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

Truong X. Duong and Felix Meschke *

First version: June 19, 2007

This version: April 8, 2008

*We thank Raj Aggarwal, Gordon Alexander, Tom Issaevitch, Patrick Kelly, Raj Singh, Eng Joo Tan, and seminar participants at California State University at Fullerton, National University of Singapore, Singapore Management University, University of Cologne, University of Minnesota and University of Vienna as well as participants in the North Carolina State University Conference on Tournaments, Contests and Relative Performance Evaluation for helpful comments and suggestions. Chuan Guo provided excellent research assistance. Both authors are at the Carlson School of Management, University of Minnesota, 321 19th Avenue South, Room 3-122, Minneapolis, MN 55455. Truong Duong can be reached at Tel: 612-626-9703, email: duon0051@umn.edu and Felix Meschke via Tel: 612-626-2583, email: meschke@umn.edu.

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

ABSTRACT

We construct a new measure that tightens the link between stock return patterns around quarter-ends and the likelihood that these patterns result from mutual fund portfolio pumping. Both the level and the concentration of mutual fund ownership explain temporary stock price increases at the end of the quarter. We show that pumping is particularly pronounced among the best- and worst-performing funds and document a distinctive increase in this activity during the 1997–2001 period. The sharp decrease in portfolio pumping after 2001 is most likely due to academic and media attention that spawned investor activism and SEC enforcement actions. These changes in regulatory attention and scrutiny markedly affected the behavior of mutual fund managers.

JEL Classifications: G23, G28, K22

Recent theoretical work by Bhattacharyya and Nanda (2006) and Bernhardt and Davies (2008) models the incentives of mutual fund managers to boost short-term performance through strategic trading known as "portfolio pumping"[1]. These models predict that fund managers attempt to drive up the closing prices for some stocks they already hold because investors reward better-performing funds with greater inflows (Ippolito, 1992; Sirri and Tufano, 1998). Carhart, Kaniel, Musto and Reed (2002) – hereafter CKMR - provide quite persuasive, yet indirect evidence of portfolio pumping by documenting that 80 percent of equity funds outperform the S&P 500 index on the last trading day of the year, yet only 37 percent do so the following day. They also document that the quarter's best-performing funds have the largest abnormal quarter-end return reversals and that trading volume in stocks held by these best-performing funds begin to spike upwards during the last 30 minutes of the trading quarter.

Collins (2004) points out that fund NAV reversals are confounded by many effects and that the SEC has reported no enforcement actions linking portfolio pumping to mutual funds. To illustrate, consider a fund with substantial holdings in stocks A and B. If stock A increases markedly in value on the last day of the quarter and stock B drops substantially in value the following day, the fund will experience a reversal in NAV which is unrelated to portfolio pumping. Return reversals may also occur more often in funds with volatile holdings. It is also possible that issuers repurchase equities more frequently on the last day of the quarter, and the ensuing price pressure might be misconstrued as the result of portfolio pumping. Because NAV reversals are at best a noisy proxy for portfolio pumping, its prevalence, economic magnitude, and determinants are still not fully understood.

In this paper, we develop a measure of portfolio pumping that is less susceptible to confounding turn-of-quarter effects. Our portfolio pumping measure allows us to reexamine the empirical findings of CKMR and to take to the data the predictions of the theoretical literature. Specifically,

[1]Portfolio pumping is sometimes referred to as "marking the close", "high closing", "painting the tape" or "leaning for the tape".

Bernhardt and Davies (2008) predict that mutual funds who engage in portfolio pumping in a given quarter will do so again the following quarter and that stocks that constitute a fund's largest holding will be subject to the most portfolio pumping. Their model also suggests that the managers who performed well relative to others have greater opportunities to inflate portfolio values, while the worst-performing managers temporarily depress their portfolio values by selling off stocks, thereby starting the next quarter ahead of others.

