# The Rise and Fall of Portfolio Pumping Among U.S. Mutual Funds

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## ABSTRACT

Fund managers have incentives to inflate their quarterly performance through last-minute purchases of stocks they already own. This study identifies two distinct changes in the market environment that reduced those incentives, increased regulatory attention in late 2000 and improved market liquidity following the implementation of Regulation NMS in 2007. Greater attention by regulators raises the likelihood of getting caught, while improved liquidity reduces the price impact of last-minute purchases. Once regulators paid attention to portfolio pumping, the magnitude of last-minute price spikes in mutual fund holdings and in institutional trading around quarter-ends declined; those declines are largest around year-ends. After the implementation of Reg NMS, last-minute price spikes in fund holdings largely disappeared, and institutional trading at quarter-ends declined even further. While Ben-David et al. (2013) and recent SEC actions indicate that some hedge funds still inflate their holdings, the results in this study suggest that regulatory scrutiny and faster markets greatly reduced portfolio pumping among U.S. mutual funds.



JEL Classifications: G18, G23, G28, K22

# I. Introduction

"When does finance help ordinary people and when does it take advantage of them?" asks Luigi Zingales in his 2015 Presidential Address to the American Finance Association. "To separate the wheat from the chaff, we need to identify the rent-seeking components of finance, that is, those activities that while profitable from an individual point of view are not so from a societal point of view." (Zingales, 2015, 1343). One activity that fits Zingales' description of rent-seeking is *portfolio pumping*: By aggressively purchasing additional stocks during the last minutes of the trading quarter, fund managers can temporarily drive up stock prices, disclose inflated portfolio values, and report misleadingly high fund returns. Managers have incentives to do this because better-performing managers attract more investors and receive larger bonuses (Bhattacharyya and Nanda, 2013).

Allegations of deliberate price manipulations around quarter-ends date back decades (Zweig, 1997), and Carhart, Kaniel, Musto, and Reed (2002) argue that the practice is rampant during the mid-1980s and 1990s: CKMR document quarter-end reversals for aggregate mutual fund indices, for individual fund values, and for stocks held by mutual funds. Subsequent studies find similar results for mutual funds in Australia (Gallagher, Gardner, and Swan, 2009), in South Korea (Lee, Baek, and Park, 2014), in China (Shackleton, Yan, and Yao, 2017) and for hedge funds (Agarwal, Gay, and Ling, 2014; Ben-David, Franzoni, Landier, and Moussawi, 2013). Reversals are more pronounced at year-ends and for funds with greater *incentives* to temporarily boost their portfolio values. Yet these studies do not examine actual *trades* of mutual fund managers.

The first paper to examine aggregate daily trading of large institutional investors covered by *Ancerno* between 1999 and 2010 is Hu, McLean, Pontiff, and Wang (2014). If mutual fund managers drive up stock prices at the end of reporting periods, the spikes in their holdings should be caused by spikes in last-minute stock purchases at quarter-ends, and by even more pronounced surges in last-minute purchases at year-ends. Yet Hu et al. (2014) find that aggregate daily purchases of *Ancerno's* clients stay the same at quarter-ends and actually *decline* at year-ends. Institutional investors are also reluctant to sell stocks at quarter-ends, presumably to avoid downward price pressure on their holdings. Hu et al. (2014) point out that this reduction in liquidity can amplify the price impact of last-minute purchases by other market participants. Large institutional investors might contribute to price spikes in fund holdings not through last-minute purchases, but through depressed selling.

In this study, we identify two distinct events that reduce managers' incentives to engage in portfolio pumping. We hypothesize that these events reduce the magnitude of quarter-end price spikes in aggregate mutual fund indices, individual fund values, and fund holdings as well as last-minute purchases by institutional investors. The first event is increased *regulatory attention* after the release of CKMR's study in late 2000, and the second is the implementation of *Reg NMS* in 2007. We expect that both events decrease those incentives, albeit through different mechanisms: Heightened regulatory attention reduces pumping incentives by raising the likelihood of getting caught and fined, while improved market quality reduces incentives since it lowers the expected price impact of last-minute trading. Consequently, we examine the three different periods that surround these two events. The initial period cor-

responds to CKMR's sample and extends until the third quarter of 2000, the middle period captures the increased regulatory attention that resulted from CKMR's release (2000Q4 – 2007), and the last period reflects the full implementation of Reg NMS (2008 – 2011).

During the initial period, when portfolio pumping evades regulatory attention, we find price spikes in daily Lipper mutual fund indices that mirror those reported by CKMR. These spikes are pronounced among small cap growth funds, which increase, on average, by 0.84% at quarter-ends, and by 1.76% at year-ends. Aggregate institutional trading imbalances also indicate last-minute spikes during the early period: Abnormal institutional stock purchases are 92.78% higher in the last thirty minutes of trading in 1999, and are 57% higher, on average, at other quarter-ends in 1999 and 2000. While institutional trading records indicate intraday surges in abnormal buying prior to increased regulatory attention, this finding needs to be interpreted cautiously because *Ancerno's* time stamps are frequently inaccurate. Yet taken together, data from a variety of different sources suggest that last-minute purchases by mutual fund managers are a likely cause for the widespread end-of-quarter price spikes in mutual fund NAVs before regulatory attention increased in late 2000.

Between the fourth quarter of 2000 and 2007, none of the Lipper indices spike at year-end, but evidence of price spikes at other quarter-ends does not completely vanish: Abnormal institutional buying decreased from 57% to 12%, and quarter-end spikes in the small-cap growth index dropped from 0.84% to 0.55%. Once Reg NMS increases competition and improves market quality in 2007, we show that Lipper indices no longer spike and that abnormal institutional buying is negative at quarter-ends.

Our study provides several insights. First, it identifies two events that reduce managers' incentives to inflate their quarterly holdings, increased attention by regulators from late 2000 onward, and improved market liquidity following the implementation of Regulation NMS in 2007. Greater regulatory attention increases the likelihood of fines and reputational demage, thereby raising the *cost* of pumping. Improved liquidity reduces the price impact of last-minute purchases, and hence, lowers the *benefits* from pumping. Second, it shows that the magnitudes of last-minute spikes in mutual fund values, in fund holdings, and in institutional trading decline once regulators watch out for portfolio pumping. Declines around year-ends are larger than around quarter-ends. Third, last-minute spikes largely disappear after the implementation of Regulation NMS. Regulatory scrutiny and faster markets appear to have drastically decreased fund managers' portfolio pumping since the turn of the millennium.

This finding contributes to a growing literature that examines the impact of regulatory attention in financial markets. Christie, Harris, and Schultz (1994) record a sharp increase in Nasdaq dealers' use of odd-eighth quotes once the Justice Department had confirmed its investigation into possible antitrust violations; Kedia and Rajgopal (2011) show that the SEC is more likely to investigate firms located closer to its offices; Cohen, Malloy, and Pomorski (2012) document that opportunistic insiders reduce their trading following waves of SEC insider trading enforcement; and Del Guercio, Odders-White, and Ready (2017) link insider trading enforcement to SEC budgets. We use the release of CKMR's study as an instrument and document that increased regulatory enforcement of portfolio pumping sharply reduced last-minute abnormal institutional purchases and price spikes in mutual fund NAVs.

Regulatory attention is not the only reason why systematic evidence of portfolio pumping has disappeared among U.S. mutual funds. Improved market liquidity following the implementation of Reg NMS in 2007 seems to further reduce the price impact of last-minute stock purchases. Angel, Harris, and Spatt (2011, 2015) document that the traditional measures of market quality, such as execution speed, bid-ask spreads, and transactions costs, all improve dramatically due to the growth in electronic trading. Hendershott and Moulton (2011) show that implementing the NYSE's Hybrid Market, with increasing automation and fast trading, made prices more efficient. Conversely, Chung and Chuwonganant (2012) claim that Reg NMS has proven to be detrimental to most traders. We are not aware of any other study that examines the effect of Reg NMS on incentives to engage in illicit trading behavior.

# II. Research Design

Economic theory makes several crisp predictions about the costs and benefits of portfolio pumping, the differences in fund managers' ability to temporarily inflate quarter-end closing prices, and the timing of their trades (Bhattacharyya and Nanda, 2013; Bernhardt and Davies, 2009; Ippolito, 1992; Sirri and Tufano, 1998; Khorana, 1996, 2001, among others): Fund managers benefit from inflated holdings because disclosing better performance can lead to larger inflows, higher bonuses, and greater job security for them; incentives are higher for active managers of *better-performing funds* (because of the convex flow-performance relation) and of *younger funds* (since establishing a positive track record is particularly lucrative); managers who invest in *small, illiquid stocks* have more opportunities to generate a sizeable

price impact; stock purchases during the *last minutes of the disclosure period* have the highest price impact; expected costs of portfolio pumping are a function of the likelihood that pumping will get detected and the expected cost due to legal penalties (i.e., injunctive relief, disgorgement of illicit profits, civil lawsuits) and reputational damage.

