$, the controls (i.e. volatility and the number of dual traders) and the surprise (column heading m'), and $C_{k,t}$ with day dummies (column heading m''). The inclusion of day dummies in specification m'' allows us to control for *all* deterministic time series variations (including those of the control variables) and, therefore, only explore the cross-section.

The results from estimating (5) are reported in Table 5. In column (1), we find that the number of customer trades 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 add the control variables and find that the estimate of the number of customer trades remains positive

[11] Jones, Kaul, and Lipson (1994) show that the positive volume-volatility relationship reflects the positive relationship between the number of trades and volatility, and that trade size has little incremental information content.

and significant, although its magnitude is about halved, 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 find that the results from the pure cross-sectional regression 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 5, we use the number of signed customer trades as a proxy for the dual trader's access to customer order flow. 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 5, 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 5, 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 the controls are excluded, 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 possible determinants of profits such as volatility, competition for order flow and the announcement surprise.

8. Do Superior Skills Explain Dual Traders' Profits?

Previously, we have argued that the customer order flow is informative on announcement days, and that it is the source of dual traders' additional profits on these days. In this section, we consider the alternative explanation that dual traders' profits are mainly due to their superior trading skills, compared to locals; furthermore, informed customers give their orders to dual traders in order to benefit from their greater skills. Note that, while this line of argument provides an alternative explanation for dual trader profits, it nevertheless acknowledges that customer order flow is informative.

To examine whether superior trading skills or access to customer order flow is the source of dual trader profits, we follow Fishman and Longstaff (1992) and focus on the group of floor

traders who are dual traders on some days and locals on other days. We call this group the "non-pure dual traders," and compare their trading profits on local and dual days. Since the comparison is for different days of the same trader, we control for the skill level of the floor trader. Thus, significantly higher profits on dual days of the same trader must be due to the trader's access to customer order flow on his/her dual days.

Panel A of Table 6 reports the difference in profits on local and dual days of non-pure dual traders for the 8:30 to 8:45 A.M. time period, with a positive number indicating that non-pure dual traders have higher profits on their dual days. We find that the profit difference is positive about 63% of the time and a binomial test shows that this percentage is significantly different from 50%. These results imply that observing the customer order flow is the source of dual trader profits, and not trading skills. In the next two columns, we show results after splitting the sample into announcement and non-announcement days. For non-announcement days, we find that the profits difference is positive only 55% of the time, which is not statistically different from 50%. However, for announcement days, the profits difference is positive 58% of the time, which is statistically significant. These results provide additional support the idea that the customer order flow is particularly informative on announcement days, and observing these flows is profitable for dual traders.

To further examine the issue of whether dual traders have special trading skills, we define a group of "pure locals," who are floor traders who trade only for their personal accounts every day that they are active in the sample. We then compare the profits on local days of pure locals and non-pure dual traders. Since neither group observes customer order flow on these days, any difference in profits is most likely be due to differences in trading skills. Panel B of Table 6 reports the in profits on local days of non-pure dual traders and locals for the 8:30 to 8:45 A.M.

time period. We find that the median profits of dual traders and locals are statistically indistinguishable on local days. When we split the sample into announcement and non-announcement days, we find that trading profits of both locals and dual traders are higher on announcement days, consistent with our earlier results and with the idea that supplying liquidity on announcement days is costly due to the high volatility. However, there is no statistically significant difference in median profits of dual traders and locals either on announcement or on non-announcement days.

Our results in this section clearly indicate that trading skills are not the source of dual trader profits. In particular, profits of locals and dual traders are statistically similar on local days, when neither group directly observes customer order flows. In contrast, dual traders have higher profits on their dual days compared to their *own* local days. Hence, the source of dual traders' profits is his/her access to customer order flow, and not trading skills.

9. Customers' Choice of Brokers

So far, we have established that informed customers choose dual traders to execute their trades, especially on announcement days. However, since dual traders make additional profits on these days, it follows that trading costs of customers must also be higher on announcement days. This is indicated by the results in Panel B of Table 3, which show that customer trades of dual traders have higher bid-ask spreads than those of brokers both on announcement and non-announcement days. This appears to be a puzzle: why are customers willing to give their orders to dual traders in spite of higher trading costs?

