ASYMMETRIC PRICE BEHAVIOUR SURROUNDING BLOCK TRADES: A MARKET MICROSTRUCTURE EXPLANATION

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February 1, 2003

Abstract

This paper analyses price effects of block trades for the 30 stocks that comprise the Dow Jones Industrial Average for the period January 1993 to October 2001. Previous research has documented an asymmetric price effect between block purchases and sales. Extant literature has offered several conjectures as to the source of the asymmetry. We replicate the asymmetry documented in previous literature and provide new conjectures as to its source, specifically bid-ask bias and systematic difference in nature of block purchases and sales sampled. Results show that purging block trade price effects of bid-ask bias and the elimination of systematic differences between block purchase and sales produces symmetry in the behaviour of block trade price effects. This suggests research design issues are driving the asymmetry documented in previous literature, and that purchases are not more informative than sales.

JEL classification: G14
Keywords: Asymmetry, Bid-Ask Bias; Block Trades; Execution Costs; Market Microstructure

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1. Introduction

In 2001, over 51 percent of total NYSE trading volume was executed in parcels of 10,000 or greater; in 1960 block trades represented just two percent of total NYSE volume. Given this significant rise, it is not surprising that block trading has received considerable attention in the academic literature. The interest stems from the practical implications of such research, including investigations of the mechanisms available to execute block trades and the roles they serve;\(^1\) whether block trades disrupt the market and the speed with which markets adjust to the effects of these trades;\(^2\) identification of technical trading strategies available to exploit associated price effects;\(^3\) and the costs of purchasing and selling such trades.\(^4\)

Extant literature examining block transactions documents an engaging result that implies an asymmetry in the price effects of buyer and seller initiated trades on the NYSE, AMEX and NASDAQ markets. The asymmetry indicates that block sellers pay a liquidity premium while buyers do not, as price reversals accompany block sales while price continuations follow block purchases. An asymmetry has also been confirmed for markets other than the US, including the London Stock Exchange (Gemmill, 1996), and the Australian Stock Exchange (Aitken and Frino, 1996a, 1996b) where the price impacts of block purchases and sales differ. The literature has described this asymmetry in price behaviour around block trades as “intriguing” (Holthausen, Leftwich and Mayers, 1990, 

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2 See for example Ball and Finn (1998), Dann, Mayers and Raab (1977), Aggarwal and Chen (1990), Holthausen, Leftwich and Myers (1987, 1990), Kumar, Sarin and Shastri (1992), and Moulton (1998) 
p. 90; Chan and Lakonishok, 1993, p. 175) and emerging as “a key puzzle” (Chan and Lakonishok, 1993, p. 184), and has called for further research in the area.

The behaviour and measurement of the price impacts associated with block trades is of significant importance to regulators and policy makers concerned with promoting market liquidity, and investors who seek significant investment returns with minimal implementation costs. The transaction costs faced by market participants can be categorised into two groups (i) explicit and (ii) implicit. Minimisation of explicit costs is difficult if not impossible as these are usually levied at predetermined rates. Implicit costs on the other hand can be minimised. Schwartz and Shapiro (1992) argue that institutional investors, who normally transact in large quantities, are more concerned with market impact and opportunity costs as they are more detrimental to returns than paying a higher quoted bid-ask spread. These market impact and opportunity costs are usually associated with block trades, where trade initiators offer either inducements through price concessions or forego the opportunity to trade.

Motivated by the above suggestions, this paper re-examines the price impact of block trades, and conducts several novel tests in order to determine the cause of the asymmetry between block purchases and sales. Specifically we investigate two issues that have been overlooked in the previous literature, firstly bid-ask biases in transactions data and secondly systematic differences in the nature of buyer and seller initiated trades.

The remainder of this paper is organised as follows. The data and method for testing the price impacts of block trades is outlined in section 2. Section 3 documents and

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5 Several exchanges such as the NYSE and Australian Stock Exchange have established alternative trading platforms for the execution of block trades, the upstairs and downstairs market. Derivative markets also have followed suit, establishing block trading facilities such as that which exist on the London International Financial Futures and Options Exchange and the Sydney Futures Exchange.

6 Explicit costs include brokerage and taxes. Implicit costs encompass bid-ask spreads, market impact costs and opportunity costs.
replicates the asymmetry documented in previous literature. Alternative explanations for the asymmetry are provided in section 4. Results and robustness tests are provided in sections 5 and 6. Section 7 concludes.

