Tape Painting: Excessive Buying versus Depressed Selling[*]

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Abstract

We study a large sample of institutional trades, and find evidence of both excessive buying and depressed selling on quarter-end and especially year-end days. Excessive buying is atypical, and limited to stocks in which institutions hold large positions, whereas depressed selling is more pervasive. Both types of trading inflate stock prices, suggesting that both activities create the inflated fund NAVs reported in other studies. Hence, depressed selling is a previously undocumented, but widespread and effective form of tape painting. Depressed selling may be prevalent because it is less costly and more difficult to detect. Moreover, excessive buying declined, and depressed selling increased, during and after the 2003 late trading investigations.

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1. Introduction

On the final day of each quarter there is an opportunity for portfolio managers to exaggerate their performances, by manipulating the closing prices of the securities in their portfolios. One way that managers can achieve this is through the excessive buying of securities that they already own. This practice is commonly referred to as "portfolio pumping" or "tape painting".[1] The incentives for tape painting are described in Carhart, Kaniel, Musto, and Reed (2002) (CKMR hereafter), Bernhardt and Davies (2005), Bhattacharyya and Nanda (2006), and Bernhardt, Davies, and Westbrook (2007). Empirical evidence of tape painting is shown in CKMR and Bernhardt and Davies (2005). These papers show that both fund NAVs and the share prices of stocks that are widely held by funds are inflated on quarter-end, and especially year-end days.

In this paper we extend the literature on tape painting by studying institutional trades, rather than fund NAVs and share prices, as done in previous studies. Our sample spans from 1999 through 2005, and in each year includes the trades of more than 300 institutions. The trades in our sample account for 7% to 10% of the total dollar volume in CRSP in each of the years that we study. Our use of trade data allows us to uncover several interesting patterns regarding tape painting, which are novel to this study.

We find that the average trading activity of the institutions in our sample is abnormal at quarter-end, and especially at year-end, in that ratio of buys to sells increases sharply on the last day of the quarter. We find this for both large and small institutions, and across both

[1] A related, but different practice is known as window dressing. Window dressing involves buying (selling) securities that have performed well (poorly) towards the end of the quarter or year. Window dressing is done to mislead investors, who judge managers based on their portfolios' quarter-end holdings. Papers that study window dressing and its effects on security prices include Haugen and Lakonishok (1988), Lakonishok, Shleifer, Vishny, and Thaler (1991), Chevalier and Ellison (1997), Musto (1997 and 1999), He, Ng, and Wang (2004), Ng and Wang (2004), Morey and O'Neal (2006), and Sias (2007).

large and small stocks, although the effect is greater in small stocks. These findings are broadly consistent with tape painting, and support the arguments in CKMR, who contend that the inflated quarter-end fund NAVs and share prices documented in their study are the result of abnormal trading by institutional investors.

Previous studies and media articles on tape painting assume that high quarter-end prices are the result of excessive buying.[2] Yet share prices can be inflated by either excessive buying, or depressed selling, or both. An important advantage of our trade data is that it allows us to examine buying and selling activities separately. To the best of our knowledge, depressed selling has not yet been suggested as a means by which managers may be inflating quarter-end prices.

We find that on average, the institutions in our sample do not engage in excessive quarter-end buying. We show that when institutions do engage in excessive buying, it is limited to stocks in which the institutions hold large positions. We do however find evidence of widespread depressed quarter-end selling. The magnitude of depressed selling is economically significant; on average, the institutions in our sample do 17% less selling on the last day of the quarter relative to other month-ends, and 33% less selling on the last day of the year relative to other month-ends.

We show that both excessive buying and depressed selling are reversed early in the subsequent quarter, and that both types of trading behaviours are more prevalent in stocks which institutions hold large positions. These results suggest that share price manipulation is the motive behind the abnormal trading. Moreover, we show that both depressed selling and excessive buying inflate quarter-end share prices, suggesting that both types of trading are

[2] Previous studies have used the terms "tape painting" and "portfolio pumping" inter-changeably. The term "portfolio pumping" seems to suggest excessive buying, not depressed selling. We use the term "tape painting" to include both excessive buying and depressed selling behaviours.

effectual methods of share price manipulation. Hence, we find that depressed selling is both a common and effective, yet previously undocumented, form of tape painting.

Why is depressed selling more pervasive than excessive buying? Excessive buying can be costly. CKMR note that excessive buying might draw attention from regulators, who regard the practice as illegal.[3] Moreover, excessive buying is most effective at inflating the prices of small, illiquid stocks. Thus, excessive buying creates extra transactions in stocks with high transaction costs. Delaying a sale, on the other hand, does not create extra transaction costs. Moreover, depressed selling is probably hard to detect, so it is less likely to cause legal problems for fund managers.

We also study how increasing regulatory scrutiny and media attention affect the trading behaviour of institutional investors. This part of our analysis tests whether institutional trading changed around 2003. In 2003 at least 21 separate institutions were investigated for allowing either late trading or market timing of their shares.[4] We do not know whether any of the institutions in our sample were under investigation for late trading during this time. However, institutional investors in general did at this time begin to receive more scrutiny from both regulators and the media (see Carnahan (2003) and Atlas and Barboza (2003)), and this scrutiny may have caused them to decrease all behaviours that regulators were likely to disapprove of.[5]

[3] In August of 2001 ABN Amro and Oechsle International Advisors were censured by the SEC for employing a portfolio manager who engaged in portfolio pumping. Each firm was fined $200,000 and the portfolio manager involved in the incident was fined $75,000 and suspended from practice for 12 months. The SEC stated that the portfolio manager had "willfully violated Section 10(b) of the Exchange Act and Rule 10b-5 thereunder, and willfully aided and abetted violations of Sections 206(1) and (2) of the Advisers Act." The SEC administrative proceeding for this matter can be found here: http://www.sec.gov/litigation/admin/34-44679.htm.

[4] This is according to a March 16, 2004 Wall Street Journal article.

[5] In addition, CKMR was published in the *Journal of Finance* in 2002. It might also have had an impact on institutional investors' tape painting behaviours after 2002.

We find that institutions substantially decreased their quarter-end trading after the investigation. This decrease in trading is equally prevalent in buying and selling. In 2003 and the subsequent years in our sample, institutions do 14% less selling and 16% less buying on quarter-end days as compared to quarter-end days prior to 2003. The magnitudes of the decreases in buying and selling are such that the two effects cancel one another out, as the ratio of buys to sells is the same in the two periods. One explanation for these results is that due to the investigations in 2003, institutional investors reduced their excessive buying, so as to not to draw attention from regulators. However, to keep quarter-end prices high, institutions also reduced their quarter-end selling.

Our findings not only extend the literature on tape painting, but also extend a larger literature, which shows that there is an incentive to paint the tape, because investors chase past performance when choosing mutual funds. Papers by Spitz (1970), Smith (1980), Patel, Zeckhauser, and Hendricks (1991), Kane, Santini, and Aber (1991), and Lakonishok, Shleifer, and Vishny (1992) all find evidence of a positive relation between investment performance and subsequent investment flows. More recent studies have shown that this relation is nonlinear, in that the best performing funds receive especially high flows, whereas poor performing funds do not receive low flows. These studies include Ippolito (1992), Gruber (1996), Chevalier and Ellison (1997), Goetzmann and Peles (1997), and Sirri and Tufano (1998). Our analysis of trades suggests that professional money managers are aware of the performance-flow relation, and place their quarter-end trades accordingly.

The rest of this paper is organized as follows. Section 2 describes our sample. Section 3 describes our main results. Section 4 describes the changes in tape painting behaviours during and after the late trading investigations. Section 5 concludes.

2. Data and Summary Statistics

We obtain transaction-level institutional trading data from a leading execution quality measurement service provider for institutional investors. The data are similar in nature to those used by several other studies on institutional trading, such as Keim and Madhavan (1995), Conrad, Johnson, and Wahal (2001), Jones and Lipson (2001), Goldstein, Irvine, Kandel, and Wiener (2006), Irvine, Lipson, and Puckett (2006), and Lipson and Puckett (2006).

The data cover equity trading transactions made by a large sample of institutions from January 1999 through December 2005. For each transaction, the data include the date of the transaction, the stock traded (identified by both symbols and CUSIPs), the number of shares traded, the dollar principal traded, commissions paid by the institution, and whether the trade is a buy or a sell. The names of the institutions are removed from the data. However, identification codes are provided enabling us to separately identify each institution.

The sample institutions are either investment managers or plan sponsors. Investment managers are mutual fund families such as Fidelity Investments, Putnam Investments, and Lazard Asset Management. Examples of plan sponsors include the California Public Employees' Retirement System (CalPERS), the Commonwealth of Virginia, and United Airlines.[6] We merge the institutional trading data with the daily CRSP files from which we get information on share prices, number of shares outstanding, share volume, NYSE size breakpoints, and daily returns.

[6] We did many of the tests reported in this paper for investment managers and plan sponsors separately. The results were similar for the two groups, so we only report results for the full sample.

Table 1 provides some descriptive statistics of our sample. In each year we have between 300 and 342 institutions. Table 1 shows that throughout the seven years that our sample covers, the institutions in our sample account for between 7.19% and 10.49% of the total trading volume in CRSP. Table 1 also summarizes trading volume trading volume within daily NYSE size quintiles. We see that the institutions in our sample account for a significant amount of trading in both large and small firms. Throughout our sample period, the percentage of total trading volume done by the institutions in our sample ranges from 4.87% to 10.13% for the smallest size quintile, and 7.63% to 10.49% for the large size quintile. With the larger stocks the percentages have remained relatively flat over the sample period, but with the smaller stocks the percentages have increased from 4.87% in 1999 to 9.94% in 2005.

3. Results

3.1. Is the Ratio of Buys to Total Trades Abnormally High at Quarter-End?

In this Section we take a first look at the quarter-end and year-end trading behaviour of institutional investors. We compute the daily ratio of buys to total trades (buy ratio) at both quarter-end and year-end days, and compare them to the buy ratios computed at the other month-end days. If institutions engage in tape painting, then we expect the buy ratio to be relatively high on quarter-end and year-end days relative to buy ratios measured on other month end days.

3.1.1 Buy Ratio Methodology

For each institution *i*, the buy ratio is defined as the number of buys on a particular day, divided by the total number of trades (buys + sells) on the same day. We measure buy

ratios in dollars traded, shares traded, and number of trades. We create the buy ratio on a daily basis for each institution, and then generate a daily average across the institutions in our sample.

$$Buy\ Ratio_t = Average_t\ (Buys_{i,t} / (Buys_{i,t} + Sells_{i,t}))$$

We generate this daily average using both equal-weights and value-weights. To create the value weights, we use each institution's dollar trading volume on the measurement day as its value. We then measure each institution's daily value as a percentage of the sample's aggregate value on the same day to create the value weights. Equal-weighting provides a better description of how the typical institution in our sample is trading, as it accounts for both large and small institutions equally, whereas value-weighting yields results that are more influenced by larger institutions.

Ex-ante it is not clear what the quarter-end and year-end buy ratios should be under the null hypothesis of no tape painting. If the net flows to the institutions over our sample period were zero, then we would expect our sample average buy ratio to equal 0.50. However if the net flows are positive, then the buy ratios should be greater than 0.50. This is why we test for differences between the year-end and quarter-end buy ratios and buy ratios measured at other month-ends. If the institutions in our sample are on average painting the tape, then the buy ratios should be higher on quarter-end and year-end days as compared to other month-end days. We conduct this analysis in our full sample, and in each of the five stock size quintiles, as tape painting is expected to be more prevalent in smaller stocks, which have prices that are easier to manipulate.

3.1.2. Differences in Buy Ratios: Tests for Differences in Means

Panel A of Table 2 reports the results for the equal-weighted buy ratio tests. As noted above, we measure buy ratios using three different methods: dollars traded, shares traded, and number of trades. The differences between the year-end and other month-end buy ratios are both economically and statistically significant. As an example, in the full sample the average dollars traded buy ratio for the non-year-end months is 0.522, whereas the year-end average is 0.618, approximately 18% higher. This difference of 0.096 has a *t*-statistic of 9.69.

Panel A shows that the differences in buy ratios are larger for small stocks than for large stocks, consistent with tape painting. With respect to the year-end differences, all three buy ratios have differences in the smallest size quintile that are almost twice is large as those in the largest size quintile. Moreover, for all three buy ratios the *t*-statistics for the year-end differences in the smallest size quintile are all substantially greater than those for the largest size quintile. This pattern is consistent with the results in CKMR, who show that quarter-end price inflation is most prevalent in small stocks.

Most of the quarter-end buy ratio differences are also significant, but are not as large as those at year-end. As an example, the quarter-end difference in dollar value buy ratios for the full sample is 0.035 (*t*-statistic = 4.66), which is about a third of the difference reported at year-end. This is again consistent with CKMR, who show that price inflation is greater at year-end, as compared to quarter-end.