Despite these detailed theoretical predictions, studying portfolio pumping empirically is challenging because individuals engaged in illicit activities typically hide their trails. As Jacob and Levitt (2003, 871) note:

> "The intellectual exercise associated with uncovering [...] misdeeds differs substantially from the typical economic application in which the research starts with a well-defined measure of the outcome variable (e.g., earnings, economic growth, profits) and then attempts to uncover the determinates of these outcomes. In the case of corruption, there is typically no clear outcome variable, making it necessary for the research to employ nonstandard approaches in generating such a measure."

Since fund managers' motives for trading and their actual trades are unobservable, most studies infer portfolio pumping indirectly from price and volume spikes. CKMR document that these price spikes are widespread, affect aggregate mutual fund indices, and vary cross-sectionally with managers' incentives and opportunities to inflate reported quarterly returns.

An obvious concern is that the documented quarter-end spikes are not actually caused by illicit last-minute trading. The literature advances window dressing and depressed selling as alternative explanations. Sias and Starks (1997), Musto (1997, 1999), He, Ng, and Wang

(2004), Sias (2007), Agarwal, Gay, and Ling (2014), and others document that some managers buy outperforming stocks and sell underperforming stocks prior to quarterly reporting dates to appear as if they held winning stocks throughout the quarter. It is conceivable that quarter-end price and volume spikes in stocks that performed well during the quarter are unintended consequences of this *window dressing* by underperforming fund managers and not due to deliberate price manipulations by fund managers who already own these stocks.[1]

HMPW attribute year-end price spikes to *depressed selling*. Their analysis of daily institutional trading imbalances shows no significant difference between typical days and quarter-end days. On the last day of the year, institutions actually buy and sell *fewer* stocks. At first glance, HMPW's results contradict CKMR's assertion that mutual fund managers temporarily inflate year-end prices through *excess* buying. However, three caveats are in order: First, the sample period between the two different studies barely overlaps. Second, due to noisy *Ancerno* time stamps, HMPW examine aggregate trading at daily frequencies, while theory predicts that pumping occurs primarily in the last minutes of the quarter among funds with specific incentives to inflate closing prices. Third, *Ancerno* aggregates trades by fund family and anonymizes family identities so that researchers cannot link institutional trading to managers' incentives.

In this study, we hypothesize that two events reduce managers' incentives to engage in portfolio pumping. By investigating variations in incentives over time, we mitigate the

[1]Window dressing is indeed most common among poorly performing mutual funds (Agarwal, Gay, and Ling, 2014), while portfolio pumping seems more pronounced among well-performing fund managers who are more likely to hold the well-performing stocks that window dressers buy at quarter-ends.

limitation of *Ancerno's* anonymized, aggregate data, which prevent researchers from linking fund managers' trades to their incentives cross-sectionally. We also develop a fund-level measure of pumping that only considers price spikes during the last thirty minutes of the quarter, and price reversals during the subsequent thirty minutes of the next trading quarter. Similarly, we only attribute excess buying by institutions during the last thirty minutes of the trading quarter to portfolio pumping; it is highly unlikely that window dressers delay their stock purchases until the waning minutes of the trading quarter.[2]

**Event 1: Increased Regulatory Enforcements in the Wake of CKMR**

The first event that raised expected costs of portfolio pumping is CKMR's study. Initially released in June of 1999 under the title "Mutual Fund Returns and Market Microstructure," this paper quickly drew attention from regulators, academics, and practitioners. The authors presented it at the Securities and Exchange Commission (SEC) in spring of 2000, at the Western Finance Association Annual meeting on June 23, 2000 (where a financial economist from the SEC discussed the paper), and at the Academic/Practitioners Conference on Mutual Funds at the Investment Company Institute (ICI) in September of 2000. The ICI is the national association of U.S. investment companies and a major part of that conference focused "on identifying and remedying abusive short-term trading."[3]

While CKMR provide evidence of widespread portfolio pumping in the United States,

[2]Mark Hulbert of MarketWatch points out: "To the extent that lower-ranked funds engage in window dressing, they will spread their cosmetic purchases out over several trading sessions rather than wait to the very last minute, when it is almost guaranteed that they will receive very poor executions on their trades." See *Only their managers know for sure*, MarketWatch, 10/6/2004, www.marketwatch.com/ story/illegal-end-of-quarter-portfolio-pumping. Accessed 6/14/2015.

[3]Investment Company Institute, https://www.ici.org/policy/regulation/compliance/ci.faqs_trading_chron.print

the initial regulatory response occurs in Canada. On June 29, 2000, the Ontario Securities Commission accuses RT Capital, the pension arm of the Royal Bank of Canada, "to intentionally, repeatedly and openly (within RT Capital) effect high-closings of securities on significant month-, quarter-, and year-end dates for the purpose of improving the appearance of portfolio performance"(OSC, 2000b). The Royal Bank takes out full-page ads in major Canadian newspapers on July 14, 2000 to publish an apology signed by its CEO, John E. Cleghorn (AP, 2000) and agrees on June 20, 2000 to pay C$3.08 million in fines. Nine employees were suspended from trading, some of them for life (OSC, 2000a).

A few months later portfolio pumping receives attention from regulators in the United States. Paul Roye, director of the SEC's Investment Management Division, mentions on October 12, 2000 that the SEC had established a task force to study portfolio pumping (McCarty, 2000). The SEC announces on November 27, 2000 that it "has requested trading records from some mutual fund companies as part of a task force investigation into the possibility that funds are engaging in the practice" (Hansard, 2000). The next year, the SEC pursues enforcement actions in cases where phone or written records help establish fund managers' intention to manipulate closing prices: It files fraud charges against a hedge fund manager on June 1, 2001 (SEC, 2001c) and brings charges against ABN AMRO, Oechsle International Advisor, and two of their employees on August 10, 2001, alleging market manipulation and portfolio pumping (SEC, 2001b).

Once the SEC steps up its enforcement efforts against portfolio pumping, the exchanges enhance their trading surveillance systems of orders entered during the closing period

(Markham, 2014). Nasdaq implements closing price auctions in November of 2004 to improve price discovery at closing. Fund companies also tighten their internal controls and implement Compliance Trade Oversight Programs to prevent illicit activities like portfolio pumping. For example, ABN AMRO now requires that a supervisor reviews and approves large orders received for execution in the final thirty minutes of trading. Similarly, Oechsle requires that all equity trades be initiated and monitored by the trading department, and not by portfolio managers. Oechsle also hired additional compliance and trading personnel, upgraded its trading system, and strengthened its compliance program (SEC, 2001a). All these actions deter price inflation through last-minute trading.

**Event 2: Implementation of Reg NMS**

The second event occurs with the implementation of Regulation National Market System (Reg NMS) in 2007. As two SEC Commissioners put it, "[t]he impetus for the Commission's efforts to modernize the securities markets was the outdated Intermarket Trading System ("ITS") trade-through rule that impeded the ability of electronic trading centers to compete against floor-based exchanges in the listed market" (Glassman and Atkins, 2005). In July of 2007, the industry had to fully comply with Rules 610 and 611 for approximately 250 stocks listed on the New York Stock Exchange, Nasdaq, and the American Stock Exchange. Rule 611, known as *order protection rule* or *trade-through rule*, requires market centers to route orders they receive to other markets that have better prices available. Rule 610, known as *access rule*, mandates linkages between the markets that enable the routing of orders to other markets in compliance with Rule 611 (SEC, 2005).

Chester Spatt, the SEC's Chief Economist from 2004–2007, told the House Subcommittee on Capital Markets and Government Sponsored Enterprises on February 28, 2014:

> "In the aftermath of Regulation NMS there is much faster execution due to the preference NMS provided to 'fast markets' as well as greater competition among platforms and more fragmentation of order activity among platforms, as reflected by the decline in the New York Stock Exchange's share of trading in its own listings from about 80% to 20%. We have seen substantial declines in spreads and trading costs."[4]

Automation and trading speed are increasingly important aspects of competition among trading venues. Hendershott and Moulton (2011) use the New York Stock Exchange's introduction of its Hybrid Market to study how increasing automation and speed within a market affect market quality and find that it reduces noise in prices. Angel, Harris, and Spatt (2011, 2015) document that traditional measures of market quality, such as execution speed, bid-ask spreads, and transactions costs, all improved dramatically due to the growth in electronic trading. Anand, Hua, and McCormick (2016) find that net effective spreads decline after NYSE Arca expanded make-take pricing in options on November 1, 2012. These findings suggest that automation, improved market quality and increased competition erode the price impact of portfolio pumping, making it difficult for fund managers to inflate stock prices at quarter-ends.

