

Large Trades and Intraday Futures Price Behavior

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Abstract

This paper examines the effects of outside customer large trades on the futures prices of five contracts traded on the Chicago Mercantile Exchange (CME): (1) S&P 500 Index futures; (2) NASDAQ-100 Index futures; (3) British Pound futures; (4) Live Cattle futures; and (5) Eurodollar futures. The Commodity Futures Trading Commission's unique Computer Trade Reconstruction (CTR) data is used for our analysis and the sample period covers January 2001 to December 2004. We find, for the whole sample period, that the buyer-initiated large trades have a larger permanent price impact than the seller-initiated large trades have and vice versa for the liquidity price effects. These results are consistent with previous findings on block and institutional trades in the equity markets. However, we find that the information (permanent) price effect of large sells are larger than the effects of large buys in bearish markets while the results are reversed in bullish markets. The liquidity price effects of buys are larger than the liquidity price effects of sells in bearish markets whereas the reverse results hold in bullish markets. Thus, our results are consistent with the hypothesis advanced by Chiyachantana, Jian, Jiang and Wood (*J. Finance* LIX, (2004)) that the current economic condition is a key determinant of asymmetric price effects between large buys and large sells.

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1. Introduction

Futures market participants have increasingly paid attention to the price impact of large trades as the trading activity of large traders (i.e., commodity pools, hedge funds and others) in futures markets has surged. The price impact of large trades is one of the major components of transaction costs, which influence alternative trading strategies and the performance of investment returns. However, to the best of our knowledge, there is no empirical literature on the price impact of large trades in US futures markets. This paper seeks to fill this void.

Most of the existing literature on the price impact of large trades is concentrated in the equity markets. Previous literature on the price impact of block trades in equity markets includes Kraus and Stoll (1972), Holthausen, Leftwich and Mayers (1987, 1990), Gemmill (1996), Keim and Madhavan (1996), and others. Chan and Lakonishok (1993, 1995) investigated the price impact of institutional trades on equity prices. In general, prior empirical studies document two interesting results:

(1) The total price impact of buyer-initiated transactions is higher than the total price impact of seller-initiated transactions. This suggests that markets react differently to buy and sell trades; and

(2) There is an asymmetric price response of buys and sells when the total price impact is separated into information (permanent) effects and liquidity (temporary) effects after the execution of a large trade transaction.

Saar (2001) provides a theoretical model to explain these puzzling results. His model relates the price impact of block trades to the underlying economic environment and suggests that the history of a particular stock's price performance influences the shape of the asymmetrical information effects between buys and sells. Chiyachantana, Jain, Jiang and Wood (2004) report empirical evidence of the price impact of institutional trading behavior in international stocks from thirty-seven countries. They demonstrate that the contemporaneous market condition is the major factor affecting asymmetric price impacts. For example, in bearish markets, the price impact of seller-initiated trades is higher than that of buyer-initiated trades, and vice versa under bullish market conditions.

Frino and Oetomo (2005) examine the market impact cost (slippage) of packages of trades in stock index futures and interest rate futures contracts traded on the Sydney Futures Exchange.¹ They find that the slippage costs incurred in executing packages of trades in these contracts are significantly smaller than the market impact costs documented previously for equity markets. Furthermore, they obtain two interesting results: (1) there is strong evidence that market impact costs are mainly due to liquidity costs; and (2) the market impact cost is symmetrical for buys and sells.

Our paper makes several contributions to the literature on the price impact of large trades in futures markets. First, we use a unique data set, Computer Trade Reconstruction data (CTR), to examine the total, liquidity and information price impacts of outside customer large trades within a single day on five futures contracts traded on the Chicago Mercantile Exchange (CME) during the time period from January 2001 to December 2004. These five futures contracts include: S&P 500 Index, NASDAQ-100

¹ A sequence of trades is grouped into trade packages that belong to the same original order. Particularly, trades are grouped into packages if they are executed (a) by the same trader, (b) in the same direction, and (c) consecutively without a one-day trading break. See Frino and Oetomo (2005), p. 1133.

Index, Live Cattle, British Pound and Eurodollars. This is the first paper to examine the market impact costs of outside customer large trades in US futures contracts. Second, we compare our findings on market impact, information and liquidity costs with the results previously documented in the equity markets and the Australian futures markets. Third, we test the contemporaneous market condition hypothesis suggested by Chiyachantana, Jain, Jiang and Wood (2004) to explain the asymmetric response of buys and sells in the market impact, information and liquidity price effects. Chiyachantana, et al. (2004) only confirmed this hypothesis on total price impact costs.²

The paper is organized in five sections. Section 2 reviews the previous literature on the price impact of large trades, including empirical evidence and alternative hypotheses to explain the reasons for the price movements for large trades. Section 3 discusses the data and empirical methodology. Empirical results are reported in section 4. Section 5 presents summary and conclusions.

2. Literature Review – Reasons for Price Movement

In this section, we review alternative hypotheses and empirical evidence regarding the price impact of large trades and institutional trades in the equity markets and the Australian futures markets.

Previous studies on the price impacts of block trades (Kraus and Stoll (1972), Holthausen, Leftwich and Mayers (1987, 1990), Gemmill (1996)) have found a general pattern that a purchase block trade in the equity markets is accompanied by an increase in the individual equity's price, which continues to rise after the block trade. These studies also find that a sale block trade is usually accompanied by a drop in the equity's price,

² They use daily volume-weighted average price (see Jones and Lipson (2001) and Berkowitz, Logue and Noser (1988)) as the benchmark to calculate the total price effect of large trades. For this reason, they cannot separate the total price effects into information and liquidity effects.

but there is subsequently a strong price reversal. Thus, they provide empirical evidence that block purchases have larger total price and permanent price impacts than block sales have. The empirical research on the price impacts of institutional trades (Chan and Lakonishok (1993, 1995) and others) document similar results.

Chan and Lakonishok (1993) and Keim and Madhavan (1996) suggest that the asymmetric price response of block purchases and sales is due to differences in the information content. They suggest that the creation of new long positions is more likely the result of new private information (firm-specific information). They base this conjecture on the following:

(1) Institutional investors devote large research resources to identify those individual stocks whose prices are expected to rise out of the many stock alternatives available to them; and

(2) Most mutual funds limit their investment to the funds received from shareholders, rather than borrowing from other sources.³ Therefore, an investment in one stock has an associated opportunity cost from not investing in other stocks.

On the other hand, they suggest that sales of institutional trades are primarily made for liquidity-motivated reasons. For example, a particular stock may be sold because it has failed to meet the objectives of the mutual fund, or because of a portfolio asset reallocation.

The differences in price and liquidity effects of block and institutional trades may be due to differences in short-run liquidity costs. Large (block) traders are willing to accommodate customer's sales by purchasing shares and holding them in inventory, and

³ Further detailed discussions on the behavior and investment strategy of mutual fund manager may be found in Saar (2001, pp. 1154, 1160-64).

are compensated by short-run price concessions. Most block traders are less willing to do short selling in order to meet the needs of the block buyers because they are concerned that the prices may rise after the block purchase. For this reason, most of the drop in prices of block sales is due to short-run liquidity costs; hence, there is strong price recovery subsequent to the block sales.

Another possible reason for price changes associated with block trades may be imperfect substitution for a particular stock(Scholes (1972)). A buyer faces an upward supply curve and a seller face a downward demand curve. Thus, a premium has to be offered by the buyer or seller of a block trade in order to attract the opposite side of the trade. If supply is more inelastic than demand, than the permanent price effect of purchases would be larger than the permanent effects of sales. Consequently, liquidity effects (price reversals) would be smaller for purchases than for sales.

Saar (2001) develops a theoretical model to explain the previous empirical evidence found in equity markets that the permanent (information) effect of buys is greater than that of sales. His model demonstrates how the trading strategy of institutional portfolio managers generates a difference in information content of purchases and sales.⁴ The theoretical model states that past price performances influences the shape of the asymmetry between the permanent effects of buys and sells after a block trade. For example, the model predicts that the information effects of sales is greater than that of buys following a long period of price run-ups, and the information effect of buys is greater than that of sales following a long period of price declines.

However, he did not validate his model using real-world data.

⁴ Saar (2001, p. 1154) presents an excellent discussion on four basic assumptions on investment and trading strategy of mutual funds mangers. Based on these assumptions, he derives his theoretical model.

Chiyachantana, Jain, Jiang and Wood (2004) examine the characteristics of institutional trading in international stocks from 37 countries during the periods 1997 to 1998, and 2001. They find that the current economic condition is a major determinant of the asymmetry of total price impact of institutional buys and sells. They show that the total price impact of buys is greater than that of sells in bullish markets, and that the pattern is reversed in bearish markets. They suggest that all previous studies on US equity markets employed data during the bullish market periods only. The basic reasoning behind their hypothesis is that price impact is a function of market liquidity provided by the opposite side of a transaction. Institutional investors must pay for liquidity when selling in falling markets and purchasing in rising markets. Institutional traders effectively provide liquidity when trading against price trends in the market. Thus, they face lower price impacts in this situation. However, Chiyachantana et al. did not examine the asymmetry between information effects of buys and sells in bullish and bearish markets because they did not decompose the total (market) price impact (cost) into permanent and liquidity price effects.

Frino and Oetomo (2005) is the first paper to report empirical evidence of market price impact (slippage) of trading packages in futures markets. They characterize the market, information, and liquidity price effects incurred in executing package of trades in four main futures contracts (S&P 500, BAB, 3-year bonds and 10-year bonds) on the Sydney Futures Exchange, using intraday data from July 1, 2000 to June 30, 2003. They obtain three interesting results:

(1) The market impacts incurred in executing trade packages in stock index futures and interest rate futures are significantly smaller than the price-impact costs documented previously for US equity markets.

(2) There is little evidence of asymmetry in the price impact of buys and sells, which is contrary to the findings in US equity markets. And

(3) The liquidity effect is the major portion of spillage costs in Sydney futures markets, and there is little information effect. They claim that these results are consistent with previous work, which conjectures an absence of private information in stock index futures.

The major objectives of our paper are twofold:

(1) To document the empirical patterns of total price impacts in five futures contracts traded on the CME using four-year intraday data. Thus, we can observe whether the empirical results documented by Frino and Oetomo (2005) in the Australian futures markets are consistent with the empirical results we obtain in the US futures markets.

(2) To perform a direct test on whether the economic condition hypothesis proposed by Chiyachantana, Jain, Jaing and Wood (2004) is a major determinant of the asymmetry between price, liquidity and information effects of block buys and sells in US futures markets.

3. Data and Empirical Methodology

3.1 Data

Our study uses a unique data set, Computer Trade Reconstruction (CTR) data, to examine the total price, liquidity and information effects of outside customer large trades on five futures contracts traded on the CME. The CTR data set is the major audit trail

information source used by the Commodity Futures Trading Commission (CFTC) to track every trade by each trader in the market. This data is reconstructed based on the trading cards submitted by traders to the exchange clearinghouse for settlement and reconciliation at the end of each day's trading. The CTR data contain the following information: the commodity code, the trading date and time, the price, the quantity, and the identification of executing traders and trade direction (i.e., whether the trade was a buy or a sell) by four types of traders. The Customer Type Indicator (CTI) 1 trader is a local who trades for his own account as well as for outside customers; a CTI2 trader is a clearing member's house account; a CTI3 trader is a local trading for another local; and a CTI4 trader trades for any other type of customer (outside customers). This unique data set provides us with information on the trade initiation by trader types. Thus, we minimize the errors of using trade classification methods.⁵

To cover a broad spectrum of futures contracts, this study includes: (1) two index futures (S&P 500 and NASDAQ-100); (2) one physical commodity futures (Live Cattle); (3) one foreign exchange futures (British Pound); and (4) one interest rate futures (Eurodollars). The key features of each contract are described in the Appendix.

The nearby futures contracts are used in our analysis because they are the most liquid contracts.⁶ Given that some large trades are split into a sequence of smaller trades, we aggregated trades if they satisfied the following criterion: (1) they had the same trade

⁵ The procedure suggested by Lee and Ready (1991) is the most widely used procedure to identify the directions of trades. Holthausen, Leftwich and Mayers (1987) find that the method classifies only 52.8% of a sample of trades which are known to be buyer-initiated trades.

⁶ During the maturity months, the nearby futures prices are rolled over into the daily prices of the first deferred contract month. The date of the rollover occurs when the trading volume of the first deferred contract is greater than the trading volume of the nearby contract. The rollovers often occur in the middle or later parts of the maturity month.

identification; (2) they were executed in the same trade direction; and (3) they were executed in the same time interval of our investigation.

Table 1 presents descriptive statistics of trading activities by trader types in these five futures contracts. Panel A in Table 1 clearly suggests that trading volume contributed by CTI4 traders is significant; the percentage of the total volume ranges from 55.83% (Live Cattle futures) to 35.6% (Eurodollar futures). The trade frequency in percentage among the four trader groups are reported in Panel B of Table 1. We observe that the major counterpart of CTI4 traders are the local (CTI1) traders.

<INSERT TABLE 1>

3.2 Empirical Methods.

In this section, we describe our empirical procedures to measure total, liquidity and permanent price effects of buyer and seller-initiated large trade transactions by order size within a single day. Our empirical procedures used to calculate these price effects are described as follows:

$$\text{Total Price effect} = \ln(P_b / P_{p,b}) \times 100$$

$$\text{Liquidity (Temporary) effect} = \ln(P_b / P_{p,a}) \times 100$$

$$\text{Information (Permanent) effect} = \ln(P_{p,a} / P_{p,b}) \times 100$$

P_b denotes the price of either a buyer or seller-initiated large trade transaction. $P_{p,b}$ is the benchmark market price prior to the large trade transaction. It represents the equilibrium price of the contract absent any information about the incoming large trade. $P_{p,a}$ is the benchmark (equilibrium) price after the large trade transaction. To analyze the price effects after either a buyer or seller-initiated large trade (in order to measure the price reversal effect following the large trade), we calculate the liquidity

effect as the log difference between P_b and $P_{p,a}$. Thus we expect that the liquidity effect will be negative for the seller-initiated trades and positive for the buyer-initiated trades. A negative liquidity effect for buyer-initiated trades suggests that the price further increases after a buyer-initiated trade. Similarly, a positive liquidity effect for seller-initiated trades indicates that the price decreases even further after a sell trade. The permanent price effect measures the difference between $\ln P_{p,a}$ and $\ln P_{p,b}$. This difference reflects the information content of a large trade. All measures are in percentage terms. Based on these definitions, the total price effect is equal to the sum of the liquidity price effect and the permanent price effect.⁷

To take account of the volume effect and to minimize data noise, we also calculate volume-weighted total, liquidity and information (permanent) price effects for buyer and seller-initiated large trades.⁸ Volume weights for buyer-initiated trades is given by the volume of the i^{th} buyer-initiated trade divided by the total volume for the complete data period of all buyer-initiated trades that belong to the corresponding trade size class. The weights for the seller-initiated trades are obtained analogously.

In general, the selection of benchmark prices before and after a large trade to measure the price effects of a trade depends on the timing of a trader's decision to trade. Following Chan and Lakonishok (1993), we use the opening price as the benchmark price before a large trade and the closing price as the benchmark price after a large trade. The selection of benchmark prices rests on the implicit assumption that

⁷ There are two ways to decompose total price effects into permanent (information) and liquidity effects. We follow the procedure used by Holthausen, Leftwich and Mayers (1987) and Gemmill (1996). The other procedure, used by Chan and Lakonishok (1993), produces the result that the sum of the total price effects and the liquidity effects equals the permanent price effects. In this case, the expected sign of the liquidity effect of buys is negative and the sign of price reversal (liquidity) effects of sells is positive.