2. Sample and Methodology

This study focuses on block trades in the 30 stocks that are included in the Dow Jones Industrial Average (DJIA). DJIA stocks are of particular interest as they account for a substantial fraction of total NYSE volume and market capitalisation. Block trades are sampled as defined by the NYSE, namely trades of 10,000 shares or greater. The data used in this study were obtained from the Trades and Quotes (TAQ) database for the period January 4, 1993 to October 5, 2001. Several filters are applied to the trades and quotes,\(^7\) and we exclude non-NYSE trades and quotes.\(^8\)

Important to any analysis quantifying block price impacts is the determination of how trades are classified. Trades are designated as being seller or buyer initiated using the trade direction algorithm developed by Ellis, Michaely and O’Hara (2000), which states that if a trade occurs at the ask quote the trade is classified as buyer initiated; similarly if the trade is executed at the bid price then the trade is classified as seller initiated. Trades which execute at neither the bid or ask price are classified using the tick test, such that if

\(^7\) Trades are omitted if they are indicated in the TAQ database to be coded out of time sequence, or coded as involving an error or a correction (TAQ error correction indicators of 2 or greater). Trades indicated to be exchange acquisitions or distributions, or that involve non-standard settlement (TAQ Sale Condition codes A, C, D, N, O, R, and Z) are also omitted, as are trades that are not preceded by a valid same-day quote. Also omitted are trades that involve price changes (since the prior trade, and/or open price) of 50% or more if the prior price is over $2 per share. Quotes are omitted if either the ask or bid price is negative, if the difference between the ask and bid prices exceeds $5 or is negative, or if the change in the quote midpoint (since the prior trade or opening midpoint quote) exceeds 50% and the midpoint is more than $2. Also omitted areas are quotes associated with trading halts or designated order imbalances, or that are non-firm (TAQ quote condition codes 4, 7, 9, 11, 13, 14, 15, 19, 20, 27 and 28).

\(^8\) Blume and Goldstein (1997) find that the NYSE usually determines or matches the best bid and ask quotes.
the last price change was an uptick the trade is buyer initiated, and vice versa for seller initiated trades. Contemporaneous bid and asks are used in the study as suggested by Bessembinder (2002) and Peterson and Sirri (2002) who show the accuracy of trade classification techniques increases as the difference in time between trades and quotes decreases.

Table 1 Summary Statistics of Trade Size
This table reports the number of observations, the mean, median, minimum, maximum and standard deviation of block trade size. The sample consists of all NYSE trades in DJIA 30 stocks of 10,000 or more shares for the period January 4, 1993 to October 5, 2001.

<table>
<thead>
<tr>
<th></th>
<th>Number of Mean</th>
<th>Median</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>observations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Panel A Buy and Sell Blocks in DJIA Stocks</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Block Buys</td>
<td>1,548,535</td>
<td>20,394</td>
<td>15,000</td>
<td>10,000</td>
<td>12,700,000</td>
</tr>
<tr>
<td>Block Sells</td>
<td>1,248,026</td>
<td>21,288</td>
<td>15,000</td>
<td>10,000</td>
<td>18,270,000</td>
</tr>
</tbody>
</table>

Table 1 profiles the block trades analysed in this study. The overall sample consists of 1,548,535 block purchases, and 1,248,026 block sales. The sample is very large when compared with those used in previous studies. In terms of number of trades examined, Madhavan and Cheng (1997) examine 16,343 blocks while Chan and Lakonishok (1993) analyse 1,215,387 transactions. The time frame for our study is also longer than in previous papers. The mean and median trade sizes analysed are 20,394 and 15,000 respectively for block purchases, and 21,288 and 15,000 respectively for block sales. Madhavan and Cheng (1997) examine similar sized block transactions executed on the NYSE trading floor, while they find larger sized trades are typically executed in the upstairs market for DJIA stocks.

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Following previous literature block trade price effects are measured as follows:

\[
\text{Temporary Effect} = \ln \left( \frac{P_b}{P_c} \right) \quad (1)
\]

\[
\text{Permanent Effect} = \ln \left( \frac{P_c}{P_p} \right) \quad (2)
\]

\[
\text{Total Effect} = \ln \left( \frac{P_b}{P_p} \right) \quad (3)
\]

where \( P_p \) is the equilibrium market price prior to the block transaction, while \( P_c \) is the equilibrium price after a block trade has been executed. \( P_b \) represents the block price. For price effects measured using transaction prices, substitute the open and closing price for \( P_p \) and \( P_c \), respectively. While this is consistent with previous methodology, it also attempts to capture the effect blocks being shopped and any information leakage as identified by Keim and Madhavan (1996) and Madhavan and Cheng (1997).

### 3. Price Impact Asymmetry

Table 2 summarises the price impact of block purchases and sales. Consistent with previous research, there appears to be a significant asymmetry in the price impact of buyer and seller initiated trades. Panel B suggests price behaviour surrounding block sales is consistent with all three price impact hypotheses.\(^{10}\) Reversals predicted by short run liquidity costs follow sales and consistent with the information hypothesis, permanent price effects suggest block sales move the price of a stock on average by –35.11 basis points.