[4]See http://financialservices.house.gov/calendar/eventsingle‘.aspx?EventID=370440

# III. Data

We use data from multiple sources. *Ancerno* (also known as Abel Noser), a company that monitors equity trading costs for institutional investors, provides transaction-level institutional trading data that cover trade executions for about 400 large institutions. These institutions include Vanguard, Putman Investments, Massachusetts Financial Services, and Lazard Asset Management and account for a substantial fraction of total trading volume in the U.S. stock market.[5] Our sample period spans from January 1999 through December 2011, which is similar to HMPW. We obtain mutual fund characteristics and daily fund net asset values (NAVs) from the *CRSP Mutual Fund Database* and use WRDS's *Mutual Funds Links* to match these data to fund holdings from *Thomson Financial*. Stock prices come from the *Trade and Quote* (TAQ) and the *CRSP* databases, Lipper fund indices from *Morningstar*, and *Datastream* provides additional daily NAVs.

To avoid cross-sectional dependence from regression analysis on the fund share-class level, we aggregate all observations to the fund level by using CRSP portfolio identifiers.[6] Fund level assets are the *sum* of share-class level assets, while fund level expense and turnover ratios are calculated as *value-weighted averages* of the share-class level ratios. We restrict our analysis to domestic equity funds, exclude index and sector funds, small funds with assets below $5 million and funds that invest less than 50% of their assets in stocks. We classify funds as Aggressive Growth, Growth, Growth and Income, or Small Stocks.

[5]Hu, Jo, Wang, and Xie (2018) provide an excellent description of the *Ancerno* database and survey the growing academic literature that uses it.

[6]The CRSP portfolio identifiers are available from 2003 onwards. For funds that exit the database prior to 2003, we rely on fund names to aggregate share classes to the fund level.

# IV. Empirical Results

## *A.* Excess Returns of Lipper Indices around Quarter-Ends

We hypothesize that quarter-end NAV spikes occur most prominently during times when regulators show little concern about portfolio pumping, that increased regulatory attention reduces these spikes, and that the implementation of Reg NMS further diminishes them. Our first set of tests replicates and extends CKMR's analysis of daily Lipper indices. These Lipper mutual fund indices correspond to the *Morningstar Style Box*, a nine-square grid that categorizes equity mutual funds according to the concentration of their stock holdings. One style dimension classifies fund holdings by market capitalization, while the other dimension considers value and growth characteristics.

We follow CKMR by regressing daily fund index returns net of the S&P 500 on six indicator variables:

$$R_{i,t} = b_{i,1}YEND_t + b_{i,2}YBEG_t + b_{i,3}QEND_t + b_{i,4}QBEG_t + b_{i,5}MEND_t + b_{i,6}MBEG_t + e_{i,t} \tag{1}$$

$R_{i,t}$ denotes the daily excess return of style index $i$ on day $t$, and $YEND_t$ equals to one only on the last day of each year, and equals zero otherwise. Similarly, $QEND_t$ denotes the last day of each calendar quarter that is not a year-end, and $MEND_t$ denotes the last day of each month that is not a quarter-end. The variables $YBEG_t$, $QBEG_t$, and $MBEG_t$ are defined analogously, except that they indicate the first day of the period. CKMR document significantly positive coefficients on $YEND_t$ and $QEND_t$, significantly negative coefficients

on $YBEG_t$, and $QBEG_t$, and greater economic magnitudes for year-end coefficients compared to quarter-end coefficients.

To investigate whether aggregate return reversals diminish as regulatory attention increases and as Reg NMS mandates faster markets, we examine the three different time periods described previously. The first column of Table I transcribes the results from CKMR, which cover the time period from July 14, 1992 through July 7, 2000. The column titled *1992–2000* displays our replication of that result for the period from July 14, 1992 through the third quarter of 2000, when portfolio pumping largely escaped regulatory attention. The column titled *2001–2007* shows results for the middle period with heightened regulatory attention, yet prior to the full implementation of Reg NMS. The last column, titled *2008–2011*, covers the last time period from January 1, 2007 through December 31, 2011, when regulatory attention remains high and fast markets further reduce its price impact.

Before the SEC increased regulatory attention in late 2000, we find price changes in daily Lipper mutual fund indices that closely mirror those reported by CKMR. All nine indices show significant spikes at year-end, and all but the large cap value index show significant spikes at quarter-ends. These spikes are most pronounced among small cap growth funds, which increase, on average, by 0.84% at quarter-ends, and by 1.76% at year-ends. Mutual fund index returns are negative, on average, on the first day of the year, and on the first day of each quarter.

From 2001 through 2007, the period of increased regulatory attention, but prior to Reg NMS, none of nine indices show significant increases at year-end. In contrast, quarter-end

price spikes are still positive, although the economic magnitude decreased by about one-third for the small cap indices, where the spikes are largest. From 2008 onward, after the implementation of Reg NMS, mutual fund indices exhibit neither year-end nor quarter-end spikes. In the next section we investigate whether institutional trading records show a similar pattern.

## *B.* Institutional Trading at Quarter-ends

Abnormal institutional buying at quarter-ends should occurs when regulators show little concern about portfolio pumping, this buying should reduce in response to increased regulatory attention, and should further diminish after the full implementation of Reg NMS. To test this hypothesis using *Ancerno* data, we follow HMPW and calculate daily averages of institution abnormal buying, which is the dollar value of buys on day t minus the average dollar value of buys over days t to t-4, all scaled by the average dollar value of buys over days t to t-4. We regress the daily averages on YEND, a dummy variable indicating the last trading day of the year, QEND, a dummy variable for last trading day of a calendar quarter other than the last, and other controls. We report separate results for the three sub-periods: from 1999 to the end of the third quarter of 2000, from the fourth quarter of 2000 to 2007, and from 2008 to 2010 in Table II. Like HMPW, we find negative coefficients for YEND, indicating a lower level of buying on year-end dates. The coefficients for QEND are significantly positive for the first two sub-periods; the magnitude declines over time, and becomes insignificant in the years after 2007. This pattern is consistent with our earlier

results using Lipper Indices.

After investigating whether institutions in aggregate purchase more stocks at quarter-ends, we next test sharper predictions by asking whether institutions purchase more stocks *during the last minutes of the quarter* in periods *when regulators seem unconcerned about portfolio pumping*. We use *Ancerno's* execution time stamps to aggregate the dollar value of each fund's stock purchases into thirty-minute time intervals ($T$). For each interval and each fund, we calculate the average dollar value over the quarter. Similar to HMPW's daily measure, our intraday measure of abnormal buying for time interval $T$ is the dollar values of buys scaled by the average dollar value in time interval $T$ over the quarter. Abnormal selling is calculated analogously. As Anand, Irvine, Puckett, and Venkataraman (2013) point out on page 586, *Ancerno* time stamps are very noisy. Prior to 2005, more than half of the trades recorded in the *Ancerno* database were placed at closing. After 2005, that fraction drops, while the proportion of trades executed after the market closed increases. It is important to remain cognizant of *Ancerno's* data limitations when drawing conclusions from our intraday analysis.

With that caveat in mind, the top half of Table III shows results from regressions where the dependent variable is daily abnormal buying (*Abnormal Buy*) for each of the thirty-minute intraday intervals. The bottom half shows results for daily abnormal selling (*Abnormal Sell*). Two indicator variables denote quarter-ends (*Q-End*) and year-ends (*Y-End*). Since stock markets closed three hours early on December 31, 1999, we report the year-end results of the 1999–2000 period at 1:00 p.m. instead of 4:00 p.m.

For the *1999–2000* period of the sample, when regulators paid little attention to portfolio pumping, the quarter-end coefficient in the last thirty-minute regression indicates that abnormal institutional buying was 57.12% higher than usual during the last half-hour. Abnormal selling also increased by almost 37%. CKMR report that year-end spikes in fund NAVs are particularly pronounced. Consistent with their results, the year-end coefficient in the last thirty-minute regression shows that abnormal institutional buying spiked by a whopping 92.78% during the last half-hour of trading in 1999. Abnormal selling, in contrast, decreased by 25% and is not statistically significant.

From the fourth quarter of 2000 through 2007, after regulatory attention increased sharply, year-end institutional abnormal buying *decreased* by 23.7%, and abnormal selling decreased by 48.83%. In contrast, institutional abnormal buying during the last half hour of the quarter still spikes by 12%. From 2008 through 2011, once Reg NMS is effective, abnormal buying at quarter-ends is 12% less than typical trading days, and abnormal buying at year-ends is 72% lower.

As predicted, price spikes in mutual fund indices and last-minute institutional buying at year-ends both disappear after regulators begin pursuing portfolio pumping in late 2000. Interestingly, aggregate price spikes and excess institutional buying still occurs at quarter-ends until the implementation of Reg NMS. From 2008 onward, neither institutional trading records nor mutual fund indices show any evidence consistent with portfolio pumping.

## *C.* Evidence from Cross-sectional NAV Reversals of Mutual Funds

Increased regulatory scrutiny should not affect all mutual funds equally. Evidence of pumping is particularly pronounced for the best-performing mutual funds and for funds that invest in small, less liquid stocks, according to CKMR. As a result, we expect regulators to focus their attention on these funds, and portfolio pumping should therefore decrease more among well-performing and small-cap funds. Unfortunately, we cannot test these cross-sectional hypotheses by analyzing institutional trading imbalances because *Ancerno* aggregates trades by fund family and anonymizes family identities. Instead, we investigate whether the decrease in quarter-end price reversal is more pronounced for funds that are more likely to invite scrutiny.