⁸ Further discussion on the advantages of using volume-weighted average price as a less noisy estimate of unobservable equilibrium price is referred to Ting (2006).

traders usually decide to trade before the opening of the trading session.⁹ To increase the robustness of our results, we also use as benchmark prices those prices generated fifteen minutes before and fifteen minutes after a large trade.

There is no consensus to what constitutes a large transaction (block trade) in futures markets. We construct five trade sizes based on the empirical distribution of the intraday CTI4 trading volume for the whole sample period. We define the five trade size classes as follows: trade size 1 equals the empirical distribution up to but not including the 50th percentile; trade size 2: from the 50th percentile to the 70th percentile; trade size 3: from the 70th percentile to the 90th percentile; trade size 4: from the 90th percentile to the 95th percentile; and trade size 5: greater than the 95th percentile. The five trade size classes allow us to test the hypothesis that the price, liquidity and information (permanent) effects are positively correlated with trade size in futures markets. Furthermore, since the definition of trade size 5 uses the same criteria as the threshold of block trades established by the CME and the CFTC in US futures markets, our empirical results provide valuable estimates of the price effects of block trades on the CME exchange floor.

4. Empirical Results

4.1. Price Impacts of Large Trades

Table 2 presents descriptive statistics to highlight some of the sample characteristics of the CTI4 data used in our analysis. The sample consists of 2,752,050 buy and 2,755,730 sell trades in S&P 500 Index futures, 881,480 buys and 886,100 sells in NASDAQ-100 Index futures, 273,480 buys and 268,370 sells in Live Cattle futures,

⁹ Further discussions on the pros and cons regarding the selection of alternative benchmarks are referred to Collins and Fabozzi (1991) and Harris (2003, Chapter 21).

128,200 buys and 128,230 sells in British Pound futures and 439,750 buys and 439,360 sells in Eurodollar futures. In terms of trading frequency, we find that the most active trading occurred in the smallest trade size class and the least active trading occurred in the largest size class. This is true across all five contracts. However, in terms of daily total CTI4 trading volume, about 35-45 percent of buys and sells of these five contracts occurred in the largest trade size class, which is equal to or above the 95th percentile of their corresponding empirical distributions of daily CTI4 trading volumes. Thus, we can see the importance of large CTI4 trades in influencing the intraday futures price behavior. The S&P 500 Index futures is the most active contract in terms of trading frequency, while Eurodollar futures is the most active contract in terms of average daily trading volume on the CME.

<INSERT TABLE 2>

Table 3 reports three measures of average total price (slippage), liquidity and information effects incurred in executing the four largest trade size classes. We use opening and closing prices of CTI4 trades as the benchmark prices in estimating the total price, liquidity and information effects in each trade size class.¹⁰ The total price effect for the largest trade size class (size 5) in S&P 500 (Panel A), NASDAQ-100 Index (Panel B), Live Cattle (Panel C), British Pound futures (Panel D) and Eurodollar futures (Panel E) are 0.0952 percent, 0.3144 percent, 0.1065 percent, 0.1119 percent and 0.0027 percent for buy trades and -0.0812 percent, -0.2671 percent, -0.0821 percent, -0.0929 percent and -0.0006 percent for sell trades, respectively. We observe that the total price impacts of buy trades are larger than the corresponding total price impacts of sell trades for each

¹⁰ We used the mean of first five trades of CTI 4 as the benchmark of opening price and the mean of last five trades of CTI4 as the benchmark of closing prices.

contract. These results are consistent with the previous results found in equity markets showing an asymmetry between total price impacts of buys and sells.

<INSERT TABLE 3>

In comparison with previous results in equity markets, Keim and Madhavan (1997) report that the institutional purchases and sales incur an average price impact of 0.34 percent and -0.31 percent, respectively, for transactions executed on the New York Stock Exchange. Recently, Chiyachantana, Jain, Jiang and Wood (2004) reported that the price impact of institutional trading in US stocks are 0.59 percent for purchases and -0.21 percent for sells during the period 1997 through 1998. Thus, it is clear that the magnitude of total price impacts of buys and sells of the five futures contracts in our study are significantly smaller than the corresponding total price impacts documented for equity markets. This is consistent with the perception that futures markets selected in this study are more liquid than the equity markets documented in previous research results (Fleming, Ostdiek and Whaley (1996)). We also observe that the magnitudes of the total price and information (permanent) effects increase monotonically with the trade size classes. This result is consistent with previous findings from equity markets.

Table 4 reports the total price, liquidity and information effects by the trade size classes based on the benchmark prices taken fifteen minutes before and after the large trade. For the largest trade size class, we find again that the total price and information impacts of buys are greater than the corresponding total price and information effects of sells for all five contracts. These results are similar to the results based on the use of opening and closing prices as the benchmarks documented in Table 3.

<INSERT TABLE 4>

The liquidity effects for the largest trade size in S&P 500 (Panel A), NASDAQ-100 (Panel B), Live Cattle (Panel C), British Pound (Panel D) and Eurodollar (Panel E) are 0.0062, 0.0203, 0.0104, 0.0143 and 0.00001 percent for buy trades, respectively. Thus we observe that there are some price reversals following the buy trades using the alternative benchmark prices (i.e., prices fifteen minutes before and fifteen minutes after the large trade). For the liquidity effects of the sell trades, we find that there are price reversals for all five contracts. In general, the magnitude of the price reversals following the sell trades is higher than the magnitude of price reversals after the buy trades.

In summary, based on two alternative benchmarks, we obtain the interesting empirical result that there is asymmetric total price and information effects of purchases and sells during the whole sample period. Our results are consistent with the previous results of block and institutional trades in the equity markets.

4.2. Current Economic Conditions and Asymmetry between Price Impacts of Buys and Sells

Following the month-to-month analysis criteria proposed by Chiyachantana, Jain, Jiang and Wood (2004), we classify our whole sample into bullish markets when the average return of the month is positive, and bearish markets when the average return of the month is negative. Table 5 documents total price, liquidity and information effects of the large trades in these five contracts based on the opening and closing prices as the benchmark prices, and Table 6 reports these effects using the prices of fifteen minutes before and fifteen minutes after the trade as the benchmarks. We can summarize the major results from these two tables as follows:

(1) Buys have bigger price and information effects than sells, while sells have stronger liquidity effects than buys in bullish markets. We find the reverse asymmetry

between the price and information effects of buys and sells in bearish markets. These results are consistent across all five contracts. Time series behavior of the monthly average of price impacts of buys versus sells during bullish and bearish markets are plotted in Panels (a) to (e) of Figure 1. These plots clearly illustrate these phenomena. From Tables 5 and 6, we find that the number of bullish months is greater than bearish months. For example, there are 30 and 29 bullish months and 18 and 19 bearish months in S&P 500 and Eurodollar futures, respectively, during our whole sample period. This fact explains why the patterns of price, liquidity and information effects found in Tables 3 and 4 are closer to the patterns of those effects identified in bullish markets.

(2) Our empirical results are consistent with those Chiyachantana, Jain, Jiang and Wood (2004) found in international equity markets. We confirm that the current economic condition hypothesis can also explain the asymmetry between price impacts of buys and sells in futures contracts traded on the CME. However, we provide additional evidence that the current economic condition hypothesis is also a key determinant of asymmetry between information effects of buys and sells. This is a new empirical result because Chiyachantana et al. (2004) only analyzed the total price effects of buys and sells in bullish versus bearish markets. Furthermore, our results are consistent with the following two hypotheses: (1) the information content of buys is higher than that of sells in bullish markets, and the reverse is true in bearish markets; and (2) large traders engage in a positive-feedback trading strategy (see Chan and Lakonishok (1993)). Further research distinguishing these two hypotheses is called for.

<INSERT TABLE 5>

<INSERT TABLE 6>

<INSERT FIGURE 1>

In short, using the unique data set, we have provided empirical evidences to support the hypothesis that the current economic condition is a key determinant of asymmetry between price and information effects of buys and sells.

4.3 Regression Analysis

In this section, we use regression analysis to test the hypothesis that total price, liquidity and information effects are positively related to the trade size classes. The regression model is specified as follows:

$$S_i = \beta_0 + \beta_2 D_2 + \beta_3 D_3 + \beta_4 D_4 + \beta_5 D_5 + e_i$$

where

S_i , $i=1, 2, 3$, represents total price, liquidity and information effects, respectively.

D_i , $i=2, 3, 4, 5$ denotes the i^{th} dummy variable. D_i is equal to one if the trade size falls into the i^{th} trade size class and equal to zero otherwise.

OLS is used to estimate the parameters of the model and White procedure is employed to calculate heteroscedasticity-consistent standard errors. The results from the regression analysis of these five contracts for the whole sample period are reported in Table 7. We observe that the coefficients on the trade size dummy variables increase and decrease monotonically from the smallest to the largest trade sizes of buys and sells, respectively, for total price and information price effects. These results are true for all five contracts. For example, for the total price effects, the coefficients of the differences of trade size class 2 to class 5 with respect to trade size 1 in buy trades increase from

0.0321 to 0.135 (S&P 500), 0.076 to 0.425 (NASDAQ-100), 0.0414 to 0.1503 (Live Cattle), 0.0237 to 0.0999 (British Pound), and 0.0001 to 0.0012 (Eurodollar), and in sell trades decrease from -0.0234 to -0.054 (S&P 500), -0.056 to -0.262 (NASDAQ-100), -0.0422 to -0.144 (Live Cattle), -0.0309 to -0.126 (British Pound) and -0.0006 to -0.013 (Eurodollar). Based on F statistics, and t statistics, the results are all statistically significant at the one percent level. These results are consistent with the findings from the equity markets (Chan and Lakonishok (1993)) and from the futures markets (Frino and Oetomo (2005)). The regression results on the information effects are very similar to the regression results on the total price effects. However, our results do not find a strong relationship between the liquidity effects and the trade size (from the smallest to the largest trade size class) for both buys and sells in these five futures contracts.

<INSERT TABLE 7>

Table 8 presents regression results on the total price, liquidity and information effects on trade size class dummy variables of these five contracts under bullish and bearish markets. It is interesting to observe again that the coefficients on the trade size dummy variables increase and decrease monotonically from the smallest to the largest trade sizes of buys and sells, respectively, for total price and information price effects under both bullish and bearish markets. Again, there is a weak relationship between the liquidity effects and the order of trade sizes in both bullish and bearish markets. In short, our regression results are consistent with the hypothesis suggested by Easley and O'Hara (1987) that the information content of the trades is positively related to the trade sizes.

<INSERT TABLE 8>

5. Summary and Conclusions

This paper uses a unique data set, Computer Trade Reconstruction (CTR) intraday data, from January 2001 to December 2004 to examine the market impact effects of large outside customers (CTI4 traders) on intraday futures prices in five futures contracts.

These five contracts include two index futures (S&P 500 and NASDAQ-100), one physical commodity futures (Live Cattle), one foreign exchange futures (British Pound) and one interest rate futures (Eurodollar). Our data set contains millions of observations for the buy and sell sides of CTI4 trades and the direction of these trades. These distinctive features of our data set enhance the internal and external validity of our research in estimating the market impact, liquidity and information (permanent) effects of the five CME futures contracts.

We have obtained several interesting results:

(1) The magnitude of the total price, liquidity and information (permanent) effects are smaller than the corresponding previous estimates found in equity markets. Our findings are consistent with similar results of those price impacts obtained in index futures and interest rate futures traded on the Sydney Futures Exchange.

(2) In general, we observe for the whole sample period that the price and information effects of purchases are greater than those of sells. There are strong post-trade price reversals for the sells and weak or no reversals for the buys of large trades. These results are consistent with the existence of short-run liquidity costs for sells. The post-trade price behavior for purchases is consistent with the hypothesis on differences in the information

content in buys and sells. Our empirical results obtained from the whole sample period are consistent with the previous findings in equity markets.

(3) Following Chiyachantana, Jain, Jiang and Wood (2004), we split our sample into bullish and bearish markets. The empirical results confirm that the price and information effects of buys are greater than those of sells in bullish markets and that there is a strong reverse asymmetry between total price and information (permanent) effects of purchases and sells in bearish market conditions. Our results support their hypothesis that the current economic condition (bullish or bearish) is the major determinant of the asymmetry between total price impacts of buys and sells. Furthermore, we also provide strong evidence that the current economic condition is the major determinant of the asymmetry between the information effects of buys and sells. This finding is also consistent with the hypothesis that outside large traders employ a positive herding trading strategy in bullish and bearish markets (Chan and Lakonishok (1993)).

(4) Our regression analysis confirms that the total price and information effects are positively correlated with trade sizes during the whole sample period, as well as during bullish and bearish markets. These results are consistent with the conjecture that the information content of a trade is positively correlated with the trade size (Easley and O'Hara (1987)).

(5) We find that the largest trade size (class 5) accounts for more than thirty percents of CTI4 total trades (see Table 2). Furthermore, these trades carry information (permanent) effects for both buy and sell trades. Thus, our empirical results do not support the assumption made by Diagler and Wiley (1999) in their paper that all CTI4 traders are noise traders.

It should be mentioned that the differences between the effects of large buys and sells on Sydney Futures exchanges versus CME may be due to the difference in the benchmark used by respective studies. We use opening and closing prices of a single trading day to measure the effects of buy and sell of a single trade, while Frino and Oetomo (2005) use opening and closing prices of more than one day to measure the effects of buy and sell of a trading package.

Our paper can also provide guidance for establishing the criteria for the threshold of block trades in futures markets. For example, in establishing the criteria, regulators or exchanges can first find consensus on the acceptable price impacts of large traders, and then search for the corresponding percentile of the empirical distribution of the trading volume which is consistent with the accepted total price impact of large trades. The current procedure is simply based on an arbitrary selection of the percentile of the empirical distributions of the trading volume without knowledge of the potential market price impacts of those trades which fall into the threshold trade size class.

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Table 1: Descriptive statistics by trader type categories.

<i>Panel A</i>					
	Percentage of Total Volume per Trade Group				Total Daily Average Volume
	CTI 1	CTI 2	CTI 3	CTI 4	
S&P500	50.15	2.85	6.98	40.02	52,155.94
NASDAQ-100	48.50	4.91	4.95	41.64	14,046.12
Live Cattle	37.68	1.24	5.25	55.83	13,145.28
British Pound	32.79	16.82	1.84	48.54	1,833.55
Eurodollar	39.95	4.78	19.64	35.63	450,467.60

<i>Panel B</i>										
	Trade Frequency (in Percentage) Among the Trade Groups									
	1-1	1-2	1-3	1-4	2-2	2-3	2-4	3-3	3-4	4-4
S&P500	31.51	2.61	11.72	45.24	0.05	0.28	1.01	0.30	2.10	4.87
NASDAQ-100	32.89	3.77	5.60	44.39	0.14	0.33	2.10	0.24	3.94	6.38
Live Cattle	7.80	1.29	5.25	54.57	0.02	0.16	1.26	0.30	5.35	22.49
British Pound	13.84	3.39	3.43	64.95	0.11	0.38	6.84	0.4	0.81	5.61
Eurodollar	13.10	4.00	23.33	36.37	0.21	1.83	2.28	3.50	8.22	6.28

This table presents descriptive statistics for the following futures contracts: S&P 500, NASDAQ-100, Live Cattle, British Pound, and Eurodollar. Panel A tabulates the percentage of the total volume for each of the four types of traders. The trader categories are locals who trade for their own accounts as well as for outside customers (CTI1), clearing members (CTI2), locals who trade for other locals' accounts (CTI3), and outside customers (CTI4). Panel B presents the trade frequencies in percentage among the four categories of trades. The column labels i - j refer to trades between CTI i and CTI j for $i, j = 1, 2, 3, 4$.