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\(^{10}\) In less than perfect capital markets, three discriminating explanation developed by Kraus and Stoll (1972) and Scholes (1972) account for the price effects of block trades, these are short-run liquidity costs, imperfect substitutes and information.
points. Block purchases on the other hand execute at prices 0.2526 percent above the opening price, and exhibit a significant continuation, which is subsequently subsumed into the permanent effect of 28.55 basis points. This demonstrates that there is clearly a significant asymmetry in the price behaviour of buyer and seller initiated trades.

Price effects reported in table 2 are relatively smaller than previous comparable research. Chan and Lakonishok (1993) document that prices following block purchases increase by 0.12 percent, while prices proceeding sales reverse by 0.10 percent. The price changes are perhaps less dramatic because of the relative liquidity of stocks sampled, reinforcing views expressed by Keim and Madhavan (1996) that attention be paid to the liquidity of stocks. Unlike Madhavan and Cheng (1987) we are unable to distinguish between block trades executed in the upstairs and downstairs markets. A parsimonious comparison to results they document for downstairs trades, as they [like Hasbrouck, Sofianos and Sosebee (1993)] show approximately 80 percent of blocks are executed on the floor of the NYSE, price effects are similar in magnitude to those documented in table 2.

Contrary to conjectures provided by Chan and Lakonishok (1993) and Keim and Madhavan (1995) that the asymmetry is due to buy orders conveying more information than sales, panel C reports block sales have a greater permanent price impact vis-à-vis purchases, suggesting sales are more informative than buys. Similar evidence is provided by Daley, Hughes and Rayburn (1995) who examine block trades around earnings announcements, and Dey and Radhakrishna (2001) who show the adverse selection component of the spread around institutional trades is significant for sales exclusively.
Tests of equality for all three measured price impacts show that sales have a significantly greater impact than purchases.

Table 2 Transaction Price Effects of Block Trades

This table reports transaction returns surrounding block trades of 10,000 shares or more executed on the NYSE DJIA stocks for the period January 4, 1993 to October 5, 2001, broken down by buyer (Panel A) and seller (Panel B) initiated trades. Three measures of price impact are reported: (1) Temporary, defined as the logarithmic return from the closing price on the day of the block to the block price; (2) Permanent, defined as the logarithmic return from the opening price on the day of the block to the closing price on the day of the block; and (3) Total, defined as the logarithmic return from the opening price on the day of the block to the block price. All numbers are denominated in basis points.

Panel A Buys (n = 1,548,535)

<table>
<thead>
<tr>
<th></th>
<th>Temporary</th>
<th>Permanent</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>-3.29</td>
<td>28.55</td>
<td>25.26</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>149.93</td>
<td>245.73</td>
<td>197.36</td>
</tr>
<tr>
<td>3rd Quartile</td>
<td>64.59</td>
<td>162.08</td>
<td>162.08</td>
</tr>
<tr>
<td>Median</td>
<td>0.00</td>
<td>23.78</td>
<td>23.07</td>
</tr>
<tr>
<td>1st Quartile</td>
<td>-68.14</td>
<td>-110.25</td>
<td>-68.73</td>
</tr>
<tr>
<td>t-statistic</td>
<td>-27.35**</td>
<td>144.59**</td>
<td>159.25**</td>
</tr>
</tbody>
</table>

Panel B Sells (n = 1,248,026)

<table>
<thead>
<tr>
<th></th>
<th>Temporary</th>
<th>Permanent</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>-1.26</td>
<td>-35.11</td>
<td>-36.38</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>150.22</td>
<td>245.30</td>
<td>197.12</td>
</tr>
<tr>
<td>3rd Quartile</td>
<td>65.67</td>
<td>97.21</td>
<td>59.82</td>
</tr>
<tr>
<td>Median</td>
<td>0.00</td>
<td>-35.34</td>
<td>-28.53</td>
</tr>
<tr>
<td>1st Quartile</td>
<td>-66.59</td>
<td>-166.52</td>
<td>-127.83</td>
</tr>
<tr>
<td>t-statistic</td>
<td>-9.39**</td>
<td>-159.92**</td>
<td>-206.17**</td>
</tr>
</tbody>
</table>

Panel C Tests of Equality

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>-4.55</td>
<td>-6.56</td>
<td>-11.12</td>
</tr>
<tr>
<td>t-statistic</td>
<td>-25.24**</td>
<td>-22.22**</td>
<td>-46.87**</td>
</tr>
</tbody>
</table>

** 0.0001 level of significance
* 0.001 level of significance
4. Explanations for Asymmetry

Extant literature offers several possible conjectures as to the source of the asymmetric price behaviour (see Chan and Lakonishok, 1993; Keim and Madhavan, 1995; Madhavan and Cheng, 1997; and Saar, 2002). Two possible explanations that have been overlooked are (i) bid-ask bias in transactions data and (ii) systematic differences in the nature of buyer and seller initiated trades.

