The Impact of Outside Customer Trades on Futures Prices

By

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Abstract

This paper examines the effects of outside customer large trades on the futures prices of S&P 500 index futures traded in Chicago Mercantile Futures Exchanges (CME). The Computer Trade Reconstruction (CTR) data is used for our analysis and the sample period covers from January 1994 to December 2004. We find for whole sample period, that buyer initiated large trades have a larger permanent price impacts than seller initiated large trades and vice visa for the liquidity price effects between buys and sells large trade. These results are consistent with previous findings in block and institutional trades in the equity markets. However, we find the permanent price effect of large sells are larger than large buys in bearish markets and the results are revered in bullish markets. For buyer initiated large trades, the liquidity price effects are larger than liquidity price effect of seller' large trades in bearish markets and the results are reversed in bullish markets. Our results are consistent with the hypothesis that economic conditions is major determinant of asymmetric price effects between large buys and larger sells (Chiyachantana, Jian, Jiang and Wood (J. Finance LIX, (2004))

1. Introduction

The trading activity of large trades has surged in S&P 500 index futures market over time (Huang and Stoll( )). Market participants, exchanges and regulators are interested in market impact costs for differ order and trade sizes. Market Impact costs of large trades influence investors' decision of implementing alterative trading strategies and determine the performance of investment return. Exchanges and regulators interest in measuring the price impacts of various trade sizes because it is one of the implicit component of transaction cost and transaction cost measurement is used as one of the criteria to judge the quality of trading markets. However, to the best of our knowledge, there is no empirical literature on examining price impact of large trades in S& P 500 index futures traded in Chicago Mercantile exchange (CME). The major purpose of this paper is to fill this gap in futures market literature.

Most of the existing literature on price impact of large trades is concentrated in the equity markets. Previous literature on the price impacts of block trades in equity markets includes Kraus and Stoll (1972), Houlthausen, Leftwich and Mayers(1987, 1990), Gemmill (1996), Keim and Madhavan (1996) and others. Chan and Lakonishok (1993, 1995) and others investigated the price impacts of institutional trades on equity prices. They have found a general pattern that the purchases of a block trade in equity market are accompanied by an increase in its price, which continue to rise after the block trade and sales of a block trades usually accompanied by a drop in prices , but there is subsequently a strong price reversals. Thus, they provided empirical evidence that the total price and permanent price impacts of block purchases have larger total price and permanent impact than block sales.

Chan and Lakonishok (1993) and Kiem and Madhavan (1996) suggest the asymmetric price response between block purchases and sales is due to differences in information contents of buys and seals. They suggest that the creation of new long positions, is more likely the result of new private information (firm specific information). On other hand, they suggest that sales of institutional trades most are due to liquidity –motivated reasons. For example, the choice of particular stock to sell may be due to the stock has failed to meet the objectives of the mutual funds or due to asset reallocation to their portfolio.

Differences in price and liquidity effects of block and institutional trades may be due to difference in short –run liquidity costs. Large (block) traders are willing to accommodate customer's sales by purchase shares and holding them in inventory with compensation by short run price concessions. Most block traders are less willing to do short selling in order to meet the needs of the block buys because they concerns the prices may likely to rise after the bock purchases. For this reason, most of the drop in prices of block sells is due to short –run liquidity costs and there is strong price recovery subsequent the block sells.

Another possible reason that the price changes around block trades may be due to imperfect substitution for particular stock (Scholes (1972),Shleifer(1986)). A buyer faces face an upward supply curve and a seller face a downward demand curve. Thus, a premium has to be offered by the buyer and sellers in a block trade in order to attract their opposite sides of their trades. If supply is more inelastic than the demand, than the permanent price effect of purchases would be larger the permanent effects of sells. As a consequent, liquidity effects (price reversals) of buys would be smaller than the same effects of sales.

Saar (2001) develops a theoretical model to explain the previous empirical evidence found in equity markets that permanent (information) effect of buys is greater than that of sells. His model demonstrates that how the trading strategy of institutional portfolio managers generate a difference in information content of purchases and sells.[1] The theoretical model relates the history of past price performances influences the shapes of asymmetry between the permanent effects of buys and sells after a block trade. For example, the model predict that the information effects of sells 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 delines.