Table 2: Descriptive statistics by trade size categories.

	All		1		2		3		4		5	
	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell
<i>Panel A: S&P 500</i>												
Total Trading Frequency (10^3)	2,752.05	2,755.73	1,262.98	1,286.71	306.32	308.64	567.95	561.70	433.87	423.50	180.93	175.18
Percentage of Total Volume	---	---	10.69	11.05	6.53	6.70	19.70	19.87	29.79	29.63	33.29	32.74
Daily Trading Volume												
Mean	3,168.45	3,110.49	1,693.51	1,719.11	1,034.78	1,042.28	3,121.38	3,090.06	4,719.33	4,608.56	5,273.26	5,092.42
Median	2,570.00	2,538.50	1,686.00	1,698.50	1,021.50	1,034.00	3,092.50	3,041.50	4,518.50	4,470.50	4,804.50	4,682.00
Daily Dollar Value (10^6)												
Mean	840.11	824.63	455.57	462.27	277.03	278.94	833.79	825.88	1,250.40	1,220.53	1,383.75	1,335.55
Median	693.43	684.54	396.78	402.74	244.10	247.39	748.38	736.61	1,166.43	1,139.16	1,279.09	1,253.41
<i>Panel B: NASDAQ-100</i>												
Total Trading Frequency (10^3)	881.48	886.10	435.07	439.60	95.36	96.53	202.88	200.46	104.05	104.80	44.12	44.71
Percentage of Total Volume	---	---	13.65	13.69	7.29	7.36	25.03	24.70	25.36	25.37	28.67	28.88
Daily Trading Volume												
Mean	865.37	870.16	590.54	595.48	315.64	320.16	1,083.06	1,074.84	1,097.17	1,103.94	1,240.43	1,256.38
Median	717.50	722.00	506.00	504.00	265.00	266.00	917.50	918.00	1,010.50	1,047.00	1,093.00	1,115.00
Daily Dollar Value (10^6)												
Mean	123.39	123.89	87.96	88.99	47.07	47.82	159.41	157.91	155.01	155.19	167.48	169.56
Median	97.69	98.49	60.88	61.64	32.41	31.97	112.80	110.60	131.69	136.34	147.11	148.46
<i>Panel C: Live Cattle</i>												
Total Trading Frequency (10^3)	273.48	268.37	131.69	132.61	37.57	36.14	75.16	71.68	11.01	10.61	18.05	17.32
Percentage of Total Volume	---	---	11.20	11.60	8.01	7.97	33.04	32.77	10.31	10.27	37.45	37.39
Daily Trading Volume												
Mean	401.34	388.10	224.33	225.10	160.61	154.60	662.91	635.65	207.09	199.32	752.17	726.27
Median	258.00	252.00	216.00	217.00	153.50	149.00	628.00	612.00	193.00	189.00	656.00	607.00
Daily Dollar Value (10^6)												
Mean	12.04	11.62	6.68	6.70	4.79	4.60	19.84	18.98	6.20	5.95	22.69	21.86
Median	7.66	7.45	6.41	6.44	4.52	4.39	18.59	17.99	5.73	5.48	19.16	17.75

Table 2 (continue):

	All		1		2		3		4		5	
	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell
<i>Panel D: British Pound</i>												
Total Trading Frequency (10 ³)	128.20	128.23	58.85	59.38	30.61	30.51	22.67	22.61	9.38	9.19	6.70	6.54
Percentage of Total Volume	---	---	9.20	9.36	10.88	10.94	18.61	18.75	16.88	16.82	44.43	44.13
Daily Trading Volume												
Mean	130.38	130.82	60.18	60.71	69.66	69.50	119.20	119.37	110.42	110.91	298.28	306.21
Median	83.00	82.00	57.00	57.00	63.00	62.00	106.00	104.00	94.50	90.00	208.00	210.00
Daily Dollar Value (10 ⁶)												
Mean	12.73	12.76	5.85	5.90	6.76	6.75	11.59	11.61	10.82	10.84	29.21	29.95
Median	8.12	8.06	5.53	5.58	6.31	6.05	10.46	10.30	9.26	8.85	20.61	21.13
<i>Panel E: Eurodollar</i>												
Total Trading Frequency (10 ³)	439.75	439.36	181.91	183.48	123.47	121.46	90.04	90.07	2.12	2.18	42.21	42.18
Percentage of Total Volume	---	---	10.38	10.43	20.83	20.59	29.40	29.44	1.18	1.22	38.21	38.32
Daily Trading Volume												
Mean	6,830.20	6,793.09	3,385.16	3,404.36	6,804.71	6,717.64	9,601.91	9,614.21	494.63	493.55	12,491.15	12,514.62
Median	5,084.0	4,881.5	3,249.00	3,204.00	6,208.00	6,125.00	8,921.00	8,649.50	375.00	372.00	10,188.50	9,832.50
Daily Dollar Value (10 ⁶)												
Mean	6,785.70	6,748.70	3,362.13	3,381.17	6,758.50	6,671.96	9,539.22	9,550.98	491.41	490.33	12,412.77	12,435.96
Median	5,059.67	4,840.74	3,233.03	3,177.63	6,146.73	6,064.74	8,861.89	8,587.18	373.11	369.66	10,103.99	9,744.68

This table contains sample characteristics of the trades initiated by the outside customers (CTI4) for the following futures contracts: S&P 500, NASDAQ-100, Live Cattle, British Pound, and Eurodollar. The trades are categorized into five groups based on the percentiles of the empirical trade size distribution for trades initiated by the CTI4 traders. Transactions with trade sizes less than the 50th percentile belong to group 1; trade sizes between the 50th and 70th percentiles belong to class 2; trade sizes in the ranges 70th to 90th and 90th to 95th belong to categories 3 and 4, respectively; transactions with a trade size larger than the 95th percentile are classified as 5. The trade sizes at these percentiles for the contracts are,

	50 th	70 th	90 th	95 th
S&P500	3	5	10	20
NASDAQ-100	3	5	10	16
Live Cattle	3	5	12	20
British Pound	2	4	10	20
Eurodollar	50	100	175	200

Total trading frequency denotes the total number of trades for the complete period in thousands; Percentage of total volume is the percentage of trades per category computed for buys and sells separately; Daily trading volume reports the mean and median of the total daily volumes; and Daily dollar value reports the mean and median of the total daily dollar value in millions where the dollar value is computed per transaction by multiplying the price by the contract multiplier and the trade size.

Table 3: Price effect (in percentage) using opening and closing prices as benchmark prices.

	2		3		4		5	
	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell
<i>Panel A: S&P 500</i>								
Total Price Effect								
<i>Volume Weighted</i>	-0.0238	-0.0433	-0.0132	-0.0543	0.0089	-0.0525	0.0952	-0.0812
<i>Mean</i>	-0.0251	-0.0434	-0.0163	-0.0528	0.0046	-0.0507	0.0782	-0.0742
<i>Standard Error</i>	0.0016	0.0016	0.0012	0.0012	0.0014	0.0014	0.0024	0.0023
<i>Median</i>	-0.0177	-0.0288	-0.0144	-0.0337	0.0000	-0.0361	0.0471	-0.0480
<i>Proportion</i>	0.4838	0.5239	0.4862	0.5256	0.4995	0.5268	0.5460	0.5479
Liquidity Effect								
<i>Volume Weighted</i>	-0.0287	-0.0448	-0.0318	-0.0431	-0.0370	-0.0480	-0.0372	-0.0543
<i>Mean</i>	-0.0284	-0.0445	-0.0321	-0.0430	-0.0370	-0.0475	-0.0377	-0.0530
<i>Standard Error</i>	0.0016	0.0016	0.0012	0.0012	0.0014	0.0014	0.0021	0.0022
<i>Median</i>	-0.0249	-0.0394	-0.0286	-0.0398	-0.0300	-0.0374	-0.0231	-0.0362
<i>Proportion</i>	0.4731	0.5340	0.4697	0.5336	0.4663	0.5336	0.4690	0.5376
Permanent Effect								
<i>Volume Weighted</i>	0.0049	0.0015	0.0186	-0.0112	0.0458	-0.0046	0.1324	-0.0269
<i>Mean</i>	0.0034	0.0011	0.0157	-0.0098	0.0416	-0.0032	0.1158	-0.0213
<i>Standard Error</i>	0.0023	0.0023	0.0017	0.0017	0.0020	0.0020	0.0032	0.0032
<i>Median</i>	0.0528	0.0524	0.0634	0.0463	0.0918	0.0442	0.1577	0.0074
<i>Proportion</i>	0.5194	0.4812	0.5221	0.4855	0.5299	0.4864	0.5510	0.4966
<i>Panel B: NASDAQ-100</i>								
Total Price Effect								
<i>Volume Weighted</i>	-0.0369	-0.0529	0.0790	-0.1062	0.1895	-0.1565	0.3144	-0.2671
<i>Mean</i>	-0.0404	-0.0480	0.0795	-0.1056	0.1887	-0.1546	0.3084	-0.2532
<i>Standard Error</i>	0.0059	0.0060	0.0042	0.0041	0.0057	0.0055	0.0080	0.0077
<i>Median</i>	-0.0354	-0.0321	0.0194	-0.0877	0.1043	-0.1478	0.1973	-0.2141
<i>Proportion</i>	0.4839	0.5129	0.5104	0.5332	0.5465	0.5615	0.5951	0.6034
Liquidity Effect								
<i>Volume Weighted</i>	0.0587	0.0134	0.0555	-0.0003	0.0425	-0.0179	0.0259	-0.0339
<i>Mean</i>	0.0589	0.0110	0.0554	0.0000	0.0434	-0.0180	0.0236	-0.0298
<i>Standard Error</i>	0.0058	0.0058	0.0040	0.0040	0.0052	0.0052	0.0066	0.0068
<i>Median</i>	0.0255	-0.0142	0.0161	-0.0186	0.0000	-0.0305	0.0000	-0.0410
<i>Proportion</i>	0.5098	0.5043	0.5054	0.5065	0.4995	0.5137	0.4923	0.5263
Permanent Effect								
<i>Volume Weighted</i>	-0.0957	-0.0664	0.0234	-0.1059	0.1470	-0.1385	0.2885	-0.2332
<i>Mean</i>	-0.0992	-0.0589	0.0241	-0.1056	0.1453	-0.1366	0.2847	-0.2234

<i>Standard Error</i>	0.0085	0.0085	0.0059	0.0059	0.0079	0.0078	0.0106	0.0105
<i>Median</i>	-0.0439	-0.0139	0.0333	-0.0913	0.1593	-0.1158	0.2532	-0.1873
<i>Proportion</i>	0.4900	0.5029	0.5082	0.5155	0.5335	0.5219	0.5678	0.5418

Table 3 (continue):

	2		3		4		5	
	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell
<i>Panel C: Live Cattle</i>								
Total Price Effect								
<i>Volume Weighted</i>	-0.0146	0.0432	0.0031	0.0201	0.0394	-0.0102	0.1065	-0.0821
<i>Mean</i>	-0.0157	0.0445	-0.0014	0.0239	0.0382	-0.0081	0.0932	-0.0574
<i>Standard Error</i>	0.0039	0.0039	0.0027	0.0028	0.0073	0.0074	0.0058	0.0061
<i>Median</i>	0.0000	0.0073	0.0000	0.0000	0.0332	0.0000	0.0470	-0.0202
<i>Proportion</i>	0.4990	0.4806	0.5049	0.4913	0.5359	0.5122	0.5611	0.5378
Liquidity Effect								
<i>Volume Weighted</i>	0.0079	-0.0135	0.0058	0.0073	0.0161	-0.0096	0.0194	-0.0375
<i>Mean</i>	0.0066	-0.0133	0.0056	0.0068	0.0164	-0.0089	0.0149	-0.0246
<i>Standard Error</i>	0.0036	0.0037	0.0026	0.0027	0.0069	0.0070	0.0055	0.0056
<i>Median</i>	0.0000	-0.0068	0.0000	0.0000	0.0069	0.0000	0.0125	-0.0068
<i>Proportion</i>	0.4996	0.5032	0.4990	0.4931	0.5032	0.4974	0.5080	0.5036
Permanent Effect								
<i>Volume Weighted</i>	-0.0225	0.0567	-0.0026	0.0129	0.0233	-0.0005	0.0871	-0.0446
<i>Mean</i>	-0.0223	0.0578	-0.0070	0.0171	0.0219	0.0008	0.0784	-0.0328
<i>Standard Error</i>	0.0053	0.0054	0.0038	0.0039	0.0099	0.0103	0.0079	0.0082
<i>Median</i>	-0.0069	0.0588	-0.0065	0.0141	0.0210	0.0000	0.0780	-0.0400
<i>Proportion</i>	0.4915	0.4740	0.4935	0.4882	0.5062	0.4994	0.5260	0.5106
<i>Panel D: British Pound</i>								
Total Price Effect								
<i>Volume Weighted</i>	0.0281	0.0094	0.0656	-0.0313	0.0810	-0.0628	0.1119	-0.0929
<i>Mean</i>	0.0257	0.0108	0.0642	-0.0284	0.0809	-0.0622	0.1018	-0.0845
<i>Standard Error</i>	0.0018	0.0018	0.0021	0.0021	0.0035	0.0035	0.0043	0.0043
<i>Median</i>	0.0199	0.0000	0.0322	-0.0138	0.0366	-0.0193	0.0338	-0.0273
<i>Proportion</i>	0.5645	0.5113	0.6154	0.5642	0.6462	0.6042	0.6713	0.6374
Liquidity Effect								
<i>Volume Weighted</i>	-0.0028	-0.0253	-0.0093	-0.0228	-0.0077	-0.0237	-0.0062	-0.0123
<i>Mean</i>	-0.0027	-0.0246	-0.0087	-0.0222	-0.0073	-0.0230	-0.0080	-0.0180
<i>Standard Error</i>	0.0015	0.0016	0.0018	0.0018	0.0030	0.0029	0.0040	0.0037
<i>Median</i>	0.0000	-0.0193	0.0000	-0.0147	0.0025	-0.0138	0.0021	-0.0108
<i>Proportion</i>	0.4979	0.5635	0.5017	0.5611	0.5092	0.5688	0.5047	0.5596
Permanent Effect								
<i>Volume Weighted</i>	0.0308	0.0347	0.0749	-0.0084	0.0887	-0.0391	0.1181	-0.0807

<i>Mean</i>	0.0284	0.0354	0.0728	-0.0062	0.0882	-0.0392	0.1098	-0.0665
<i>Standard Error</i>	0.0023	0.0024	0.0027	0.0028	0.0043	0.0045	0.0051	0.0053
<i>Median</i>	0.0354	0.0338	0.0677	0.0000	0.0894	-0.0251	0.1076	-0.0636
<i>Proportion</i>	0.5437	0.4569	0.5811	0.4962	0.5950	0.5269	0.6153	0.5585

Table 3 (continue):