Panel B reports the results that were generated with the value-weighted buy ratios. The patterns in Panel B are similar to those in Panel A. As an example, for the entire sample the difference in dollar value year-end buy ratios is 0.065 (*t*-statistic = 4.55), showing that value-weighted buy ratios at year-end are 12.6% higher than at other month-ends. Most of

the results in Panel B are statistically significant for the year-end tests differences, but not for the quarter-end differences. Taken together with the results in Panel A, the results in Panel B suggest that tape painting is common among both small and large institutions, although the quarter-end results are more robust for the equal-weighted tests. The results described in this Section are also displayed in Figure 1.

3.1.3. Differences in Buy Ratios: Regression Tests

In the previous Section we discussed results which showed that buy ratios are especially high on year-end and quarter-end days, as compared to other month-end days. The results in this Section are a robustness check to the results in previous Section in at least two ways. First, we estimate the effects of quarter-end and year-end days on the buy ratio contemporaneously, allowing us to measure the effect of one while controlling for the other. Second, we test whether our results are caused by seasonality, as it could be that buy ratios are high every day in quarter-ending months, whereas tape painting predicts that buy ratios should be high only on the last day of quarter-ending months. In order to get at these issues, we conduct our analyses in this Section using the following regression equation:

$$BR_t = a + b_2 QEND_t + b_3 YEND_t + e_t$$

YEND and *QEND* are dummy variables that are equal to 1 if the day was in a quarter-end or year-end month, and zero otherwise. The dependent variables in Panel A are buy ratios computed on the last day of each month. The dependent variables in Panel B are buy ratios computed on the non-last days of each month. In Panel C, the dependent variables are the differences in buy ratios between the last day and non-last days of each month. If our results in the previous Section were due to tape painting, then the results in Panel A should

be significant and the results in Panel B should not, while the differences reported in Panel C should be significant. In this Section, for the sake of brevity, we only report results using dollar value buy ratios, although the results are similar with the other buy ratio measures. We again conduct our tests using both equal-weighted and value-weighted buy ratios.

Panel A shows that buy ratios are abnormally high on the last day of both quarter-end and year-end months. For the equal-weighted buy ratios, the *YEND* and *QEND* coefficients for the full sample are 0.071 (*t*-statistic = 5.63) and 0.035 (*t*-statistic = 4.72). The intercept term is 0.513, so the results show that buy ratios are approximately 14% and 7% higher at quarter-end and year-end, as compared to other month-ends. Like in Table 2, the value-weighted buy ratio results are similar to the equal-weighted buy ratio results, but are slightly smaller at year-end, and are insignificant at quarter-end. In both the equal-weighted and value-weighted tests, the *YEND* and *QEND* coefficients are smallest in the largest size quintile. This finding is consistent with tape painting, as the prices of large stocks are difficult to manipulate.

Panel B shows that our results are not due to a seasonal effect. With the equal-weighted buy ratios, the *YEND* and *QEND* coefficients for the full sample are 0.005 (*t*-statistic = 0.89) and 0.003 (*t*-statistic = 1.00). Throughout the various size quintiles the *YEND* and *QEND* coefficients are mostly insignificant, showing that the abnormally high buy ratios found in quarter-end and year-end months primarily arise only on the last day of the month, consistent with tape painting. This result is displayed in Figure 2, which shows that buy ratios are similar in all twelve months on non-last days of each month.

Panel C reports results on the differences in buy ratios between the last day and non-last days of the month. In the equal-weighted tests, all of the *YEND* coefficients and 5 of the

6 *QEND* coefficients are positive and significant, suggesting that the differences in buy ratios between the last day and non-last days of the month are larger in year-ending and quarter-ending months. This result is consistent with tape painting. The value-weighted results are similar for the *YEND* coefficients, but the *QEND* coefficients are mostly insignificant.

3.2. How do Institutions Tape Paint? Excessive Buying, Depressed Selling, or Both?

In the previous Tables we showed that the institutions in our sample have high buy ratios on quarter-end and especially year-end days. Previous studies have assumed that high quarter-end share prices and fund NAVs are the result of excessive buying by institutional investors. However, such price inflation could be caused by either excessive buying, or depressed selling, or both. In this Section we take a first step at determining which of these three explanations is correct.

3.2.1. Abnormal Buying and Selling Methodology

For each institution *i*, our abnormal trading measure is the dollar volume on the last day of the month, divided by the average daily dollar volume over the last five days of the month. We create this measure for buys and sells separately. As with the buy ratio, we make our daily abnormal trading measures for each institution separately, and then generate a daily average for our entire sample. We compute the abnormal trading ratios using both equal-weighted and value-weighted averages.

$$Abnormal\ Buying_t = Average_t\ (Buys_{i,t} / Average_{i,\ t\text{-}4\ to\ t}\ (Buys_{i,\ t\text{-}4\ to\ t}) - 1)$$

$$Abnormal\ Selling_t = Average_t\ (Sells_{i,t} / Average_{i,\ t\text{-}4\ to\ t}\ (Sells_{i,\ t\text{-}4\ to\ t}) - 1)$$

If trading on the last day of the month is typical, then both abnormal trade ratios should equal zero. If institutions engage in excessive buying on the last day of the month, then *Abnormal Buying* should be positive. If institutions engage in depressed selling on the last day of the month, then the *Abnormal Selling* should be negative. As in the previous tables our tests involve comparing the values of each measure at year-end and quarter-end to other month-ends.

3.2.2. Abnormal Buying and Selling Results

Panel A of Table 4 describes our equal-weighted results. Surprisingly, the average institution in our sample does less abnormal buying at year-end as compared to non-year-end months. This result is mainly driven by trading in large stocks; in the largest size quintile the difference in abnormal buying between year-end and non year-end months is -0.202 (*t*-statistic = -2.69), while none of the other size quintiles is significant. The quarter-end differences are also negative, but insignificant. The results show that the average institution in our sample does not engage in excessive buying with most of its holdings. However, it is possible that some institutions engage in excessive buying with some of their holdings.

Panel A shows that unlike excessive buying, depressed selling is very widespread. The average institution tends to reduce its selling activity at both year-end and quarter-end in stocks of all sizes. The differences in abnormal selling overall are -0.331 (*t*-statistic = -5.03) and -0.160 (*t*-statistic = -3.54) at year-end and quarter-end as compared to other month-ends. The differences are statistically significant in each of the five size quintiles, for both the year-end and quarter-end tests.

Panel B reports the results of the value-weighted tests. We do not find any evidence of abnormal buying at year-end; however in the first three size quintiles there is evidence of abnormal buying at quarter-end, although the significance is marginal in all but the smallest quintile. Panel B also shows that there is no abnormal selling at quarter-end, but there is some at year-end, as the differences in the three middle size quintiles are statistically significant. This result is more in line with CKMR's stock price inflation findings.

Panel C displays the percentage of firms that engage in abnormal trading. In the full sample, about 38% of the institutions engage in abnormal buying at the end of both non-quarter-end and quarter-end months. The results are similar for year-end trading, although there are a significantly smaller percentage of institutions engaged in the abnormal buying in large stocks. These results concur with our equal-weighted tests reported in Panel A, in that they show that on average institutions do not engage in excessive buying on year-end and quarter-end days as compared to other month-end days.

Like Panel B, Panel C shows that there is widespread depressed selling on both year-end and quarter-end days. In the full sample, in non-year-end months, 63.9% of the institutions engage in depressed selling, whereas at year-end 78.1% engage in depressed selling. The differences between year-end and other month-ends are statistically significant in all five size quintiles, and range from 8.2% to 13.4%. The quarter-end results are also significant. In the full sample, in non-quarter-end months, 62.9% of the institutions engage in depressed selling, compared to 69.4% that engage in depressed selling at quarter-end. The quarter-end differences in all five size quintiles are statistically significant.

Overall the results show that excessive buying is not common. These findings, are consistent with the hypothesis that, due to the costliness of excessive buying, it is likely to be

limited. Depressed selling on the other hand is widespread across both stocks and institutions, indicating that depressed selling is less costly than excessive buying from fund managers' point of view. Some of the results from this Section are displayed in Figure 3, which shows evidence of higher depressed selling, but not excessive buying, in quarter-end and year-end months.

3.3. Robustness Check: Abnormal Trading and Portfolio Weightings

In the last Section we showed that on average institutions do not engage in excessive buying, but do engage in depressed selling. This however does not mean that some institutions do not excessively buy some stocks. Excessive buying generates extra transaction costs, and might create problems with regulators. Therefore excessive buying is costly, and should only occur when there are clear benefits from the activity. Hence, we expect that all tape painting activities, and especially excessive buying, should be greater in stocks that make up a relatively large part of a fund's portfolio, as these stocks have more of an impact on the portfolio's returns. In this Section we test whether the weight of a stock in an institution's portfolio influences the institution's quarter-end trading activity in the stock.

3.3.1. Portfolio Weighting Measurement and Methodology

In order to estimate the weight that a stock has in an institution's portfolio, we accumulate the institution's trades in the stock over our sample period, and use this value as an estimate of the institution's net position in the stock. If the accumulated net position is negative, then we assign it a value of 0. For each institution, we then sum up the individual stock positions to create an estimate of the institution's total portfolio. We then divide each

individual stock's position by the total value of the portfolio; this is an estimate of the stock's weight for a particular institution, W_i. We also construct a weight based on the market value of the stock relative to the market values of the other stocks in the institution's portfolio; this weight is called M_i. M_i is the market value of stock *i* divided by the sum of the market values of all of the stocks in the institution's portfolio. *Overweight (OW)* is the difference between W_i and M_i: $OW_i = W_i - M_i$. Intuitively, a positive (negative) *OW* measure means the institution is overweighting (underweighting) the particular stock relative to its market weight compared to other stocks held by the institution.

We test for a relation between *OW* and abnormal trading with the following Logit regression model:

$$Pr(Buy_{i,j,t} = 1) = F(a + b_1 OW_{i,j,t-1} + b_2 YEND_t + b_3 OWD_{i,j,t-1} * YEND_t + b_4 Past\ Return_{j,t-1})$$

$$Pr(Sell_{i,j,t} = 1) = F(a + b_1 OW_{i,j,t-1} + b_2 YEND_t + b_3 OWD_{i,j,t-1} * YEND_t + b_4 Past\ Return_{j,t-1})$$

The subscript *i* refers to an institution, the subscript *j* refers to a stock, while the subscript *t* refers to a day. Our sample includes trades that occur on the last day of each month. In the above equations *Buy* (*Sell*) is a dummy variable that is equal to 1 if institution *i* buys (sells) stock *j* on day *t*, and 0 otherwise. *OW* is *Overweight*, and is measured from the beginning of the sample period up until the day in which the trades occur. *OWD* is equal to 1 if *Overweight* is positive, and 0 otherwise. *Past Return* is the buy and hold return over the last three months, adjusted for size and book-to-market. We also estimate the regressions by replacing *YEND* with *QEND*. We estimate the standard errors by clustering on the institution.

Our main variable of interest is the *OWD * YEND* interaction term. We expect this variable's coefficient to be positive when the dependent variable is *Buy*, and negative when

the dependent variable is *Sell*. In other words, if an institution is overweighted in a security, then it is more likely to buy, and less likely to sell that security on the last day of the year or quarter.

3.3.2. Portfolio Weighting Results

The results for this Section are displayed in Table 5, and are broadly consistent with tape painting. Panels A and B report the results for the buys. The *YEND* and *QEND* coefficients are mostly insignificant, showing that the institutions in our sample do not, on average, engage in abnormal buying on the last day of the quarter or year. This is consistent with the results in the previous tables. The results do however show that institutions are more likely to buy stocks that are overweighted, as the *Overweight* coefficients are positive and significant in each of the regressions. Moreover, institutions are more likely to buy overweighted stocks on the last day of the year and quarter, as both the *OWD * YEND* and *OWD * QEND* coefficients are positive and significant. These results suggest that tape painting considerations play an important role in an institution's decision to buy stocks that it already owns.

Panels C and D of Table 7 report the results for the sells. Like with the buys, the results for the sells are consistent with tape painting. The *OWD * YEND* and *OWD * QEND* coefficients are all negative and significant, showing that institutions are less likely to sell stocks that that they have overweighted positions in on the last day of the quarter or year. This suggests that tape painting considerations play a strong role in managers' decisions to not sell securities that they have large positions in on quarter-end and year-end days. The *YEND* coefficients are negative and significant, showing that the institutions in our sample

do, on average, avoid selling shares on the last day of the year, consistent with what we showed in the previous tables.

3.4. Robustness Check: Abnormal Trading Reversals

In this Section we provide another robustness check as to whether the abnormal trading that we have documented is the result of tape painting. If institutions engage in tape painting, then one might expect that trades that are the result of tape painting (or lack of trades with selling) will be reversed early in the subsequent quarter. Hence excessive buying should be followed by depressed buying, and depressed selling should be followed by excessive selling. We test for these trading reversals in this Section.