4.1 Bid-Ask Bias

Measurement error caused by systematic trading at the bid or ask has been used to explain a number of phenomena in the finance literature. For example, Harris (1989) and Foerster, Keim and Porter (1990) suggest that bid-ask bias may explain part of the intraday patterns in stock returns, while Bhardwaj and Brooks (1992) provide evidence that suggests it may explain a portion of the turn-of-year effect. Lease, Masulis and Page (1991) also find that bid-ask bounce explains abnormal returns around seasoned equity offerings, while Cox and Peterson (1994) find that it explains price reversals following large one-day price declines.

Extant block trading literature measures price impact using transaction prices. This implicitly assumes an equal probability of a trade at the bid or ask. If this is not the case, block trade price effects will be systematically biased. There is evidence that prices at the open and close of trade on the NYSE have a tendency to occur at the ask (Harris, 1989 and Porter, 1992).\textsuperscript{11} This implies that returns measured using prices near the close

\textsuperscript{11} Aitken, Brown, Izan, Hua and Walter (1995) document similar evidence for closing trades on the ASX.
will be upwardly biased. The asymmetry in the price behaviour of returns following block and institutional trades is consistent with such biases.

Figure 1 demonstrates how the asymmetric price behaviour surrounding block trades documented in the previous literature is possibly influenced by bid-ask biases. In the absence of bid-ask spreads, the notional block purchase is executed at prices above the opening price, and traders earn a positive return to the close of trade, the opposite is true for block sales. Consistent with the theoretical modelling of block trades (see Easley and O’Hara, 1987, Seppi 1990, and Keim and Madhavan, 1996) block purchases and sales are associated with a predominant information effect, a view supported by the empirical literature, and price behaviour is symmetric.

Figure 1 Price Behaviour of Block Trades

Extant empirical block trading literature however has measured price impacts in the presence of bid-ask spreads. With the existence of the spread and the previous literature’s documentation of tendency for the opening and closing prices to be at the ask
price (see Porter, 1992) in addition to block purchases transacting close to ask quotes and
block sales occurring close to bid quotes,\textsuperscript{12} it can easily be observed how the asymmetry
between block purchases and sales might arise. In particular for sales, the revision in
price is a consequence of the closing price on average being on the ask side of the quote.
This has obvious consequences on the magnitude of associated price effects.

In order to explore whether the asymmetry between block buys and block sells is
attributable to the propensity to trade at the ask, we test for the impact of bid-ask bias on
returns in two ways. Firstly, we determine the location of trade prices used to calculate
block trade price effects. Secondly, we calculate returns which are purged of bid-ask
effects.

The propensity to trade at the quotes is examined by documenting the frequency of
trades (1) above and below the ask and bid quotes, (2) at the bid and ask, (3) between the
quotes and midpoint quote, and (4) at the midquote. Further, the mean of the order flow
ratio is calculated for the open and closing price on block trading days, as follows:

\[
\text{OrderFlowRatio} = \frac{(\text{ask} - \text{price})}{(\text{ask} - \text{bid})}
\]

As the order flow ratio approaches 1 it is more likely the trade price is at the bid price,
while the closer the ratio is to zero the greater is the likelihood the trade is at the ask (see

The adoption of quote returns, as suggested by Lease, Masulis and Page (1991), will
mitigate the effects of systematic order flow imbalances biasing transaction prices. To
purge transaction returns of bid-ask bounce quote return measures are devised. Jang and

\textsuperscript{12} While this is predominantly influenced by trader classification algorithms, the asymmetry is still
observed in studies where trader classification algorithms are not implemented, see Chan and Lakonishok
(1993).
Venkatesh (1991) show that typically only one side of the market, the bid or ask, is revised following trades. Engle and Patton (2000) also note an asymmetry in the impact of buyer or seller initiated transactions on market quotes. They argue that purchases exhibit a greater impact on the ask side of the market, while the bid price leads the ask price following sales. In order to incorporate this, seller initiated block trade price effects are calculated using bid prices, while block purchase price effects are examined via ask quotes.

Quote effects, identified as bid-trade-bid/ask-trade-ask replace $P_p$ in equations 2 and 3 with the opening bid/ask quote and $P_c$ in equations 1 and 2 with the closing bid/ask price, while maintaining $P_b$ as the block trade price, in order to gauge how much of the asymmetry is due to bid-ask bias in open and closing prices.¹³

### 4.2 Systematic Difference in Buyer and Seller Initiated Trades

Extant empirical research has shown that the level of trade complexity influences the price impacts of block trades. The difficulty that arises however is which variables adequately measure trade complexity. Block size, trade duration, order type, investment style, trader reputation, trading platform, firm size and market structure have commonly been advocated by researchers to proxy the difficulty with which assets are traded (see Chan and Lakonishok, 1993, 1995; Keim and Madhavan, 1995, 1996, 1997; Aitken and Frino, 1996b; and Madhavan and Cheng, 1997). Absent from this list however are more generic proxies that describe the trading environment of markets.