We find that the data broadly supports these predictions: Our quarterly measure of portfolio pumping is positively related to its lagged value, and the more mutual funds have of a given stock as their top holding, the more likely the stock exhibits price pressure around quarter-ends. More generally, the level and concentration of mutual fund ownership significantly affect price pressure in individual stocks. Consistent with previous findings by CKMR, fund managers with better relative performance are more likely to engage in portfolio pumping. Contrary to the predictions of Bernhardt and Davies (2008), poorly-performing fund managers do not depress their portfolio values, but engage in portfolio pumping in a manner similar to managers that perform well. This might be due to avoiding dismissal, a motive not modeled in Bernhardt and Davies (2008).

We also document a distinctive increase in portfolio pumping during the period 1998–2001, followed by a sharp decrease afterwards. Such a decrease is consistent with increased ability of market participants to anticipate fund managers' attempts at portfolio pumping (Bhattacharyya and Nanda, 2006). Alternatively, closer attention by regulators and the media as well as increased threat of litigation may prevent fund managers from attempting to distort quarter-end prices altogether. Our investigation of these competing hypotheses suggests that media reports of CKMR's findings resulted in activities by investor advocacy groups and the Securities and Exchange Commission (SEC) that most likely explain the sharp reduction in portfolio pumping.

We also test and reject several alternative hypotheses that might explain the documented reduction in portfolio pumping. More generally, we are able to tighten the link between stock return

patterns and the likelihood that these patterns result from mutual fund portfolio pumping and show that changes in regulatory attention and scrutiny, unaccompanied by changes in the regulatory or legal framework, markedly affected the behavior of mutual fund managers.

The remainder of this paper is organized as follows: Section I describes the rationale for, and the construction of, the portfolio pumping measures and lays out the hypotheses. Section II describes the data, while Section III provides the basic regression results and documents how regulatory scrutiny has increased. Section IV investigates competing explanations for the decrease in portfolio pumping activities and Section V concludes.

I. Measure Construction and Hypothesis Development

A. Measuring Portfolio Pumping

Virtually all attempts in the literature to identify portfolio pumping of individual mutual funds involve examining daily return reversals of fund net asset values (NAVs) around quarter-ends (Zweig, 1997; McFarland, Howlett, and Walton, 2000; CKMR, 2002; Hulbert, 2004; Gallagher, Gardner, and Swan, 2005). This approach is also a starting point for investigations by the Securities and Exchange Commission (SEC). Lori Richards, the SEC's director of the Office of Compliance Inspections and Examinations states: "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."[2] Collins (2004), however, argues that changes in NAVs around quarter-end could be driven by effects unrelated to portfolio pumping: The stock holdings that cause the NAV to increase may not be the stock holdings responsible for the NAV reversal on the following day, funds invested in more volatile stocks are likely to exhibit NAV reversals more often than funds invested in less volatile stocks, and news-related stock price movements or repurchases may be more likely to occur on the last day

[2]John Labate and Elizabeth Wine: "SEC probes mutual funds", 30 November 2000, *Financial Times*.

of the quarter. The measures constructed in the next section directly address concerns that arise from using NAV reversals to infer portfolio pumping.

A.1. **Portfolio Pumping Measure**

Our portfolio pumping measure is constructed as follows: For each quarter q and fund f, we obtain the most recent quarterly holdings from Thomson Financial. For each stock j in the fund's holdings, we use transaction prices from the New York Stock Exchange Trade and Quote (TAQ) database to calculate each stock's returns for the last 30 minutes of each trading day.[3] To classify a given stock as pumped, we require that it beats the S&P 500 during the last 30 minutes of day t and underperform the S&P 500 on day $t+1$[4].

Formally, let $\text{ExR30}_{j,t}$ be the 30-minute return for stock j on day t in excess of the S&P 500 Index, calculated for the time period 3:30–4:00 p.m. Similarly, let $\text{ExR}_{j,t+1}$ be the next-day's return in excess of the S&P 500 Index. For each stock j and day t, then define:

$$\text{Ret30}^{*}_{j,t} = \begin{cases} \text{ExR30}_{j,t} \text{ if } \text{ExR30}_{j,t} > 0 \ \& \ \text{ExR}_{j,t+1} < 0 \\ 0 \text{ otherwise} \end{cases} \tag{1}$$

For each mutual fund f and quarter-end q, we want to measure how much of a fund's quarterly performance can be attributed to stocks that are most likely pumped, that is, stocks that outperform the S&P 500 index during the last 30 minutes preceding the quarter-end and underperform the index

[3] More specifically, for all stocks held by mutual funds at quarter-ends, we acquire the Actual Trade Prices closest to the 30 minutes before the closing mark and the closing price. This time period is 3:30–4:00 p.m. for all quarters with the exception of Dec. 31, 1999. That day, the market closed early and hence we use 12:30–1:00 p.m. We exclude non-quarter-end days if the market closed prior to 4:00 p.m.