Chiyachantana, Jain, Jiang and Wood (2004) examines the characteristics of institutional trading in international stocks from 37 countries study from 1997 to 1998 and 2001. They find that the current economic condition is a major determinant of total price impact of the asymmetry between the price impacts of institutional buys and sells. They shows that in the bullish markets, the total price impacts of buys is greater than that of sells and the asymmetry pattern of total price impact is reversed in the bearish markets. They suggest that all previous studies on US equity markets employed data during the bullish markets periods. The basic reasoning behind their hypothesis is that price impact is a function of market liquidity of the opposite side. Institution investors pay for demanding liquidity in selling in the falling markets and in purchasing in the rising markets. Institutional traders effectively provide liquidity when trading against price trend in the market. Thus, they face lower price impacts in this situation.

Frino and Oetomo (2005) is the first paper report the empirical evidences of market price impact (slippage) of trading packages in futures market literature. They characterize the market price effect , information and liquidity price effects incurred in executing package of trades of four main futures contracts (SPI200, BAB, 3-

[1] Saar (2001,p 1154) presents excellent discussions on four basic assumptions on investment and trading strategy of mutual funds mangers. Based on these assumptions, he derived his theoretical model .

yearbond and 10-year bound futures) traded in the Sydney Futures Exchanges with intraday data from July 1 , 2000 to June 30, 2003. They document three interesting results : (1) the market impacts incurred in executing trade package in stock index futures and interest-rate futures are significantly smaller than price impact cost documented previously based on US equity markets; (2) there is little evidence on asymmetry between the price impacts of purchases and sells, which is in contrary to the findings in US equity and (3)the liquidity price impacts (costs) are the major portion spillage cost in the Sydney futures markets, there is little information impacts (costs). They claim these results are consistent with the previous work which conjectures there is absence of private information in stock index futures.

This paper is closely related to the work of Frino and Oetomo (2005). However, it differs in several ways. First, we use unique intraday Computer Trade Reconstruction (CTR) data with time period from 1994 to 2004 to estimate the magnitude of total price, permanent and liquidity price effects in S&P 500 index futures market .The integrity and coverage of long CTR time series data enhances the internal and external validity of the type of research reported in this paper. Second, this paper provide comparisons to total , liquidity and permanent price costs documented in previous research in the equity markets and the futures contracts traded in Sydney futures exchange. Third, the long time series data allows us to test whether current economic condition hypothesis suggested by Chiyachantana, Jain, Jiang and Wood (2004) can be used to explain the relationship between price, information and liquidity price effects of purchases versus sells in S&P 500 index futures market.

The paper is organized in four sections. Section 2 discusses the data and empirical methodology. Section 3 reports empirical results. Summary and conclusions are presented in Section 4.

2. The Data and Empirical Methods

The Sample data used in this analysis is the CTR data of the regular S&P 500 index futures covered from the period January 1994 to December 2004. The regular S&P 500 Index futures is the most active trading index futures in the world. It is traded on Open-outcry trading system and has four maturity contracts: March, June, September and December contracts.

During this sample period, it should be noted the S&P 500 index futures experienced two important events. First, E-mini S&P 500 index futures was introduced in September, 1997. The size of E- Mini S&P 500 index futures is one fifth of the size of regular index futures and is traded in electronic trading system. The E-mini contract is designed to attract small market participants and to allow market participants to fine turn their hedging position. Second, the S&P 500 Index futures had a contract split effective 3, November 1997. The main features of the contract split are (1) the contract multiplier was reduced from $ 500 to $ 250; and (2) the minimum tick size was increased from 0.05 to 0.1 index point. As a result of the combined effects, the dollar value of a minimum price tick continued to be $ 25. Ates and Wang (2005) found that these two events had affected on the trade size distribution of regular index futures before and after November, 1997.

CTR data set of S&P 500 index futures is a unique data set. This data set is the major audit trail information sources 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 exchanges clearinghouse for settlement and reconciliation at the end of day's trading. The CTD 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. the trades was a buy or sell) by four types of traders. The CTI1 traders are locals who trade for their own accounts as well as for outside customers); CTI2 are traders for clearing member s, CTI3 is the trading between locals and CTI4 is the trades by outside customers. This unique data date provide us information on the trade initiation by trader types. Thus, we minimize the errors of using trade classification methods.