For the sample period of our study, it may not have been easy for customers to choose their brokers. Independent floor traders, who are more apt to dual trade, executed most customer trades—certainly most retail trades. Large customers can request order execution by the

brokerage firm's trading desk instead of by independent floor traders. But the desk's trading capacity may be limited, especially during active markets.

In the remainder of this section, we consider several reasons as to why even large customers may find it beneficial to execute their orders through dual traders. We examine whether dual traders allow risk-averse customers to smooth profits. Then, we discuss whether dual traders are better able to provide liquidity on announcement days than brokers. Finally, we discuss whether dual traders provide some unobservable benefit to their customers.

To examine the distribution of 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; many customers may trade via one trader and a customer may trade via multiple traders.[12]

The results for profits of customer trades for the full day (Panel A) and for the first 15 minutes after announcements (Panel B) are in Table 7. 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. Comparing customer profits of dual traders and brokers, we observe that customers lose more money with dual traders. These results are qualitatively similar for the full

[12] 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".

day and the first 15 minutes, and are consistent with the summary statistics reported in Panel B of Table 3.

A new result in Table 7 is that the standard deviation of customer profits is lower on announcement days for dual traders' customers, compared to broker customers. If customers are risk averse, they may value the ability of dual traders to smooth profits. Assuming negative exponential utility and normally distributed profits, the certainty equivalent profits *CEP* of a risk-averse customer is:

$$CEP = E(\text{Pr}ofits) - Var(\text{Pr}ofits)/2 \qquad (6)$$

Using the numbers from Table 7, we observe that, on announcement days, *CEP*= - -24,036 for customers of dual traders and *CEP*= -55,887 for customers of brokers. Thus, accounting for risk aversion, customers have higher expected utility when trading with dual traders. A similar calculation shows that, even on non-announcement days, risk-averse customers have higher expected utility with dual traders than with brokers.

In addition to smoothing profits, dual traders may be better able to provide liquidity to customers compared to brokers on days when the market is particularly volatile (e.g. announcement days), as argued by Grossman (1989). Indeed, considering again the results in Panel B of Table 3, we find that while the bid-ask spread for customer trades of dual traders is higher on announcement days by 13%, the corresponding number is 26% for brokers. This is indirect evidence that trade execution is more difficult on announcement days, and dual traders are able to provide *relatively* better execution than brokers on announcement days.

Another economic reason for customers to choose dual traders is that they receive some unobserved benefits, such as lower commissions. In particular, Fishman and Longstaff (1992) show that, in equilibrium, if the brokerage industry is competitive, dual traders will pass on the

additional revenues from personal trading to their customers in the form of lower commissions. Alternatively, dual traders may compensate informed customers by paying for information (Naik,Neuberger and Viswanathan, 1999), or by providing facilitation services (Aitken, Garvey and Swan, 1994).

The decision of informed customers to execute trades through dual traders is an apparent puzzle given the higher trading costs of such trades, compared to brokers' customer trades. We have shown that, in practice, it is difficult for most customers to freely choose their brokers. And, for those customers who may do so, there may be additional economic benefits to offset the higher bid-ask spreads associated with trading through dual traders.

10. 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. We do not find evidence that dual traders have greater skills than locals, and that skill is the source of their profits.

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Table 1: 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 data on macroeconomic announcements is from the International Money Market Services (MMS). The announcement days are days on which there is an 08:30 A.M. announcement and no other announcement in the morning (i.e., 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 in the Sample

Announcement Type	1994	1995	1996	1997	Total
GDP Advance	3	4	1	4	12
GDP Preliminary	3	1	1	2	7
GDP Final	3	0	5	2	10
Nonfarm Payroll Employment	9	8	7	10	34
Retail Sales	9	11	9	12	41
Personal Income	5	3	5	4	17
Personal Consumption Expenditure	5	3	5	4	17
Durable Goods Orders	11	11	8	7	37
Business Inventories	0	0	0	7	7
Net Exports	12	10	11	11	44
Producer Price Index	11	11	11	10	43
Consumer Price Index	7	7	7	7	28
Housing Starts	11	9	10	9	39
Index of Leading Indicators	5	2	6	6	19
Initial Unemployment Claims	40	37	36	43	156