In November of 2000, regulators state publicly what attracts their attention: "We are looking for funds that have changes in net asset values (NAV) at the end of a quarterly reporting season that would indicate portfolio pumping," says Lori Richards, the SEC's director of the Office of Compliance, Inspections and Examinations (Labate and Wine, 2000). To examine month, quarter, and year-end changes in NAVs, CKMR use a regression specification with six indicator variables. Bernhardt and Davies (2005) measure fund-level return reversals as the difference between the fund's quarter-end return and its return the following trading day divided by 2. Both approaches attribute the entire price movement over two trading days to portfolio pumping, raising the concern that part of the documented economic effect might be due to window dressing.

We address this worry by developing a conservative measure that focuses only on the

thirty minutes surrounding quarter-ends. Specifically, we measure return reversal for fund $f$ at quarter-end $q$ as the difference between the last thirty-minute quarter-end return, $r^f_{t,L30}$, and the return of the first thirty minutes of the following trading day, $r^f_{t+1,F30}$, divided by 2:

$$\text{Return Reversal}^f_q = \frac{r^f_{t,L30} - r^f_{t+1,F30}}{2} \tag{2}$$

For example, if a fund's NAV increased by 65 basis points in the last thirty minutes of the quarter and dropped by 55 basis points in the first thirty minutes the following day, the return reversal measure will yield 60 basis points. A fund's thirty-minute return is calculated as the weighted average of stocks' corresponding thirty-minute returns.

Our multivariate fund-level analysis has three chief advantages. First, it uses a conservative measure of portfolio pumping that only considers intraday price movements within thirty minutes of the quarter-end. Second, it allows us to investigate whether the economic magnitude of fund NAV changes varies significantly across the three different time periods identified earlier. And finally, this approach controls for fund characteristics such as fund size, fund expenses, portfolio turnover, fund age, and investment style.

We first investigate whether this approach yields comparable results to the aggregate evidence based on Lipper indices. To do this we create two indicator variables: The variable *P-1993-2000* equals one during the initial period from 1993 through 2000Q3, when portfolio pumping evades regulatory attention, and the variable *P-2008-2011* equals one during the last period when Reg NMS is fully implemented.

The positive coefficient on the *P-1993-2000* indicator in Model 1 of Table IV shows that intraday quarterly return reversals are, on average, 18.6 basis points higher during the initial period when compared to the middle period. And the negative coefficient on the *P-2008-2011* indicator suggests that return reversals decreased by an additional 23.6 basis points after Reg NMS took effect. Return reversals are greater for larger and older funds with higher expenses and higher portfolio turnover.

Managers of small-cap funds, which invest in less liquid stocks, have more opportunities to inflate their holdings through last-minute trading. If small-cap funds attract greater regulatory attention, we should see a more pronounced reduction in this investment category. In Model 2 of Table IV, we include the interaction term between the indicator denoting small-cap funds and the two indicator variables *P-1993-2000* and *P-2008-2011* (*SmallCap* $\times$ *P-1993-2000* and *SmallCap* $\times$ *P-2008-2011*) to examine return reversal over time among small-cap funds. The coefficient for the interaction term *SmallCap* $\times$ *P-1993-2000* is significantly positive, showing that intraday quarterly return reversals were, on average, 24.7 basis points higher when portfolio pumping initially evades regulatory scrutiny. The negative coefficient on the *SmallCap* $\times$ *P-2008-2011* interaction term indicates that return reversals decrease by an additional 8.5 basis points once Reg NMS is implemented.

Fund managers with the best performance have greater incentives to pump their portfolios in order to receive bigger bonuses and to benefit from the convex flow-performance relation (Ippolito, 1992; Sirri and Tufano, 1998; CKMR; Bhattacharyya and Nanda, 2013). To investigate whether top-performing funds show a greater reduction in portfolio pumping, we

specify an indicator variable, *Top Perf*, that equals one if the fund's relative past performance is in the top 20%, and interact this indicator with the two period indicators (*Top Perf* $\times$ *P-1993-2000* and *Top Perf* $\times$ *P-2008-2011*). We measure past performance over eleven months and skip the last month of the quarter. The coefficient for the interaction term *Top Perf* $\times$ *P-1993-2000* in Model 3 shows that intraday quarterly return reversals for top-performing funds were 5.4 basis points higher during the initial period. While return reversals for small-cap funds decreased even faster after the implementation of Reg NMS, the decrease for top performers was no different from other funds.

Several studies debate the role of Active Share, the fraction of all fund holdings that deviate from the fund's benchmark: Cremers and Petajisto (2009) and Petajisto (2013) document that funds with high Active Share outperform their benchmarks and recommend that investors select the most active funds. In contrast, Schlanger, Philips, and LaBarge (2012) and Frazzini, Friedman, and Pomorski (2016) do not find a link between Active Share and fund performance. We investigate whether more active mutual fund managers engage in more portfolio pumping and whether regulatory attention leads to a greater decrease in pumping among more active managers.[7] Our results in Model 4 in Table IV show a positive correlation between Active Share and intraday quarterly return reversals. The interaction effect, however, is insignificantly different from zero.

Overall, Table IV documents *time series* pattern in fund-level return reversals similar

[7]We thank Martjin Cremers and Antti Petajisto for posting the data at www.petajisto.net. Since the Active Share measure is only available until 2009, we limit our analysis in Model 4 to the regulatory attention shock.

to those in Lipper fund indices and in institutional trading imbalances. Return reversals decrease once regulators focus on portfolio pumping, and decline even further after the implementation of Reg NMS. Table IV also shows *cross-sectional* heterogeneity in portfolio pumping as predicted by economic theory. Pumping is more pronounced among smaller, better-performing funds with higher Active Share.

## *D.* Stock Return Reversals and Fund Holdings by Time Period

Stocks held by the best-performing mutual funds exhibit greater return reversals than stocks matched on size and recent performance, according to CKMR. They conclude: "Because we observe this abnormal performance in the specific holdings of top equity mutual funds, the evidence strongly suggests marking-up activity by mutual fund managers" (CKMR, 688). If regulatory attention discourages fund managers from inflating their holdings after 2000, and Reg NMS further limits their ability to mark up closing prices after 2007, we expect the relation between mutual fund holdings and stock-level return reversals to weaken in response. In this section we test that prediction.

CKMR measure return reversals as last day's stock return minus next day's stock return to capture both the initial rise and the subsequent fall caused by end-of-period marking up. To be conservative, we only consider intraday price movements within thirty minutes of the quarter-end to calculate return reversals. The dependent variable for our models in Table V is therefore $[r_t - r_{t+1})]/2$, where $r_t$ is the return for last thirty minutes of the quarter and $r_{t+1}$ is the return for the first thirty minutes of the next trading quarter.

To investigate whether the link between stock-level return reversals and mutual fund holdings weakens in response to increased regulatory attention and, even further, after the implementation of Reg NMS, we include *Fund Hold*, the fraction of outstanding shares held by all mutual funds disclosed in 13f filings, and also interact it with the two indicator variables that denote the first and last period of our sample. Following CKMR we control for size and past performance: The variable *size* is the stock's market capitalization in billion dollars, and *quarterly return* denotes the stock return until the penultimate day of the quarter. In addition, liquidity and volatility might also impact the magnitude of stock-level return reversals. Our four liquidity measures include *Non S&P500*, indicating that the stock is not part of the S&P 500 index, an indicator if the stock is traded on the *Nasdaq* stock exchange, the *number of market makers* and the *average daily volume*, which is normalized by total shares outstanding. We measure volatility as the *standard deviation of daily returns* in percent, which is calculated by excluding the five days surrounding the quarter-end, and also include industry and quarter dummies in our regression specification.

Table V shows that the interaction term *P-1993-2000* $\times$ *Fund Hold* is positive and significant, indicating that return reversals for stocks that are widely held by mutual funds are significantly higher in the early sample period when portfolio pumping largely escaped regulatory scrutiny. In contrast, the interaction term *P-2008-2011* $\times$ *Fund Hold* is significantly negative, suggesting that portfolio pumping among those stocks further reduced after the implementation of Reg NMS. The SEC states in its adopting release that this regulation aims to reduce the price impact of large orders by increasing market depth and liquidity

(SEC, 2005). Consistent with that objective, Angel, Harris, and Spatt (2011, 2015) find that the rise in electronic trading increases liquidity, which reduces the price impact of trades. After Reg NMS, marking up stock prices requires larger last-minute buy orders, which increases direct trading costs, distorts optimal portfolio balances, and attracts attention from compliance officers, stock exchanges, and regulators.