Our empirical procedures used to measure total, liquidity and permanent price effects of a buyer initiated and seller initiated large trade transaction by order size within a day are described as follows:

Total Price effect = $\ln(P_L / P_{B,L}) X100$;

Liquidity (Temporary) effect = $\ln(p_{A,L} / p_L) X100$

Information (Permanent) effect= $\ln(p_{A,L} / p_{B,L}) X100$

P_L denotes the price of a either buyer or seller initiated large trade transaction. $P_{B,L}$ 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. $P_{A,L}$ is the benchmark (equilibrium) price after the large trade transaction. To analyze the price effects after the either buyer or seller initiated large trade, we calculate the liquidity effect is the difference between $P_{A,L}$, and P_L in order to measure price reversal effect after the large trade. Thus we expect liquidity effect have positive sign for the seller initiated trades and have negative sign for the buyer initiated trades. Permanent price effect measures the difference between $\ln P_{A,L}$ and

$\ln P_{B, L.}$ This difference reflects the information content of a large trade. All measures are in percentage terms. Based on these definitions, we have the permanent price effect is equal to the sum of total price effect plus liquidity price effect.[2]

To take account of volume effect and minimize the noise of the data, we also calculate volume weighted total, liquidity and information (permanent) price effects for buyer and seller initiated large trades.[3] Volume weights for buyer initiated trade is calculated by the volume of i th buy initiated trade of t th day divided by the total volume of buyer initiated trades of t th day. The sum of volume weights for the t th day should be equal to one.

In general, the selection of benchmark prices before and after a large trade for measuring the price effects of a trade depends on the timing of a trader to make decision to trade. Following Chan and Lakonishok (1993), we use the opening prices as the benchmark price before a large trade and closing price as the benchmark price after a large trade. The selection of benchmark prices rests on the implicit assumption that traders usually decide to trade before the opening of the trading session.[4]_/ For the robustness of our results, we also use the benchmark prices fifteen minutes before and after for a large trade.

There is no consensus to what constitutes a large transaction (black trade) in futures markets. We construct four trade sizes based on the empirical distribution of intraday CT4 trading volume distribution for the whole sample period. We define following four trade size classes. They are as follows: (1) trade size 1 =1 to 2

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2 There are two ways to decompose total price effects into information (permanent) and liquidity effects. We follow the procure used by Chan an Lakonishok (1993). The other procedure used by Holthausen, Leftwich and Mayers (1987) and Gemmill (1996) produce result that the sum of information effect and liquidity effect equal to total price effects . However, the sign of liquidity effect of buys is positive and the sign of price reversals (liquidity) effects of sells is negative. The signs of liquidity effects produced by this procedure seems counter institute.

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

4 Further discussions on pro and cons of selection of alternative benchmark is referred to Collins and Fabozzi (1991) and , Harris (2003, Chapter 21)

contracts; (2) trade size 2 =3 to 10 contracts; (3) trade size 3= 11 to 20 contracts; (5) trade size 4= equal or greater than 21 contracts. These four trades size classes allows to test the hypothesis the price , liquidity and information (permanent) effects are positively correlated with trade sizes in futures markets.

4. Empirical Results

Table 1 presents descriptive statistics to high lights on sample characteristics of the CT 4 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. In term of trading frequency, we find the most active trading occurred in smallest trade size class and the most less active trading occurred in largest size class. However, in term of daily total CT4 trading volume, about 35-45 percents of buys and sells of this contact occurred in the largest trade size class which is equal to or above 95 percentile of their corresponding empirical distributions of daily CT4 trading volumes. Thus, we can see the importance of large CT4 trades in influencing intraday futures price behaviors.