[4] As a robustness check, we also require a more restrictive classification of runup and reversal: Specifically, for the 30-minute return on day t, the stock needs to exhibit a positive return in excess of the S&P 500 if the S&P 500 increases in value during the last 30 minutes of the trading day. On days where the S&P 500 return is negative during the last 30 minutes of the trading day, the stock needs to exhibit a positive 30-minute stock return. In addition, for the next-day's return on day $t+1$, we require that the stock exhibits a return more negative than the S&P 500 if the S&P 500 decreases in value; we require the stock to exhibit a negative return if the S&P 500 increases. We obtain very similar results with this classification.

the following day. We therefore calculate a simple value-weighted average of all stocks exhibiting positive excess returns during the last 30 minutes of the last trading day of the quarter T and negative excess returns the following day: $\sum_{j=1}^{n} w_{j,q}^{f} \text{Ret30}_{j,t=T}^{*}$. Yet, an important concern is that some stocks will exhibit this transitory return pattern by chance alone, and that funds invested in more volatile stocks will more likely hold stocks that exhibit this pattern at quarter-end, even if their fund managers do not engage in portfolio pumping. To address this concern, we subtract the daily time-series average from the end-of-quarter value, where the average is calculated over all days of the quarter q, except the last day (t=T). Our measure is therefore defined as:

$$\text{Portfolio Pumping Measure}_{q}^{f} = \sum_{j=1}^{n} w_{j,q}^{f} \text{Ret30}_{j,t=T}^{*} - \frac{1}{T-1} \sum_{t=1}^{T-1} \left(\sum_{j=1}^{n} w_{j,q}^{f} \text{Ret30}_{j,t}^{*} \right) \tag{2}$$

While the exact timing of trades designed to increase portfolio values is unobservable without access to audit trail data, we know from SEC enforcement actions that fund managers have to trade off the likelihood of order execution with obtaining maximum price impact on the closing price if the order is executed: Buying stocks too early allows the price impact to decay; putting orders in too late jeopardizes order execution, resulting in zero price impact. For several reasons, we only consider effects that occur during the last 30 minutes of the quarter: First, we want to minimize the risk of misattributing news-related stock price movements that occur during the last day of the quarter to portfolio pumping. Second, the SEC's Rule 10b-18, which provides issuers with a "safe harbor" from liability for manipulation when they repurchase their common stock, excludes purchases during the last half hour of trading from its safe harbor.[5] By focusing on the last 30 minutes of trading, we avoid erroneously classifying repurchase-related price pressure to portfolio pumping. Third, CKMR document evidence that at the end of the quarter a large fraction of

[5] See Rule 10b-18 at www.sec.gov/rules/final/33-8335.htm

intraday trading happens during the last half hour. Finally, examples made public through SEC enforcement actions also suggest that trades designed to increase the closing price occur only a few minutes prior to closing.[6]

The economic interpretation of this portfolio pumping measure is straightforward: It measures the performance contribution from stocks which outperform the S&P 500 index during the last 30 minutes preceding the quarter-end and underperform it the following day. Measuring portfolio pumping this way has several advantages relative to analyzing daily changes in fund net asset values (NAVs). First, it excludes the effects of stock price movements that are less likely to be associated with portfolio pumping: Stock price movements between market opening and 3:30 p.m., negative 30-minute stock returns, returns of stocks with positive 30-minute returns yet non-negative returns the following day, repurchase-related returns, and returns due to overall market movements. Second, the measure can be constructed for a larger number of mutual funds, since it is based on holdings data available through mandatory SEC filings. In contrast, databases that provide historical data on fund NAVs tend to suffer from survivorship bias. Third, it controls for the fact that funds invested in more volatile stocks will more likely exhibit NAV reversals.