Bollen and Pool (2009), Agarwal, Daniel, and Naik (2011), and Ben-David, Franzoni, Landier, and Moussawi (2013) find that hedge funds manipulate their period-end returns. This raises the possibility that institutional investors other than mutual funds drive our results. To investigate this concern, we replace mutual fund holdings with other institutional holdings, again obtained from 13f filings. Similar to our results for mutual fund holdings, Model 2 shows that the interaction term, *P-1993-2000* $\times$ *Other Inst. Hold*, is also positive and significant, while the other interaction term, *P-2008-2011* $\times$ *Other Inst. Hold*, is negative and significant.

In Model 3, we include mutual fund holdings and other institutional holdings, and interact both variables with indicators that denote the first and last period of our sample. All interaction terms maintain their economic and statistical significance, suggesting that regulatory attention and faster markets reduced the price impact of portfolio pumping among mutual funds as well as among other institutional investors. Across all three specifications the coefficients on the control variables show that return reversals are more pronounced for stocks that are not part of the S&P 500, stocks that are traded on Nasdaq, smaller stocks, more volatile stocks, and stocks with fewer market makers.

CKMR are first in linking the magnitude of stock-level return reversals to the fraction of shares held by mutual funds. We confirm their findings with a conservative measure of stock return reversals and advance their results by showing that subsequent regulatory scrutiny and Reg NMS significantly weakened the relation between fund holdings and return reversals.

## *E.* Stock Trading Volume at Period-End Days

In this section, we investigate intraday stock trading volume at period-ends and examine whether it changes in response to intensified focus on portfolio pumping in late 2000 or after the implementation of Reg NMS. First, we replicate CKMR's Figure 4 titled "Trading volume on period-end days relative to neighboring non-period-end days" to examine *aggregate* intraday stock trading volume. To do so, we count the total number of trades for each minute of year-, quarter-, and month-end days and calculate minute-by-minute abnormal trading by dividing the number of trades for those period-end days by the average number of trades for the corresponding minute in non-month-end days over the surrounding year (and by subtracting one).

Figure 1 shows a sharp increase in abnormal trading during the last thirty minutes of quarter- and year-ends for both CKMR's sample period (1993–1998) and the period (1993–2000) that precedes regulatory attention. Consistent with CKMR's findings, abnormal trading is higher for year- and quarter-ends than for month-ends. In the bottom half of Figure 1, we plot the abnormal trading activity for the 2001–2007 and 2008–2011 sub-periods. Consistent with HMPW's findings, abnormal trading activity for year-ends is negative for most of

the day, and is constantly below that of month- and quarter-ends. This effect is particularly pronounced for the last period of our sample. Interestingly, aggregate last-minute trading trends *upwards* for month-, quarter-, and year-ends in all sub-periods.

Next, we examine inter-temporal buying volumes of funds in *Ancerno* data on period-end days. The dependent variable is abnormal buying, which is the dollar values of buys on the last day of each quarter scaled by the average daily dollar value over the quarter. Results are reported in Table VI. Results in Models 1 through Model 3 confirm our earlier findings in Table III: portfolio pumping was significantly higher in the initial period, *P-1993-2000*, and further decreased after the the implementation of Reg NMS, *P-2008-2011*. In Model 3, the coefficient for Year End is negative and significant, indicating that over the entire sample, abnormal buying is less in year-end days compared to quarter-end days.

Because *Ancerno* anonymizes its data, fund characteristics are unobservable. We do, however, include the rank of a fund's quarterly dollar trading volume and the number of funds in the fund family in our analysis. The significantly positive coefficient in Model 1 on quarterly dollar trading volume, *Quintile $ Volume*, is consistent with our earlier results in Table IV that portfolio pumping is more pronounced for funds with larger size and higher turnover. Model 2 shows that funds in large families exhibit more pumping behavior, presumably because larger fund families have more funds and probably face more competition. Overall, the patterns of trading volume at quarter-ends at fund level provide further evidence that regulatory attention deterred some funds from pumping, and that Reg NMS further reduced pumping incentives.

# V. Conclusion

Managers of active equity mutual funds hold over $12.5 trillion in assets (ICI, 2018, 249). The incentives they face and the actions they take affect the financial security of millions. It is therefore disconcerting that fund managers can benefit from driving up the values of their existing holdings by purchasing additional stocks at quarter-ends. This practice, known as portfolio pumping, allows them to disclose misleadingly high returns to attract additional investors, and ultimately, higher fees. Researchers, investors and regulators need to thoroughly understand what circumstances mitigate or exacerbate portfolio pumping if they want to keep this manipulative rent seeking behavior at bay.

In this study, we hypothesize that two events reduce managers' incentives to engage in portfolio pumping. Greater regulatory attention after the release of CKMR's study in late 2000 raises expected costs of last-minute price inflation, and the implementation of Reg NMS in 2007 lowers the expected price impact of last-minute trading. CKMR and HMPW mostly analyze *aggregate daily* returns and trading. We construct *institution-specific intraday* measures of portfolio pumping for mutual funds, large institutional traders, and stocks held by mutual funds and use these measures to investigate how fund managers respond to increased regulatory attention and to Reg NMS.

We document significant time-series variation in the pervasiveness of portfolio pumping. Prior to the release of CKMR, we find comprehensive evidence of portfolio pumping. *All nine* daily Lipper mutual fund indices increase significantly at year-ends, and all execept the large cap value index increase at quarter-ends. For example, small cap indices increase between

1.48% and 1.76% at year-ends, and between 0.61% and 0.84% at quarter-ends. Abnormal institutional stock purchases are 92% higher in the last half-hour of trading in 1999, and are, on average, 57% higher at other quarter-ends in 1999 and 2000. Once regulators pay attention in late 2000, *none* of the Lipper indices differ significantly from zero at year-ends. At quarter-ends, however, they still significantly increase, albeit not as much as before. To illustrate, small cap indices increase, on average, between 0.4% and 0.55% during quarter-ends between 2001 and 2007. Instiutional stock purchases during this period are consistent with this pattern. While abnormal purchases are, on average, 24% lower in the half-hour preceeding year-ends, they are 12% higher in the half-hour ahead of quarter-ends. After Reg NMS is fully implemented in 2007, none of the Lipper indices spike at year- or quarter-ends, and last-minute abnormal institutional stock purchases decline sharply.

Imagine an accident-prone intersection where some motorists run red lights. Installing traffic cameras reduces red-light violations, but does not eliminate them; replacing the traffic signal with a roundabout does. It appears that something similar happened to portfolio pumping in the United States: The initial regulatory response to CKMR's study was increased enforcement, which reduced portfolio pumping, but did not eliminate it; faster markets in the wake of Regulation NMS did. In his 2015 Presidential Address to the American Finance Association, Luigi Zingales encourages a greater emphasis on "improprieties in the financial industry," noting that "our primary contribution as researchers is to expose ... distortions, to act as whistleblowers" (Zingales, 2015). Our study provides evidence that CKMR were right in blowing the whistle on portfolio pumping, and that regulators listened.

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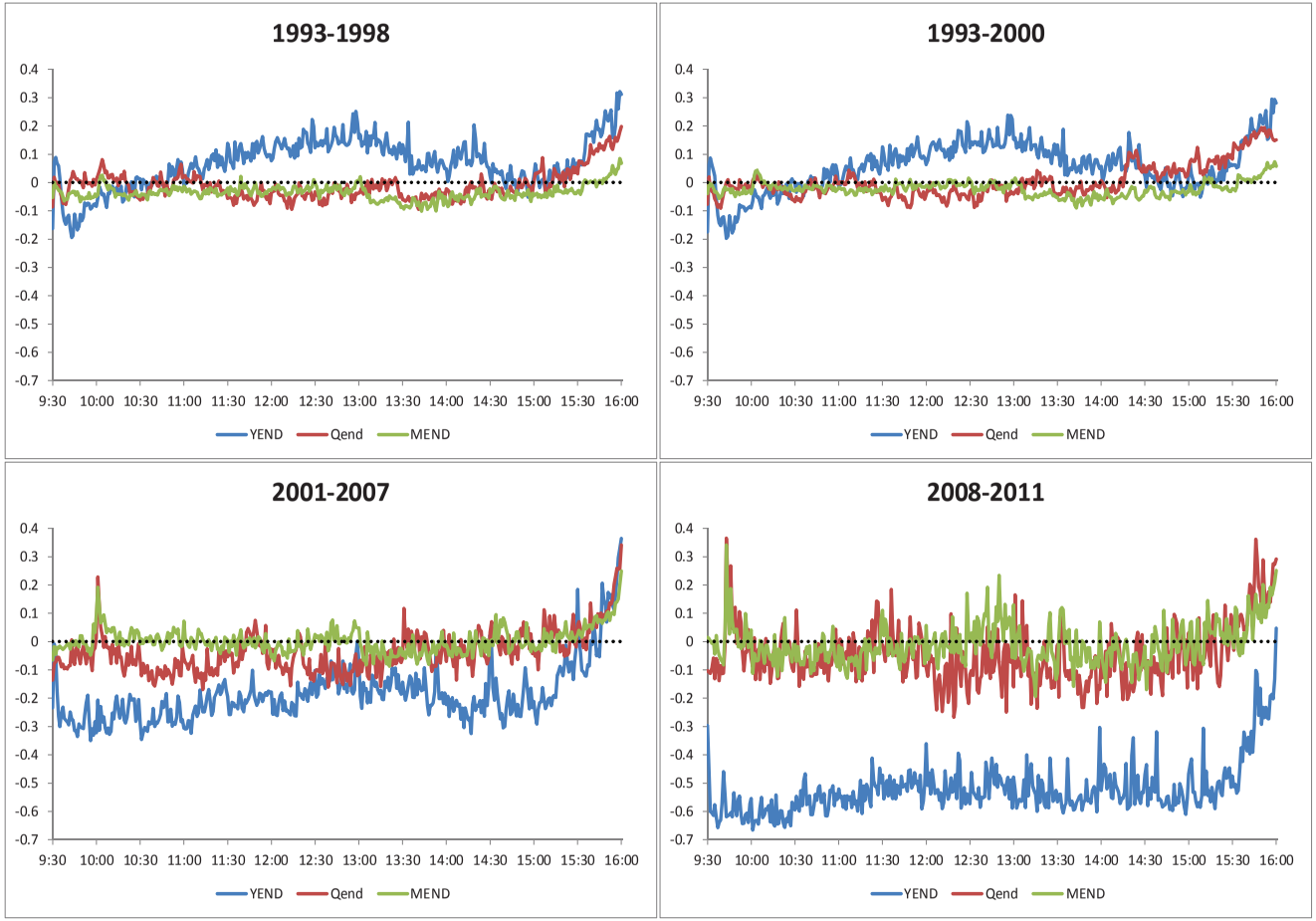
## Figure 1