Table 2 reports three measures of average slippage (total price), liquidity and information effects incurred in executing in four trade size classes. We use opening and closing prices of CT4 trades in that date as the benchmark prices in estimating the Slippage (total price), liquidity and information effects of the trades in each trade size classes. Total price effect for the largest trade size class (size 4) in S&P 500 are 0.0298 percent for buy trades and -0.0505 percent for sell trades, respectively. We observe that the total price impacts of sell trades are larger than their corresponding total price impacts of buys trades for trade size class 3 as well. This result is opposite to the previous results found in the equity markets that total the price impacts of buys are greater than total the price effects of sells. But, we found the information effects of buys are than those of sells. These results are consistent with the previous results found in equity markets.

In comparison with previous results in equity markets, Keim and Madhavan (1997) report the institutional purchases and sales incur an average price impact of 0.31 percent and 0.3 4 percent respectively for transaction executed in

New York Stock exchange. Recently, Chiyachantana, Jain , Jiang and Wood(2004) document that the price impact of institutional trading in US stocks are 0.59 percent for purchase and -0.21 percent for sells in 1997 to 1998. It is clearly that the magnitude of total price impacts of buys and sells of S&P 500 index futures are significantly smaller than the corresponding total price impacts documented for the equity markets. This is consistent with the perception that the futures market selected in this study is more liquid than the equity markets documented in previous research results. (Fleming, Ostdiek and Whaley (1996)). We also observe that magnitude of total price and information (permanent) effects increase monotonically with trade size class. This result is consistent with previous findings from the equity markets.

To examine the potential effects of introduction of E-mini S&P 500 index futures in September 1997 on Regular S&P 500 index prices, we estimate price impact effects in two subsample periods and reported in Table 3. The Panel A of Table 3 present slippage , liquidity and information effects prior to September , 9 1997 and Panel B reports these price effects after September 9, 1997. We observe that the pattern of price effects for buys and sells are remained the same for the before and after the period of introduction of E-mini S&P 500 index futures.

Table 4 reports the total price, liquidity and information effects by trade size classes based on fifteen minutes before and after of the i th trades in each trade size class. For the largest trade size class, we find again that total price impacts of buys are less than the corresponding total price effects while the information effects of buys are greater than information effects of sells. For liquidity effects, we again find that there are reversals following the sells but, there is a continuation of rising price subsequent to the buys. These results are similar to the results based on open and closing price as the benchmark documented in Table 2.

In summary, based on two alternative benchmarks, we obtain the interesting empirical results that there is asymmetric information effects of purchases and sells and reverse asymmetric liquidity effects of buys and sells in the whole sample period. These two 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 Chiychantana, Jain, Jiang and Wood (2004), we classify our whole sample into the bullish markets set if the average return of the month is positive and those months into the bearish markets if the average returns of the months are negatives. Tables 5 documents total price, liquidity and information effects of large trades based on the open and closing prices as the benchmark and Table 6 report these effects using the prices of fifteen minutes before and after the trade as the benchmark. We can summarize the major results from these two tables as follows: (1) Buys have bigger information effects than the effects of sells while sells have stronger liquidity effects than that of purchases in the bullish markets. We find there is reverse asymmetry between the information effects of buys and sells in the bearish markets. Liquidity effects of sells in the bullish markets are greater than the liquidity effects of sells in the bearish markets. It is interesting to observe that there are no price reversals following the buys in the bullish markets but, there are price reversals following the buys in the bearish markets. The empirical results in Table 5 and 6 are consistent with each other. This results support that our results rare robust to the selection of the benchmarks.

(2). Our empirical results support the current economic condition hypothesis suggested by Chiychantana, Jain, Jiang and Wood (2004) is a key determinant of asymmetry between information effects of buys and sells. This is a new empirical result because Chiychantana etc.(2004) have only analyze the total price effects of buys and sells in bullish versus bearish markets. Furthermore, our results are also consistent with the following two hypotheses : (1) the information content of buys is higher than that of sells in the bullish markets and it is reversed in the bearish markets and (2) large traders engage in positive-feedback trading strategy (see Chan and Lakonishok(1993)). Further research is called for distinguishing these two hypotheses. In short, using the unique data set, we have provide empirical evidences to perform a direct test on the hypothesis that the current economic conditions is a key determinant on asymmetry between price and information effects of buys and sells.