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¹³ The first closing quotes and opening quotes as identified in the TAQ dataset by mode 10 and 3, respectively are sampled.
To date the empirical literature consistently examines trades of different size, and possibly samples trades from systematically different market conditions, or more importantly liquidity.\textsuperscript{14} Market microstructure literature documenting patterns in common market liquidity measures such as volatility, volume, depth and bid-ask spreads has shown that the trading strategies of individuals are to some extent time dependent and that market liquidity is concentrated during certain times of the trading day and days of the week (see Lakonishok and Maberly, 1990; McInish and Wood, 1991; and McInish and Wood, 1992). Failure to adjust for these liquidity patterns and any systematic differences between block purchases and sales can lead to substantial biases in block trade price effects, possibly inducing an asymmetry between block trades. In order to achieve comparability between buys and sells, matching procedures can be used to account for the observed and unobservable differential characteristics between buyer and seller initiated trades. In particular implementing a matched pairs sampling technique to match block buys and sales on: the underlying stock, trade size, time of day and weekday can eliminate systematic differences between purchases and sales, and potentially explain part of the asymmetry.

5. Results

5.1 Propensity to Trade at the Ask Quotes

Table 3 evaluates the percentage of opening and closing transactions at the ask quote on block trading days for DJIA stocks. Clearly there is a tendency for both the opening and closing prices to be at the ask side of the quotes. Consistent with Porter (1992) we

\textsuperscript{14} Studies providing descriptive statistics regarding block trade size relative to normal trading volume illustrate this point more clearly (see Holthausen, Leftwich and Mayers, 1987 and Chan and Lakonishok 1993).
find a significant difference between the relative frequencies that trading on the NYSE commences and ceases at the bid and ask quotes. On block trading days, 33.1 percent of closing prices are at the ask quote, while only 29.8 percent are at the bid price, a similar story is depicted for the opening price, with 14.9 percent of trades at the ask and only 9.7 percent at the bid.

Table 3 Prices Relative to Bids and Asks on Block Trading Days

This table reports the distribution of opening and closing prices at the quotes on block trading days. Panel A provides the relative frequencies across the seven categories of trade position relative to quotes in addition to order flow ratios. Panel B provides chi-square tests of equality for the position of opening and closing transaction across the seven categories (Equality across all categories); across the cumulative frequency of trades being close to the bid or ask, given by the sum of relative frequencies (1) Greater than Ask/Bid, (2) At Ask/Bid, and (3) Between Ask/Bid and Midpoint (Equality across Cumulative); and between bid and ask (Equality at Bid and Ask).

Panel A Distribution of Open and Closing Prices

<table>
<thead>
<tr>
<th>Trade</th>
<th>Greater than Ask</th>
<th>At Ask</th>
<th>Between Ask and Midpoint</th>
<th>At Midpoint</th>
<th>Between Bid and Midpoint</th>
<th>At Bid</th>
<th>Less than Bid</th>
<th>Mean Order Flow Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open</td>
<td>0.27</td>
<td>14.87</td>
<td>17.83</td>
<td>49.11</td>
<td>8.08</td>
<td>9.67</td>
<td>0.17</td>
<td>0.4485</td>
</tr>
<tr>
<td>Close</td>
<td>1.97</td>
<td>33.07</td>
<td>5.38</td>
<td>23.22</td>
<td>5.81</td>
<td>29.74</td>
<td>1.45</td>
<td>0.4759</td>
</tr>
</tbody>
</table>

Panel B Tests of Percentages of Prices by Bid-Ask Position

<table>
<thead>
<tr>
<th>Price</th>
<th>Equality across all categories</th>
<th>$\chi^2 = 63,794$</th>
<th>$p$ value = 0.0001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open</td>
<td>Equality across cumulative</td>
<td>$\chi^2 = 2,417$</td>
<td>$p$ value = 0.0001</td>
</tr>
<tr>
<td>Open</td>
<td>Equality at bid and ask</td>
<td>$\chi^2 = 598$</td>
<td>$p$ value = 0.0001</td>
</tr>
<tr>
<td>Close</td>
<td>Equality across all categories</td>
<td>$\chi^2 = 43,634$</td>
<td>$p$ value = 0.0001</td>
</tr>
<tr>
<td>Close</td>
<td>Equality across cumulative</td>
<td>$\chi^2 = 115$</td>
<td>$p$ value = 0.0001</td>
</tr>
<tr>
<td>Close</td>
<td>Equality at bid and ask</td>
<td>$\chi^2 = 95$</td>
<td>$p$ value = 0.0001</td>
</tr>
</tbody>
</table>

The propensity to trade at the ask is more pronounced when one considers the cumulative frequency of trades occurring close to the bid and ask quotes, given by the
addition of relative frequencies (1) Greater than Ask/Bid, (2) At Ask/Bid, and (3) Between Ask/Bid and Midpoint. On a cumulative basis the opening transaction is closer to the ask price over the bid price by a margin of 15.05 percent. Similarly the frequency of the closing price approaching the ask quote is 40.4 percent, while it is 37.0 percent for bid quotes. Chi-square tests of equal proportions show a significant difference across all categories in table 3 indicating the open and closing price are close to the ask side of the quote. The mean order flow ratio also supports contentions that the opening and closing transactions have a propensity to execute at the ask price.