## Intraday Abnormal Trading Volume on Period-end Days

The top left figure is the replication of Carhart et al. (2002) and the top right is for the 1993 to third quarter of 2000 period. The two figures on the bottom are for periods from the fourth quarter of 2000 to 2007 and from 2008 to 2011. YEnd, QEnd, and MEnd are the average by minute abnormal volume for year-end, quarter-end, and month-end dates, respectively. By minute abnormal volume is calculated as the number of trades in each minute divided by the average number of trades in the same minute for all non-month-end days of the surrounding year (6 month before and 6 month after).



## Table I

## Excess Returns of Lipper Indices around Quarter-ends

This table reports excess returns in basis points of nine Lipper mutual fund indices on quarter-end days. We follow Carhart et al. (2002) by regressing excess returns (net of S&P500) of the nine indices on six dummy variables: YEND (last trading day of the the year), YBEG (first trading day of the year), QEND (last trading day of a calendar quarter other than the first), QBEG (first trading day of a calendar quarter other than the first), MEND (last of a month but not the last of a quarter), and MBEG (first of a month but not the first of a quarter). Coefficients YEND/YBEG are reported under Turn of Years and QEND/QBEG are reported under Turn of Calendar Quarters Other than Fourth. Column CKMR are results from Carhart et al. (2002), which is for the period of 14/7/1992 – 7/7/2000. Columns 1992-2000, 2001-2007, and 2008 report results for the period from 14/7/1992 to the end of the third quarter of 2000, from the fourth quarter of 2000 to 2007, and from 2008 to 2011, respectively. We group the indices into Small Cap, Mid Cap, and Large Cap and use ** and * to denote statistical significance at the 5 percent and 10 percent level, respectively.

| | Small Cap | | | |
|---|---|---|---|---|
| | **CKMR** | **1992-2000** | **2001-2007** | **2008-2011** |
| **Turn of Years** | | | | |
| **Value** | 141**/-30 | 148**/-41* | -5/-22 | 19/-19 |
| **Core** | 153**/-53** | 160**/-54** | -15/-50** | 20/-9 |
| **Growth** | 174**/-96** | 176**/-95** | -23/-90** | 19/-9 |
| **Turn of Calendar Quarters Other than Fourth** | | | | |
| **Value** | 59**/-33** | 61**/-29** | 40**/-30** | -28/-19 |
| **Core** | 71**/-52** | 68**/-45** | 47**/-41** | -24/-28 |
| **Growth** | 87**/-83** | 84**/-78** | 55**/-61** | -26/-47** |

| | Mid Cap | | | |
|---|---|---|---|---|
| | **CKMR** | **1992-2000** | **2001-2007** | **2008-2011** |
| **Turn of Years** | | | | |
| **Value** | 120**/-34* | 90**/-23 | 19/-19 | 18/-11 |
| **Core** | 155**/-73** | 101**/-44** | 6/-43** | 14/1 |
| **Growth** | 157**/-78** | 127**/-68** | -21/-80** | 6/8 |
| **Turn of Calendar Quarters Other than Fourth** | | | | |
| **Value** | 31**/-14 | 28**/-10 | 33**/-17** | -12/-10 |
| **Core** | 60**/-55** | 31**/-28** | 35**/-26** | -12/-19 |
| **Growth** | 69**/-82** | 42**/-59** | 37**/-45** | -13/-33** |

| | Large Cap | | | |
|---|---|---|---|---|
| | **CKMR** | **1992-2000** | **2001-2007** | **2008-2011** |
| **Turn of Years** | | | | |
| **Value** | 25**/-17** | 43**/-18 | 15/-1 | 9/-1 |
| **Core** | 30**/-20** | 35**/-15** | 3/-16** | 5/0 |
| **Growth** | 37**/-33** | 51**/-35** | -12/-34** | -1/9 |
| **Turn of Calendar Quarters Other than Fourth** | | | | |
| **Value** | 4/5 | 11/5 | 15**/-3 | 1/4 |
| **Core** | 8**/-5* | 10**/-8** | 9**/-7** | -4/-5 |
| **Growth** | 15*/-17** | 13*/-25** | 7/-17** | -8/-17* |

## Table II

# Evidence of Portfolio Pumping in Institutional Trading

The dependent variable is the daily equal-weighted average of abnormal buying across institutions in the sample. Following HMPW, abnormal buying is calculated for each institution on each day as the dollar value of buys on day t minus the average dollar value of buys over days t to t-4, all scaled by the average dollar value of buys over days t to t-4. The control variables are the CRSP value-weighted market return for each of the five previous days (R1, R2, R3, R4, and R5), the volatility of this return, which is measured as the return squared, for each of the five previous days (V1, V2, V3, V4, and V5), dummy variables indicating the day of the week (MON, TUE, THUR, FRI), the previous five days' ratios (L-RATIO1 to L-RATIO5), dummy variables for the first five days of the month (NEWM5), the first five days of the quarter (NEWQ5), the first five days of the year (NEWY5), and finally the last day of the month that is non-quarter-end (MEND). YEND is a dummy variable indicating the last trading day of the year and QEND is a dummy variable for the last trading day of a calendar quarter other than the last. Columns 1999-2000, 2001-2007, and 2008-2010 report results for the periods from 1999 to the end of the third quarter of 2000, from the fourth quarter of 2000 to 2007, and from 2008 to 2010, respectively.

| | 1999-2000 | | 2001-2007 | | 2008-2010 | |
|---|---|---|---|---|---|---|
| **Variable** | **Estimate** | **p-value** | **Estimate** | **p-value** | **Estimate** | **p-value** |
| Intercept | 0.0443 | 0.0132 | 0.0496 | <.0001 | 0.0377 | 0.0020 |
| R1 | 1.6313 | 0.0030 | 0.6961 | 0.0130 | 0.6860 | 0.0046 |
| R2 | 0.6897 | 0.2124 | -0.6449 | 0.0230 | -0.0520 | 0.8336 |
| R3 | -1.3150 | 0.0202 | 0.1458 | 0.6134 | -0.4881 | 0.0508 |
| R4 | 0.4267 | 0.4528 | 0.2606 | 0.3654 | -0.0260 | 0.9172 |
| R5 | -1.1373 | 0.0441 | -0.1977 | 0.4916 | 0.1857 | 0.4515 |
| V1 | 11.3316 | 0.6320 | 10.1149 | 0.4647 | 4.9417 | 0.3506 |
| V2 | -22.3534 | 0.3436 | -9.8759 | 0.4707 | -5.2620 | 0.3086 |
| V3 | -28.5065 | 0.2366 | -40.8604 | 0.0023 | -3.4785 | 0.5197 |
| V4 | 17.9849 | 0.4305 | 5.0468 | 0.7106 | -6.6577 | 0.1959 |
| V5 | -15.4026 | 0.5015 | -5.4809 | 0.6868 | 0.6957 | 0.8936 |
| Monday | -0.1298 | <.0001 | -0.1284 | <.0001 | -0.1256 | <.0001 |
| Tuesday | 0.0300 | 0.1834 | 0.0063 | 0.5325 | 0.0055 | 0.7310 |
| Thursday | -0.0082 | 0.7166 | 0.0017 | 0.8652 | -0.0128 | 0.4251 |
| Friday | -0.0630 | 0.0071 | -0.0794 | <.0001 | -0.0589 | 0.0006 |
| L-RATIO1 | 0.1322 | 0.0064 | 0.1682 | <.0001 | 0.1870 | <.0001 |
| L-RATIO2 | -0.0426 | 0.3790 | -0.1216 | <.0001 | -0.0487 | 0.2180 |
| L-RATIO3 | -0.1273 | 0.0074 | -0.0836 | 0.0004 | -0.1448 | 0.0002 |
| L-RATIO4 | -0.1139 | 0.0179 | -0.1528 | <.0001 | -0.0918 | 0.0227 |
| L-RATIO5 | -0.0457 | 0.3352 | -0.0103 | 0.6518 | -0.0223 | 0.5516 |
| NEWM5 | 0.0261 | 0.1596 | 0.0015 | 0.8548 | 0.0399 | 0.0028 |
| LAST | -0.0072 | 0.8539 | 0.0592 | 0.0006 | 0.0681 | 0.0151 |
| NEWQ5 | 0.0166 | 0.5697 | -0.0096 | 0.4506 | 0.0257 | 0.2090 |
| **QEnd** | **0.1078** | **0.0635** | **0.0846** | **0.0027** | **0.0209** | **0.6208** |
| NEWY5 | 0.1933 | 0.0029 | 0.1715 | <.0001 | 0.1959 | <.0001 |
| **YEnd** | **-0.2451** | **0.0822** | **-0.0188** | **0.6851** | **-0.0933** | **0.3044** |