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

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

where

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

Di, (i=2, 3,4) denotes the ith dummy variable. It is equal to one if the trade size falls into 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 regression analysis for 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 sell respectively for total price and information price effects. For example, under total price effects, the coefficients of the difference of trade size 2 to size 4 with respect to trade size 1 in buy trades increase from 0.0067 to 0.0327and decrease from -00089 to -0.0 371 for sells trades executed in S&P 500. Based on F statistics, t statistics, they are all statically significant at one percent level. These results are consistent with the findings from equity markets (Chan and Lakonishok (1993))and from futures markets(Frino and Oetomo(2005)) . The regression results on information effects are very similar to the regression results of total price effects. However, our results do not find a strong relationship between liquidity effect and trade –size from the smallest to the largest trade size class for both buys and sells traded executed in these five futures contracts.

In short, our regression results are consistent with the hypothesis suggested by Easley and O'Hara (1987) that information content of the trades is positive relates to the trade sizes.

5. **Summary and Conclusions**

This paper uses a unique data set –Computer Trade Reconstruction (CTR) intraday data from January 1994 to December 2004 to examine the market impact effects of large outside customers (CT 4 traders) trading of S&P 500 index futures. Our data set contain millions of observation for the buy and sell side of CT4 trades and the direction of trades by outside customer traders (CT4). These distinctive features of our data set enhances the internal and external validity of the type of research in estimating the market impact, liquidity and information (permanent) effects of S&P 500 index futures traded in CME futures exchange.

We have obtained several interesting results: (1) the magnitude of 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 rates futures traded in the Sydney futures exchanges.

(2) In general, we observe in whole sample period that the information effects of purchases are greater than the those of sells. There are strong post- trade price reversals for the sells and no reversals after the purchases of large trades. These results are consistent with the existence of short-run liquidity costs for sell. The behaviors of the post-trade for purchases are consistent with the hypothesis on difference in information contents in buys and sells. Our empirical results obtained from whole sample period are consistent with the previous findings in the 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 information effects of buys are greater than those of sells in the bullish markets and there is strong reserve asymmetry between information (permanent) effects of purchase and sells. Our results support their hypothesis that the current economic conditions is the major determinant of asymmetry between information price impacts of buys and sells. This finding is also consistent with the hypothesis that outside large trader employee positive herding trading strategy in the bullish and the bearish markets (Chan and Lakonishok(1993)).

(4) Our regression analysis confirm that the total price and information effects are positive correlated with trade sizes in whole sample period. These results are

consistent with the conjecture that the information contents of a trade is positively correlated with trade size (Easley O'Hara(1987))

Finally, further research is called for to account for the differences between effects of buys and sells incurred in executing large trades in the Sydney futures exchange versus in S&P 500 index futures in CME exchange. We are going to extent our study to include additional major futures contract traded in CME in order to examine the generality of our results obtained from S&P 500 index futures.

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Table 1
Descriptive Statistics by Trade Size Classes

	1 (Small)	2	3	4 (Large)	All
Panel A: Purchases					
# Trades (000)	6,236	3,160	1,473	255	11,124
Volume					
Mean	1.311	4.701	12.37	36.87	4.553
Median	1	5	10	30	1
Dollar Value ($ million)					
Mean	0.4739	1.606	4.126	13.98	1.589
Median	0.4483	1.511	3.639	11.16	1.124
Panel B: Sales					
# Trades (000)	6,493	3,201	1,459	250	11,403
Volume					
Mean	1.306	4.695	12.37	36.88	4.451
Median	1	5	10	30	1
Dollar Value ($ million)					
Mean	0.4720	1.604	4.130	13.84	1.550
Median	0.4448	1.510	3.638	11.15	1.121

This table contains sample characteristics of the trades initiated by the outside customers (CTI4) for S&P 500 index futures. The trades are categorized into four groups based on the percentiles of the empirical trade size distribution for trades initiated by the CTI4 traders. The definitions of trade size are : trade size1=1 to 2 contracts; trade size2= 3 to 10 contracts; trades size 3=11 to 20 contracts and trades size 4= equal or greater than 21 contracts. # trading frequency denotes the total number of trades for the complete period in thousands; The mean of daily volume is the average of daily trading volume size for each trade; and Daily dollar value reports the mean and median of the total daily dollar value in millions for the average of daily volume size for each trade size group. The dollar value is computed per transaction by multiplying the price by the contract multiplier and the trade size.