It should be noted that, in order to tighten the link between stock return patterns around quarter-ends and mutual fund portfolio pumping, we systematically underreport the economic impact of portfolio pumping: The effects of driving up stock prices prior to 3:30 p.m. and the effects of pumped stock that do not experience return reversals within one trading day will go undetected. Furthermore, Bernhardt and Davies (2005) find that portfolio pumping by fund managers appears to impact returns on aggregate market indices, so that measuring portfolio pumping relative to the S&P 500 index further understates the economic effect.

[6] "For instance, on December 31, 2003, the last trading day of the fourth quarter of 2003, Schultz Investment successfully [...] placed a market buy order for 80,750 shares of BIF at 3:57 p.m. EST, which constituted 76.18% of the days trading volume in BIF. The share price before the order was $5.90 and BIF closed at $6.30 that day. Similarly, Schultz placed a market buy order for 48,775 shares in JHFT at 3:50 p.m. EST, which constituted 57.84% of that days trading volume in JHFT. The share price before the order was $16.59, and JHFT closed at $18.40 that day." See www.sec.gov/litigation/admin/33–8650.pdf, p.3

A.2. **A more restrictive Pumping Measure**

While the measure developed in the previous section can deliver stronger suggestive evidence of portfolio pumping than can an analysis based on changes in fund NAVs alone, it cannot conclusively prove that a certain fund engages in portfolio pumping. Such proof would require fund-level transaction data and strong evidence of managers' intent to manipulate stock prices. While we do not have access to this type of audit-trail data, we can further reduce the likelihood that the last-minute price increases and subsequent return reversals of stocks held by mutual funds are caused by factors other than portfolio pumping. First, mutual fund managers have an incentive to mark up the prices of stocks in which they hold substantial positions. Second, due to tournament-style performance evaluation, managers should avoid marking up stocks which constitute a substantial part of their competitors' portfolios.[7] Hence, for our more restrictive portfolio pumping measure we add the additional requirements that a stock j comprises at least three percent of a fund's total holdings and that this fund holds at least 2% more of stock j than any other fund in the same investment style s:

$$\text{Ret30}^{R}_{j,t} = \begin{cases} \text{ExR30}_{j,t} \text{ if } \text{ExR30}_{j,t} > 0 \ \& \ \text{ExR}_{j,t+1} < 0 \ \& \ w^{f}_{j,t} \geq 3\% \ \& \ w^{f}_{j,t} - 2\% \ \geq w^{s}_{j,t} \forall s \neq f \\ 0 \text{ otherwise} \end{cases} \tag{3}$$

Analogous to the previous portfolio pumping measure, we calculate a simple value-weighted average of all stocks exhibiting positive returns during the last 30 minutes of the quarter and negative returns the following day. In addition, these stocks need to account for a substantial portion of the fund's holdings, and the fund has to be the largest investor among all mutual funds with the same investment style. As before we control for portfolio-specific volatility by subtracting

[7] Studies that document mutual fund tournaments include Brown, Harlow, and Starks (1996); Chevalier and Ellison (1997); Busse (2001); Basak, Pavlova and Shapiro (2004); Kempf and Ruenzi (2005).

the daily time-series average from the end-of-quarter value:

$$\text{Restrictive Pumping Measure}_q^f = \sum_{j=1}^{n} w_{j,q}^f \text{Ret30}_{j,t=T}^R - \frac{1}{T-1} \sum_{t=1}^{T-1} \left(\sum_{j=1}^{n} w_{j,q}^f \text{Ret30}_{j,t}^R \right) \tag{4}$$

This restrictive pumping measure only considers stocks where the stock price pattern surrounding quarter-ends can be tied with very high probability to one specific mutual fund. It therefore directly addresses the concern that changes in fund NAVs around quarter-ends could be driven by effects unrelated to portfolio pumping. Note that this restrictive measure underestimates the economic magnitude of portfolio pumping even more than our base measure because it does not take into account portfolio pumping if more than one fund with substantial holdings drives up the price of a given stock or if the fund's holding in a stock it pumps is below three percent.