	2		3		4		5	
	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell
<i>Panel E: Eurodollar</i>								
Total Price Effect (10 ²)								
<i>Volume Weighted</i>	0.1518	0.0260	0.1844	-0.0056	0.2660	-0.0268	0.2675	-0.0624
<i>Mean</i>	0.1462	0.0276	0.1830	-0.0050	0.2633	-0.0265	0.2556	-0.0447
<i>Standard Error</i>	0.0042	0.0043	0.0052	0.0054	0.0348	0.0329	0.0084	0.0086
<i>Median</i>	0.1006	0.0000	0.1255	0.0000	0.1256	0.0000	0.1256	0.0000
<i>Proportion</i>	0.5427	0.4914	0.5496	0.5030	0.5667	0.5051	0.5642	0.5131
Liquidity Effect (10 ²)								
<i>Volume Weighted</i>	-0.0960	-0.1349	-0.0928	-0.1446	-0.0947	-0.0990	-0.0617	-0.1346
<i>Mean</i>	-0.0956	-0.1375	-0.0932	-0.1447	-0.0948	-0.0980	-0.0746	-0.1363
<i>Standard Error</i>	0.0039	0.0039	0.0046	0.0046	0.0283	0.0286	0.0066	0.0066
<i>Median</i>	-0.0505	-0.1006	-0.0504	-0.1005	-0.0502	-0.0752	-0.0502	-0.0756
<i>Proportion</i>	0.4486	0.5481	0.4516	0.5443	0.4474	0.5381	0.4587	0.5379
Permanent Effect (10 ²)								
<i>Volume Weighted</i>	0.2478	0.1609	0.2772	0.1390	0.3607	0.0723	0.3292	0.0722
<i>Mean</i>	0.2418	0.1651	0.2761	0.1397	0.3581	0.0715	0.3302	0.0916
<i>Standard Error</i>	0.0059	0.0060	0.0072	0.0073	0.0458	0.0450	0.0110	0.0113
<i>Median</i>	0.2763	0.1762	0.2782	0.1505	0.2516	0.1008	0.3009	0.1005
<i>Proportion</i>	0.5542	0.4556	0.5536	0.4650	0.5592	0.4766	0.5574	0.4770

This table contains estimates of the price effect (in percentage) for trades initiated by the outside traders (CTI4) for the following futures contracts: S&P 500, NASDAQ-100, Live Cattle, British Pound, and Eurodollar. The total price effect, liquidity effect and information effect are estimated by,

$$\text{Total Price effect} = \ln(P_b / P_{p,b}) \times 100$$

$$\text{Liquidity (Temporary) effect} = \ln(P_b / P_{p,a}) \times 100$$

$$\text{Information (Permanent) effect} = \ln(P_{p,a} / P_{p,b}) \times 100$$

where P_b denotes the price of the transaction for which the price impact is estimated; $P_{p,b}$ and $P_{p,a}$ are the benchmark prices prior to and after the transaction of interest. For the results in this table, the daily opening and closing prices are used as benchmark prices. The price effects are computed for purchases and sales, separately. Furthermore, the trades are categorized into five groups based on the percentiles of the empirical trade size distribution for trades initiated by the CTI4 traders. Transactions with trade sizes less than the 50th percentile belong to group 1; trade sizes between the 50th and 70th percentiles belong to class 2; trade sizes in the ranges 70th to 90th and 90th to 95th belong to categories 3 and 4, respectively; transactions with a trade size larger than the 95th percentile are classified as 5. The trade sizes at these percentiles for the contracts are,

	50 th	70 th	90 th	95 th
S&P500	3	5	10	20
NASDAQ-100	3	5	10	16
Live Cattle	3	5	12	20
British Pound	2	4	10	20
Eurodollar	50	100	175	200

The estimates labeled VWAP are volume weighted averages price effects. Proportion denotes the fraction of the estimates of price effects that are positive for purchases and the fraction of estimates that are negative for sales. The VWAP, mean, and median estimates for Eurodollar are multiplied by 100.

Table 4: Price effect (in percentage) using 15-minute prices as benchmark prices.

	2		3		4		5	
	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell
<i>Panel A: S&P 500</i>								
Total Price Effect								
<i>Volume Weighted</i>	0.0080	-0.0082	0.0092	-0.0111	0.0169	-0.0155	0.0620	-0.0526
<i>Mean</i>	0.0074	-0.0080	0.0071	-0.0095	0.0149	-0.0140	0.0517	-0.0435
<i>Standard Error</i>	0.0005	0.0005	0.0004	0.0004	0.0005	0.0005	0.0008	0.0008
<i>Median</i>	0.0000	0.0000	0.0000	0.0000	0.0170	-0.0166	0.0451	-0.0435
<i>Proportion</i>	0.5090	0.5112	0.5102	0.5157	0.5270	0.5260	0.5815	0.5728
Liquidity Effect								
<i>Volume Weighted</i>	0.0079	-0.0073	0.0057	-0.0069	0.0049	-0.0074	0.0062	-0.0113
<i>Mean</i>	0.0079	-0.0071	0.0056	-0.0066	0.0047	-0.0070	0.0051	-0.0102
<i>Standard Error</i>	0.0004	0.0004	0.0003	0.0003	0.0004	0.0004	0.0006	0.0006
<i>Median</i>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0087
<i>Proportion</i>	0.4906	0.4939	0.4867	0.4942	0.4829	0.4943	0.4829	0.5015
Permanent Effect								
<i>Volume Weighted</i>	0.0001	-0.0008	0.0035	-0.0042	0.0120	-0.0081	0.0558	-0.0413
<i>Mean</i>	-0.0004	-0.0009	0.0015	-0.0029	0.0103	-0.0070	0.0466	-0.0333
<i>Standard Error</i>	0.0007	0.0007	0.0005	0.0005	0.0006	0.0006	0.0010	0.0010
<i>Median</i>	0.0000	0.0000	0.0000	0.0000	0.0108	0.0000	0.0445	-0.0327
<i>Proportion</i>	0.4879	0.4895	0.4910	0.4926	0.5054	0.4999	0.5487	0.5311
<i>Panel B: NASDAQ-100</i>								
Total Price Effect								
<i>Volume Weighted</i>	0.0179	-0.0232	0.0394	-0.0426	0.0879	-0.0770	0.1556	-0.1370
<i>Mean</i>	0.0164	-0.0215	0.0385	-0.0417	0.0874	-0.0771	0.1452	-0.1294
<i>Standard Error</i>	0.0019	0.0019	0.0013	0.0013	0.0019	0.0018	0.0029	0.0027
<i>Median</i>	0.0000	0.0000	0.0353	-0.0508	0.0786	-0.0896	0.1325	-0.1346
<i>Proportion</i>	0.5067	0.5182	0.5309	0.5403	0.5736	0.5784	0.6370	0.6359
Liquidity Effect								
<i>Volume Weighted</i>	0.0239	-0.0148	0.0205	-0.0164	0.0238	-0.0208	0.0203	-0.0322
<i>Mean</i>	0.0237	-0.0148	0.0203	-0.0161	0.0236	-0.0209	0.0215	-0.0294
<i>Standard Error</i>	0.0016	0.0016	0.0011	0.0011	0.0015	0.0015	0.0020	0.0020
<i>Median</i>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0337
<i>Proportion</i>	0.4875	0.4814	0.4859	0.4861	0.4864	0.4903	0.4821	0.5054
Permanent Effect								

<i>Volume Weighted</i>	-0.0060	-0.0084	0.0190	-0.0262	0.0641	-0.0562	0.1353	-0.1048
<i>Mean</i>	-0.0074	-0.0067	0.0182	-0.0256	0.0638	-0.0561	0.1237	-0.1001
<i>Standard Error</i>	0.0024	0.0024	0.0016	0.0017	0.0023	0.0023	0.0034	0.0033
<i>Median</i>	0.0000	0.0000	0.0000	-0.0337	0.0647	-0.0691	0.1058	-0.1028
<i>Proportion</i>	0.4730	0.4875	0.4906	0.5023	0.5234	0.5289	0.5753	0.5696

Table 4 (continue):

	2		3		4		5	
	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell
<i>Panel C: Live Cattle</i>								
Total Price Effect								
<i>Volume Weighted</i>	0.0170	-0.0137	0.0208	-0.0187	0.0354	-0.0348	0.0770	-0.0839
<i>Mean</i>	0.0163	-0.0134	0.0191	-0.0173	0.0352	-0.0343	0.0656	-0.0686
<i>Standard Error</i>	0.0017	0.0018	0.0012	0.0013	0.0035	0.0036	0.0030	0.0032
<i>Median</i>	0.0000	0.0000	0.0000	0.0000	0.0319	0.0000	0.0355	-0.0336
<i>Proportion</i>	0.5340	0.5164	0.5339	0.5154	0.5472	0.5287	0.5703	0.5521
Liquidity Effect								
<i>Volume Weighted</i>	0.0064	-0.0157	0.0045	-0.0118	0.0084	-0.0201	0.0104	-0.0434
<i>Mean</i>	0.0062	-0.0157	0.0041	-0.0118	0.0084	-0.0198	0.0066	-0.0334
<i>Standard Error</i>	0.0014	0.0015	0.0010	0.0011	0.0027	0.0028	0.0023	0.0025
<i>Median</i>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0272
<i>Proportion</i>	0.4665	0.4830	0.4604	0.4786	0.4708	0.4928	0.4642	0.5003
Permanent Effect								
<i>Volume Weighted</i>	0.0106	0.0020	0.0162	-0.0070	0.0270	-0.0147	0.0666	-0.0404
<i>Mean</i>	0.0100	0.0023	0.0149	-0.0055	0.0268	-0.0145	0.0590	-0.0352
<i>Standard Error</i>	0.0021	0.0021	0.0015	0.0016	0.0042	0.0043	0.0035	0.0037
<i>Median</i>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0373	-0.0323
<i>Proportion</i>	0.4873	0.4723	0.4933	0.4804	0.4987	0.4861	0.5274	0.5050
<i>Panel D: British Pound</i>								
Total Price Effect								
<i>Volume Weighted</i>	0.0164	-0.0133	0.0252	-0.0206	0.0299	-0.0329	0.0424	-0.0497
<i>Mean</i>	0.0160	-0.0127	0.0246	-0.0198	0.0300	-0.0318	0.0399	-0.0445
<i>Standard Error</i>	0.0008	0.0007	0.0008	0.0008	0.0018	0.0015	0.0030	0.0022
<i>Median</i>	0.0137	-0.0127	0.0140	-0.0134	0.0140	-0.0139	0.0142	-0.0218
<i>Proportion</i>	0.5762	0.5590	0.6027	0.5810	0.6282	0.6203	0.6528	0.6526
Liquidity Effect								
<i>Volume Weighted</i>	0.0093	-0.0091	0.0091	-0.0099	0.0100	-0.0104	0.0143	-0.0052
<i>Mean</i>	0.0093	-0.0091	0.0092	-0.0096	0.0103	-0.0106	0.0142	-0.0060
<i>Standard Error</i>	0.0006	0.0007	0.0007	0.0008	0.0016	0.0014	0.0025	0.0020
<i>Median</i>	0.0125	-0.0127	0.0125	-0.0125	0.0121	-0.0123	0.0125	-0.0124
<i>Proportion</i>	0.5224	0.5242	0.5226	0.5218	0.5221	0.5242	0.5343	0.5258
Permanent Effect								

<i>Volume Weighted</i>	0.0071	-0.0041	0.0161	-0.0107	0.0199	-0.0226	0.0281	-0.0445
<i>Mean</i>	0.0067	-0.0036	0.0155	-0.0102	0.0197	-0.0212	0.0257	-0.0385
<i>Standard Error</i>	0.0009	0.0008	0.0010	0.0010	0.0017	0.0018	0.0027	0.0023
<i>Median</i>	0.0000	0.0000	0.0131	-0.0055	0.0139	-0.0138	0.0220	-0.0263
<i>Proportion</i>	0.4970	0.4783	0.5204	0.5019	0.5361	0.5307	0.5562	0.5760

Table 4 (continue):

	2		3		4		5	
	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell
<i>Panel E: Eurodollar</i>								
Total Price Effect (10 ²)								
<i>Volume Weighted</i>	0.0398	-0.0227	0.0571	-0.0348	0.0709	-0.0290	0.0870	-0.0647
<i>Mean</i>	0.0387	-0.0224	0.0569	-0.0348	0.0696	-0.0282	0.0810	-0.0547
<i>Standard Error</i>	0.0016	0.0016	0.0022	0.0022	0.0133	0.0128	0.0038	0.0039
<i>Median</i>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
<i>Proportion</i>	0.5306	0.5079	0.5410	0.5099	0.5318	0.4733	0.5423	0.5195
Liquidity Effect (10 ²)								
<i>Volume Weighted</i>	0.0046	-0.0279	0.0066	-0.0306	-0.0019	-0.0215	0.0082	-0.0333
<i>Mean</i>	0.0049	-0.0280	0.0062	-0.0305	-0.0017	-0.0210	0.0060	-0.0302
<i>Standard Error</i>	0.0012	0.0012	0.0015	0.0015	0.0094	0.0094	0.0022	0.0023
<i>Median</i>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
<i>Proportion</i>	0.4007	0.4341	0.4045	0.4361	0.3762	0.4182	0.4007	0.4340
Permanent Effect (10 ²)								
<i>Volume Weighted</i>	0.0352	0.0053	0.0505	-0.0042	0.0728	-0.0076	0.0788	-0.0314
<i>Mean</i>	0.0339	0.0057	0.0507	-0.0043	0.0714	-0.0072	0.0750	-0.0245
<i>Standard Error</i>	0.0020	0.0020	0.0026	0.0027	0.0161	0.0158	0.0044	0.0045
<i>Median</i>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
<i>Proportion</i>	0.4666	0.4311	0.4745	0.4416	0.4630	0.4297	0.4800	0.4555

This table contains estimates of the price effect (in percentage) for trades initiated by the outside traders (CTI4) for the following futures contracts: S&P 500, NASDAQ-100, Live Cattle, British Pound, and Eurodollar. The total price effect, liquidity effect and information effect are estimated by,

$$\text{Total Price effect} = \ln(P_b / P_{p,b}) \times 100$$

$$\text{Liquidity (Temporary) effect} = \ln(P_b / P_{p,a}) \times 100$$

$$\text{Information (Permanent) effect} = \ln(P_{p,a} / P_{p,b}) \times 100$$

where P_b denotes the price of the transaction for which the price impact is estimated; $P_{p,b}$ and $P_{p,a}$ are the benchmark prices where $P_{p,b}$ ($P_{p,a}$) is the first trade that is executed at least fifteen minutes prior (subsequent) to the trade P_b . During the opening and closing fifteen minutes of trading, the opening and closing prices are used. The price effects are computed for purchases and sales, separately.

Furthermore, the trades are categorized into five groups based on the percentiles of the empirical trade size distribution for trades initiated by the CTI4 traders. Transactions with trade sizes less than the 50th percentile belong to group 1; trade sizes between the 50th and 70th percentiles belong to class 2; trade sizes in the ranges 70th to 90th and 90th to 95th belong to categories 3 and 4, respectively; transactions with a trade size larger than the 95th percentile are classified as 5. The trade sizes at these percentiles for the contracts are,

	50 th	70 th	90 th	95 th
S&P500	3	5	10	20
NASDAQ-100	3	5	10	16
Live Cattle	3	5	12	20
British Pound	2	4	10	20
Eurodollar	50	100	175	200

The estimates labeled VWAP are volume weighted averages price effects. Proportion denotes the fraction of the estimates of price effects that are positive for purchases and the fraction of estimates that are negative for sales. The VWAP, mean, and median estimates for Eurodollar are multiplied by 100.