Given mean bid-ask spreads at the open and close of block trading days of 0.2046 cents and 0.1482 cents, respectively, severe market microstructure biases are introduced in transactions price data used to calculate block trade price impacts. This may perpetuate an asymmetric response between block purchases and sales.

5.2 Price Impacts of Block Trades Purged of Bid-Ask Bias

The significance of the propensity for the open and closing price to be at the ask quotes is measured by changes in price effects using bid and ask quotes. Mean and median returns purged of bid-ask bias in table 4 depict a different impression of a block trade vis-à-vis those provided in table 2. Turning firstly to ask-trade-ask returns, purchases are associated with a significant permanent price of 25.61 basis point, and a total cost of 0.1094 percent. Analogous to the continuation following purchase, block sales are associated with a continued price decline of 11.27 basis points. While this is not consistent with the reversal predicted by the short run liquidity costs hypothesis, it is in accord with the information hypothesis. Rational informed investors would expect a benefit from their information, which by the end of the day should manifest itself in a
favourable return. This is reflected in the temporary price effect as purchases of stock receive a return of 14.67 basis points, while sellers forgo a loss or receive 11.27 basis point return on short sales.

Table 4 Quote Price Effects of Block Trades

This table reports transaction returns surrounding block trades of 10,000 shares or more executed on the NYSE DJIA stocks for the period January 4, 1993 to October 5, 2001, broken down by buyer (Panel A) and seller (Panel B) initiated trades. Three measures of price impact are reported the (1) Temporary, for purchases (sales) is defined as the logarithmic return from the closing ask (bid) quote on the day of the block to the block price; (2) Permanent, for purchases (sales) is defined as the logarithmic return from the opening ask (bid) price on the day of the block to the closing ask (bid) quote on the day of the block; and (3) Total, defined as the logarithmic return from the opening ask (bid) price on the day of the block to the block price. All numbers are denominated in basis points

<table>
<thead>
<tr>
<th>Panel A Buys (n = 1,548,535)</th>
<th>Ask-Trade-Ask Returns</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Temporary</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>151.41</td>
</tr>
<tr>
<td>3rd Quartile</td>
<td>53.74</td>
</tr>
<tr>
<td>Median</td>
<td>-10.26</td>
</tr>
<tr>
<td>1st Quartile</td>
<td>-79.64</td>
</tr>
<tr>
<td>t-statistic</td>
<td>-120.59**</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Panel B Sells (n = 1,248,026)</th>
<th>Bid-Trade-Bid Returns</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Temporary</td>
</tr>
<tr>
<td>Mean</td>
<td>11.27</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>152.15</td>
</tr>
<tr>
<td>3rd Quartile</td>
<td>78.28</td>
</tr>
<tr>
<td>Median</td>
<td>10.41</td>
</tr>
<tr>
<td>1st Quartile</td>
<td>-54.50</td>
</tr>
<tr>
<td>t-statistic</td>
<td>82.73**</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Panel C Tests of Equality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>t-statistic</td>
</tr>
</tbody>
</table>

** 0.0001 level of significance
* 0.001 level of significance
Table 4 implies bid-ask bias is the main explanation for the directional asymmetry in returns between buyer and seller initiated block trades. Block trades, for both purchases and sales, exhibit a price path supporting predominantly the information hypothesis, and support the theoretical modelling of block trades such that price behaviour is symmetric. Moreover the three hypotheses developed by Kraus and Stoll (1972) and Scholes (1972) to explain the impact of block trades are not necessarily all compatible representations of returns surrounding block trades, especially if information is divulged through block trades.

In the absence of the directional asymmetry, panel C of table 4 provides an improved examination of the asymmetry in the magnitude of block trade price effects. While all three price impacts remain significantly different, table 4 indicates a decrease in the size of divergence between block buy and sell effects, relative to those reported in table 2. In particular the difference in permanent and total price effects between block purchases and sales falls by three and four basis points respectively.