Table 2: 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 number of traders active, the average spread (in $) and the average volatility (in %, scaled to represent the full day figure). 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. Volatility is the maximum of the standard deviations of the customer buy and sell prices. 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 $)	6.4	5.6	1.14
Volatility (in %)	0.5	0.4	1.21

Panel B: Breakdown according to Trader Type (5min avg)

	Own Account (CTI 1)			For Customer (CTI 4)		
	Ann Days	Non-ann Days	Ratio	Ann Days	Non-ann Days	Ratio
Volume	5,203.8	3,691.2	1.41	2,708.9	1,899.8	1.43
Through Dual Trader	4,515.7	3,141.9	1.44	2,092.9	1,460.7	1.43
Through Broker	688.1	549.3	1.25	616.0	439.1	1.40
#Transactions	450.3	345.9	1.30	145.7	112.3	1.30
Through Dual Trader	353.3	264.0	1.34	117.4	90.9	1.29
Through Broker	96.9	81.8	1.18	28.2	21.4	1.32
Trade Size	10.9	10.2	1.07	17.5	16.1	1.09
Through Dual Trader	12.0	11.3	1.06	16.8	15.2	1.11
Through Broker	6.9	6.5	1.07	20.6	19.6	1.05
#Traders Active	138.3	116.8	1.18	50.9	42.4	1.20
As a Dual Trader	98.3	81.4	1.21	41.3	34.5	1.20
As a Broker	40.0	35.4	1.13	9.6	7.9	1.21
Bid-Ask Spread (in $)				6.4	5.6	1.14
Through Dual Trader				6.7	5.9	1.13
Through Broker				4.3	3.4	1.26

Table 3: 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 surprise 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 3, 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 3 (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 4: Proprietary Trading Profits per Round Trip, by Trader Type

The table reports proprietary trading profits per round trip contract for each type of trader with trading for own account (local and dual) 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 on a day if the proportion of volume for her own account, as a ratio of total (own+customer) volume, is greater than 98%. 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 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 and dual trader's CTI1 median trading profits (based on a Wilcoxon ranksum test) at the 5% level, xx at the 1% level or less.

Panel A: Proprietary 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

Panel B: Proprietary Trading Profits per Round Trip: 8:30-8:45

	#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

Table 5: 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 proprietary 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, in % and scaled to represent the full day figure) 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**	0.231**	0.211**									
	9.81	3.62	3.3									
Signed Trades												
$\lvert\sum_j D^c_{j,k,t}\rvert$				1.13**	0.725**	0.726**						
				9.89	6.23	6.23						
Quantity												
$\sum_j Q^c_{j,k,t}$							0.00358**	-0.00156	-0.00159			
							2.6	-1.12	-1.13			
Signed Quantity												
$\lvert\sum_j D^c_{j,k,t}Q^c_{j,k,t}\rvert$										0.00668*	-0.00127	-0.00143
										2.3	-0.434	-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		2.84**			2.8**			2.97**			2.97**	
		7.3			7.21			7.68			7.66	
# Duals per Cust Trade		-35.3*			-36.1*			-49.2**			-47.8**	
		-2.22			-2.31			-3.14			-3.06	
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