## Table III

# Portfolio Pumping in Institutional Trading using Time Stamp

This table reports intra-day 30-minute intervals coefficients and p-values for regressions of two institutional tradings measures, Abnormal Buy and Abnormal Sell, on QEND (last trading day of a calendar quarter other than the last), YEND (last trading day of the the year) for three subperiods: 1993 to the end of the third quarter of 2000 (1993-2000), the fourth quarter of 2000 to 2007 (2001-2007), and from 2008 to 2011 (2008-2011). Abnormal Buy and Abnormal Sell are calculated for funds at 30-minute interval. More specifically, for each fund, Abnormal Buy (Sell) for time interval T of day t is the dollar value of buys (sells) in time interval T on day t scaled by the average dollar value of buys (sells) for the same time period T over all days in quarter with day t. Standard errors are robust and intercepts are included in the regressions but not reported for brevity.

| | **1999-2000** | | | | **2001-2007** | | | | **2008-2011** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Q-End** | **p-val** | **Y-End** | **p-val** | **Q-End** | **p-val** | **Y-End** | **p-val** | **Q-End** | **p-val** | **Y-End** | **p-val** |
| **Abnormal Buy** | | | | | | | | | | | | |
| **Before Open** | 0.4173 | <.0001 | -0.9818 | <.0001 | -0.2062 | <.0001 | -0.2697 | <.0001 | 0.4704 | <.0001 | -0.6100 | <.0001 |
| **9:30-10:00** | -0.2397 | 0.0892 | -0.6397 | 0.0681 | -0.0842 | 0.0019 | -0.3219 | <.0001 | -0.0489 | 0.3172 | -0.5498 | <.0001 |
| **10:01-10:30** | -0.1153 | 0.3652 | -0.9723 | 0.0035 | -0.1833 | <.0001 | -0.4446 | <.0001 | -0.2705 | <.0001 | -0.6119 | <.0001 |
| **10:31-11:00** | -0.1079 | 0.3813 | -0.4914 | 0.1388 | -0.1156 | <.0001 | -0.3048 | <.0001 | -0.3045 | <.0001 | -0.5778 | <.0001 |
| **11:01-11:30** | -0.0588 | 0.6358 | -0.2997 | 0.3691 | -0.0795 | 0.0040 | -0.4367 | <.0001 | -0.3765 | <.0001 | -0.5113 | <.0001 |
| **11:31-12:00** | -0.3701 | 0.0050 | 0.2153 | 0.5621 | -0.0509 | 0.0633 | -0.4801 | <.0001 | -0.1761 | 0.0002 | -0.5761 | <.0001 |
| **12:01-12:30** | 0.5466 | <.0001 | -0.8629 | 0.0120 | 0.2519 | <.0001 | -0.2902 | <.0001 | 0.0862 | 0.0816 | -0.5852 | <.0001 |
| **12:31-13:00** | 0.5020 | 0.0002 | 0.9278 | 0.0075 | -0.2306 | <.0001 | -0.4183 | <.0001 | -0.1008 | 0.0507 | -0.5481 | <.0001 |
| **13:01-13:30** | 0.3876 | 0.0032 | N/A | N/A | -0.1413 | <.0001 | -0.4466 | <.0001 | -0.3770 | <.0001 | -0.3129 | 0.0019 |
| **13:31-14:00** | 0.6630 | <.0001 | N/A | N/A | 0.2954 | <.0001 | -0.3681 | <.0001 | -0.3421 | <.0001 | -0.3485 | 0.0005 |
| **14:01-14:30** | 0.6701 | <.0001 | N/A | N/A | -0.0756 | 0.0042 | -0.5136 | <.0001 | -0.0015 | 0.9745 | -0.5951 | <.0001 |
| **14:31-15:00** | 0.3896 | 0.0014 | N/A | N/A | 0.2399 | <.0001 | -0.6011 | <.0001 | -0.2719 | <.0001 | -0.6917 | <.0001 |
| **15:01-15:30** | 0.5869 | <.0001 | N/A | N/A | 0.0919 | 0.0001 | -0.4684 | <.0001 | -0.2453 | <.0001 | -0.5899 | <.0001 |
| **15:31-16:00** | 0.5712 | <.0001 | N/A | N/A | 0.1184 | <.0001 | -0.2370 | <.0001 | -0.1226 | 0.0004 | -0.7191 | <.0001 |
| **Abnormal Sell** | | | | | | | | | | | | |
| **Before Open** | 0.4538 | <.0001 | -0.9915 | <.0001 | -0.2335 | <.0001 | -0.3813 | <.0001 | 0.2612 | <.0001 | -0.7088 | <.0001 |
| **9:30-10:00** | -0.0306 | 0.8338 | -0.6933 | 0.0585 | -0.1554 | <.0001 | -0.5676 | <.0001 | 0.0949 | 0.0499 | -0.5442 | <.0001 |
| **10:01-10:30** | -0.3776 | 0.0028 | -0.8115 | 0.0150 | -0.3850 | <.0001 | -0.5072 | <.0001 | -0.2914 | <.0001 | -0.7393 | <.0001 |
| **10:31-11:00** | -0.1266 | 0.3070 | -0.9812 | 0.0035 | -0.3836 | <.0001 | -0.4597 | <.0001 | -0.3999 | <.0001 | -0.6292 | <.0001 |
| **11:01-11:30** | 0.6093 | <.0001 | -0.8950 | 0.0071 | -0.3305 | <.0001 | -0.5534 | <.0001 | -0.3014 | <.0001 | -0.6785 | <.0001 |
| **11:31-12:00** | -0.0209 | 0.8764 | -0.3220 | 0.3772 | 0.4448 | <.0001 | -0.3384 | <.0001 | -0.3407 | <.0001 | -0.6815 | <.0001 |
| **12:01-12:30** | -0.2709 | 0.0419 | -0.7537 | 0.0254 | -0.4177 | <.0001 | 1.4044 | <.0001 | -0.3250 | <.0001 | -0.6068 | <.0001 |
| **12:31-13:00** | -0.2379 | 0.0750 | -0.2504 | 0.4535 | 0.1022 | 0.0004 | -0.5151 | <.0001 | -0.2001 | 0.0001 | -0.5230 | <.0001 |
| **13:01-13:30** | 0.1159 | 0.3682 | N/A | N/A | -0.3074 | <.0001 | -0.6188 | <.0001 | -0.3129 | <.0001 | -0.5565 | <.0001 |
| **13:31-14:00** | 0.0576 | 0.6629 | N/A | N/A | -0.3781 | <.0001 | -0.5580 | <.0001 | -0.4127 | <.0001 | -0.5487 | <.0001 |
| **14:01-14:30** | -0.1656 | 0.1873 | N/A | N/A | -0.1802 | <.0001 | -0.6800 | <.0001 | -0.2026 | <.0001 | -0.6733 | <.0001 |
| **14:31-15:00** | 0.6206 | <.0001 | N/A | N/A | -0.1780 | <.0001 | -0.5573 | <.0001 | -0.2796 | <.0001 | -0.5897 | <.0001 |
| **15:01-15:30** | 0.3189 | 0.0037 | N/A | N/A | 0.0456 | 0.0648 | -0.7013 | <.0001 | -0.3689 | <.0001 | 0.5469 | <.0001 |
| **15:31-16:00** | 0.3653 | <.0001 | N/A | N/A | -0.0868 | <.0001 | -0.4883 | <.0001 | -0.2652 | <.0001 | -0.5609 | <.0001 |