3.4.1. Abnormal Trading Reversals Measurement and Methodology

We create separate trading reversal measures for buying and selling. To create our measures, we aggregate the total trading activity (buys + sells) of each institution over the last 5 days of each month and the first five days of the subsequent month. We refer to this as "total trades". Over the same period, we aggregate each institution's buys and sells separately; we refer to these measures as "total buys" and "total sells". We also measure each institution's buys, sells, and total trades over the first five days of each month. We then create our buy and sell reversal measures:

$$Buy\ Reversal_{i,\,t} = Buys_{i,\,t+1\ to\ t+5} / (Buys_{i,\,t-4\ to\ t+5}) - Total\ Trades_{i,\,t+1\ to\ t+5} / (Total\ Trades_{i,\,t-4\ to\ t+5})$$

$$Sell\ Reversal_{i,\,t} = Sells_{i,\,t+1\ to\ t+5} / (Sells_{i,\,t-4\ to\ t+5}) - Total\ Trades_{i,\,t+1\ to\ t+5} / (Total\ Trades_{i,\,t-4\ to\ t+5})$$

If the first term is greater then 0.50, then there is more buying (selling) during the first five days of the next month, relative to the last five days of this month. The second

term controls for the possibility that there may be either more or less total trading during the first five days of the next month relative to the last five days of this month.

If institutions engage in excessive buying at quarter-end, then there should be less buying at the beginning of the next quarter. Hence we expect that *Buy Reversal* will be negative in quarter-end months. If institutions engage in depressed selling at quarter-end, then there should be more selling at the beginning of the next quarter, so we expect that *Sell Reversal* will be positive in quarter-end months. For comparison, we also compute each measure in non-quarter-end months, and we do not expect that either measure will be significant in these months.

3.4.2. Abnormal Trading Reversals Results

The results for our trading reversal tests are displayed in Table 6. It shows that there are reversals in trading activities at the end of all four quarters, which is consistent with tape painting. With respect to the *Buy Reversal* at year-end, the differences are statistically significant in each of the five size quintiles. At the end of the other three quarters, there are significant differences in at least three of the size quintiles. Exploring the non-quarter-ending months, we see some sporadic significance, but nothing systematic like at quarter-end and year-end.

The results are even more robust for the *Sell Reversal* measure. *Sell Reversal* is positive and significant in each of the size quintiles at year-end and in almost all of the size quintiles at quarter-end. There is little evidence of sell reversals in non-quarter-ending months. The results here show that depressed selling that occurs at quarter-end is reversed

via excessive selling at the beginning of the subsequent quarter, which is consistent with tape painting.

3.5. Does Tape Painting Cause Price Inflation?

The Tables discussed in the previous Sections show that buy ratios on quarter-end and year-end days are abnormally high and that institutions engage in both excessive buying and depressed selling on these days. We also show that both types abnormal trading are reversed early in the subsequent quarter, suggesting that it was meant to manipulate quarter-end prices. In this Section, we test whether excessive buying and depressed selling cause the stock price inflation that is documented in CKMR.

3.5.1. Measuring Price Inflation

We want to test for a relation between quarter-end institutional trading and price inflation. Therefore stock-level measures of abnormal trading are needed. For each stock *s* on day *t* our abnormal trading measure is the dollar volume of institutional trading on the last day of each month, divided by the average daily dollar volume of institutional trading over the last five days of the month. We create this measure for buys and sells separately:

$$\textit{Stock-Level Abnormal Buying}_{s,t} = \textit{Total Buying}_{s,t} / \textit{Average (Total Buying}_{s,\,t\text{-}4\ to\ t}) - 1$$

$$\textit{Stock-Level Abnormal Selling}_{s,t} = \textit{Total Selling}_{s,t} / \textit{Average (Total Selling}_{s,\,t\text{-}4\ to\ t}) - 1$$

We follow CKMR and define price inflation (*PI*) as the return on the last day of the month, minus the return from the first day of the subsequent month. Tape painting should create a positive value of *PI*. To test for price inflation, we regress *PI* on the stock level abnormal trading measures. We expect that abnormal buying will have a positive relation

with *PI*, as excessive buying on the last day of the month should make returns abnormally high on that day. We expect that abnormal selling will have a negative relation with *PI*, as depressed selling on the last day of the month will lead to low abnormal selling values, which should result in high returns on that day.

3.5.3. Stock Level Price Inflation: Results

Table 7 displays the effects that abnormal buying and selling have on stock returns. In model 1 the only independent variable is abnormal buying. The abnormal buying coefficient is both positive and significant in each of the size quintiles, and decreases monotonically with size. The monotonic decrease is consistent with the hypothesis that tape painting will have the greatest effect on small stocks. In model 2 the only independent variable is abnormal selling. With the exception of quintile 2, each of the coefficients is negative and significant, showing that depressed selling can also have a significant influence on share prices.

Model 3 uses both abnormal buying and selling in the same regression. For both trading measures the coefficients and *t*-statistics are similar to those reported in models 1 and 2, showing that both abnormal buying and abnormal selling have independent effects on price inflation. In model 3 for the full sample the coefficient for abnormal buying is 0.195 (*t*-statistic = 20.48), while that for abnormal selling is -0.137 (*t*-statistic = -14.65). The results here show that depressed selling can have a similar effect on price inflation as compared to excessive buying. Hence depressed selling is an effective form of tape painting.

4. Abnormal Trading after the 2003 Mutual Fund Scandals Investigation

In Table 8 we examine whether institutional trading activity changed as a result of the 2003 investigations into the late trading by mutual funds. We do not know if any of the institutions in our sample was under investigation during this time. However, institutional investors in general were under more scrutiny from regulators and the media during and after these investigations, and this scrutiny might have influenced their behaviour.

In order to test for a change in trading behaviour, we regress our institutional buy ratio, abnormal buy, and abnormal sell measures on dummy variables for quarter-end and year-end days, as well as interactions of these variables with a dummy variable for year 2003 or later.

$$Abnormal\ Trading_t = a + b_2 QEND_t + b_3 YEND_t + b_3 QEND_t * Y03 + b_4 YEND_t * Y03 + e_t$$

In Panel A, in the full sample regression, the buy ratios are not statistically different after the scandals as the interaction coefficients are all insignificant. We get this result with both equal-weighted and value-weighted buy ratios, and there is not any discernable pattern across the five size quintiles. Hence the ratio of buys to sells does not seem to have changed as a result of the investigations.

In Panel B the dependent variable is abnormal buying. In the equal-weighted regressions none of the year-end interactions are significant, although this may be due to the fact that our sample ends in 2005, so the *YEND * Y03* variable is only equal to 1 three times. However the quarter-end interactions are significant. In the full sample, the *QEND**2003 coefficient is -0.166 (*t*-statistic =-2.08). An economic interpretation of this result would be if institutions on average bought $1 million over the last five days of each month, then at quarter-end they bought only $0.844 million in 2003 and later. The coefficients are significant in each of the first four size quintiles.

The value-weighted abnormal buy regressions produce results that are similar to those of the equal-weighted regressions. The *QEND * Y03* coefficient is negative and significant in the first three size quintiles and the magnitude of the interaction coefficients are such that they cancel out the effect of *QEND*. This suggests that on average abnormal buying occurred before the scandal investigations, but was no longer visible during and after the investigations.

In Panel C, abnormal selling is the dependent variable. As in Table 5, we see that there is less selling at year-end. As the YEND coefficients are negative and mostly significant. In the equal-weighted regressions the *QEND * 2003* coefficient is -0.141 (*t*-statistic = -1.67) in the full sample regression. This result is mainly driven by the medium and small size quintiles, as the first three size quintiles are significant, while the last two are not. The value-weighted interaction coefficients are also negative, but only the middle size quintile is significant. Overall, the results show that depressed selling increased in the post-investigation part of our sample.

What might these results mean? One explanation might be that as a result of the scandals in 2003, institutional investors reduced their buying activity at the end of the year and quarter, so as to not to draw extra attention from regulators. However, to keep prices from falling, institutions also reduced there selling activity. The results show that the buy ratios are mostly unchanged before and after 2003 (the interactions terms are mostly not significant), suggesting that the post-investigation reductions in buying and selling offset one another.

5. Conclusion

In this paper we study quarter-end institutional trading activity using a large sample of institutional trades over a seven-year period. We find that the ratio of buys to total trades is high on quarter-end and especially year-end days, which is consistent with tape painting by institutional investors. Our trade evidence supports the arguments in CKMR, who contend that the inflated quarter-end fund NAVs and stock prices documented by them are the result of tape painting.

We show that on average, the institutions in our sample tend not to engage in excessive buying, unless the institutions have a large position in the stock. In contrast, we find that depressed selling is very widespread, and occurs whether or not the institution has a large position in the stock. Depressed selling is less costly than excessive buying from both regulatory and transaction cost perspectives; this may explain why it is more pervasive.

We show that both excessive buying and depressed selling are followed by trade reversals in the subsequent quarter, and that both types of trading create temporary price inflation. These findings suggest that both excessive buying and depressed selling contribute to the inflated fund NAVs documented by CKMR. Therefore, we show that depressed selling is both an effective and highly pervasive form of tape painting, which, to the best of our knowledge, has not been discussed in the literature before.

We also test whether institutions began to do less tape painting after the increased scrutiny from both regulators and the media, resulting from the late trading scandals that were investigated in 2003. We find that quarter-end trading fell during and after 2003, as institutions engaged in less excessive buying and in more depressed selling. The two effects appear to cancel one another out, as the buy ratios before and after the investigation are

similar. One explanation for this result is that institutions may have decided to disengage in excessive buying because it is relatively easy to detect by regulators. With the contemporaneous reduction in selling, the impact of less excessive buying on prices may have been abated.

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Table 1. Summary Statistics of the Institutional Trading Data

The table reports the summary statistics of the institutional investors and their trading activities. It reports the number of institutions in the sample. The table also reports the dollar value of trading volume by the institutions (max of buy vs. sell) in the sample as a percentage of dollar value of total market trading volume. The table shows the trading percentage for all stocks and for stocks in five size-quintiles based on NYSE breakpoints.

		Percent of Total Market Trading Volume					
Year	**Number of Institutions**	**All Stocks**	**Small Stocks Q1**	**Q2**	**Q3**	**Q4**	**Large Stocks Q5**
1999	329	7.52	4.87	6.93	8.27	8.92	7.63
2000	321	7.19	3.83	6.10	7.90	8.05	7.35
2001	324	9.30	7.74	12.24	11.59	10.89	9.23
2002	342	10.49	10.13	12.51	12.18	11.65	10.49
2003	327	9.42	10.01	12.11	10.71	10.40	9.44
2004	300	8.81	8.59	10.85	9.35	9.68	8.91
2005	301	8.71	9.94	11.10	10.77	10.36	8.40

Table 2: Average Buy Ratio on the Last Day of Month

The table reports the average 'Buy Ratio' on the last day of month for year-end and non-year-end months, and for quarter-end and non-quarter-end months. For each institution, we aggregate the value of buy (sell) transactions based on dollar value of trading, shares traded, and number of transactions on the last day of each month. We then compute the buy ratio using the ratio of buy relative to the sum of buy and sell. For each institution, we calculate for each month three 'Buy Ratios' based on dollar value of trading, shares traded and number of transactions. We compute equal and value weighted 'Buy Ratios' across all institutions for each month, whereas the value weighted ratio is based on the dollar value of trading of each institution in that month. The average buy ratio reported in the table is the average of the equal and value-weighted buy ratios over the six-year sample period. We calculate the buy ratios for all stocks in the sample and also separately for stocks in the five size quintiles (Q1 – Q5). Panel A reports results based on equal weighted buy ratio and Panel B reports results based on value weighted buy ratio. The sample spans from 1999 through 2005, and includes the trades of more than 300 separate institutions in each of the seven years that we study.