Table 6: Profits of Non-pure Dual Traders and Pure Local Traders

The table reports the difference in average proprietary trading profits on dual days compared to local days for non-pure dual traders (Panel A) and trading profits per round trip contract for local days of pure local traders and non-pure dual traders (Panel B). 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 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%. We call a Local (Dual) Trader a Pure Local (Pure Dual) Trader if all his days are Local (Dual) Days and a Non-pure Local (Non-pure Dual) Trader if not all his days are Local (Dual) Days. With this definition a pure local trader only does proprietary trading over the full sample period, whereas a non-pure dual trader has access to customer order flow at least once during the sample (ie he has at least once a broker day and/or a dual day). We omit non-pure dual traders that only have broker and local days, thus traders that have no dual days over the sample are not included in the group of non-pure dual traders. 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 last price before 8:45. 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 in the 8:30-8:45 interval. In Panel A we solely look at the group of non-pure dual traders, comparing profit on local days with profit on dual days. For this we focus on the group of non-pure dual traders that have both local days and dual days, ignoring whether these traders possibly also have broker days. For each non-pure dual trader we subtract the average trading profits on local days from the average trading profits on dual days to get the profit advantage on dual versus local days. In Panel B we compare profits on local days of pure local traders and non-pure dual traders. In both panels we show results for the full sample and for both the announcement and non-announcement days. In Panel A we show the mean, standard deviation and the three quartiles (*1st quartile*, *Median* and *3rd quartile*) of the profit advantage (with the number of non-pure dual traders in each group in the column *#Non-pure Duals*) as calculated for the full day. The bottom two rows provide a simple test to see whether the profit advantage is significant. The percentage of times the difference is potive is given (given in the row *%-age positive*) and the z-statistic from the binomial test (in row *Test z-statistic*; conform Fishman and Longstaff, 1992). In Panel B we show mean, standard deviation (*St Dev*) and the three quartiles (*1st Q*, *Median* and *3rd Q*) of the trading profits for pure local traders and non-pure dual traders (with the number of trader days in each group in the column *#Tr. days*).

Panel A: Non-pure Dual Traders' Profit Advantage on Dual vs Local Days

Difference in profits	All Days In Sample	Non-ann Days	All Ann Days
#Non-pure Duals	234	184	200
Mean Profit Advantage	8.6	2.8	13.5
Standard Deviation	59.1	35.9	68.0
1st quartile	-8.3	-12.6	-10.2
Median	5.6	3.5	5.0
3rd quartile	24.6	14.7	34.7
%-age positive	63.2	55.4	58.0
Test z-statistic	4.05	1.47	2.26

Panel B: Trading Profits per Round Trip on Local Days, Pure Locals vs Non-Pure Duals

	#Tr. days	Mean	St Dev	1st Q	Median	3rd Q
Own Account (CTI 1)						
Local Days of Pure Local						
Non-announcement Days	33,083	2.8	37.4	-12.7	0.1	20.4
All Announcement Days	42,808	8.7	67.2	-13.6	7.8	31.2
Nonfarm, CPI, PPI	18,499	16.7	90.2	-11.7	14.4	42.7
Nonfarm Payroll Emp.	6,911	26.5	115.8	-11.6	23.4	61.7
Local Days of Non-Pure Dual						
Non-announcement Days	27,880	2.3	38.3	-13.9	0.0	20.8
All Announcement Days	36,061	8.5	67.4	-12.9	7.8	31.2
Nonfarm, CPI, PPI	5,887	17.8	101.6	-13.5	15.6	47.8
Nonfarm Payroll Emp.	1,100	27.7	131.2	-7.8	25.2	65.4

Table 7: Aggregate Customer Trading Profits per Round Trip, by Trader Type

The table reports aggregate customer trading profits per round trip contract for each type of trader with customer trades (dual and broker) 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 Broker on a day if the proportion of volume for her own account, as a ratio of total (own+customer) volume, is 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 aggregate customer 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). Since the data does not identify the customer underlying the trade but the floor trader that executed it, the profits can not be calculated on a per customer basis. The profits can however be interpreted as aggregate customer profits for the customers linked to the each floor trader. 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 broker's and dual trader's CTI4 median trading profits (based on a Wilcoxon ranksum test) at the 5% level, xx at the 1% level or less.

Panel A: Aggregate Customer Trading Profits per Round Trip: Full Day

	#Tr. days	Mean	St Dev	1st Q	Median	3rd Q
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