**Table IV**

## Portfolio Pumping Over Time: Fund Level Evidence

This table displays OLS regressions mutual funds' portfolio pumping measure defined as the value-weighted average 30-minute return reversals surrounding quarter-ends of stocks held by those funds. Independent variables include indicator variables for all quarters from 1993 to the third quarter of 2000 (P-1993-2000) and from 2008 to 2011 (P-2008-2011), an indicator variable for funds in the top quintile of style-adjusted, relative past performance (Top Perf), Active Share measure and interaction terms between them. ln(Fund Size) is the natural logarithm of fund size; Expenses is the quarterly expense ratio in percentage; Turnover is the quarterly portfolio turnover in percentage; Fund Age is the fund age in months; Aggressive Growth, Growth, and Small are indicator variables denote fund's style. The sample period is from 1993 to 2011 for Model 1–3 and is from 1993 to 2006 for Model 4 since Active Share measures are only available until 2006. Robust standard errors are clustered by funds and provided in brackets. Superscripts ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

| | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| **P-1993-2000** | 18.5884*** | 13.3611*** | 17.3576*** | 16.0669*** |
| | [0.50] | [0.49] | [0.50] | [2.73] |
| **P-2008-2011** | -23.6059*** | -21.0884*** | -23.7173*** | |
| | [0.39] | [0.42] | [0.45] | |
| **SmallCap x P-1993-2000** | | 24.6673*** | | 27.9627*** |
| | | [1.08] | | [1.48] |
| **SmallCap x P-2008-2011** | | -8.4518*** | | |
| | | [0.89] | | |
| **Top Perf** | | | 5.2762*** | 4.4154*** |
| | | | [0.67] | [0.72] |
| **TopPerf x P-1993-2000** | | | 5.4408*** | 5.0894*** |
| | | | [1.23] | [1.43] |
| **TopPerf x P-2008-2011** | | | 0.5568 | |
| | | | [1.24] | |
| **Active Share** | | | | 20.5109*** |
| | | | | [1.71] |
| **Active Share x P-1993-2000** | | | | -0.5619 |
| | | | | [3.55] |
| **ln(Fund Size)** | 0.3672** | 0.3699** | 0.2068 | 0.9324*** |
| | [0.16] | [0.15] | [0.15] | [0.18] |
| **Expenses** | 13.1812*** | 13.8449*** | 12.2333*** | 16.0106*** |
| | [2.44] | [2.34] | [2.42] | [2.93] |
| **Turnover** | 0.0731*** | 0.0702*** | 0.0689*** | 0.1266*** |
| | [0.02] | [0.02] | [0.02] | [0.02] |
| **Fund Age** | -0.0108*** | -0.0096*** | -0.0096*** | -0.0091*** |
| | [0.00] | [0.00] | [0.00] | [0.00] |
| **Aggressive Growth** | 9.8107*** | 9.8790*** | 9.8804*** | 10.2548*** |
| | [1.42] | [1.46] | [1.42] | [2.45] |
| **Growth** | -1.6574*** | -1.9588*** | -1.7297*** | -2.7754*** |
| | [0.56] | [0.55] | [0.55] | [0.61] |
| **Small** | 15.9638*** | 10.0787*** | 15.9239*** | 4.5530*** |
| | [0.80] | [0.83] | [0.79] | [0.85] |
| **Constant** | -14.5161*** | -13.3518*** | -14.4871*** | -37.1120*** |
| | [1.31] | [1.23] | [1.30] | [1.75] |
| **Adj. $R^2$** | 0.0912 | 0.1006 | 0.0942 | 0.0853 |
| **Observations** | 88894 | 88894 | 88894 | 52275 |

## Table V

## Price Pressure in Individual Stocks around Quarter-Ends

The dependent variable is 30-minute around quarter-end return reversals, a measure of price pressure for the period from 1993 to 2011. Fund Hold (Other Inst Hold) are the fraction of shares outstanding held by all actively managed mutual funds (other 13-F filing institutions other than mutual funds). P-1993-2000 and P-2008-2011 are indicator variables for all quarters from 1993 to the third quarter of 2000 and from 2008 to 2011, respectively. Non S&P500 is an indicator variable which takes value of 1 when a stock is not a constituent of the S&P 500 index. No. Market Maker is the number of market makers for Nasdaq stocks and equals one otherwise; NASDAQ denotes Nasdaq stocks and Size is the stock's market capitalization in billion. Quarterly Return is the return of the quarter excluding the quarter-end day. Average Daily Volume (volume normalized by total shares outstanding) and Std. Dev. Daily Ret.(the standard deviation of daily returns in percents) are calculated excluding the 5 days surrounding the quarter-end. Industry dummies and quarter dummies are included but coefficients are omitted for brevity. Robust standard errors are clustered by funds and provided in brackets. Superscripts ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

| | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| **P-1993-2000 x Fund Hold** | 66.2648*** | | 51.5738*** |
| | [8.0400] | | [8.7350] |
| **P-2008-2011 x Fund Hold** | -54.0154*** | | -42.6635*** |
| | [6.8011] | | [7.2349] |
| **Fund Hold** | -38.1155*** | | -31.1579*** |
| | [5.1595] | | [5.4069] |
| **P-1993-2000 x Other Inst Hold** | | 20.4072*** | 12.3791*** |
| | | [2.8499] | [3.0884] |
| **P-2008-2011 x Other Inst Hold** | | -21.1519*** | -12.7650*** |
| | | [2.8360] | [3.0238] |
| **Other Inst Hold** | | -10.9129*** | -6.4093*** |
| | | [1.9076] | [1.9934] |
| **P-1993-2000** | -22.3611*** | -23.0073*** | -23.9447*** |
| | [3.2387] | [3.2684] | [3.2783] |
| **P-2008-2011** | 27.2578*** | 29.7094*** | 30.4220*** |
| | [3.3248] | [3.4175] | [3.4314] |
| **No. Market Maker** | -0.1060*** | -0.1340*** | -0.0950*** |
| | [0.0325] | [0.0327] | [0.0330] |
| **Non S&P500 Stock Dummy** | 19.1031*** | 16.6338*** | 17.7372*** |
| | [1.0057] | [1.0377] | [1.0469] |
| **NASDAQ** | 9.6795*** | 10.0106*** | 9.5823*** |
| | [0.9752] | [0.9854] | [0.9855] |
| **Quarterly Return** | 0.4141 | 0.4046 | 0.4849 |
| | [1.3537] | [1.3538] | [1.3537] |
| **Avg. Daily Volume** | -0.1201* | -0.0578 | -0.0949 |
| | [0.0660] | [0.0510] | [0.0580] |
| **Size** | -0.0801*** | -0.0589*** | -0.0713*** |
| | [0.0231] | [0.0209] | [0.0221] |
| **Std. Dev. Daily Ret.** | 2.0050*** | 2.0195*** | 1.9931*** |
| | [0.1613] | [0.1619] | [0.1617] |
| **Constant** | -5.4095 | -0.3165 | -2.6964 |
| | [5.5106] | [5.4891] | [5.5212] |
| **Observations** | 570431 | 570431 | 570431 |
| **Adj. R Sq** | 0.0185 | 0.0183 | 0.0186 |

**Table VI**

## Institutional Trading Evidence at the Fund Level

The dependent variable is Abnormal Buy for funds from *Ancerno*. For each fund, Abnormal Buy of day t is the dollar value of buys on day t scaled by the average dollar value of buys over all days in quarter with day t. P-1993-2000 and P-2008-2011 are indicator variables for all quarters from 1993 to the third quarter of 2000 and from 2008 to 2011, respectively. Quintile $ Volume is the fund's quintile based on its total dollar trading volume in the quarter, which takes value of 5(1) for funds with the largest(smallest) total dollar trading volume. Family Nbr of Funds is the number of funds in the family. Year End is an indicator variable which takes value of 1 when the trading date is the last of the year. Robust standard errors are clustered by funds and provided in brackets. Superscripts ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively

| | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| P-1993-2000 | 0.2930*** | 0.5105*** | 0.2915*** |
| | [0.04] | [0.04] | [0.04] |
| P-2008-2011 | -0.0665*** | -0.2649*** | -0.6453*** |
| | [0.01] | [0.01] | [0.01] |
| Quintile $ Volume | 2.3519*** | | 2.3654*** |
| | [0.02] | | [0.02] |
| Family Nbr of Funds | | 0.0297*** | 0.0325*** |
| | | [0.00] | [0.00] |
| Year End | | | -0.6406*** |
| | | | [0.01] |
| Constant | -3.8019*** | 0.9162*** | -3.7451*** |
| | [0.03] | [0.01] | [0.03] |
| Adj. $R^2$ | 0.1297 | 0.0038 | 0.1358 |
| Observations | 775953 | 775953 | 775953 |