Table 5: Price effect (in percentage) in bull and bear markets using opening and closing prices as benchmark prices.

	2		3		4		5	
	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell
<i>Panel A.1: S&P 500 Bull Market (30 Months)</i>								
Total Price Effect								
<i>Volume Weighted</i>	0.0395	0.0248	0.0542	0.0147	0.0790	0.0121	0.1579	-0.0264
<i>Mean</i>	0.0388	0.0245	0.0507	0.0160	0.0756	0.0136	0.1423	-0.0159
Liquidity Effect								
<i>Volume Weighted</i>	-0.0827	-0.0986	-0.0839	-0.0952	-0.0826	-0.0948	-0.0729	-0.0911
<i>Mean</i>	-0.0829	-0.0986	-0.0845	-0.0954	-0.0826	-0.0939	-0.0739	-0.0924
Permanent Effect								
<i>Volume Weighted</i>	0.1223	0.1234	0.1381	0.1099	0.1615	0.1069	0.2308	0.0646
<i>Mean</i>	0.1217	0.1231	0.1353	0.1114	0.1583	0.1075	0.2161	0.0766
<i>Panel A.2: S&P 500 Bear Market (18 Months)</i>								
Total Price Effect								
<i>Volume Weighted</i>	-0.1053	-0.1286	-0.0996	-0.1413	-0.0841	-0.1366	-0.0051	-0.1666
<i>Mean</i>	-0.1070	-0.1283	-0.1019	-0.1392	-0.0892	-0.1340	-0.0195	-0.1613
Liquidity Effect								
<i>Volume Weighted</i>	0.0407	0.0226	0.0350	0.0226	0.0236	0.0129	0.0199	0.0028
<i>Mean</i>	0.0414	0.0231	0.0348	0.0228	0.0233	0.0127	0.0174	0.0059
Permanent Effect								
<i>Volume Weighted</i>	-0.1460	-0.1512	-0.1346	-0.1639	-0.1077	-0.1496	-0.0251	-0.1694
<i>Mean</i>	-0.1484	-0.1514	-0.1367	-0.1621	-0.1125	-0.1467	-0.0369	-0.1672
<i>Panel B.1: NASDAQ-100 Bull Market (25 Months)</i>								
Total Price Effect								
<i>Volume Weighted</i>	0.2216	0.2148	0.3320	0.1586	0.3930	0.0757	0.4790	-0.1037
<i>Mean</i>	0.2190	0.2208	0.3336	0.1605	0.3940	0.0780	0.4804	-0.0797
Liquidity Effect								
<i>Volume Weighted</i>	-0.0704	-0.1095	-0.0769	-0.1231	-0.0774	-0.1444	-0.0708	-0.1352
<i>Mean</i>	-0.0710	-0.1138	-0.0778	-0.1237	-0.0757	-0.1452	-0.0778	-0.1376
Permanent Effect								
<i>Volume Weighted</i>	0.2920	0.3243	0.4089	0.2817	0.4705	0.2201	0.5498	0.0315
<i>Mean</i>	0.2900	0.3347	0.4114	0.2843	0.4697	0.2232	0.5582	0.0579
<i>Panel B.2: NASDAQ-100 Bear Market (23 Months)</i>								

Total Price Effect								
<i>Volume Weighted</i>	-0.2604	-0.2864	-0.1531	-0.3397	-0.0092	-0.3767	0.1022	-0.4664
<i>Mean</i>	-0.2645	-0.2816	-0.1535	-0.3398	-0.0114	-0.3753	0.1023	-0.4514
Liquidity Effect								
<i>Volume Weighted</i>	0.1703	0.1206	0.1771	0.1079	0.1597	0.1020	0.1505	0.0899
<i>Mean</i>	0.1711	0.1195	0.1777	0.1090	0.1595	0.1027	0.1451	0.0933
Permanent Effect								
<i>Volume Weighted</i>	-0.4307	-0.4069	-0.3302	-0.4476	-0.1689	-0.4787	-0.0483	-0.5563
<i>Mean</i>	-0.4355	-0.4011	-0.3312	-0.4488	-0.1710	-0.4779	-0.0428	-0.5447

Table 5 (continue):

	2		3		4		5	
	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell
<i>Panel C.1: Live Cattle Bull Market (24 Months)</i>								
Total Price Effect								
<i>Volume Weighted</i>	0.0544	0.1102	0.0690	0.0837	0.1115	0.0679	0.1901	-0.0046
<i>Mean</i>	0.0532	0.1109	0.0641	0.0876	0.1103	0.0703	0.1719	0.0218
Liquidity Effect								
<i>Volume Weighted</i>	-0.0450	-0.0638	-0.0452	-0.0471	-0.0299	-0.0574	-0.0187	-0.1019
<i>Mean</i>	-0.0468	-0.0637	-0.0450	-0.0459	-0.0299	-0.0558	-0.0315	-0.0874
Permanent Effect								
<i>Volume Weighted</i>	0.0994	0.1741	0.1142	0.1308	0.1414	0.1252	0.2089	0.0974
<i>Mean</i>	0.1000	0.1746	0.1091	0.1335	0.1402	0.1261	0.2034	0.1092
<i>Panel C.2: Live Cattle Bear Market (14 Months)</i>								
Total Price Effect								
<i>Volume Weighted</i>	-0.1204	-0.0620	-0.1004	-0.0818	-0.0768	-0.1267	-0.0351	-0.1938
<i>Mean</i>	-0.1212	-0.0598	-0.1041	-0.0782	-0.0781	-0.1256	-0.0360	-0.1742
Liquidity Effect								
<i>Volume Weighted</i>	0.0890	0.0656	0.0859	0.0944	0.0903	0.0616	0.0841	0.0555
<i>Mean</i>	0.0885	0.0658	0.0849	0.0914	0.0910	0.0612	0.0909	0.0681
Permanent Effect								
<i>Volume Weighted</i>	-0.2095	-0.1277	-0.1863	-0.1762	-0.1671	-0.1883	-0.1191	-0.2493
<i>Mean</i>	-0.2096	-0.1257	-0.1890	-0.1696	-0.1691	-0.1868	-0.1269	-0.2423
<i>Panel D.1: British Pound Bull Market (28 Months)</i>								
Total Price Effect								
<i>Volume Weighted</i>	0.0596	0.0322	0.0926	-0.0032	0.1016	-0.0345	0.1238	-0.0570
<i>Mean</i>	0.0581	0.0336	0.0911	-0.0005	0.1017	-0.0348	0.1188	-0.0464
Liquidity Effect								
<i>Volume Weighted</i>	-0.0209	-0.0417	-0.0220	-0.0400	-0.0163	-0.0326	-0.0105	-0.0443
<i>Mean</i>	-0.0208	-0.0405	-0.0216	-0.0389	-0.0145	-0.0316	-0.0123	-0.0420
Permanent Effect								
<i>Volume Weighted</i>	0.0804	0.0739	0.1146	0.0367	0.1179	-0.0019	0.1343	-0.0127
<i>Mean</i>	0.0789	0.0740	0.1127	0.0384	0.1162	-0.0032	0.1311	-0.0044
<i>Panel D.2: British Pound Bear Market (20 Months)</i>								
Total Price Effect								

<i>Volume Weighted</i>	-0.0073	-0.0149	0.0311	-0.0601	0.0523	-0.0907	0.0965	-0.1233
<i>Mean</i>	-0.0101	-0.0133	0.0298	-0.0574	0.0518	-0.0893	0.0784	-0.1182
Liquidity Effect								
<i>Volume Weighted</i>	0.0175	-0.0079	0.0069	-0.0052	0.0041	-0.0149	-0.0006	0.0148
<i>Mean</i>	0.0172	-0.0078	0.0078	-0.0050	0.0028	-0.0144	-0.0020	0.0033
Permanent Effect								
<i>Volume Weighted</i>	-0.0248	-0.0070	0.0242	-0.0549	0.0482	-0.0758	0.0971	-0.1380
<i>Mean</i>	-0.0273	-0.0056	0.0220	-0.0525	0.0490	-0.0749	0.0804	-0.1215

Table 5 (continue):

	2		3		4		5	
	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell
<i>Panel E.1: Eurodollar Bull Market (29 Months)</i>								
Total Price Effect (10 ²)								
<i>Volume Weighted</i>	0.2348	0.1377	0.2851	0.1515	0.3586	0.0982	0.3982	0.2120
<i>Mean</i>	0.2277	0.1376	0.2833	0.1516	0.3574	0.0980	0.3778	0.1966
Liquidity Effect (10 ²)								
<i>Volume Weighted</i>	-0.1644	-0.2082	-0.1714	-0.2184	-0.1273	-0.1598	-0.1504	-0.2181
<i>Mean</i>	-0.1636	-0.2098	-0.1716	-0.2183	-0.1293	-0.1578	-0.1569	-0.2200
Permanent Effect (10 ²)								
<i>Volume Weighted</i>	0.3992	0.3460	0.4566	0.3700	0.4859	0.2580	0.5486	0.4302
<i>Mean</i>	0.3913	0.3474	0.4549	0.3699	0.4866	0.2558	0.5347	0.4166
<i>Panel E.2: Eurodollar Bear Market (19 Months)</i>								
Total Price Effect (10 ²)								
<i>Volume Weighted</i>	-0.0149	-0.1928	0.0104	-0.2741	0.1027	-0.2269	0.0718	-0.4476
<i>Mean</i>	-0.0194	-0.1905	0.0092	-0.2731	0.0971	-0.2261	0.0666	-0.3969
Liquidity Effect (10 ²)								
<i>Volume Weighted</i>	0.0414	0.0086	0.0431	-0.0183	-0.0371	-0.0017	0.0712	-0.0174
<i>Mean</i>	0.0427	0.0060	0.0426	-0.0187	-0.0341	-0.0021	0.0527	-0.0140
Permanent Effect (10 ²)								
<i>Volume Weighted</i>	-0.0563	-0.2014	-0.0327	-0.2558	0.1398	-0.2252	0.0006	-0.4302
<i>Mean</i>	-0.0621	-0.1965	-0.0334	-0.2544	0.1312	-0.2240	0.0140	-0.3829

This table contains estimates of the price effect (in percentage) for trades initiated by the outside customers (CTI4) for the following futures contracts: S&P 500, NASDAQ-100, Live Cattle, British Pound, and Eurodollar. The total price effect, liquidity effect and information effect are estimated by,

$$\text{Total Price effect} = \ln(P_b / P_{p,b}) \times 100$$

$$\text{Liquidity (Temporary) effect} = \ln(P_b / P_{p,a}) \times 100$$

$$\text{Information (Permanent) effect} = \ln(P_{p,a} / P_{p,b}) \times 100$$

where P_b denotes the price of the transaction for which the price impact is estimated; $P_{p,b}$ and $P_{p,a}$ are the benchmark prices prior to and after the transaction of interest. For the results in this table, the daily opening and closing prices are used as benchmark prices. The price effects are computed for purchases and sales for bullish and bearish markets, respectively. For each contract, the market is classified per month as bullish if the monthly price return is positive and bearish otherwise. The price return is computed as the log difference between the first and the last trade price of the month. The number of bullish and bearish months is noted in parenthesis in the table panels. Furthermore, the trades are categorized into five groups based on the percentiles of the empirical trade size distribution for trades initiated by the CTI4 traders. Transactions with trade sizes less than the 50th percentile belong to group 1; trade sizes between the 50th and 70th percentiles belong to class 2; trade sizes in the ranges 70th to 90th and 90th to 95th belong to categories 3 and 4, respectively; transactions with a trade size larger than the 95th percentile are classified as 5. The trade sizes at these percentiles for the contracts are,

50th 70th 90th 95th

S&P500	3	5	10	20
NASDAQ-100	3	5	10	16
Live Cattle	3	5	12	20
British Pound	2	4	10	20
Eurodollar	50	100	175	200

The estimates labeled VWAP are volume weighted averages price effects. Proportion denotes the fraction of the estimates of price effects that are positive for purchases and the fraction of estimates that are negative for sales. The VWAP, mean, and median estimates for Eurodollar are multiplied by 100.

Table 6: Price effect (in percentage) in bull and bear markets using 15-minute prices as benchmark prices.

	2		3		4		5	
	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell
<i>Panel A.1: S&P 500 Bull Market (30 Months)</i>								
Total Price Effect								
<i>Volume Weighted</i>	0.0138	-0.0024	0.0148	-0.0055	0.0241	-0.0115	0.0698	-0.0477
<i>Mean</i>	0.0135	-0.0023	0.0127	-0.0040	0.0224	-0.0103	0.0592	-0.0383
Liquidity Effect								
<i>Volume Weighted</i>	0.0042	-0.0099	0.0030	-0.0102	0.0027	-0.0092	0.0048	-0.0107
<i>Mean</i>	0.0041	-0.0098	0.0028	-0.0099	0.0024	-0.0088	0.0036	-0.0100
Permanent Effect								
<i>Volume Weighted</i>	0.0097	0.0075	0.0119	0.0046	0.0214	-0.0022	0.0650	-0.0369
<i>Mean</i>	0.0094	0.0075	0.0100	0.0059	0.0200	-0.0015	0.0556	-0.0282
<i>Panel A.2: S&P 500 Bear Market (18 Months)</i>								
Total Price Effect								
<i>Volume Weighted</i>	0.0004	-0.0154	0.0020	-0.0182	0.0074	-0.0208	0.0496	-0.0603
<i>Mean</i>	-0.0003	-0.0152	-0.0001	-0.0164	0.0050	-0.0188	0.0402	-0.0513
Liquidity Effect								
<i>Volume Weighted</i>	0.0126	-0.0041	0.0093	-0.0028	0.0079	-0.0051	0.0085	-0.0121
<i>Mean</i>	0.0127	-0.0038	0.0092	-0.0025	0.0076	-0.0045	0.0074	-0.0105
Permanent Effect								
<i>Volume Weighted</i>	-0.0122	-0.0113	-0.0073	-0.0154	-0.0005	-0.0158	0.0412	-0.0482
<i>Mean</i>	-0.0131	-0.0115	-0.0093	-0.0140	-0.0026	-0.0143	0.0329	-0.0408
<i>Panel B.1: NASDAQ-100 Bull Market (25 Months)</i>								
Total Price Effect								
<i>Volume Weighted</i>	0.0375	0.0037	0.0596	-0.0146	0.1087	-0.0492	0.1902	-0.1157
<i>Mean</i>	0.0359	0.0053	0.0588	-0.0139	0.1082	-0.0493	0.1757	-0.1053
Liquidity Effect								
<i>Volume Weighted</i>	0.0123	-0.0244	0.0076	-0.0258	0.0134	-0.0302	0.0086	-0.0378
<i>Mean</i>	0.0121	-0.0246	0.0073	-0.0257	0.0130	-0.0303	0.0103	-0.0356
Permanent Effect								
<i>Volume Weighted</i>	0.0253	0.0280	0.0520	0.0112	0.0953	-0.0190	0.1816	-0.0779
<i>Mean</i>	0.0238	0.0299	0.0516	0.0118	0.0952	-0.0189	0.1654	-0.0696
<i>Panel B.2: NASDAQ-100 Bear Market (23 Months)</i>								
Total Price Effect								