A.3. **Return Reversal**

In order to compare our results to previous findings, we also examine daily return reversals of fund NAVs around quarter-ends. We follow Bernhardt and Davies (2005) and measure return reversal for fund f at quarter-end q as the difference between the quarter-end return, r_t^f, and the return the following trading day, r_{t+1}^f, divided by 2:

$$\text{Return Reversal}_q^f = \frac{r_t^f - r_{t+1}^f}{2} \tag{5}$$

For example, if a fund's NAV increased by 65 basis points at quarter end and dropped by 55 basis points the following day, the return reversal measure will yield 60 basis points. As pointed out earlier, by attributing the entire price movement on day t and $t+1$ to portfolio pumping, this measure may provide an upper bound of the economic effect. In contrast, the two measures developed earlier are much more conservative and underestimate the economic effect of portfolio

pumping.

B. Hypothesis Development

B.1. Portfolio Pumping and Past Performance

A well-developed literature on mutual fund tournaments examines how the economic incentives derived from relative positions within peer groups affect the risk-taking behavior of mutual fund managers (see, among others, Brown, Harlow, and Starks, 1996; Chevalier and Ellison, 1997; Busse, 2001; Basak, Pavlova and Shapiro, 2004; Kempf and Ruenzi, 2005). Bhattacharyya and Nanda (2006) and Bernhardt and Davies (2008) specifically model the incentives of mutual fund managers that lead them to (attempt to) influence the closing prices of their stock holdings by executing purchase or sale market orders at or near market close at the end of the quarter.

Bernhardt and Davies (2008) develop a partial equilibrium model of an informed and risk-neutral mutual fund manager with an endogenous budget constraint. Their model predicts that managers who performed well relative to others have greater opportunities to inflate portfolio values. Correspondingly, the "leaning-for-the-tape" hypothesis of CKMR argues that fund managers with the best performance pump their portfolios in order to receive a bigger bonus and to benefit from the convex flow-performance relation (Ippolito, 1992; Sirri and Tufano, 1998). In addition, their "benchmark-beating" hypothesis predicts that mutual fund managers with median past performance mark up to receive bonuses, which often requires above-median relative performance or beating a passive benchmark index such as the S&P 500.

While the best-performing managers and those close to their benchmark have clear incentives to trade in the direction of their existing holdings, poorly-performing fund managers face a more ambiguous situation: On the one hand, Bernhardt and Davies (2008) predict that the worst-performing managers temporarily depress their portfolio values by selling off stocks, thereby starting the next quarter ahead of others. On the other hand, these fund managers may pump their portfolios

to avoid losing their job. Such behavior would be consistent with the results of Brown, Harlow, and Starks (1996) who document that underperforming fund managers increase their portfolio risk. We dub this possibility the "clutching-at-straws" hypothesis.

CKMR find evidence consistent with "leaning-for-the-tape", whereas support for "benchmark-beating" is mixed. On the one hand, articles in the popular press report many incidents of suspicious "benchmark-beating" for mutual funds in the United States (Zweig, 1997; Hulbert, 2004) and Canada (McFarland, Howlett, and Walton, 2000), and hedge funds that are in-the-money as of November-end exhibit December returns significantly higher than their average returns from January to November (Agarwal, Daniel, and Naik, 2007). On the other hand, CKMR find no evidence that mutual funds engage in portfolio pumping to beat their benchmark. To our knowledge, the Bernhardt and Davies (2008) hypothesis of poorly-performing managers depressing their portfolio values and the "clutching-at-straws" hypothesis have not been investigated.