Table 2 - Continued

Panel A: Equal Weighted Individual Institution

	Dollar Value						Number of Shares						Number of Transactions					
Month	All	Small	Q2	Q3	Q4	Large	All	Small	Q2	Q3	Q4	Large	All	Small	Q2	Q3	Q4	Large
YEND	0.618	0.627	0.662	0.662	0.616	0.595	0.621	0.622	0.657	0.662	0.618	0.600	0.635	0.638	0.665	0.664	0.622	0.617
Other	0.522	0.517	0.548	0.530	0.515	0.518	0.523	0.504	0.542	0.529	0.516	0.519	0.539	0.515	0.548	0.533	0.526	0.533
Diff	0.096	0.111	0.113	0.132	0.101	0.077	0.099	0.117	0.115	0.133	0.103	0.081	0.096	0.123	0.117	0.131	0.096	0.084
***t*-statistic**	*9.69*	*10.80*	*5.76*	*4.97*	*3.68*	*4.66*	*7.35*	*11.82*	*5.26*	*5.17*	*3.89*	*3.93*	*10.35*	*11.77*	*6.09*	*5.11*	*3.36*	*4.92*
QEND	0.547	0.539	0.564	0.552	0.538	0.543	0.546	0.532	0.554	0.545	0.538	0.545	0.564	0.539	0.562	0.555	0.551	0.557
Other	0.513	0.508	0.543	0.522	0.506	0.509	0.514	0.494	0.537	0.523	0.507	0.510	0.53	0.506	0.543	0.525	0.516	0.524
Diff	0.035	0.031	0.021	0.030	0.032	0.034	0.033	0.038	0.017	0.022	0.031	0.035	0.034	0.033	0.018	0.030	0.035	0.033
***t*-statistic**	*4.66*	*1.89*	*1.65*	*2.60*	*2.53*	*3.23*	*4.65*	*2.21*	*1.27*	*1.91*	*2.45*	*3.27*	*4.61*	*2.07*	*1.45*	*2.80*	*2.87*	*3.05*

Panel B: Value Weighted Individual Institution

	Dollar Value						Number of Shares						Number of Transactions					
Month	All	Small	Q2	Q3	Q4	Large	All	Small	Q2	Q3	Q4	Large	All	Small	Q2	Q3	Q4	Large
YEND	0.582	0.646	0.622	0.641	0.614	0.561	0.586	0.617	0.602	0.621	0.616	0.565	0.633	0.669	0.650	0.67	0.648	0.589
Other	0.517	0.517	0.534	0.531	0.513	0.513	0.514	0.484	0.523	0.522	0.510	0.513	0.557	0.526	0.548	0.554	0.556	0.548
Diff	0.065	0.129	0.088	0.110	0.100	0.048	0.072	0.134	0.079	0.099	0.106	0.053	0.076	0.143	0.101	0.115	0.092	0.041
***t*-statistic**	*4.55*	*3.84*	*3.63*	*5.14*	*5.24*	*2.72*	*5.04*	*3.73*	*3*	*4.45*	*5.32*	*2.72*	*5.22*	*4.49*	*3.75*	*5.09*	*4.27*	*2.17*
QEND	0.524	0.510	0.547	0.534	0.530	0.525	0.523	0.482	0.541	0.517	0.529	0.528	0.574	0.533	0.57	0.567	0.578	0.564
Other	0.514	0.519	0.530	0.530	0.507	0.509	0.510	0.484	0.516	0.524	0.503	0.507	0.550	0.524	0.54	0.549	0.548	0.542
Diff	0.010	-0.010	0.017	0.004	0.023	0.016	0.013	-0.002	0.025	-0.007	0.027	0.022	0.024	0.009	0.03	0.018	0.03	0.022
***t*-statistic**	*1.25*	*-0.45*	*1.13*	*0.28*	*1.81*	*1.51*	*1.53*	*-0.11*	*1.56*	*-0.48*	*2.21*	*1.91*	*2.74*	*0.52*	*1.86*	*1.24*	*2.10*	*1.80*

Table 3: Regression Results: Buy Ratios

The table reports time series regression results of the 'Buy Ratio' using Year-end and Quarter-end Dummies: $BR_t = a + b_Q QEND_t + b_Y YEND_t\ BR_t$ is the average 'Buy Ratio' for each month, and YEND and QEND are year-end and quarter-end dummies. We use three buy ratios calculated based on dollar value of trading as defined in the text: buy ratio on the last day of the month (Panel A), buy ratio of each month excluding the last day of the month (Panel B), and the difference in the two above buy ratios (Panel C). The table reports results for both equal and value weighted buy ratios, and for the overall stock sample and for the five size-sorted quintiles. The sample spans from 1999 through 2005, and includes the trades of more than 300 separate institutions in each of the seven years that we study. T-statistics are reported in italics.

Table 3 - Continued

	Equal-Weighted							Value-Weighted					
	All	Small	Q2	Q3	Q4	Large		All	Small	Q2	Q3	Q4	Large
Panel A: Last Day of Month													
Intercept	0.513	0.508	0.543	0.522	0.506	0.509	Intercept	0.514	0.519	0.529	0.530	0.507	0.509
	132.76	*61.85*	*81.59*	*82.57*	*74.63*	*92.63*		*106.40*	*45.44*	*64.61*	*72.67*	*79.56*	*86.11*
YEND	0.071	0.088	0.098	0.110	0.078	0.052	YEND	0.057	0.136	0.075	0.107	0.083	0.036
	5.63	*3.29*	*4.52*	*5.35*	*3.54*	*2.90*		*3.64*	*3.65*	*2.81*	*4.50*	*4.01*	*1.88*
QEND	0.035	0.031	0.021	0.030	0.032	0.034	QEND	0.010	-0.010	0.017	0.004	0.023	0.016
	4.72	*1.95*	*1.65*	*2.48*	*2.43*	*3.23*		*1.13*	*-0.44*	*1.11*	*0.29*	*1.90*	*1.39*
R^2	0.536	0.233	0.308	0.410	0.280	0.288	R^2	0.214	0.155	0.151	0.244	0.283	0.104
Panel B: Non-Last Day of Month													
Intercept	0.486	0.485	0.516	0.495	0.464	0.480	Intercept	0.500	0.514	0.533	0.519	0.504	0.494
	272.17	*68.88*	*151.46*	*175.38*	*141.48*	*203.63*		*248.29*	*65.55*	*106.66*	*141.21*	*153.60*	*189.03*
YEND	0.005	0.007	0.007	0.018	-0.001	0.008	YEND	-0.002	0.029	0.022	0.018	0.001	-0.005
	0.89	*0.31*	*0.64*	*1.94*	*-0.07*	*1.10*		*-0.32*	*1.13*	*1.32*	*1.51*	*0.10*	*-0.57*
QEND	0.003	0.032	0.004	-0.005	0.009	0.003	QEND	0.001	0.014	-0.007	-0.004	0.010	-0.002
	1.00	*2.40*	*0.66*	*-0.85*	*1.39*	*0.57*		*0.15*	*0.93*	*-0.68*	*-0.51*	*1.58*	*-0.32*
R^2	0.037	0.089	0.018	0.044	0.027	0.030	R^2	0.001	0.044	0.021	0.028	0.038	0.009
Panel C: Last Day-Non Last Day													
Intercept	0.026	0.023	0.026	0.027	0.042	0.028	Intercept	0.014	0.005	-0.004	0.011	0.003	0.015
	7.05	*2.95*	*3.71*	*4.29*	*6.61*	*5.43*		*3.03*	*0.51*	*-0.43*	*1.49*	*0.55*	*2.59*
YEND	0.066	0.081	0.091	0.093	0.079	0.044	YEND	0.059	0.107	0.054	0.089	0.082	0.041
	5.36	*3.15*	*3.91*	*4.53*	*3.85*	*2.56*		*3.94*	*3.17*	*1.90*	*3.70*	*4.14*	*2.20*
QEND	0.031	-0.002	0.017	0.035	0.023	0.031	QEND	0.010	-0.024	0.024	0.008	0.013	0.017
	4.37	*-0.11*	*1.23*	*2.89*	*1.89*	*3.15*		*1.12*	*-1.19*	*1.45*	*0.55*	*1.14*	*1.58*
R^2	0.506	0.127	0.240	0.376	0.271	0.261	R^2	0.237	0.111	0.109	0.191	0.253	0.135

Table 4: Abnormal Buying and Selling on the Last Day of Month

The table reports the average Abnormal Buy (Sell) ratios on the last day of month for year-end and non-year-end months, and for quarter-end and non-quarter-end months. For each institution, we aggregate the value of buy (sell) transactions based on dollar value of trading on the last day of each month and then compute the ratio of buy (sell) on the last day relative to the last five trading days in the same month. The 'Abnormal Buy (Sell) Ratio' is defined as the relative buy (sell) ratio minus one. We compute equal weighted and value weighted abnormal buy (sell) ratios across all institutions for each month, and then calculate the time series average of abnormal buy (sell) ratios over the sample period. Panels A, B report results for the equal- and value-weighted abnormal buy (sell) ratios respectively. In Panel C, we report the average percentage of institutions exhibit abnormal buy (abnormal buy ratio greater than zero) and abnormal sell (abnormal sell ratio less than 0) activities. The sample spans from 1999 through 2005, and includes the trades of more than 300 separate institutions in each of the seven years that we study.

Table 4 – Continued

Panel A: Abnormal Trading Equal-Weighted Tests

Year End vs. Non Year End

	All	Small	Q2	Q3	Q4	Large
Abnormal Buy						
YEND	-0.152	0.125	0.014	0.021	-0.065	-0.183
N-YEND	0.016	0.057	0.067	0.059	0.051	0.019
Difference	-0.168	0.068	-0.053	-0.039	-0.116	-0.202
t-statistic	*-2.15*	*0.77*	*-0.59*	*-0.48*	*-1.25*	*-2.69*
Abnormal Sell						
YEND	-0.373	-0.189	-0.311	-0.349	-0.331	-0.365
N-YEND	-0.042	0.063	0.009	-0.017	-0.024	-0.044
Difference	-0.331	-0.252	-0.320	-0.332	-0.307	-0.321
t-statistic	*-5.03*	*-3.04*	*-3.25*	*-3.74*	*-3.91*	*-5.13*

Quarter-End vs. Non Quarter-End

	All	Small	Q2	Q3	Q4	Large
Abnormal Buy						
QEND	-0.036	0.095	0.062	0.067	-0.008	-0.029
N-QEND	0.021	0.047	0.063	0.050	0.066	0.018
Difference	-0.056	0.049	-0.001	0.017	-0.074	-0.047
t-statistic	*-1.34*	*1.11*	*-0.01*	*0.37*	*-1.57*	*-1.07*
Abnormal Sell						
QEND	-0.176	-0.021	-0.106	-0.133	-0.159	-0.162
N-QEND	-0.016	0.073	0.027	-0.001	0.005	-0.026
Difference	-0.160	-0.094	-0.133	-0.132	-0.164	-0.136
t-statistic	*-3.54*	*-1.78*	*-2.51*	*-2.67*	*-3.76*	*-2.74*

Table 4 – Continued

Panel B: Abnormal Trading Value-Weighted Tests

Year-End vs. Non Year-End

	All	Small	Q2	Q3	Q4	Large
Abnormal Buy						
YEND	0.033	0.137	0.051	0.052	0.068	0.023
N-YEND	0.062	0.067	0.096	0.075	0.059	0.053
Difference	-0.028	0.07	-0.045	-0.024	0.009	-0.031
t-statistic	*-0.24*	*0.57*	*-0.41*	*-0.25*	*0.08*	*-0.25*
Abnormal Sell						
YEND	-0.152	-0.005	-0.179	-0.211	-0.186	-0.113
N-YEND	0.021	0.11	0.072	0.026	0.051	0.015
Difference	-0.173	-0.115	-0.251	-0.237	-0.237	-0.128
t-statistic	*-1.56*	*-0.74*	*-2.43*	*-2.19*	*-2.07*	*-1.06*

Quarter-End vs. Non Quarter-End

	All	Small	Q2	Q3	Q4	Large
Abnormal Buy						
QEND	0.102	0.174	0.166	0.135	0.088	0.094
N-QEND	0.038	0.023	0.056	0.043	0.046	0.029
Difference	0.064	0.152	0.110	0.092	0.042	0.065
t-statistic	*1.25*	*2.40*	*1.79*	*1.75*	*0.80*	*1.24*
Abnormal Sell						
QEND	0.000	0.121	0.038	0.009	-0.024	0.007
N-QEND	0.009	0.090	0.057	0.005	0.059	0.003
Difference	-0.010	0.032	-0.019	0.004	-0.083	0.005
t-statistic	*-0.18*	*0.45*	*-0.31*	*0.06*	*-1.58*	*0.08*

Table 4 – Continued

Panel C: Percentage of Institutions with Abnormal Trading

Year End vs. Non Year End

	All	Small	Q2	Q3	Q4	Large
Abnormal Buy						
YEND	0.317	0.384	0.362	0.365	0.326	0.270
N-YEND	0.398	0.359	0.385	0.379	0.368	0.375
Difference	-0.082	0.025	-0.022	-0.015	-0.042	-0.106
t-statistic	*-2.23*	*0.74*	*-0.76*	*-0.43*	*-1.28*	*-3.21*
Abnormal Sell						
YEND	0.781	0.726	0.759	0.782	0.767	0.767
N-YEND	0.639	0.643	0.640	0.649	0.659	0.658
Difference	0.142	0.082	0.119	0.134	0.108	0.108
t-statistic	*4.77*	*3.16*	*3.58*	*3.70*	*3.40*	*3.76*

Quarter-End vs. Non Quarter-End

	All	Small	Q2	Q3	Q4	Large
Abnormal Buy						
QEND	0.375	0.377	0.380	0.382	0.350	0.349
N-QEND	0.399	0.353	0.384	0.376	0.371	0.375
Difference	-0.024	0.024	-0.005	0.005	-0.021	-0.026
t-statistic	*-1.21*	*1.55*	*-0.27*	*0.31*	*-1.18*	*-1.37*
Abnormal Sell						
QEND	0.694	0.674	0.681	0.692	0.709	0.699
N-QEND	0.629	0.638	0.634	0.643	0.647	0.651
Difference	0.065	0.035	0.048	0.049	0.062	0.048
t-statistic	*3.10*	*2.02*	*2.35*	*2.47*	*3.61*	*2.45*