5.3 Price Impacts of Matched Block Trades

An advantage of matching techniques is that no functional form is imposed to control for differences in transactions. This is particularly important for block trade price effects, as several authors have indicated a nonlinear relationship between trade size and price revisions (see Barclay and Warner, 1993, Hasbrouck, 1991, Madhavan and Smidt, 1991 and Keim and Madhavan, 1996). Block purchases and sales are as closely matched as possible. Analysis of the data indicates a search within five minutes of the trade of interest is suitable and congruent with the diurnal literature, which usually segments the trading day into intervals comprising several minutes (see Wood et al. 1985, Brock and
Kleidon, 1992, McInish and Wood, 1992, and Choe et al, 1995). Matches have been selected on a minute-by-minute and week-by-week sequential search before and after the block trade such that pairs are not selected on the same day and do not exceed a one-year event window.\textsuperscript{15}

An issue that arises with matching is whether pairs are selected with or without replacement. The difference between the two techniques is a question of independence. Sampling with replacement results in two independent samples, unlike samples selected without replacement, where the extent of covariance between samples depends on the population size. If the population is very large this covariance is very close to zero, such that sampling with or without replacement is almost synonymous. Given the large number of possible matches available, pairs are selected with replacement.\textsuperscript{16} Table 5 shows that the matched trades are relatively smaller than the unmatched trades, and reflect the impact of the strict matching procedure.

Table 5 Summary Statistics of Matched Block Trades

<table>
<thead>
<tr>
<th></th>
<th>Number of observations</th>
<th>Mean</th>
<th>Median</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Panel A Matched Block Trades in DJIA Stocks</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Block Buys</td>
<td>943,708</td>
<td>16,445</td>
<td>11,400</td>
<td>10,000</td>
<td>1,000,000</td>
<td>11,853</td>
</tr>
<tr>
<td>Block Sells</td>
<td>943,708</td>
<td>16,445</td>
<td>11,400</td>
<td>10,000</td>
<td>1,000,000</td>
<td>11,853</td>
</tr>
</tbody>
</table>

\textsuperscript{15} If block purchases and sales were matched on the same day differences between permanent price effects would be downwardly biased, falsely accepting tests of equality between buy and sell information effects. \textsuperscript{16} Results presented are for block purchases matched to block sales with replacement. Results however are analogous when sales are matched to purchases. Similarly results are unaffected when analysis is conducted without replacement.
Table 6 Price Effects of Matched Block Trades

This table reports transaction returns surrounding block trades of 10,000 shares or more executed on the NYSE DJIA stocks for the period January 4, 1993 to October 5, 2001, broken down by buyer (Panel A) and seller (Panel B) initiated trades, based on matching purchases with replacement to sales on size, stock, time of day and weekday. Three measures of price impact are reported the (1) Temporary, for purchases (sales) is defined as the logarithmic return from the closing ask (bid) quote on the day of the block to the block price; (2) Permanent, for purchases (sales) is defined as the logarithmic return from the opening ask (bid) price on the day of the block to the closing ask (bid) quote on the day of the block; and (3) Total, defined as the logarithmic return from the opening ask (bid) price on the day of the block to the block price. All numbers are denominated in basis points.

Panel A Buys (n = 943,708)

<table>
<thead>
<tr>
<th></th>
<th>Temporary</th>
<th>Permanent</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>-15.34</td>
<td>27.52</td>
<td>12.18</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>150.90</td>
<td>245.85</td>
<td>195.44</td>
</tr>
<tr>
<td>3rd Quartile</td>
<td>53.76</td>
<td>161.59</td>
<td>107.99</td>
</tr>
<tr>
<td>Median</td>
<td>-10.77</td>
<td>22.40</td>
<td>8.53</td>
</tr>
<tr>
<td>1st Quartile</td>
<td>-80.53</td>
<td>-114.17</td>
<td>-83.68</td>
</tr>
<tr>
<td>t-statistic</td>
<td>-98.73**</td>
<td>108.69**</td>
<td>60.55**</td>
</tr>
</tbody>
</table>

Panel B Sells (n = 943,708)

<table>
<thead>
<tr>
<th></th>
<th>Temporary</th>
<th>Permanent</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>13.51</td>
<td>-27.41</td>
<td>-13.91</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>148.88</td>
<td>242.24</td>
<td>189.59</td>
</tr>
<tr>
<td>3rd Quartile</td>
<td>79.84</td>
<td>103.92</td>
<td>80.00</td>
</tr>
<tr>
<td>Median</td>
<td>12.28</td>
<td>-26.63</td>
<td>0.00</td>
</tr>
<tr>
<td>1st Quartile</td>
<td>-51.23</td>
<td>-157.07</td>
<td>-103.15</td>
</tr>
<tr>
<td>t-statistic</td>
<td>88.13**</td>
<td>-109.93**</td>
<td>-71.26**</td>
</tr>
</tbody>
</table>

Panel C Paired Tests of Equality

<table>
<thead>
<tr>
<th></th>
<th>Temporary</th>
<th>Permanent</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>-1.83</td>
<td>0.11</td>
<td>-1.73</td>
</tr>
<tr>
<td>t-statistic</td>
<td>-8.38**</td>
<td>0.30</td>
<td>-6.15**</td>
</tr>
</tbody>
</table>