B.2. **Portfolio Pumping through Time**

We investigate three hypotheses regarding the aggregate time-series pattern of portfolio pumping. First, Bernhardt and Davies (2005) argue that the magnitude of portfolio pumping is driven by the growing presence of mutual funds in the market. Using data from 1970 until the third quarter of 2001, they find that the aggregate share of all equity held by mutual funds predicts the size of return reversals around quarter-ends in the CRSP equally-weighted index. If this pattern continues to hold, we should expect portfolio pumping to intensify over time since the share of all equity held by mutual funds increases throughout our sample period. On the level of individual mutual funds, the model of Bernhardt and Davies (2008) predicts that mutual funds who engage in portfolio pumping in a given quarter will do so again in the following quarter.

Second, Bhattacharyya and Nanda (2006) develop a model where an informed and risk-neutral mutual fund manager trades a risky and a riskless asset and engages in portfolio pumping even if

the trading is not expected to generate a price impact in equilibrium. The model suggests that strategic traders such as hedge funds attempt to predict mutual fund trading behavior based on publicly available holdings information and trade against funds attempting to drive up quarter-end stock prices. Hence, this model is consistent with the notion that the observed price impact of mutual fund managers' attempts to affect stock prices decays over time as other market participants become more sophisticated in trading against mutual funds. Note that this is true even as fund managers continue to trade with the intention of driving up stock prices.

Finally, portfolio pumping is illegal and increased attention by regulators and the media may significantly reduce the magnitude of mutual funds pumping activities. Such a reduction would be analogous to the reaction of Nasdaq market makers in response to Christie and Schultz (1994): Their study provides strong circumstantial evidence that market makers of active Nasdaq stocks implicitly colluded to maintain spreads of a least \$0.25 by avoiding odd-eighth quotes. Once several national newspapers had reported their findings and the Justice Department had confirmed that it was launching an investigation into possible antitrust violations, Nasdaq dealers sharply increased their use of odd-eighth quotes (Christie, Harris, and Schultz, 1994; Christie and Schultz, 1995). We investigate which of these three hypotheses regarding the time-series dynamics of portfolio pumping bears out empirically.

II. Data

Our data are provided by multiple sources. Fund characteristics data are obtained from the CRSP Mutual Fund Database (CRSP MF), fund holdings information from Thomson Financial, and index funds are identified using annual Morningstar Principia discs. We use Mutual Funds Links (MFLINKS) from the Wharton Research Data Services to link the CRSP Mutual Fund Database with Thomson's holdings. Stock prices are extracted from the Trade and Quote (TAQ) and the CRSP databases, and daily fund net asset values (NAVs) from the CRSP mutual fund database

and Datastream. Federal Reserve US Flow of Funds accounts provide the dollar value of domestic equity and the dollar value of domestic equity held by mutual funds. The Chicago Board Options Exchange (CBOE) Volatility Index (VIX) is obtained from the CBOE's website.

To avoid cross-sectional dependence arising from regression analysis on the fund share-class level, we aggregate all observations to the fund level by using CRSP portfolio identifiers.[8] Fund total net assets are calculated as the sum of share-class level total net assets; expense and turnover ratios are the value-weighted averages of the respective share class level variables. We restrict our analysis to domestic equity funds since holdings information is often incomplete for other investment styles. We also exclude index funds, sector funds, funds with total net assets below $5 million and funds that invests less than 50% of their assets in stocks.[9] Every fund in our sample is classified as either Aggressive Growth, Growth, Growth and Income, or Small Stocks. Funds are sorted each quarter into performance quintiles based on their relative performance over the previous eleven months.[10] The remaining variables are defined in Table I.

Table II reports fund characteristics for our sample, which consists of 64,952 fund-quarter observations. The average fund is about 12 years old, charges annualized expenses of 1.32% (4×33 basis points), has an annualized turnover rate of 95% (4×23.74 basis points), and quarterly return reversals of 53 basis points. Our conservative pumping measure suggests that the average fund reports quarterly performance that is 3.57 basis points too high due to portfolio pumping. Table III shows the Spearman rank correlations between our two portfolio pumping measures and the return reversal measure described in Section I.A, the Market Premium, the Sentiment Index, the Percentage of Equity Held in Mutual Funds, and the CBOE Volatility Index (VIX). As expected,

[8]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.

[9]For 90% of the fund-quarter observations, the fraction of total net assets invested in equity exceeds 80%.