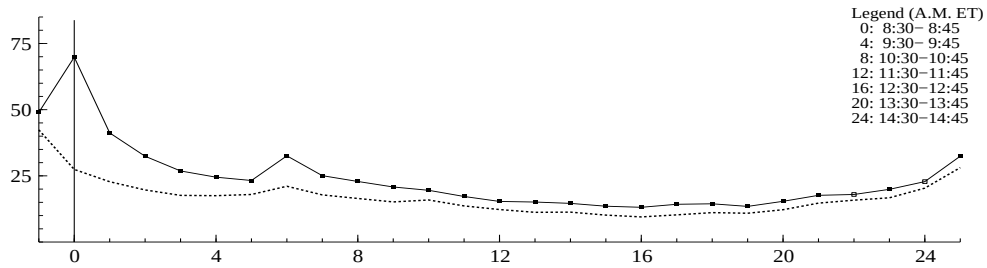
Panel B: Aggregate Customer Trading Profits per Round Trip: 8:30-8:45

	#Tr. days	Mean	St Dev	1st Q	Median	3rd Q
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

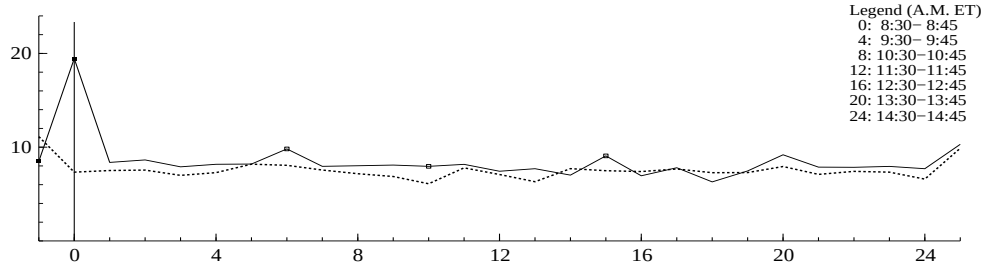
Figure 1: Intraday Patterns (15-minute intervals)

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, bid-ask spread in dollars and volatility in % and scaled to represent the full day figure.

(a) Volume (in 1,000 contracts)



(b) Bid-Ask Spread (in $)



(c) Volatility (in %)

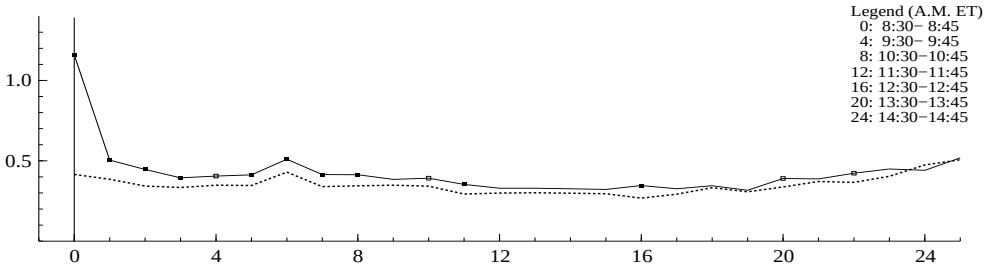
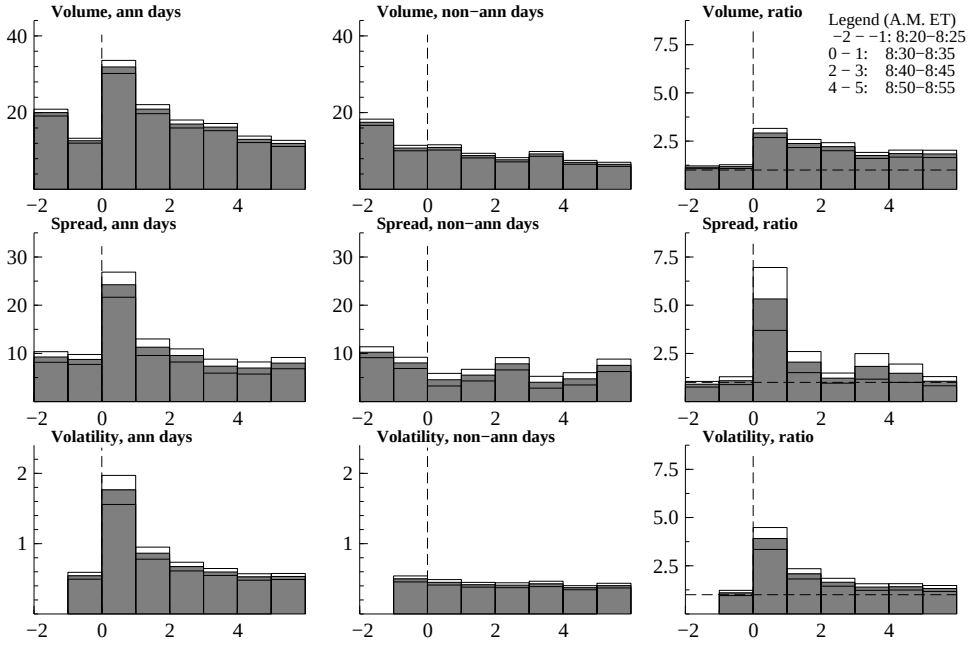