Table 5: Abnormal Trading and Portfolio Weights

For each institution, and for each stock, we use accumulate each institution's trades in each stock to estimate the institution's net position in each stock. If the accumulated net position is negative, then we assign it a value of 0. Once we have the net position of each stock we estimate the weight of each stock in the institution's portfolio. We call this W_i. For the same stocks in the portfolio, we construct a portfolio weight based on the market weight of the stocks; this weight is called M_i. M_i is not the raw market weight; it is market value of stock *i* divided by the sum of market values of all of the stocks in the institution's portfolio. *Overweight* is the difference between W_i and M_i. We test for the relation between portfolio holdings and abnormal trading with the following Logit regression model:

$$Pr(Buy_{i,j,t} = 1) = F(a + b_1 OW_{i,j,t-1} + b_2 YEND_t + b_3 OWD_{i,j,t-1} * YEND_t + b_4 Past\ Return_{j,t-1})$$

$$Pr(Sell_{i,j,t} = 1) = F(a + b_1 OW_{i,j,t-1} + b_2 YEND_t + b_3 OWD_{i,j,t-1} * YEND_t + b_4 Past\ Return_{j,t-1})$$

Our sample includes all trades that occur on the last day of the month. In the above equations *Buy* and *Sell* are dummy variables equal to 1 if the institution buys or sells a particular stock and 0 otherwise. *OW* is *Overweight*, *YEND* is as before, *OWD* is equal to 1 if *Overweight* is greater than zero, and 0 otherwise. The subscript *i* refers to an institution, and the subscript *j* refers to a stock. *Past Return* is the buy and hold return over the last three months, adjusted for size and book-to-market. We also estimate the regressions by replacing *YEND* with *QEND*. *Overweight* is measured from the beginning of the sample period up until the day in which the trades are measured, so we avoid a mechanical relation between these variables due an overlap in the measurement periods. The sample spans from 1999 through 2005, and includes the trades of more than 300 separate institutions in each of the seven years that we study. P-values are reported in italics. The standard errors were computed by clustering on the institution.

Table 5 - Continued

Panel A: Dependent Variable is Buy Dummy Variable					
	Intercept	*OW*	*YEND*	*OWD * YEND*	*Past Return*
Model 1	-1.675	0.098	0.053		
	0.00	*0.00*	*0.55*		
Model 2	-1.675	0.093	-0.122	0.345	
	0.00	*0.00*	*0.32*	*0.00*	
Model 3	-1.677	0.093	-0.130	0.342	0.373
	0.00	*0.00*	*0.29*	*0.00*	*0.00*

Panel B: Dependent Variable is Buy Dummy Variable					
	Intercept	*OW*	*QEND*	*OWD * QEND*	*Past Return*
Model 1	-1.750	0.099	0.222		
	0.00	*0.00*	*0.00*		
Model 2	-1.749	0.076	0.061	0.328	
	0.00	*0.00*	*0.32*	*0.00*	
Model 3	-1.751	0.076	0.062	0.325	0.367
	0.00	*0.00*	*0.30*	*0.00*	*0.00*

Table 5 - Continued

Panel C: Dependent Variable is Sell Dummy Variable					
	Intercept	*OW*	*YEND*	*OWD * YEND*	*Past Return*
Model 1	-1.951	-0.053	-0.315		
	0.00	*0.00*	*0.01*		
Model 2	-1.951	-0.052	-0.262	-0.118	
	0.00	*0.00*	*0.02*	*0.04*	
Model 3	-1.950	-0.052	-0.256	-0.116	-0.270
	0.00	*0.00*	*0.03*	*0.04*	*0.00*

Panel D: Dependent Variable is Sell Dummy Variable					
	Intercept	*OW*	*QEND*	*OWD * QEND*	*Past Return*
Model 1	-1.988	-0.054	0.045		
	0.00	*0.00*	*0.16*		
Model 2	-1.988	-0.034	0.188	-0.338	
	0.00	*0.00*	*0.32*	*0.00*	
Model 3	-1.986	-0.034	0.186	-0.335	-0.308
	0.00	*0.00*	*0.30*	*0.00*	*0.00*

Table 6: Patterns of Institutional Trading around the Turn of the Month

The table reports patterns of institutional trading activities around the end of each of the twelve months. For each institution, we aggregate the value of buy (sell) transactions based on dollar value of trading for the last five days of each month and the first 5 days of the subsequent month. We compute the ratio of buying (selling) in the first five days of the subsequent month relative to the total buying (selling) over the ten day period. We then subtract the ratio with the ratio of the first five day trading relative to total trading in the ten day period. We compute equal weighted ratios across all institutions for each month. The table report the average of the equal-weighted ratios (in percentage) over the six-year sample period. We calculate the ratios for all stocks in the sample and also separately for stocks in the five size quintiles (Q1 – Q5). The sample spans from 1999 through 2005, and includes the trades of more than 300 separate institutions in each of the seven years that we study. T-statistics are reported in italics.

Table 6 – Continued

	Buying						Selling					
Month	*All*	*Small*	*Q2*	*Q3*	*Q4*	*Large*	*All*	*Small*	*Q2*	*Q3*	*Q4*	*Large*
1	-0.441	-0.905	-1.579	-0.293	-0.141	0.070	0.503	0.086	1.280	1.133	0.457	0.053
	-1.69	*-1.43*	*-2.12*	*-0.59*	*-0.25*	*0.12*	*1.43*	*0.09*	*1.52*	*1.65*	*0.85*	*0.13*
2	-0.462	-0.688	-1.383	-1.639	-0.257	-0.450	0.560	0.989	0.699	0.654	-0.273	0.471
	-1.31	*-0.90*	*-2.66*	*-2.08*	*-0.42*	*-0.81*	*1.85*	*0.96*	*1.08*	*0.79*	*-0.50*	*0.94*
3	**-0.527**	**-2.276**	**-1.012**	**-0.308**	**-1.563**	**0.214**	**1.050**	**2.791**	**0.685**	**0.208**	**1.484**	**0.939**
	-2.00	***-2.60***	***-3.86***	***-0.36***	***-2.63***	***0.48***	***4.66***	***2.86***	***1.81***	***0.45***	***2.62***	***3.63***
4	-0.392	-1.368	0.284	-1.186	-1.066	0.187	0.495	-0.072	-0.415	1.579	1.010	0.247
	-0.95	*-2.37*	*0.67*	*-2.49*	*-1.16*	*0.58*	*1.29*	*-0.08*	*-0.52*	*1.80*	*2.11*	*1.01*
5	-0.246	-0.504	-0.208	-0.589	-1.273	-0.145	0.890	0.270	0.154	1.466	0.913	0.140
	-0.39	*-0.46*	*-0.40*	*-0.97*	*-1.13*	*-0.20*	*1.22*	*0.26*	*0.24*	*1.90*	*0.92*	*0.18*
6	**-1.369**	**0.039**	**-1.495**	**-1.956**	**-2.080**	**-1.032**	**1.462**	**1.543**	**1.634**	**1.765**	**1.683**	**1.159**
	-4.94	***0.04***	***-1.51***	***-4.66***	***-1.90***	***-2.77***	***3.32***	***1.51***	***1.85***	***1.82***	***2.34***	***2.52***
7	0.579	-0.253	-0.130	0.338	0.285	0.743	-0.437	-0.962	-0.586	-0.672	-0.409	-0.433
	1.49	*-0.41*	*-0.14*	*0.55*	*0.39*	*3.11*	*-1.66*	*-1.37*	*-0.54*	*-1.37*	*-0.72*	*-1.01*
8	0.105	-0.329	-0.832	-0.917	-1.163	0.350	0.380	-0.953	0.809	0.350	0.795	0.350
	0.23	*-1.87*	*-1.45*	*-1.09*	*-1.25*	*1.03*	*1.27*	*-1.46*	*1.50*	*0.42*	*0.88*	*0.92*
9	**-1.298**	**-2.729**	**-1.427**	**-1.082**	**-0.946**	**-1.162**	**1.987**	**4.270**	**2.285**	**2.222**	**1.381**	**1.568**
	-4.68	***-3.38***	***-1.72***	***-1.16***	***-1.65***	***-2.59***	***5.37***	***3.61***	***2.93***	***2.91***	***2.21***	***2.99***
10	-0.478	0.373	-0.669	-0.338	-0.259	-0.642	0.673	-1.165	0.510	0.050	0.249	0.834
	-0.77	*0.38*	*-1.17*	*-0.71*	*-0.74*	*-0.87*	*1.43*	*-1.31*	*0.59*	*0.08*	*0.66*	*1.32*
11	-0.130	0.715	-0.018	0.021	-0.791	-0.470	0.438	-1.121	0.172	0.659	1.005	0.715
	-0.25	*0.87*	*-0.03*	*0.03*	*-0.77*	*-0.69*	*0.64*	*-2.31*	*0.20*	*0.93*	*1.10*	*0.91*
12	**-1.341**	**-2.650**	**-1.233**	**-2.137**	**-2.312**	**-1.100**	**1.906**	**2.371**	**1.410**	**2.687**	**1.225**	**1.551**
	-2.31	***-3.41***	***-2.73***	***-2.91***	***-3.05***	***-2.24***	***2.96***	***1.91***	***1.86***	***3.08***	***1.84***	***3.11***

Table 7: Institutional Trading Activity and Price Inflation

The table reports regression results of price inflation and institutional trading activities on the last day of the month: $PI_{i,t} = a + b_{buy}ABUY_{ti,t} + b_{sell}ASELL_{i,t}$. For each stock, price inflation (PI) is defined as the difference between the return on the end of the each month and the return on the first day of the subsequent month. "Abnormal Buy" (ABUY) and "Abnormal Sell" (ASELL) are calculated as the ratio of total buys (sells) of all institutions on the last day of the month relative to the average daily buys (sells) by these institutions over the last five days of the month minus one. The sample spans from 1999 through 2005, and includes the trades of more than 300 separate institutions in each of the seven years that we study. T-statistics are reported in italics.

	Model 1						Model 2						Model 3					
	All	Small	Q2	Q3	Q4	Large	All	Small	Q2	Q3	Q4	Large	All	Small	Q2	Q3	Q4	Large
Intercept	0.082	0.202	0.248	0.150	0.119	0.029	0.179	0.183	0.250	0.101	0.041	-0.014	0.109	0.188	0.243	0.101	0.045	-0.015
	5.86	*5.29*	*8.25*	*5.11*	*4.34*	*1.18*	*13.09*	*4.77*	*8.16*	*3.37*	*1.47*	*-0.56*	*7.69*	*4.88*	*7.95*	*3.39*	*1.61*	*-0.63*
ABUY	0.188	0.537	0.444	0.282	0.233	0.187							0.195	0.524	0.443	0.289	0.269	0.243
	19.79	*12.02*	*11.92*	*7.47*	*6.41*	*5.29*							*20.48*	*11.67*	*11.89*	*7.68*	*7.41*	*6.86*
ASELL							-0.128	-0.188	-0.040	-0.275	-0.486	-0.430	-0.137	-0.141	-0.028	-0.283	-0.504	-0.459
							-13.66	*-4.30*	*-1.12*	*-7.63*	*-13.85*	*-12.49*	*-14.65*	*-3.22*	*-0.79*	*-7.83*	*-14.34*	*-13.24*
R^2	0.028	0.040	0.032	0.020	0.026	0.021	0.027	0.036	0.029	0.020	0.030	0.025	0.030	0.040	0.032	0.021	0.032	0.026

Table 8: Regression Results: Change of Last-day Buying and Selling Activities

The table reports time series regression results of institutional trading activities on the last day of the month: $ATR_t = a + b_2QEND_t + b_3YEND_t + b_3QEND_t * Y03 + b_4YEND_t * Y03$. YEND and QEND are year-end and quarter-end dummies. *Y03* is a dummy variable for years greater than or equal to 2003 and is interacted with QEND and YEND respectively. We use three dependent variables in the regression for ATR_t: (1) the average 'Buy Ratio' for each month calculated based on dollar value of trading on the last day of the month (Panel A); (2) abnormal buy (Panel B) and abnormal sell (Panel C). The abnormal buy and sell are calculated based on dollar value trading volume o on the last day of month relative to the dollar trading volume in the last five days of the month. The sample spans from 1999 through 2005, and includes the trades of more than 300 separate institutions in each of the seven years that we study. T-statistics are reported in italics.