<i>Volume Weighted</i>	0.0009	-0.0466	0.0209	-0.0673	0.0676	-0.1033	0.1109	-0.1630
<i>Mean</i>	-0.0006	-0.0447	0.0198	-0.0663	0.0671	-0.1034	0.1087	-0.1571
Liquidity Effect								
<i>Volume Weighted</i>	0.0340	-0.0064	0.0323	-0.0080	0.0340	-0.0119	0.0354	-0.0253
<i>Mean</i>	0.0338	-0.0062	0.0322	-0.0077	0.0338	-0.0120	0.0350	-0.0222
Permanent Effect								
<i>Volume Weighted</i>	-0.0331	-0.0402	-0.0114	-0.0592	0.0336	-0.0914	0.0755	-0.1377
<i>Mean</i>	-0.0343	-0.0385	-0.0124	-0.0586	0.0333	-0.0914	0.0738	-0.1349

Table 6 (continue):

	2		3		4		5	
	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell
<i>Panel C.1: Live Cattle Bull Market (24 Months)</i>								
Total Price Effect								
<i>Volume Weighted</i>	0.0327	0.0014	0.0385	-0.0019	0.0544	-0.0062	0.1074	-0.0539
<i>Mean</i>	0.0318	0.0014	0.0367	-0.0006	0.0545	-0.0054	0.0898	-0.0400
Liquidity Effect								
<i>Volume Weighted</i>	-0.0006	-0.0209	0.0005	-0.0179	0.0067	-0.0189	0.0061	-0.0486
<i>Mean</i>	-0.0008	-0.0207	0.0000	-0.0176	0.0068	-0.0182	-0.0005	-0.0419
Permanent Effect								
<i>Volume Weighted</i>	0.0333	0.0223	0.0380	0.0160	0.0476	0.0128	0.1013	-0.0052
<i>Mean</i>	0.0326	0.0221	0.0367	0.0170	0.0477	0.0128	0.0903	0.0019
<i>Panel C.2: Live Cattle Bear Market (14 Months)</i>								
Total Price Effect								
<i>Volume Weighted</i>	-0.0071	-0.0375	-0.0071	-0.0457	0.0048	-0.0775	0.0256	-0.1271
<i>Mean</i>	-0.0075	-0.0368	-0.0086	-0.0442	0.0039	-0.0776	0.0258	-0.1107
Liquidity Effect								
<i>Volume Weighted</i>	0.0170	-0.0076	0.0109	-0.0019	0.0110	-0.0218	0.0178	-0.0359
<i>Mean</i>	0.0170	-0.0079	0.0105	-0.0025	0.0109	-0.0222	0.0183	-0.0209
Permanent Effect								
<i>Volume Weighted</i>	-0.0241	-0.0299	-0.0180	-0.0437	-0.0062	-0.0558	0.0077	-0.0911
<i>Mean</i>	-0.0245	-0.0289	-0.0192	-0.0417	-0.0070	-0.0553	0.0075	-0.0899
<i>Panel D.1: British Pound Bull Market (28 Months)</i>								
Total Price Effect								
<i>Volume Weighted</i>	0.0211	-0.0096	0.0310	-0.0145	0.0341	-0.0274	0.0421	-0.0421
<i>Mean</i>	0.0207	-0.0091	0.0305	-0.0138	0.0342	-0.0263	0.0430	-0.0347
Liquidity Effect								
<i>Volume Weighted</i>	0.0081	-0.0098	0.0078	-0.0115	0.0097	-0.0101	0.0114	-0.0055
<i>Mean</i>	0.0082	-0.0097	0.0078	-0.0110	0.0101	-0.0101	0.0135	-0.0047
Permanent Effect								
<i>Volume Weighted</i>	0.0130	0.0002	0.0232	-0.0030	0.0244	-0.0174	0.0307	-0.0367
<i>Mean</i>	0.0126	0.0006	0.0227	-0.0028	0.0241	-0.0163	0.0294	-0.0300
<i>Panel D.2: British Pound Bear Market (20 Months)</i>								
Total Price Effect								

<i>Volume Weighted</i>	0.0111	-0.0172	0.0178	-0.0269	0.0241	-0.0383	0.0427	-0.0561
<i>Mean</i>	0.0108	-0.0165	0.0172	-0.0260	0.0242	-0.0373	0.0357	-0.0532
Liquidity Effect								
<i>Volume Weighted</i>	0.0107	-0.0085	0.0108	-0.0083	0.0105	-0.0107	0.0180	-0.0050
<i>Mean</i>	0.0106	-0.0085	0.0109	-0.0082	0.0106	-0.0112	0.0150	-0.0071
Permanent Effect								
<i>Volume Weighted</i>	0.0004	-0.0087	0.0070	-0.0185	0.0136	-0.0277	0.0247	-0.0511
<i>Mean</i>	0.0002	-0.0081	0.0063	-0.0178	0.0136	-0.0261	0.0207	-0.0461

Table 6 (continue):

	2		3		4		5	
	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell
<i>Panel E.1: Eurodollar Bull Market (29 Months)</i>								
Total Price Effect (10 ²)								
<i>Volume Weighted</i>	0.0525	-0.0069	0.0737	-0.0020	0.0793	-0.0110	0.1204	-0.0014
<i>Mean</i>	0.0515	-0.0069	0.0738	-0.0017	0.0774	-0.0103	0.1096	0.0000
Liquidity Effect (10 ²)								
<i>Volume Weighted</i>	0.0001	-0.0347	-0.0015	-0.0387	-0.0058	-0.0339	-0.0012	-0.0393
<i>Mean</i>	0.0004	-0.0345	-0.0017	-0.0382	-0.0054	-0.0329	-0.0020	-0.0367
Permanent Effect								
<i>Volume Weighted</i>	0.0524	0.0278	0.0751	0.0366	0.0850	0.0229	0.1216	0.0379
<i>Mean</i>	0.0511	0.0276	0.0755	0.0365	0.0828	0.0226	0.1116	0.0367
<i>Panel E.2: Eurodollar Bear Market (19 Months)</i>								
Total Price Effect (10 ²)								
<i>Volume Weighted</i>	0.0143	-0.0536	0.0285	-0.0908	0.0562	-0.0579	0.0369	-0.1534
<i>Mean</i>	0.0128	-0.0530	0.0277	-0.0915	0.0559	-0.0569	0.0369	-0.1345
Liquidity Effect (10 ²)								
<i>Volume Weighted</i>	0.0138	-0.0148	0.0205	-0.0169	0.0049	-0.0016	0.0223	-0.0247
<i>Mean</i>	0.0140	-0.0153	0.0199	-0.0173	0.0047	-0.0019	0.0185	-0.0207
Permanent Effect (10 ²)								
<i>Volume Weighted</i>	0.0006	-0.0388	0.0080	-0.0739	0.0512	-0.0563	0.0147	-0.1287
<i>Mean</i>	-0.0012	-0.0377	0.0078	-0.0741	0.0512	-0.0550	0.0183	-0.1138

This table contains estimates of the price effect (in percentage) for trades initiated by the outside customers (CTI4) for the following futures contracts: S&P 500, NASDAQ-100, Live Cattle, British Pound, and Eurodollar. The total price effect, liquidity effect and information effect are estimated by,

$$\text{Total Price effect} = \ln(P_b / P_{p,b}) \times 100$$

$$\text{Liquidity (Temporary) effect} = \ln(P_b / P_{p,a}) \times 100$$

$$\text{Information (Permanent) effect} = \ln(P_{p,a} / P_{p,b}) \times 100$$

where P_b denotes the price of the transaction for which the price impact is estimated; $P_{p,b}$ and $P_{p,a}$ are the benchmark prices where $P_{p,b}$ ($P_{p,a}$) is the first trade that is executed at least fifteen minutes prior (subsequent) to the trade P_b . During the opening and closing fifteen minutes of trading, the opening and closing prices are used. The price effects are computed for purchases and sales for bullish and bearish markets, respectively. For each contract, the market is classified per month as bullish if the monthly price return is positive and bearish otherwise. The price return is computed as the log difference between the first and the last trade price of the month. The number of bullish and bearish months is noted in parenthesis in the table panels. Furthermore, the trades are categorized into five groups based on the percentiles of the empirical trade size distribution for trades initiated by the CTI4 traders. Transactions with trade sizes less than the 50th percentile belong to group 1; trade sizes between the 50th and 70th percentiles belong to class 2; trades sizes in the ranges 70th to 90th and 90th to 95th belong to categories 3 and 4, respectively; transactions with a trade size larger than the 95th percentile are classified as 5. The trade sizes at these percentiles for the contracts are,

50th 70th 90th 95th

S&P500	3	5	10	20
NASDAQ-100	3	5	10	16
Live Cattle	3	5	12	20
British Pound	2	4	10	20
Eurodollar	50	100	175	200

The estimates labeled VWAP are volume weighted averages price effects. Proportion denotes the fraction of the estimates of price effects that are positive for purchases and the fraction of estimates that are negative for sales. The VWAP, mean, and median estimates for Eurodollar are multiplied by 100.

Table 7: Regression Analysis I

	Total Price Effect		Liquidity Effect		Permanent Effect	
	Buy	Sell	Buy	Sell	Buy	Sell
<i>Panel A: S&P 500</i>						
Intercept	-0.0572 (-72.68)	-0.0200 (-25.72)	-0.0277 (-35.27)	-0.0468 (-60.07)	-0.0295 (-25.97)	0.0267 (23.79)
D2	0.0321 (18.02)	-0.0234 (-13.19)	-0.0007 (-0.42)	0.0023 (1.28)	0.0328 (12.78)	-0.0256 (-10.05)
D3	0.0408 (28.91)	-0.0327 (-23.15)	-0.0044 (-3.11)	0.0037 (2.64)	0.0452 (22.19)	-0.0365 (-17.90)
D4	0.0618 (39.71)	-0.0307 (-19.57)	-0.0093 (-5.98)	-0.0007 (-0.47)	0.0711 (31.67)	-0.0299 (-13.26)
D5	0.1353 (60.91)	-0.0542 (-24.07)	-0.0100 (-4.50)	-0.0062 (-2.78)	0.1453 (45.33)	-0.0480 (-14.79)
Adj R ²	0.0017	0.0004	0.0000	0.0000	0.0010	0.0002
F statistic	1167.45	270.04	12.82	5.05	671.71	130.07
<i>Panel B: NASDAQ-100</i>						
Intercept	-0.1166 (-42.73)	0.0084 (3.07)	0.0558 (21.01)	0.0054 (2.07)	-0.1724 (-44.13)	0.0029 (0.76)
D2	0.0762 (11.84)	-0.0563 (-8.77)	0.0031 (0.49)	0.0055 (0.89)	0.0732 (7.94)	-0.0619 (-6.76)
D3	0.1962 (40.53)	-0.1140 (-23.39)	-0.0004 (-0.08)	-0.0054 (-1.15)	0.1965 (28.36)	-0.1086 (-15.64)
D4	0.3053 (49.15)	-0.1629 (-26.22)	-0.0124 (-2.05)	-0.0235 (-3.91)	0.3177 (35.72)	-0.1395 (-15.76)
D5	0.4250 (47.25)	-0.2616 (-29.15)	-0.0322 (-3.68)	-0.0352 (-4.07)	0.4572 (35.50)	-0.2264 (-17.71)
Adj R ²	0.0053	0.0017	0.0000	0.0000	0.0028	0.0007
F statistic	1174.63	388.48	4.52	8.09	628.85	149.06
<i>Panel C: Live Cattle</i>						
Intercept	-0.0571 (-27.75)	0.0866 (42.15)	0.0155 (8.03)	-0.0241 (-12.54)	-0.0726 (-25.68)	0.1107 (39.17)
D2	0.0414 (9.48)	-0.0422 (-9.49)	-0.0089 (-2.17)	0.0108 (2.59)	0.0503 (8.38)	-0.0529 (-8.66)
D3	0.0557 (16.31)	-0.0627 (-18.07)	-0.0100 (-3.10)	0.0309 (9.53)	0.0656 (13.99)	-0.0936 (-19.61)

D4	0.0953 (12.88)	-0.0948 (-12.55)	0.0008 (0.12)	0.0152 (2.15)	0.0945 (9.28)	-0.1099 (-10.58)
D5	0.1503 (25.38)	-0.1440 (-23.82)	-0.0007 (-0.12)	-0.0005 (-0.09)	0.1510 (18.54)	-0.1435 (-17.25)
Adj R ²	0.0031	0.0031	0.0000	0.0003	0.0018	0.0023
F statistic	213.19	206.65	3.11	23.88	123.17	153.98

Table 7 (continue):

	Total Price Effect		Liquidity Effect		Permanent Effect	
	Buy	Sell	Buy	Sell	Buy	Sell
<i>Panel D: British Pound</i>						
Intercept	0.0019 (1.48)	0.0416 (31.76)	-0.0063 (-5.75)	-0.0291 (-26.75)	0.0082 (4.91)	0.0708 (41.80)
D2	0.0237 (10.58)	-0.0309 (-13.71)	0.0036 (1.91)	0.0045 (2.43)	0.0202 (7.05)	-0.0354 (-12.18)
D3	0.0622 (25.02)	-0.0701 (-28.06)	-0.0024 (-1.15)	0.0069 (3.31)	0.0646 (20.36)	-0.0769 (-23.86)
D4	0.0789 (22.31)	-0.1038 (-29.00)	-0.0010 (-0.35)	0.0062 (2.07)	0.0800 (17.71)	-0.1100 (-23.79)
D5	0.0999 (24.34)	-0.1261 (-30.32)	-0.0017 (-0.51)	0.0112 (3.23)	0.1016 (19.41)	-0.1373 (-25.56)
Adj R ²	0.0101	0.0149	0.0000	0.0001	0.0065	0.0105
F statistic	326.45	486.85	1.91	5.19	212.25	341.22
<i>Panel E: Eurodollar</i>						
Intercept	0.0013 (37.73)	0.0009 (24.57)	-0.0008 (-25.83)	-0.0012 (-38.91)	0.0021 (43.97)	0.0021 (42.76)
D2	0.0001 (2.55)	-0.0006 (-10.58)	-0.0001 (-2.97)	-0.0002 (-3.09)	0.0003 (3.76)	-0.0004 (-5.68)
D3	0.0005 (8.34)	-0.0009 (-14.90)	-0.0001 (-2.25)	-0.0002 (-4.13)	0.0006 (7.48)	-0.0007 (-8.14)
D4	0.0013 (4.02)	-0.0011 (-3.47)	-0.0001 (-0.48)	0.0002 (0.83)	0.0015 (3.21)	-0.0014 (-3.05)
D5	0.0012 (15.29)	-0.0013 (-16.08)	0.0001 (0.88)	-0.0001 (-1.95)	0.0012 (10.48)	-0.0012 (-10.39)
Adj R ²	0.0006	0.0009	0.0000	0.0000	0.0003	0.0003
F statistic	69.34	99.66	3.61	5.45	35.48	36.83

This table presents the results from a regression analysis to test the hypothesis that the total price, liquidity and information effects for trades initiated by the outside customers (CTI4) are positively related to the trade size classes. The regression model is specified as follows,

$$S_i = \beta_0 + \beta_2 D2 + \beta_3 D3 + \beta_4 D4 + \beta_5 D5 + e_i$$

where S_i , $i=1, 2, 3$ represents the total price, liquidity and information effects, respectively. D_i , $i=2, 3, 4, 5$ denotes the i^{th} dummy variable, which is equal to one if the trade size falls into the i^{th} trade size class and zero otherwise. The trades are categorized into five groups based on the percentiles of the empirical trade size distribution for trades initiated by the CTI4 traders. Transactions with trade sizes less than the 50th percentile belong to group 1; trade sizes between the 50th and 70th percentiles belong to class 2; trade sizes in the ranges 70th to 90th and 90th to 95th belong to categories 3 and 4, respectively; transactions with a trade size larger than the 95th percentile are classified as 5. The trade sizes at these percentiles for the contracts are,

	50 th	70 th	90 th	95 th
S&P500	3	5	10	20
NASDAQ-100	3	5	10	16
Live Cattle	3	5	12	20
British Pound	2	4	10	20
Eurodollar	50	100	175	200

OLS is used to estimate the parameters of the model and the White procedure is employed to calculate heteroscedasticity consistent standard errors. The t-statistic is reported in parentheses for each estimate.