Table 2
Price Impact Estimates (in Percentage) Using Opening and closing Prices as Benchmark

	1 (Small)		2		3		4 (Large)	
	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell
Slippage								
Volume Weighted	-0.0037	-0.0089	0.0031	-0.0142	0.0046	-0.0230	0.0298	-0.0505
Mean	-0.0051	-0.0093	0.0016	-0.0142	0.0021	-0.0220	0.0262	-0.0475
Median	0	0	0.0075	0	0.0076	0	0.0273	-0.0220
Std. Deviation	0.2499	0.2508	0.2693	0.2732	0.2985	0.3101	0.3567	0.3554
Liquidity								
Volume Weighted	0.0028	0.0131	0.0026	0.0148	0.0038	0.0184	0.0047	0.0253
Mean	0.0025	0.0132	0.0022	0.0141	0.0040	0.0178	0.0036	0.0237
Median	0	0	0	0	0	0	0	0
Std. Deviation	0.2024	0.2005	0.2096	0.2131	0.2278	0.2358	0.2506	0.2583
Information								
Volume Weighted	-0.0009	0.0042	0.0057	0.0006	0.0084	-0.0046	0.0345	-0.0252
Mean	-0.0026	0.0039	0.0038	-0.0001	0.0061	-0.0042	0.0298	-0.0238
Median	0	0.0003	0.0005	0	0.0020	0	0.0236	-0.0117
Std. Deviation	0.2971	0.2981	0.3148	0.3171	0.3422	0.3491	0.3927	0.3935

This table contains estimates of the price effect (in percentage) for trades initiated by the outside traders (CTI4) for S&P 500 index futures. The Slippage price effect, liquidity effect and information effect are estimated by,:

Slippage (Total Price) effect = $\ln(P_L / P_{B,L}) X 100$;

Liquidity (Temporary) effect = $\ln(p_{A,L} / p_L) X 100$

Information (Permanent) effect= $\ln(p_{A,L} / p_{B,L}) X 100$

P_L denotes the price of a either buyer or seller initiated large trade transaction. $P_{B,L}$ 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. 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 3
Price Impacts Estimates (in percentage) Surrounding Introduction of E-Mini SP500

	1 (Small)		2		3		4 (Large)	
	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell
Panel A: Pre-Introduction *(prior to 9/9/1997)*								
# Trades	2,755,488	2,890,519	1,213,517	1,229,104	446,594	433,982	69,037	67,305
Mean Volume	1.456	1.450	5.115	5.109	13.30	13.28	44.67	43.48
Slippage								
Volume Weighted	-0.0007	-0.0075	0.0032	-0.0061	0.0060	-0.0113	0.0154	-0.0273
Mean	-0.0011	-0.0056	0.0028	-0.0055	0.0056	-0.0099	0.0143	-0.0247
Liquidity								
Volume Weighted	0.0067	0.0135	0.0052	0.0125	0.0042	0.0140	0.0076	0.0183
Mean	0.0044	0.0122	0.0048	0.0113	0.0038	0.0128	0.0059	0.0173
Information								
Volume Weighted	0.0060	0.0065	0.0084	0.0064	0.0102	0.0027	0.0230	-0.0090
Mean	0.0033	0.0066	0.0076	0.0058	0.0094	0.0029	0.0202	-0.0074
Panel B: Post-Introduction *(after 9/9/1997)*								
# Trades	3,334,874	3,454,035	1,873,721	1,897,137	989,418	987,071	179,573	175,564
Mean Volume	1.325	1.320	4.728	4.724	12.42	12.42	37.42	37.47
Slippage								
Volume Weighted	-0.0041	-0.0091	0.0044	-0.0173	0.0060	-0.0252	0.0385	-0.0561
Mean	-0.0053	-0.0081	0.0036	-0.0163	0.0043	-0.0235	0.0350	-0.0520
Liquidity								
Volume Weighted	-0.0012	0.0124	-0.0006	0.0148	0.0026	0.0190	0.0017	0.0262
Mean	-0.0013	0.0123	-0.0006	0.0144	0.0026	0.0186	0.0010	0.0250
Information								
Volume Weighted	-0.0053	0.0033	0.0038	-0.0025	0.0086	-0.0062	0.0402	-0.0299
Mean	-0.0066	0.0042	0.0030	-0.0019	0.0069	-0.0049	0.0036	-0.0270