	Equal Weighted						**Value-Weighted**					
Panel A												
Buy Ratio	All	Small	Q2	Q3	Q4	Large	All	Small	Q2	Q3	Q4	Large
Intercept	0.513	0.508	0.543	0.522	0.506	0.509	0.514	0.519	0.529	0.530	0.507	0.509
	131.92	*64.58*	*81.45*	*84.89*	*77.84*	*92.95*	*106.79*	*45.03*	*64.31*	*71.92*	*79.10*	*87.14*
YEND	0.075	0.109	0.092	0.073	0.079	0.075	0.071	0.157	0.092	0.114	0.098	0.053
	4.44	*3.22*	*3.19*	*2.74*	*2.81*	*3.18*	*3.43*	*3.15*	*2.58*	*3.57*	*3.52*	*2.10*
QEND	0.038	-0.003	0.012	0.029	0.056	0.032	0.014	-0.020	0.005	0.007	0.025	0.024
	4.15	*-0.13*	*0.77*	*1.99*	*3.59*	*2.47*	*1.25*	*-0.74*	*0.24*	*0.40*	*1.63*	*1.71*
YEND*Y03	-0.008	-0.049	0.015	0.088	-0.001	-0.054	-0.033	-0.048	-0.038	-0.015	-0.033	-0.039
	-0.32	*-0.95*	*0.34*	*2.17*	*-0.02*	*-1.49*	*-1.03*	*-0.63*	*-0.70*	*-0.31*	*-0.78*	*-1.01*
QEND*Y03	-0.008	0.078	0.020	0.002	-0.056	0.004	-0.009	0.025	0.030	-0.007	-0.004	-0.019
	-0.64	*2.99*	*0.93*	*0.10*	*-2.61*	*0.24*	*-0.56*	*0.65*	*1.10*	*-0.28*	*-0.19*	*-0.98*
R^2	0.542	0.314	0.323	0.456	0.355	0.311	0.239	0.160	0.165	0.248	0.292	0.147

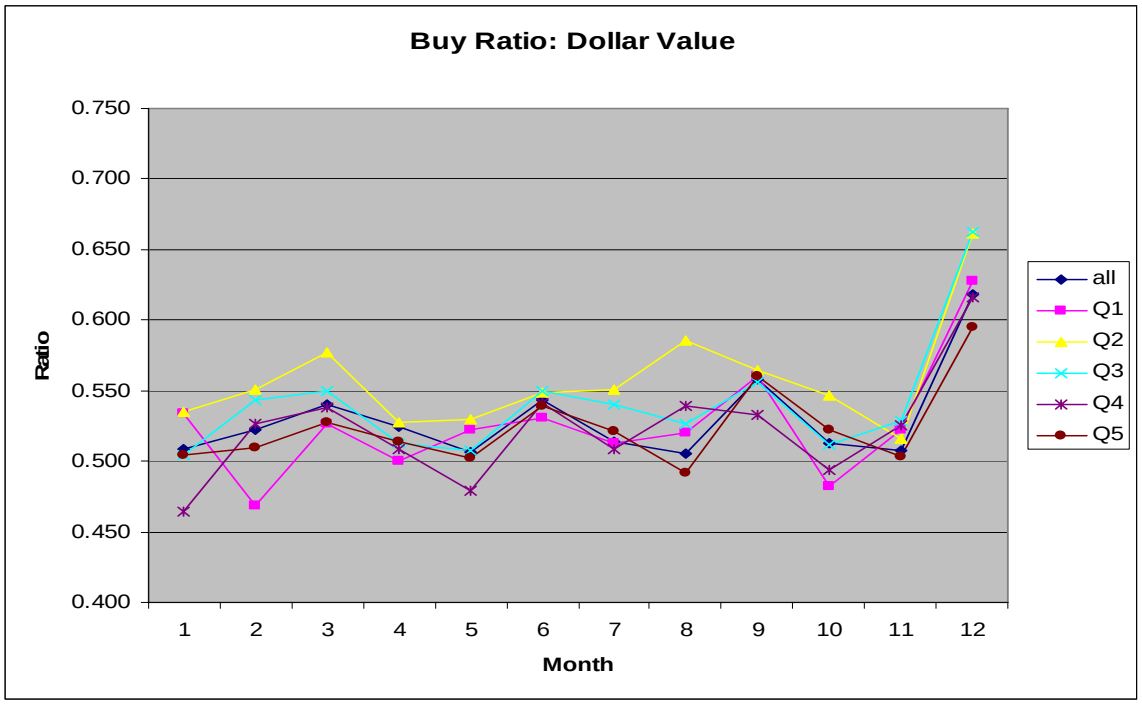
Table 8 - Continued

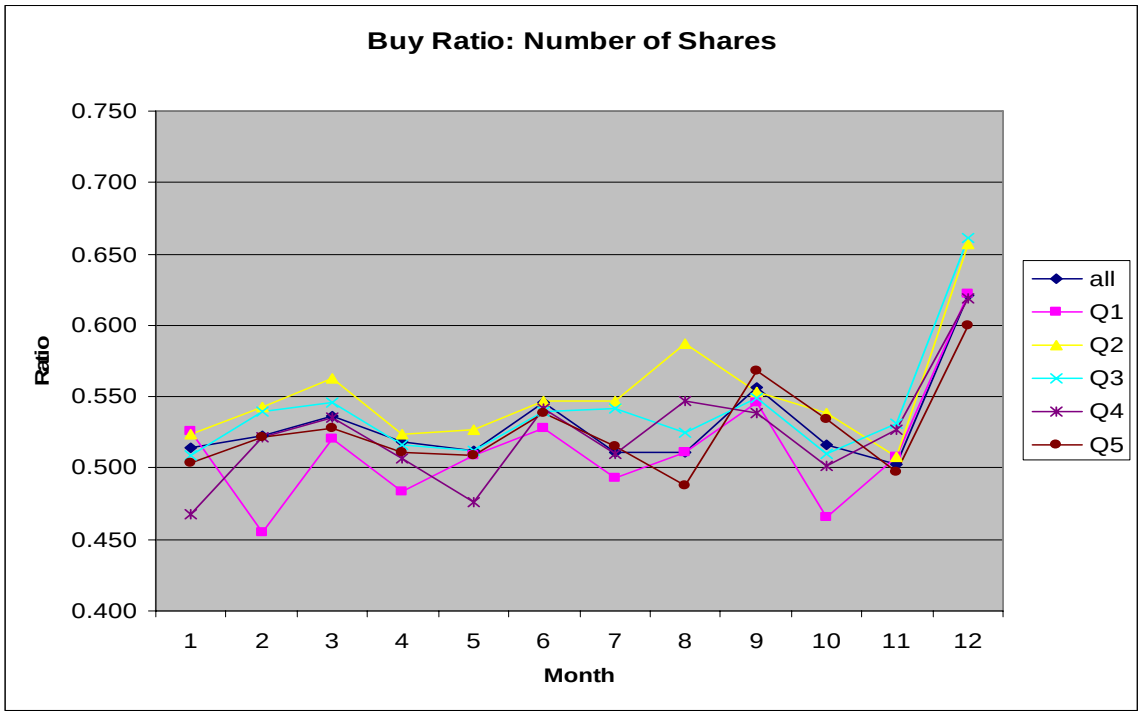
	Equal Weighted						Value-Weighted					
Panel B												
Abnormal Buy	All	Small	Q2	Q3	Q4	Large	All	Small	Q2	Q3	Q4	Large
Intercept	0.021	0.047	0.063	0.05	0.066	0.018	0.038	0.023	0.056	0.043	0.046	0.029
	0.85	*1.77*	*2.18*	*1.93*	*2.21*	*0.7*	*1.29*	*0.66*	*1.66*	*1.44*	*1.43*	*0.94*
YEND	-0.218	-0.009	-0.12	-0.151	-0.118	-0.248	-0.193	-0.153	-0.232	-0.229	-0.071	-0.206
	-2.08	*-0.08*	*-0.96*	*-1.33*	*-0.91*	*-2.26*	*-1.51*	*-1.03*	*-1.61*	*-1.78*	*-0.51*	*-1.54*
QEND	0.054	0.127	0.09	0.124	0.018	0.055	0.14	0.295	0.237	0.202	0.085	0.13
	0.94	*2.04*	*1.3*	*1.98*	*0.25*	*0.92*	*1.99*	*3.62*	*2.97*	*2.86*	*1.1*	*1.76*
YEND*Y03	0.146	0.112	0.129	0.207	0.097	0.101	0.236	0.24	0.185	0.275	0.103	0.258
	0.91	*0.65*	*0.67*	*1.20*	*0.49*	*0.60*	*1.21*	*1.06*	*0.84*	*1.40*	*0.48*	*1.26*
QEND*Y03	-0.166	-0.206	-0.173	-0.214	-0.17	-0.119	-0.124	-0.306	-0.207	-0.192	-0.083	-0.095
	-2.08	*-2.38*	*-1.82*	*-2.47*	*-1.72*	*-1.42*	*-1.27*	*-2.7*	*-1.87*	*-1.96*	*-0.78*	*-0.94*
R^2	0.112	0.086	0.046	0.079	0.069	0.105	0.054	0.152	0.103	0.098	0.016	0.049
Panel C												
Abnormal Sell	All	Small	Q2	Q3	Q4	Large	All	Small	Q2	Q3	Q4	Large
Intercept	-0.016	0.073	0.027	-0.001	0.005	-0.026	0.009	0.090	0.057	0.005	0.059	0.003
	-0.64	*2.50*	*0.92*	*-0.03*	*0.20*	*-0.86*	*0.28*	*2.16*	*1.60*	*0.15*	*1.88*	*0.08*
YEND	-0.323	-0.241	-0.302	-0.328	-0.252	-0.344	-0.311	-0.130	-0.359	-0.424	-0.256	-0.275
	-2.91	*-1.90*	*-2.43*	*-3.09*	*-2.24*	*-2.67*	*-2.17*	*-0.72*	*-2.32*	*-3.17*	*-1.89*	*-1.75*
QEND	-0.034	0.043	0.020	0.037	-0.075	-0.019	0.079	0.127	0.129	0.158	-0.013	0.072
	-0.56	*0.61*	*0.30*	*0.63*	*-1.21*	*-0.26*	*1.00*	*1.28*	*1.51*	*2.13*	*-0.18*	*0.83*
YEND*Y03	0.144	0.038	0.066	0.093	0.054	0.169	0.252	-0.090	0.161	0.307	0.095	0.268
	0.85	*0.20*	*0.35*	*0.58*	*0.32*	*0.86*	*1.15*	*-0.33*	*0.68*	*1.50*	*0.46*	*1.12*
QEND*Y03	-0.141	-0.187	-0.197	-0.226	-0.075	-0.116	-0.088	-0.123	-0.177	-0.188	-0.037	-0.064
	-1.67	*-1.94*	*-2.08*	*-2.79*	*-0.87*	*-1.18*	*-0.81*	*-0.90*	*-1.50*	*-1.83*	*-0.36*	*-0.53*
R^2	0.244	0.146	0.207	0.284	0.212	0.170	0.059	0.041	0.097	0.134	0.081	0.038

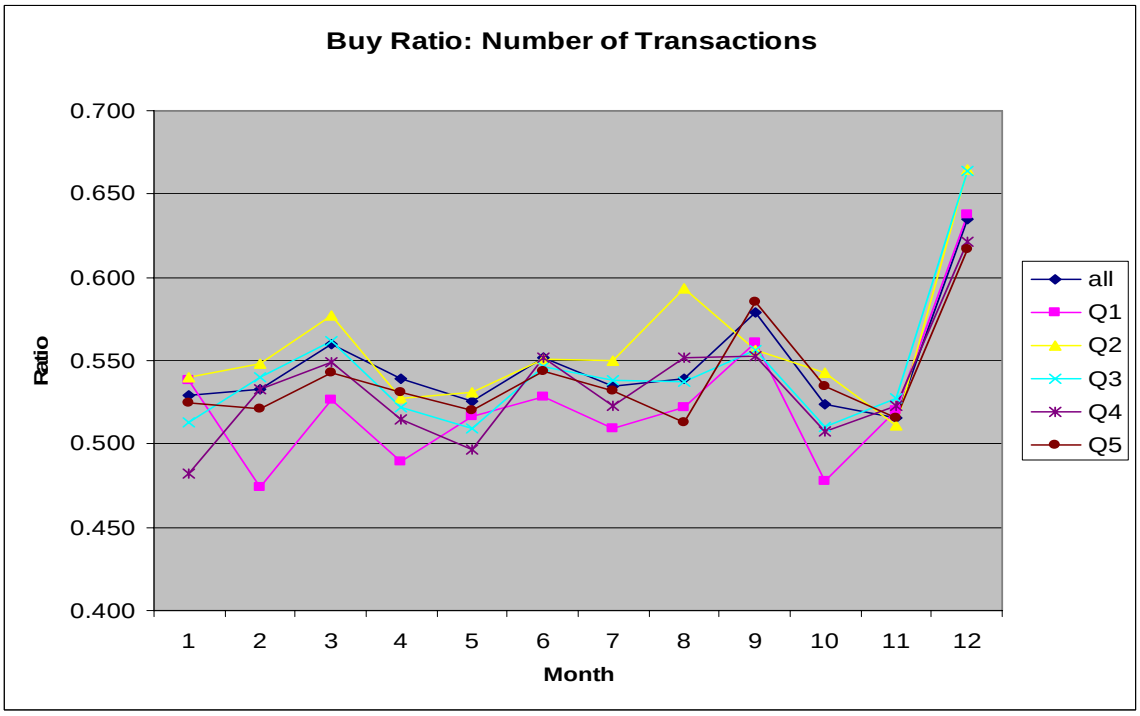
Figure 1: Buy Ratio on Last Day of Month

The figure depicts the average 'Buy Ratio' on the last day of month for the twelve months. For each institution, we aggregate the value of buy (sell) transactions based on dollar value, shares traded, and number of transactions on the last day of each month. We then compute the buy ratio using the value of buy relative to the sum of buy and sell. For each institution, we calculate for each month three ratios based on dollar value of trading, shares trades and number of transactions. We compute equal and value weighted Buy Ratios across all institutions for each month, whereas the value weighted ratio is based on the dollar value of trading of each institution. The average buy ratio in this figure is the average over the six year sample period. We calculate the buy ratios for all stocks in the sample (ALL) and also separately for stocks in the five size quintiles (Q1 – Q5). Panel A reports equal weighted buy ratio and Panel B reports value weighted buy ratio. The sample spans from 1999 through 2005, and includes the trades of more than 300 separate institutions in each of the seven years that we study.