** 0.0001 level of significance
* 0.001 level of significance

Results in panels A and B of table 6, strongly reflect those reported above. Price impacts associated with buyer and seller initiated are not associated with a temporary effect consistent with the short-run liquidity cost hypothesis, prices continue to drift upwards and remain at their higher levels. The contribution of the matching procedure in
conjunction with quote return on the block trade asymmetry however is observed in panel C. The suggestion that the asymmetric price response between block buys and sell may be explained by the differential information content of buys and sells is rejected. Block purchases and sales are associated with a permanent price effect of 27.52 basis points and –27.41 basis points, respectively, indicating an insignificant difference of 0.11 basis points. While differential temporary and total price impacts between sales and purchases are significant, they are inconsequential at less than two basis points. Results reported in panel C are also smaller than those reported in table 4, demonstrating the effect of controlling for the market environment and systematic differences between block purchases and sales, on block trade price effects.  

6. Robustness Tests

Several robustness tests are carried out to examine the persistence of the results from the previous sections. Firstly, results are analysed across block trade sizes, and on a year-by-year basis. Secondly, contemporaneous quotes at the time of the block trade are substituted for block trade prices, and finally, quotes in effect before the closing transaction are used to re-estimate temporary, total and permanent block trade effects.

Partitioning block trades into categories of 10,000 to 20,000, 20,000 to 50,000 and greater than 50,000, following Madhavan and Cheng (1997), the asymmetry documented in table 2 for trade price effects is observed consistently. Once quote returns are substituted for transaction prices, the asymmetric price response between purchases and sales is eliminated. Across the nine years examined, the asymmetry is observed for eight

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17 Results for matched pairs in conjunction with transaction price effects also leads to a directional symmetry albeit economically small, however the magnitude of divergence between buy and sell effects remains statistically significant, results available on request.
years, and it is insignificant in only 2000. This consequently has implication for block trade impacts measured using quotes, however strong support is found for our conjecture that the asymmetry is a consequence of market microstructure bias.

All of the above analysis so far has been conducted with the block transaction price, however replicating results using contemporaneous quotes at the time of the block trade provide analogous results, even across size partitions and years. This reinforces our contention that it is the propensity to trade at the ask during the open and close of trade on the NYSE that results in an anomaly in the empirical block trading literature.

Our final analysis to support the resolution of the asymmetry, is to replicate all tests discussed using the bid and ask quotes in effect before the closing price. The results are unambiguously and qualitatively similar. Block purchases and sales are associated with a significant total impact and continuation in price behaviour that is subsequently consumed into the permanent price impact.

In light of the robustness of the results, two caveats are in order. First, in order to ensure that our results are unaffected by the occurrence of block purchases and sales being executed on similar days, we analyse days where only one type of block, either buyer or seller initiated, occurs. Lack of data however limits any meaningful interpretation of the results. Secondly, in an attempt to remove the effect of leading and trailing blocks trades on price effects, block trades are excluded if a large transaction lead them by 60 minutes or followed them within 60 minutes. This however too restricted the sample to only 7,643 purchases and 6,961 sales, implying only 1 in 200 of the original sample is analysed.

7. Conclusion and Directions for Future Research
The impact of block trades on stock market behaviour has been the concern of a number of empirical studies. Broadly these studies have established that block transactions have an impact on trading activity, and that an asymmetry exists in the price behaviour surrounding buyer and seller initiated trades.

In this paper an alternative explanation is provided to explain the asymmetry and a number of empirical tests are conducted. Specifically, an examination and measurement of temporary, permanent and total price effects purged of bid-ask bounce and systematic differences.

Considerable attention in previous literature has focused on the effects of firm size and relative trade size as determinants of the impact of block trades. Largely ignored however are biases introduced through the existence of the specialist’s spread. Results reported in this study show that by, estimating block price effects using quote returns to eliminate bid-ask bounce in transaction price returns produces symmetrical behaviour in price effects surrounding block trades. A significant positive price reaction followed by a continuation is reported for purchases, and a significant negative price reaction followed by a permanent price fall for sales. Furthermore matching block trades on underlying stock, trade size, time of day and weekday eliminates systematic difference between block purchases and sales, rejecting conjectures that block purchases are more informative than sales. This suggests research design issues are driving the asymmetry documented in previous literature, and that purchases are not more informative than sales.

A number of possible avenues for future research follow from the results. An obvious extension of this study would be to confirm that the block price impact asymmetry documented in other US markets and comparative international evidence is a
result of microstructure biases, rather than institutional differences. It may also be interesting to re-examine block trades executed in upstairs and downstairs markets. In particular, in addition to quote returns, applying the matching procedure may provide an insignificant difference between block buy and sell temporary and total effects. Madhavan and Cheng (1997) show that block traders are able to obtain different execution prices in the two markets, which significantly effect the measurement of the temporary and total block trade price effects.
References