Table 4

Price Impacts Estimates (in percentage) using Fifteen Minutes Pre- and Post- Trade as the Benchmarks

	1 (Small)		2		3		4 (Large)	
	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell
Slippage								
Volume Weighted	-0.0121	-0.0010	0.0021	-0.0127	0.0086	-0.0266	0.0444	-0.0661
Mean	-0.0151	-0.0010	-0.0004	-0.0128	0.0046	-0.0260	0.0392	-0.0623
Liquidity								
Volume Weighted	0.0065	0.0180	0.0073	0.0195	0.0111	0.0246	0.0132	0.0346
Mean	0.0064	0.0180	0.0073	0.0191	0.0110	0.0240	0.0123	0.0327
Information								
Volume Weighted	-0.0056	0.0170	0.0094	0.0068	0.0197	-0.0020	0.0576	-0.0315
Mean	-0.0087	0.0170	0.0069	0.0063	0.0156	-0.0020	0.0515	-0.0296

This table contains estimates of the price effect (in percentage) for trades initiated by the outside traders (CTI4) for S&P 500 index futures. The Slippage price effect, liquidity effect and information effect are estimated by,:

Slippage (Total Price) effect = $\ln(P_L / P_{B,L}) X 100$;

Liquidity (Temporary) effect = $\ln(p_{A,L} / p_L) X 100$

Information (Permanent) effect= $\ln(p_{A,L} / p_{B,L}) X 100$

P_L denotes the price of a either buyer or seller initiated large trade transaction. $P_{B,L}$ 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. 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 Impact Estimates (in percentage) in Bull and Bear Markets Using Open and Closing Prices as Benchmark.

	1 (Small)		2		3		4 (Large)	
	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell
Panel A: Bull Market *(69 months)*								
Slippage								
Volume Weighted	-0.0040	-0.0082	0.0027	-0.0134	0.0051	-0.0219	0.0335	-0.0452
Mean	-0.0048	-0.0080	0.0020	-0.0124	0.0034	-0.0203	0.0294	-0.0428
Liquidity								
Volume Weighted	0.0069	0.0167	0.0068	0.0189	0.0090	0.0222	0.0103	0.0293
Mean	0.0067	0.0164	0.0067	0.0181	0.0091	0.0225	0.0088	0.0284
Information								
Volume Weighted	0.0029	0.0085	0.0095	0.0055	0.0141	0.0003	0.0438	-0.0159
Mean	0.0019	0.0084	0.0087	0.0057	0.0125	0.0022	0.0382	-0.0144
Panel B: Bear Market *(53 months)*								
Slippage								
Volume Weighted	-0.0037	-0.0115	0.0030	-0.0165	0.0038	-0.0251	0.0252	-0.0577
Mean	-0.0049	-0.0105	0.0025	-0.0158	0.0019	-0.0228	0.0245	-0.0523
Liquidity								
Volume Weighted	-0.0050	0.0073	-0.0054	0.0079	-0.0041	0.0114	-0.0046	0.0183
Mean	-0.0048	0.0074	-0.0053	0.0075	-0.0037	0.0111	-0.0044	0.0169
Information								
Volume Weighted	-0.0087	-0.0042	-0.0024	-0.0086	-0.0003	-0.0137	0.0206	-0.0394
Mean	-0.0097	-0.0031	-0.0028	-0.0083	-0.0018	-0.0117	0.0201	-0.0354

This table contains estimates of the price effect (in percentage) for trades initiated by the outside traders (CTI4) for S&P 500 index futures. The Slippage price effect, liquidity effect and information effect are estimated by,: Slippage (Total Price) effect = $\ln(P_L / P_{B,L}) X 100$; Liquidity (Temporary) effect = $\ln(p_{A,L} / p_L) X 100$; Information (Permanent) effect= $\ln(p_{A,L} / p_{B,L}) X 100$. P_L denotes the price of a either buyer or seller initiated large trade transaction. $P_{B,L}$ 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. 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
Bull and Bear Markets Using Alternative Pre- and Post- Trade Benchmarks