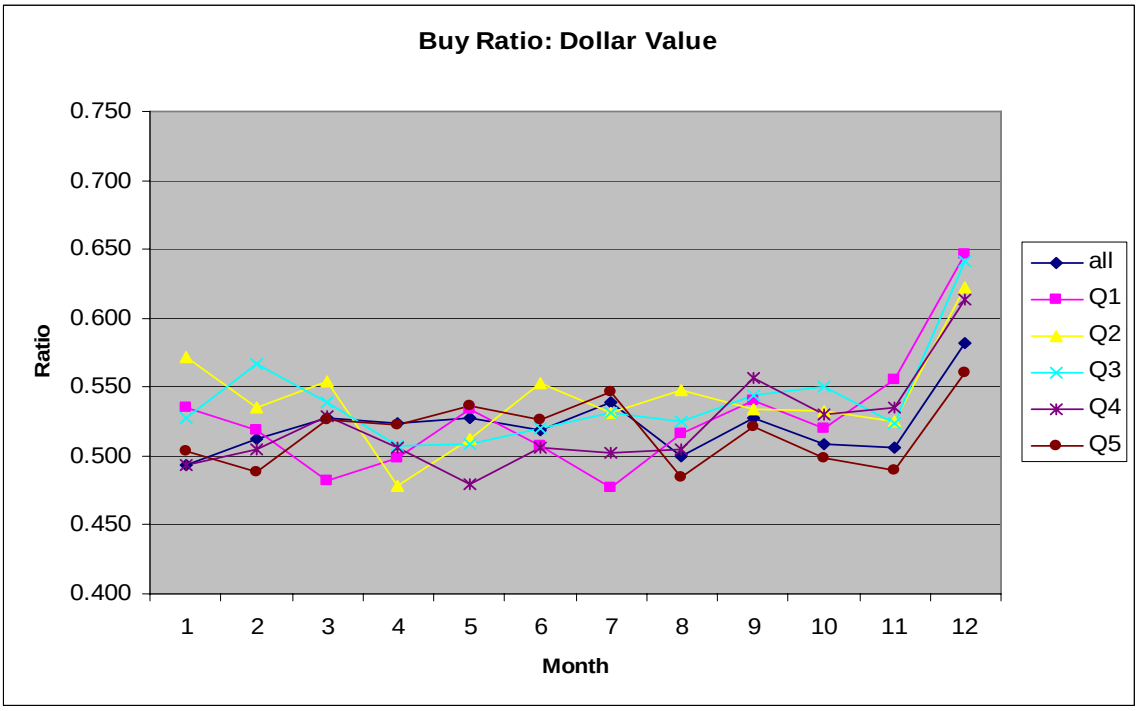
Panel A: Equal Weighted Buy Ratio

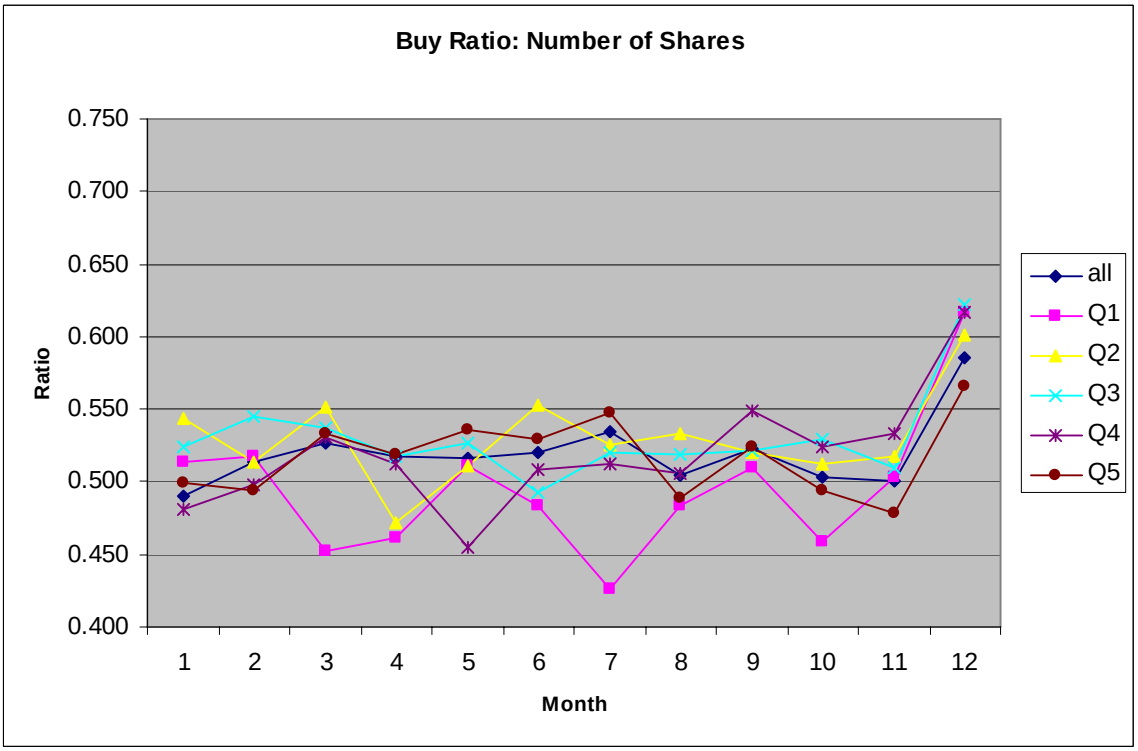



Buy Ratio: Number of Shares
0.750
0.700
0.650
0.600
0.550
0.500
0.450
0.400
Ratio
1
2
3
4
5
6
7
8
9
10
11
12
Month
all
Q1
Q2
Q3
Q4
Q5


Buy Ratio: Number of Transactions
0.700
0.650
0.600
0.550
0.500
0.450
0.400
Ratio
1
2
3
4
5
6
7
8
9
10
11
12
Month
all
Q1
Q2
Q3
Q4
Q5

Panel B: Value Weighted Buy Ratio





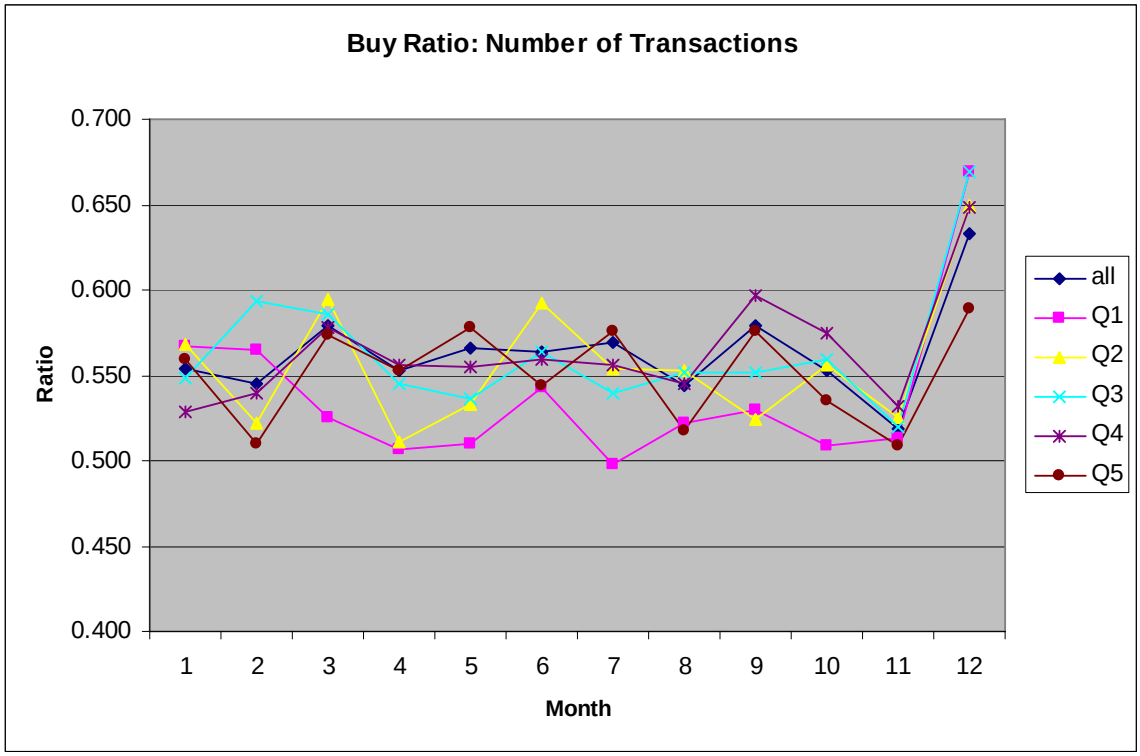
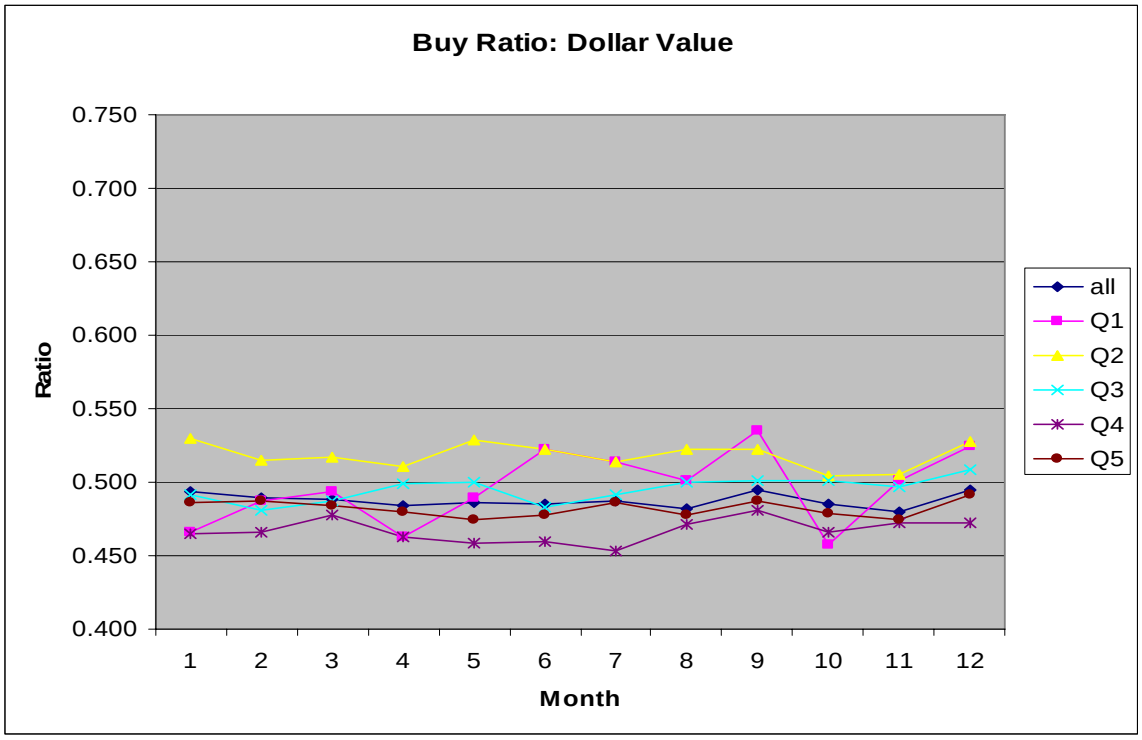
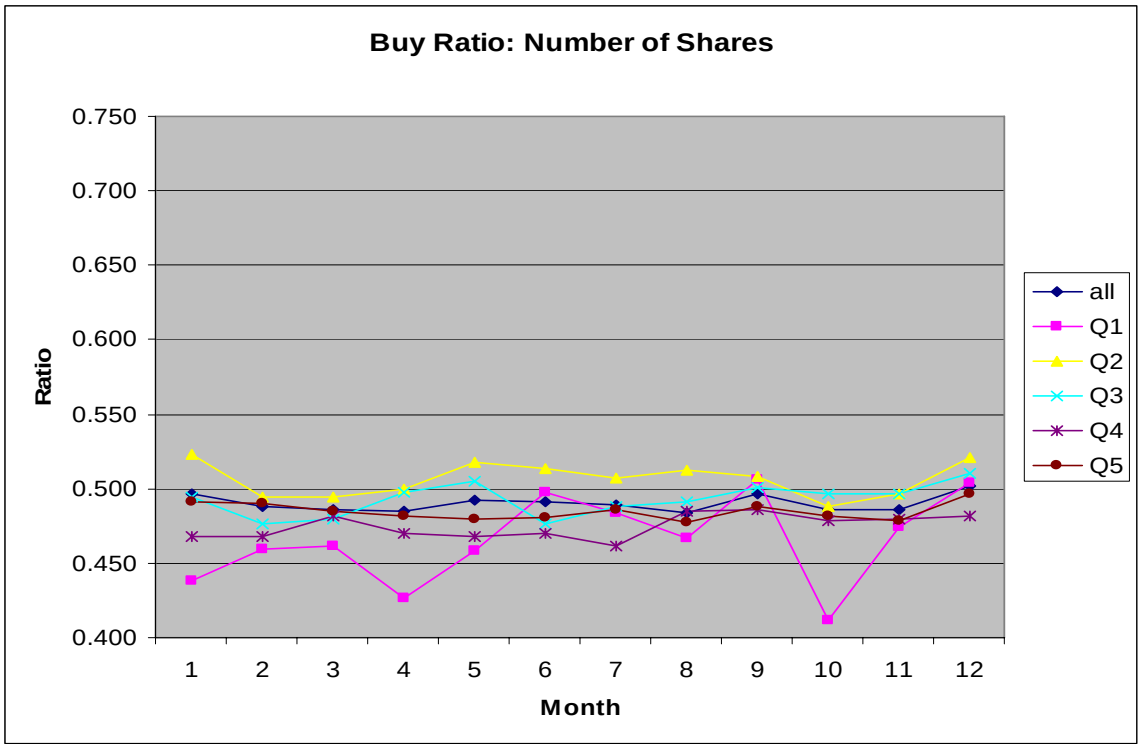