Figure 2: Patterns around announcement interval

Panel (a) shows the patterns in volume (in 1,000 contracts), bid-ask spread (in dollars) and volatility (in %, scaled to represent the full day figure) 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 (in $) and volatility (in %)



(b) Volume per group

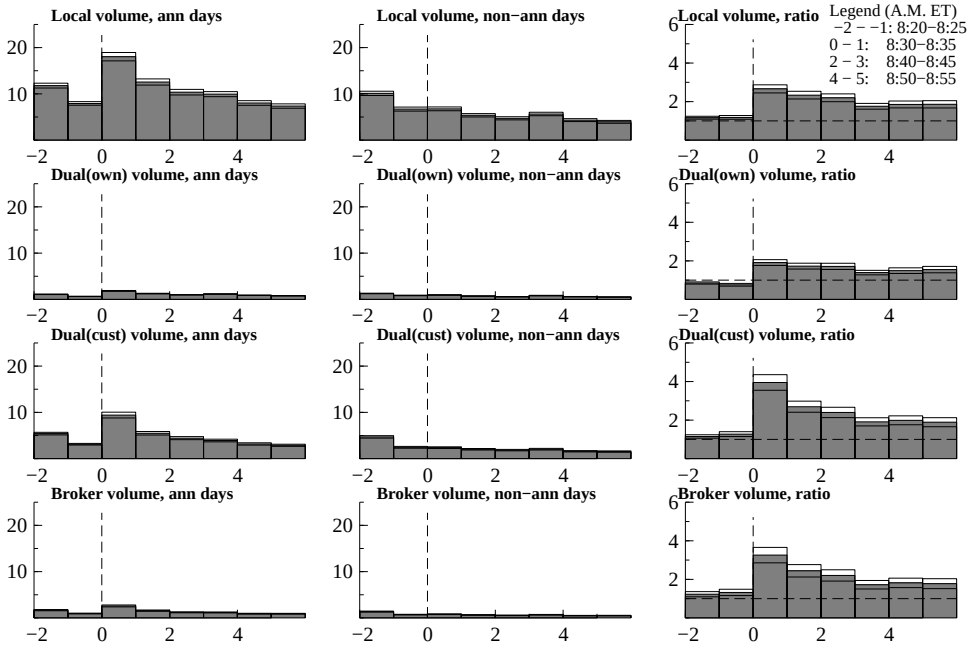
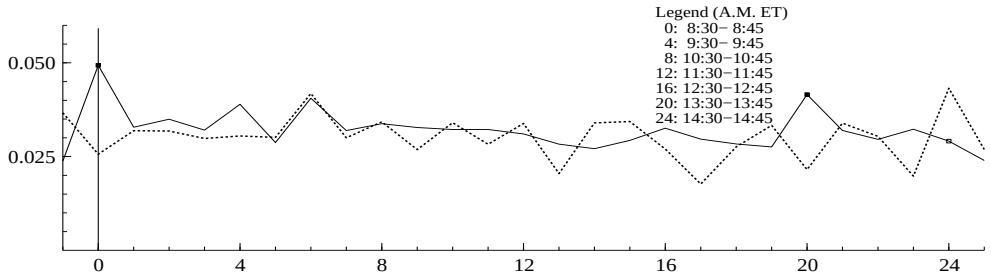


Figure 3: Intraday Pattern of Price Impact of Customer Order Flow (15-minute intervals)

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.



Appendix A: 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 (ET)	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	