	1 (Small)		2		3		4 (Large)	
	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell
Panel A: Bull Market *(69 months)*								
Slippage								
Volume Weighted	-0.0082	0.0021	0.0065	-0.0076	0.0150	-0.0202	0.0567	-0.0534
Mean	-0.0099	0.0031	0.0054	-0.0065	0.0126	-0.0181	0.0516	-0.0483
Liquidity								
Volume Weighted	0.0141	0.0248	0.0153	0.0272	0.0200	0.0324	0.0230	0.0402
Mean	0.0139	0.0247	0.0153	0.0270	0.0197	0.0320	0.0211	0.0387
Information								
Volume Weighted	0.0059	0.0269	0.0218	0.0196	0.0350	0.0122	0.0797	-0.0132
Mean	0.0040	0.0278	0.0207	0.0205	0.0323	0.0139	0.0727	-0.0096
Panel B: Bear Market *(53 months)*								
Slippage								
Volume Weighted	-0.0208	-0.0082	-0.0063	-0.0226	-0.0023	-0.0387	0.0236	-0.0877
Mean	-0.0229	-0.0065	-0.0076	-0.0212	-0.0047	-0.0354	0.0246	-0.0798
Liquidity								
Volume Weighted	-0.0079	0.0051	-0.0063	0.0065	-0.0029	0.0126	-0.0026	0.0263
Mean	-0.0079	0.0051	-0.0064	0.0063	-0.0028	0.0120	-0.0018	0.0241
Information								
Volume Weighted	-0.0287	-0.0031	-0.0126	-0.0161	-0.0052	-0.0261	0.0210	-0.0614
Mean	-0.0308	-0.0014	-0.0140	-0.0149	-0.0075	-0.0234	0.0228	-0.0557

This table contains estimates of the price effect (in percentage) for trades initiated by the outside traders (CTI4) for S&P 500 index futures. The Slippage price effect, liquidity effect and information effect are estimated by,: Slippage (Total Price) effect = $\ln(P_L / P_{B,L}) X100$; Liquidity (Temporary) effect = $\ln(p_{A,L} / p_L) X100$; Information (Permanent) effect= $\ln(p_{A,L} / p_{B,L}) X100$. P_L denotes the price of a either buyer or seller initiated large trade transaction. $P_{B,L}$ 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. 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 Results

	Total Effect		Temporary Effect		Permanent Effect	
	Purchases	Sales	Purchases	Sales	Purchases	Sales
Intercept	-0.0046	-0.0089	0.0024	0.0130	-0.0023	0.0040
	(0.000107)	(0.000107)	(0.000085)	(0.000084)	(0.000127)	(0.000125)
Size2	0.0067	-0.0046	-0.0006	0.0008	0.0062	-0.0038
	(0.000186)	(0.000186)	(0.000147)	(0.000146)	(0.000218)	(0.000217)
Size3	0.0079	-0.0119	0.0008	0.0043	0.0086	-0.0076
	(0.000247)	(0.000250)	(0.000195)	(0.000196)	(0.000290)	(0.000292)
Size4	0.0327	-0.0371	-0.0000	0.0099	0.0327	-0.0272
	(0.000545)	(0.000556)	(0.000430)	(0.000436)	(0.000639)	(0.000650)
F-Statistic	1635.78	2093.42	14.57	309.57	1186.59	773.42
R-Squared	0.05	0.06	0.00	0.01	0.03	0.02

This table presents the results from a 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,

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

where S_i, i= 1, 2 3 represents the total price, liquidity and information effects, respectively. Di, i=2, 3, 4, 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 trade size classes are defined as: trade size1 =1 to 2 contract ; trade size 2= 3 to 10 contracts ; trade size 3= 11 to 20 contracts and trade size 4 = 2 1 plus contracts. OLS is used to estimate the parameters of the model and White procedure is employed to calculate heteroscedasticity consistent standard errors. The standard error is reported in parentheses for each estimate.