Buy Ratio: Number of Transactions
0.700
0.650
0.600
0.550
0.500
0.450
0.400
Ratio
1
2
3
4
5
6
7
8
9
10
11
12
Month
all
Q1
Q2
Q3
Q4
Q5

Figure 2: Buy Ratio: Excluding Last Day of Month (Equal Weighted)

The figure depicts the average 'Buy Ratio' for each month excluding the last day of the month. For each institution, we aggregate the value of buy (sell) transactions based on dollar value, shares traded, and number of transactions for each month excluding the last day of the month. We then compute the buy ratio using the ratio of buy relative to the sum of buy and sell. For each institution, we calculate for each month three ratios based on dollar value of trading, shares trades and number of transactions. We calculate the buy ratios for all stocks in the sample and also separately for stocks in the five size quintiles (Q1 – Q5). We compute equal and value weighted Buy Ratios across all institutions for each year. The average buy ratio in this figure is the average over the six year sample period. The sample spans from 1999 through 2005, and includes the trades of more than 300 separate institutions in each of the seven years that we study.




Buy Ratio: Number of Shares
0.750
0.700
0.650
0.600
0.550
0.500
0.450
0.400
Ratio
1
2
3
4
5
6
7
8
9
10
11
12
Month
all
Q1
Q2
Q3
Q4
Q5

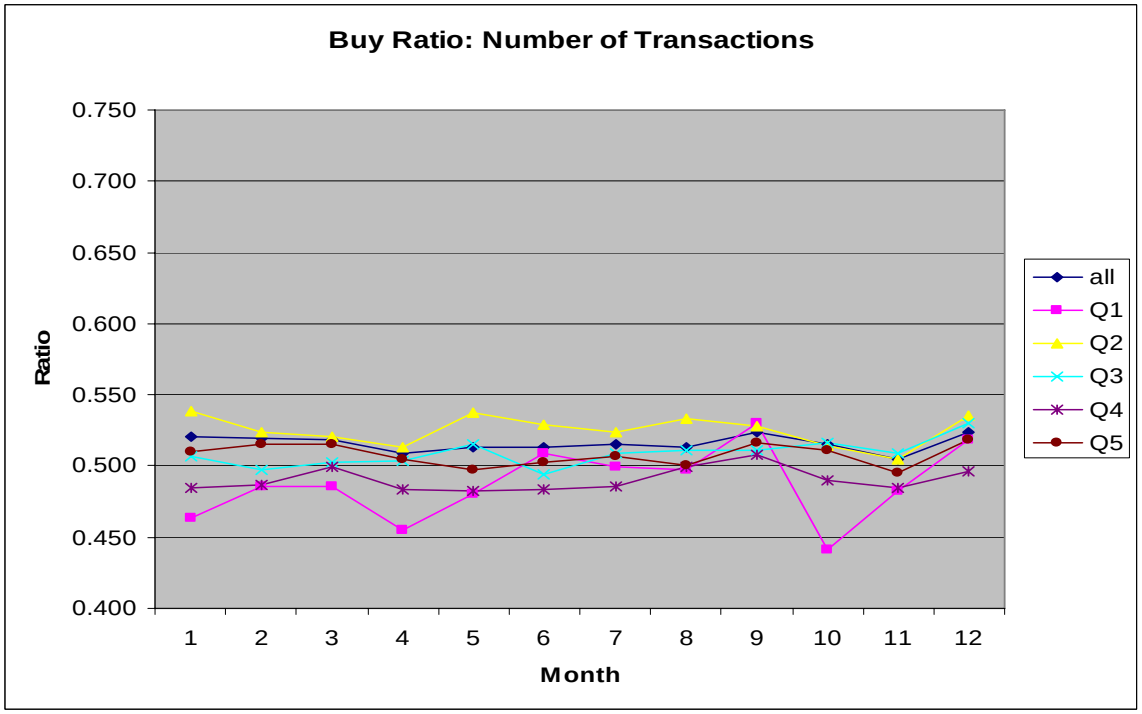
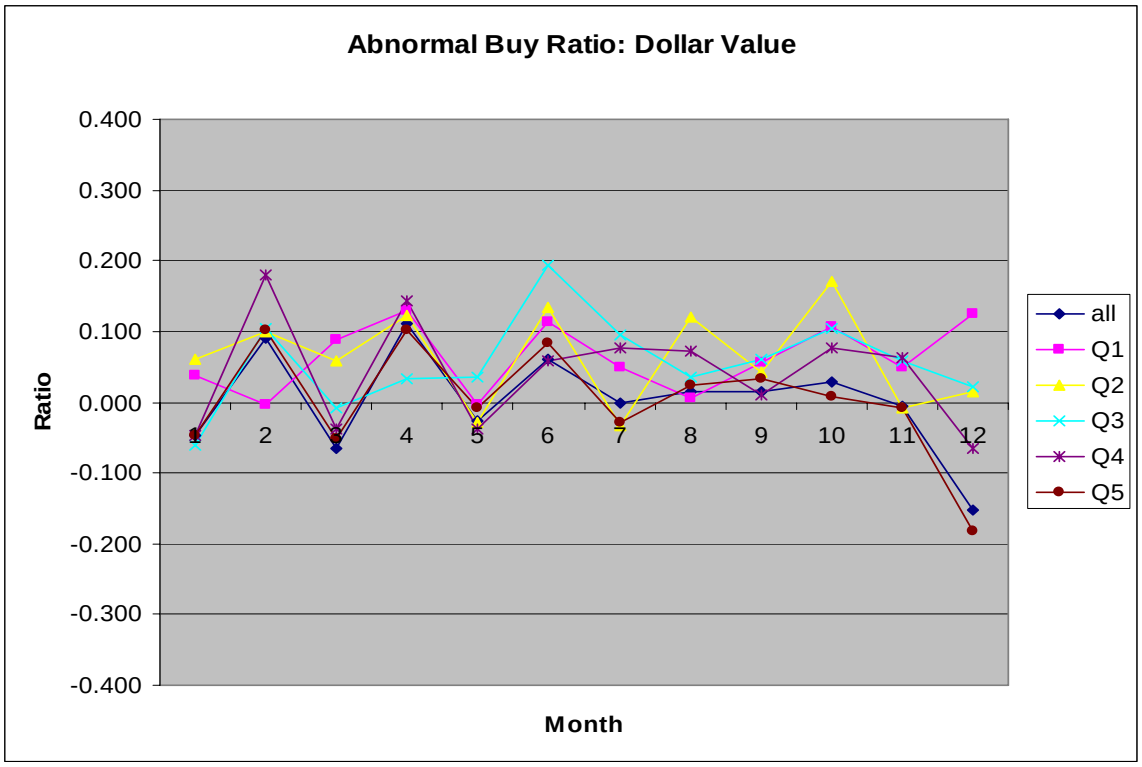
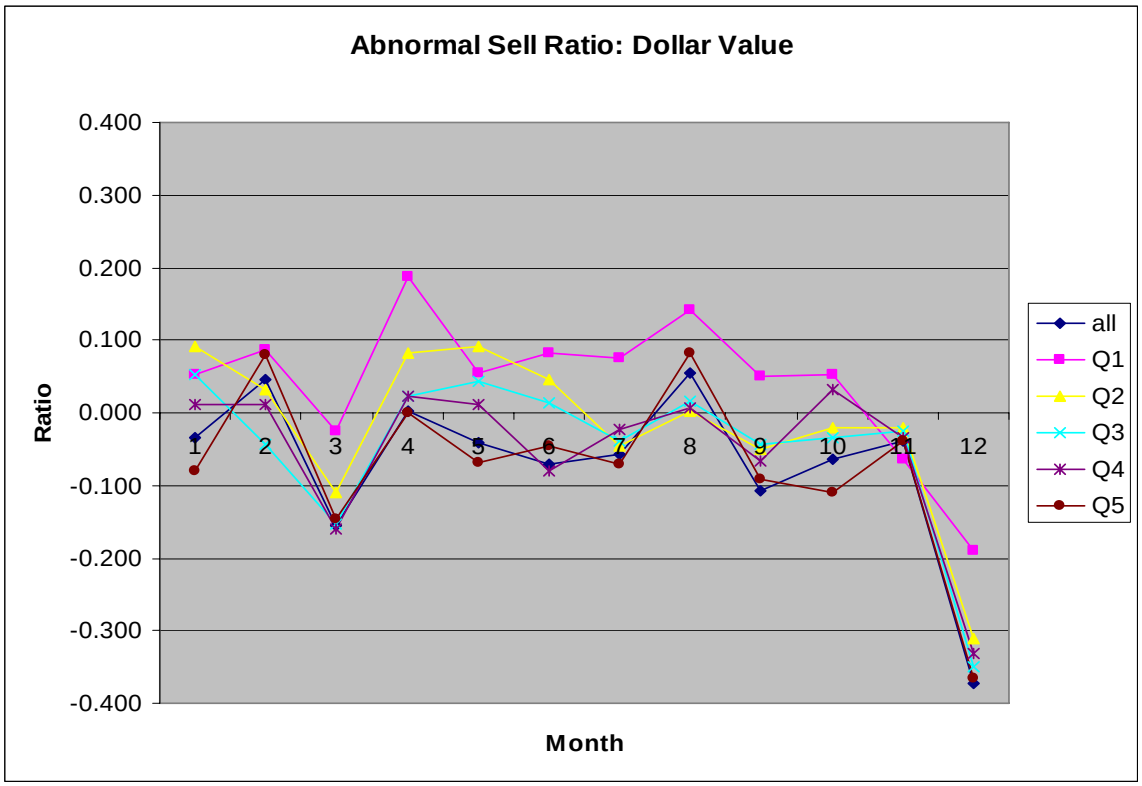

Buy Ratio: Number of Transactions
0.750
0.700
0.650
0.600
0.550
0.500
0.450
0.400
Ratio
1
2
3
4
5
6
7
8
9
10
11
12
Month
all
Q1
Q2
Q3
Q4
Q5

Figure 3: Last Day of Month Trading vs. Last Five Days of Month Trading

The figure depicts the ratio of trading activity of the last day of the month relative to the average trading activity in the last five days of the month. For each institution, we calculate the ratio of buy, sell and total trading in dollar value on last day of month relative to its average trading in the last five days of the month. We then compute the equal weighted ratios across all institutions for each month. The ratios are computed for all stocks in the sample and also separately for stocks in the five size quintiles (Q1 – Q5), and are averaged for the six year sample period. The sample spans from 1999 through 2005, and includes the trades of more than 300 separate institutions in each of the seven years that we study.




Abnormal Sell Ratio: Dollar Value
0.400
0.300
0.200
0.100
0.000
-0.100
-0.200
-0.300
-0.400
Ratio
1
2
3
4
5
6
7
8
9
10
11
12
Month
all
Q1
Q2
Q3
Q4
Q5