Table 8: Regression Analysis II

	Total Price Effect				Liquidity Effect				Permanent Effect			
	Buy		Sell		Buy		Sell		Buy		Sell	
	Bull	Bear	Bull	Bear	Bull	Bear	Bull	Bear	Bull	Bear	Bull	Bear
<i>Panel A: S&P 500</i>												
Intercept	0.0023 (2.41)	-0.1342 (-104.28)	0.0435 (45.26)	-0.1018 (-79.96)	-0.0819 (-86.48)	0.0424 (32.17)	-0.0976 (-104.18)	0.0187 (14.32)	0.0842 (61.26)	-0.1765 (-93.76)	0.1411 (103.83)	-0.1205 (-64.77)
D2	0.0364 (16.54)	0.0272 (9.36)	-0.0190 (-8.64)	-0.0265 (-9.21)	-0.0011 (-0.50)	-0.0010 (-0.32)	-0.0010 (-0.45)	0.0044 (1.50)	0.0375 (12.03)	0.0282 (6.62)	-0.0180 (-5.80)	-0.0309 (-7.35)
D3	0.0484 (27.68)	0.0322 (14.00)	-0.0276 (-15.73)	-0.0374 (-16.25)	-0.0027 (-1.57)	-0.0076 (-3.20)	0.0022 (1.29)	0.0042 (1.77)	0.0511 (20.65)	0.0398 (11.80)	-0.0298 (-12.02)	-0.0415 (-12.36)
D4	0.0733 (38.27)	0.0450 (17.61)	-0.0299 (-15.50)	-0.0322 (-12.56)	-0.0008 (-0.42)	-0.0191 (-7.30)	0.0037 (1.98)	-0.0060 (-2.29)	0.0741 (27.34)	0.0641 (17.14)	-0.0337 (-12.33)	-0.0262 (-6.99)
D5	0.1399 (52.52)	0.1147 (30.25)	-0.0594 (-21.98)	-0.0595 (-15.56)	0.0080 (3.09)	-0.0250 (-6.43)	0.0052 (1.96)	-0.0128 (-3.26)	0.1319 (34.99)	0.1396 (25.17)	-0.0646 (-16.90)	-0.0467 (-8.37)
Adj R ²	0.0024	0.0009	0.0005	0.0004	0.0000	0.0001	0.0000	0.0000	0.0011	0.0007	0.0003	0.0002
F statistic	927.53	276.26	176.42	121.10	3.75	21.35	2.09	6.53	438.04	204.72	105.34	52.94
<i>Panel B: NASDAQ-100</i>												
Intercept	0.1198 (28.31)	-0.3246 (-93.77)	0.2640 (62.97)	-0.2236 (-64.34)	-0.0821 (-21.07)	0.1771 (49.05)	-0.1225 (-32.13)	0.1215 (33.64)	0.2019 (33.49)	-0.5017 (-100.96)	0.3865 (65.12)	-0.3452 (-69.32)
D2	0.0992 (9.90)	0.0601 (7.39)	-0.0432 (-4.33)	-0.0580 (-7.14)	0.0111 (1.20)	-0.0061 (-0.71)	0.0086 (0.95)	-0.0021 (-0.25)	0.0881 (6.17)	0.0661 (5.66)	-0.0518 (-3.67)	-0.0559 (-4.80)
D3	0.2138 (28.70)	0.1711 (27.68)	-0.1034 (-13.73)	-0.1162 (-18.80)	0.0043 (0.62)	0.0006 (0.09)	-0.0013 (-0.19)	-0.0126 (-1.95)	0.2095 (19.74)	0.1705 (19.22)	-0.1022 (-9.58)	-0.1037 (-11.71)
D4	0.2742 (29.08)	0.3131 (38.95)	-0.1860 (-19.64)	-0.1517 (-18.98)	0.0065 (0.74)	-0.0176 (-2.10)	-0.0227 (-2.64)	-0.0189 (-2.27)	0.2678 (19.93)	0.3307 (28.66)	-0.1633 (-12.18)	-0.1328 (-11.60)
D5	0.3606 (27.69)	0.4269 (34.84)	-0.3437 (-26.22)	-0.2278 (-18.88)	0.0043 (0.36)	-0.0320 (-2.51)	-0.0151 (-1.27)	-0.0283 (-2.25)	0.3563 (19.21)	0.4589 (26.09)	-0.3286 (-17.71)	-0.1995 (-11.55)
Adj R ²	0.0042	0.0058	0.0023	0.0017	0.0000	0.0000	0.0000	0.0000	0.0020	0.0031	0.0010	0.0006
F statistic	438.91	673.21	247.11	198.03	0.45	2.62	2.59	2.72	208.81	362.22	107.54	74.86

Table 8 (continue):

	Total Price Effect				Liquidity Effect				Permanent Effect			
	Buy		Sell		Buy		Sell		Buy		Sell	
	Bull	Bear	Bull	Bear	Bull	Bear	Bull	Bear	Bull	Bear	Bull	Bear
<i>Panel C: Live Cattle</i>												
Intercept	0.0126 (4.93)	-0.1601 (-47.33)	0.1403 (56.19)	-0.0022 (-0.62)	-0.0413 (-17.52)	0.0996 (30.38)	-0.0713 (-31.06)	0.0541 (16.05)	0.0538 (15.33)	-0.2597 (-56.50)	0.2116 (61.80)	-0.0562 (-11.69)
D2	0.0406 (7.54)	0.0389 (5.38)	-0.0294 (-5.41)	-0.0577 (-7.69)	-0.0056 (-1.12)	-0.0111 (-1.58)	0.0076 (1.52)	0.0118 (1.64)	0.0462 (6.23)	0.0500 (5.09)	-0.0370 (-4.96)	-0.0695 (-6.77)
D3	0.0515 (12.26)	0.0560 (9.87)	-0.0527 (-12.45)	-0.0760 (-12.89)	-0.0038 (-0.97)	-0.0147 (-2.66)	0.0254 (6.52)	0.0373 (6.61)	0.0553 (9.56)	0.0707 (9.16)	-0.0780 (-13.45)	-0.1133 (-14.05)
D4	0.0978 (10.81)	0.0820 (6.57)	-0.0699 (-7.49)	-0.1234 (-9.83)	0.0114 (1.37)	-0.0086 (-0.71)	0.0155 (1.81)	0.0071 (0.59)	0.0864 (6.94)	0.0905 (5.34)	-0.0854 (-6.67)	-0.1305 (-7.60)
D5	0.1594 (22.08)	0.1241 (12.39)	-0.1185 (-15.81)	-0.1720 (-17.16)	0.0098 (1.47)	-0.0087 (-0.89)	-0.0161 (-2.34)	0.0141 (1.46)	0.1496 (15.06)	0.1328 (9.75)	-0.1023 (-9.96)	-0.1861 (-13.57)
Adj R ²	0.0036	0.0021	0.0022	0.0042	0.0000	0.0000	0.0003	0.0004	0.0017	0.0015	0.0015	0.0032
F statistic	151.41	57.77	90.95	108.92	1.86	1.99	14.29	11.00	73.08	40.78	63.48	84.69
<i>Panel D: British Pound</i>												
Intercept	0.0307 (17.58)	-0.0304 (-15.53)	0.0599 (34.42)	0.0194 (9.84)	-0.0199 (-12.79)	0.0090 (5.96)	-0.0418 (-27.57)	-0.0137 (-8.79)	0.0506 (22.73)	-0.0395 (-15.82)	0.1017 (45.28)	0.0331 (13.02)
D2	0.0274 (9.14)	0.0204 (6.11)	-0.0263 (-8.62)	-0.0328 (-9.91)	-0.0009 (-0.34)	0.0082 (3.16)	0.0013 (0.50)	0.0059 (2.27)	0.0283 (7.41)	0.0122 (2.88)	-0.0276 (-7.01)	-0.0387 (-9.08)
D3	0.0604 (18.61)	0.0603 (15.83)	-0.0603 (-17.71)	-0.0769 (-21.06)	-0.0017 (-0.59)	-0.0012 (-0.41)	0.0029 (0.98)	0.0087 (3.02)	0.0621 (15.01)	0.0615 (12.68)	-0.0632 (-14.39)	-0.0856 (-18.21)
D4	0.0710 (15.69)	0.0822 (14.76)	-0.0947 (-19.10)	-0.1087 (-21.10)	0.0054 (1.33)	-0.0063 (-1.46)	0.0102 (2.36)	-0.0007 (-0.17)	0.0656 (11.38)	0.0885 (12.47)	-0.1049 (-16.39)	-0.1080 (-16.28)
D5	0.0881 (16.78)	0.1088 (16.88)	-0.1063 (-17.93)	-0.1377 (-23.60)	0.0076 (1.62)	-0.0111 (-2.22)	-0.0002 (-0.03)	0.0170 (3.70)	0.0805 (12.03)	0.1199 (14.60)	-0.1061 (-13.87)	-0.1546 (-20.59)
Adj R ²	0.0093	0.0098	0.0114	0.0175	0.0000	0.0003	0.0000	0.0003	0.0053	0.0072	0.0076	0.0124
F statistic	162.67	147.11	194.70	271.19	1.40	5.65	1.51	5.45	93.28	107.41	130.19	191.35

Table 8 (continue):

	Total Price Effect				Liquidity Effect				Permanent Effect			
	Buy		Sell		Buy		Sell		Buy		Sell	
	Bull	Bear	Bull	Bear	Bull	Bear	Bull	Bear	Bull	Bear	Bull	Bear
<i>Panel E: Eurodollar</i>												
Intercept	0.0022 (54.39)	-0.0004 (-5.92)	0.0017 (41.35)	-0.0007 (-10.34)	-0.0015 (-39.01)	0.0004 (7.65)	-0.0018 (-48.77)	-0.0001 (-1.21)	0.0037 (64.88)	-0.0008 (-9.16)	0.0035 (61.64)	-0.0006 (-6.87)
D2	0.0001 (1.05)	0.0002 (1.86)	-0.0003 (-4.82)	-0.0012 (-11.55)	-0.0002 (-3.11)	0.0000 (-0.05)	-0.0003 (-4.58)	0.0001 (1.43)	0.0002 (2.81)	0.0002 (1.39)	0.0000 (-0.44)	-0.0014 (-9.42)
D3	0.0006 (8.70)	0.0005 (4.31)	-0.0002 (-2.37)	-0.0021 (-18.15)	-0.0003 (-3.97)	0.0000 (-0.07)	-0.0004 (-5.38)	-0.0001 (-1.24)	0.0009 (8.88)	0.0005 (3.19)	0.0002 (1.84)	-0.0019 (-12.63)
D4	0.0014 (3.55)	0.0014 (2.29)	-0.0007 (-1.82)	-0.0016 (-2.72)	0.0002 (0.46)	-0.0008 (-1.51)	0.0002 (0.70)	0.0000 (0.10)	0.0012 (2.25)	0.0021 (2.63)	-0.0010 (-1.76)	-0.0016 (-2.07)
D5	0.0016 (16.19)	0.0011 (7.38)	0.0003 (2.84)	-0.0033 (-22.93)	-0.0001 (-1.29)	0.0001 (0.77)	-0.0004 (-4.13)	-0.0001 (-0.59)	0.0017 (12.50)	0.0010 (4.92)	0.0007 (4.75)	-0.0032 (-16.57)
Adj R ²	0.0011	0.0004	0.0001	0.0044	0.0001	0.0000	0.0001	0.0000	0.0007	0.0002	0.0001	0.0022
F statistic	80.75	16.22	11.44	170.49	4.90	0.76	11.11	1.53	50.63	8.43	7.80	87.95

This table presents the results from a regression analysis to test the hypothesis that the total price, liquidity and information effects for trades initiated by the outside customers (CTI4) are positively related to the trade size classes in bullish and bearish markets. The regression model is specified as follows,

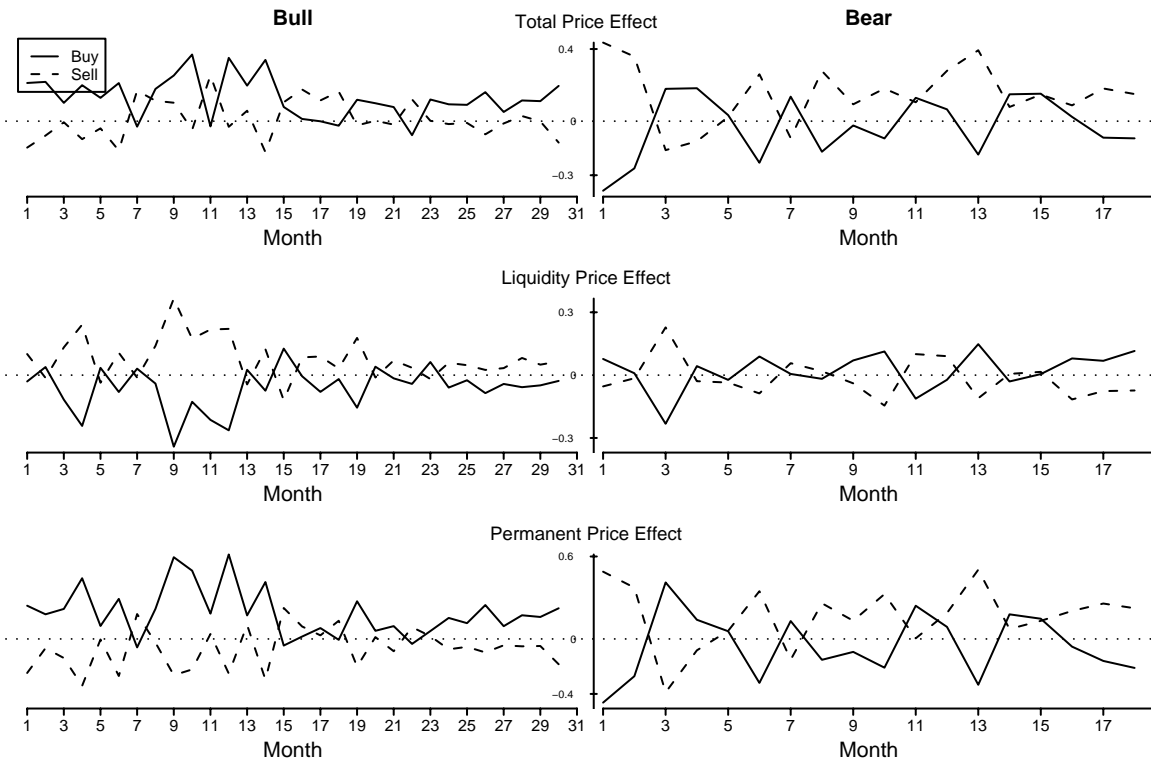
$$S_i = \beta_0 + \beta_1 D1 + \beta_2 D2 + \beta_3 D3 + \beta_4 D4 + \beta_5 D5 + e_i$$

where S_i , $i=1, 2, 3$, represents the total price, liquidity and information effects, respectively. D_i , $i=2, 3, 4, 5$, denotes the i^{th} dummy variable, which is equal to one if the trade size falls into the i^{th} trade size class and zero otherwise. For each contract, the market is classified per month as bullish if the monthly price return is positive and bearish otherwise. The price return is computed as the log difference between the first and the last trade of the month. The number of bullish and bearish months is noted in parenthesis in the table panels. The trade size classes are defined based on the percentiles of the empirical trade size distribution for trades initiated by the CTI4 traders. Transactions with trade sizes less than the 50th percentile belong to group 1; trade sizes between the 50th and 70th percentiles belong to class 2; trade sizes in the ranges 70th to 90th and 90th to 95th belong to categories 3 and 4, respectively; transactions with a trade size larger than the 95th percentile are classified as 5. The trade sizes at these percentiles for the contracts are,

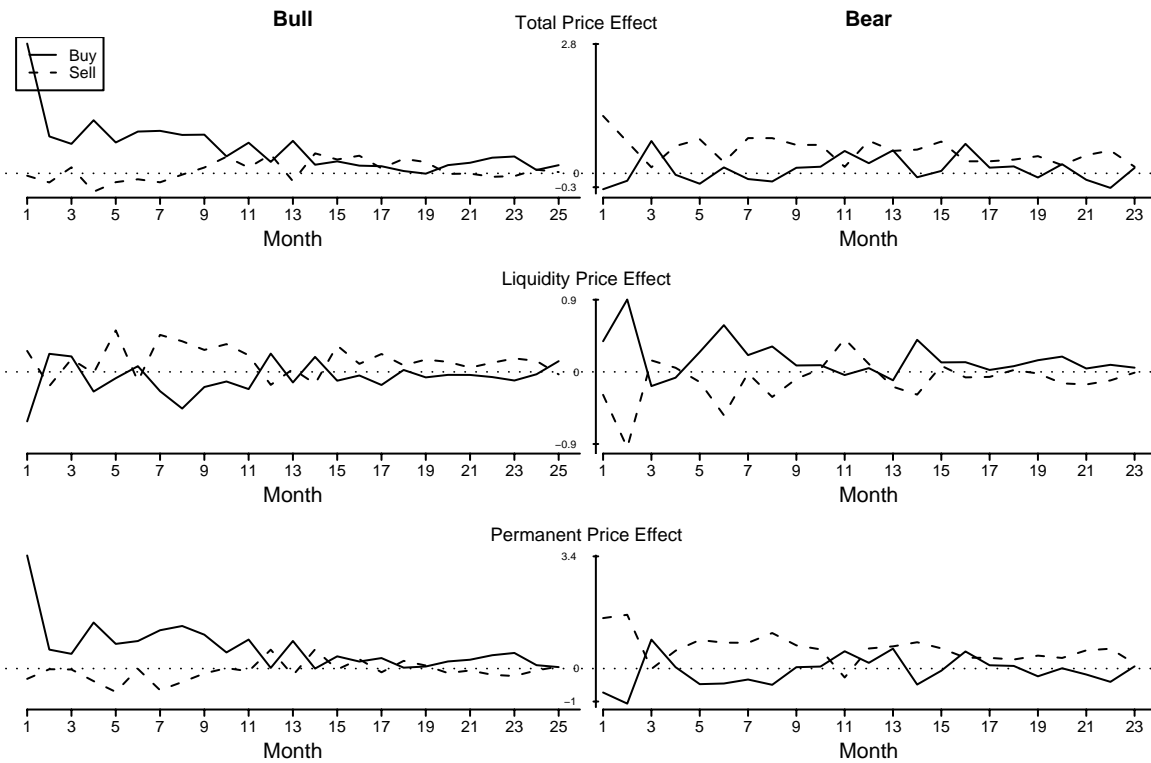
	50 th	70 th	90 th	95 th
S&P500	3	5	10	20
NASDAQ-100	3	5	10	16
Live Cattle	3	5	12	20
British Pound	2	4	10	20
Eurodollar	50	100	175	200

OLS is used to estimate the parameters of the model and the White procedure is employed to calculate heteroscedasticity consistent standard errors. The t-statistic is reported in parentheses for each estimate.

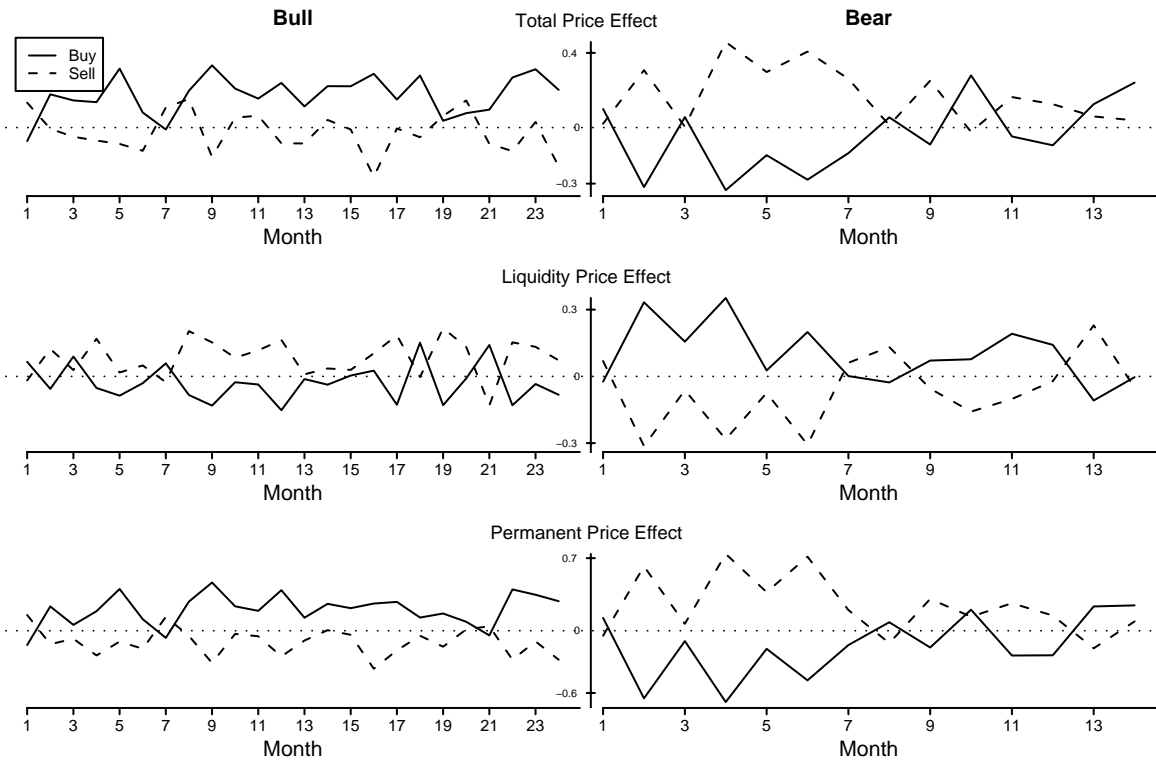
Figure 1
Panel A: S&P 500



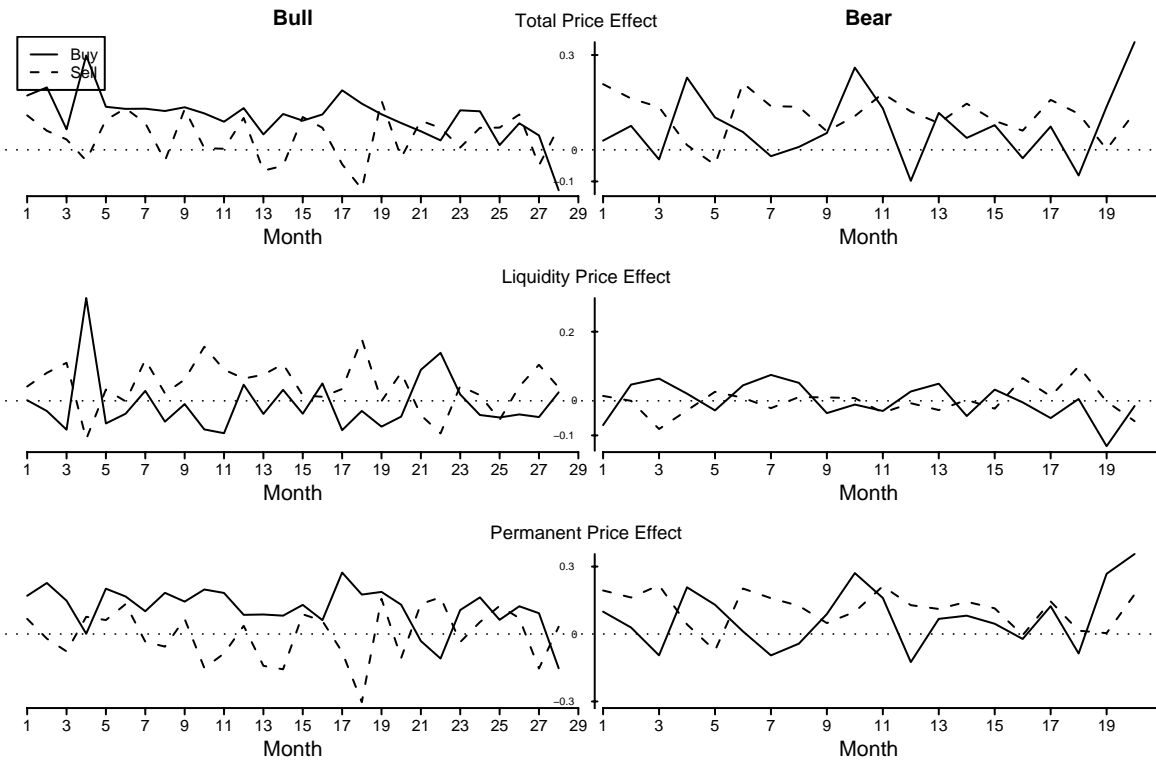
Panel B: NASDAQ-100

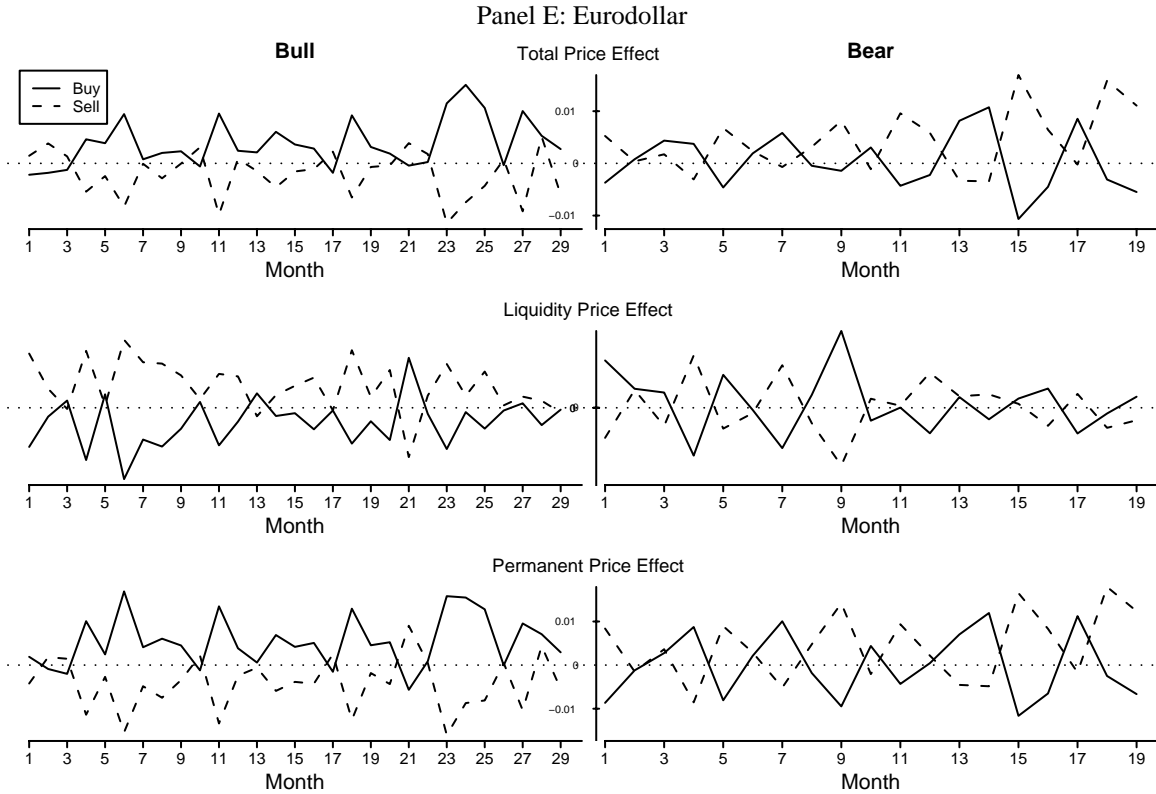


Panel C: Live Cattle



Panel D: British Pound





The figure plots the monthly mean values of the price effect (in percentage) for trades initiated by the outside customers (CTI4) for the following futures contracts: S&P 500, NASDAQ-100, Live Cattle, British Pounds, and Eurodollar. The total price effect, liquidity effect and information effect are estimated by,

$$\text{Total Price effect} = \ln(P_b / P_{p,b}) \times 100$$

$$\text{Liquidity (Temporary) effect} = \ln(P_b / P_{p,a}) \times 100$$

$$\text{Information (Permanent) effect} = \ln(P_{p,a} / P_{p,b}) \times 100$$

where P_b denotes the price of the transaction for which the price impact is estimated; $P_{p,b}$ and $P_{p,a}$ are the benchmark prices prior to and after the transaction of interest. The daily opening and closing prices are used as benchmark prices. The left column plots the monthly estimates for buys and sells in bullish markets while the column to the right plots the estimates for bearish markets. For each month, the market for each contract is classified as bullish if the monthly price return is positive and bearish otherwise. The price return is computed as the log difference between the first and the last trade price of the month. Furthermore, these estimates are for transactions with a trade size larger than the 95th percentile based on the percentiles of the empirical trade size distribution for trades initiated by the CTI4 traders. The estimates for the sells are multiplied by -1 so that they can be compared to buy.

Appendix

Table A.1: CME Futures Contract Specifications for S&P500, NASDAQ-100, Live Cattle, British Pound, Eurodollar

Contract Size	RTH Hours	Contract Listing	Tick Size	Price Limits
S&P 500		March, June,		
\$250XS&P 500 Index	8:30am to 3:15pm	September, December	\$25.00	No price limits
NASDAQ-100		March, June, September,		
\$100X NASDAQ-100 Index	8:30 am to 3: 15pm	December	\$50.00	No price limits
Live Cattle		February, April, June,		
40,000 Pounds	9:05 a.m. – 1:00 p.m.	August, October, December	\$10.00	\$.030/lb
British Pound ^a		March, June,		
£62,500	7:20 a.m. to 2:00 p.m.	September, December	\$6.25	No price limits
Eurodollar		March, June,		
\$1,000,000 ^b	7:20 a.m. to 2:00 p.m.	September, December	\$25.00	No price limits

^a The minimum tick size for the British Pound contracts changed to \$6.25 effective starting with GLOBEX trading on Sunday, October 5, 2003, for the trade date of Monday, October 6, 2003. Before that the minimum tick size was \$12.50.

^b Eurodollar Time Deposit has a principal value of \$1,000,000 with a three-month maturity.