[10]Performance is measured relative to all other funds with the same investment objective. We do not include the last month of the current quarter since this would, by construction, confound with quarter-end portfolio pumping. The cumulative past performance for the year-end (4th quarter), for example, is calculated from January through November.

the three measures are positively correlated with each other. All three measures are negatively correlated with the market premium, suggesting that portfolio pumping is more pronounced at quarter-ends following down-markets.

III. Results

A. Evidence from fund-level regressions

We now investigate whether the magnitude of portfolio pumping has changed over time and how managers' propensity to engage in pumping relates to their past performance. We start by plotting the data. Panel A of Figure 1 shows box plots by year for our measure of portfolio pumping. The measure suggests that portfolio pumping was particularly prevalent during 1998 through 2000. Pumping activity reduced in 2001 and 2002, and the magnitude of pumping from 2003 on is much lower. The dispersion of the measure has also reduced drastically. In sum, price impact of portfolio pumping activity appears to have peaked in 2000 and reduced in recent years.

Figure 2 shows two-dimensional scatter plots for each fund investment style and for three different time periods. The vertical axis displays the values of the portfolio pumping measure constructed in Equation (4). The horizontal axis shows the relative (percentage) ranking over the previous eleven months within each investment style. The much higher values during the 1998–2001 period reiterate the pattern shown in Figure 1. But in addition, the plots show that portfolio pumping is not just concentrated among the best-performing funds. Furthermore we observe "across-the-board" increases in pumping activities for all investment styles and at all levels of style-adjusted past performance. Especially during the 1998–2001 period, growth funds as well as growth and income funds exhibit a "U-shaped" relation between their relative past performance ranking and the magnitude of portfolio pumping.

To analyze our graphical findings formally, we employ multivariate regressions.[11] In Panel A of Table IV, we regress the three different measures of portfolio pumping from Section I.A. on an indicator that equals one after 2001 (Post 2001) and zero otherwise. To investigate whether mutual fund managers are leaning for the tape, attempting to beat their benchmark, or clutching at straws, we sort each fund into quintiles based on their past performance, which is measured over the previous eleven months relative to all other funds within the same investment style. Past Performance Q1 is an indicator variable equal to one if the fund's relative past performance is in the bottom 20% and zero otherwise. Past Performance Q2 equals to one if the fund's relative past performance is in the penultimate quintile and zero otherwise. Past Performance Q3 through Q5 are defined analogously, where Q5 denotes the quintile of best-performing funds. Control variables include the natural logarithm of fund size, quarterly fund expense and turnover ratios, fund age, and indicator variables denoting the fourth quarter (year-end) and the fund's investment style.

The negative coefficient on the Post 2001 indicator variable shows that portfolio pumping activity has been significantly reduced from 2002 onwards. Average return reversals reduced by 43 basis points per quarter, and portfolio pumping, as measured by our more conservative pumping measure, reduced by 9 basis points per quarter. Even our most restrictive alternative measure indicates a statistically significant reduction in pumping activity.

The positive and significant coefficients on the indicator variables denoting the best- and worst-performing funds show that managers who performed particularly well or particularly poorly engage in more portfolio pumping than managers with median performance. The finding that better-performing managers mark up stocks more than managers in the middle performance quintile is consistent with that of CKMR (2002), who find evidence for the "leaning-for-the-tape" hypothesis, but not for the "benchmark-beating" hypothesis.[12]

[11] Following Petersen (2007), all regressions display White standard errors clustered by funds.

[12] In contrast, Agarwal,Daniel, and Naik (2007) provide suggestive evidence that some hedge fund managers do in fact engage in "benchmark-beating" behavior. Specifically, hedge funds that are in-the-money as of November-end exhibit December returns significantly higher than their average returns from January to November.

In addition to confirming these previous findings using a larger sample and a more refined measure of portfolio pumping, we also provide evidence for the "clutching-at-straws" hypothesis: Portfolio managers in the bottom performance quintile, who face the highest threat of dismissal (Khorana, 1996; 2001), also engage in portfolio pumping. The economic magnitude of their activity is slightly lower when compared to that of the top performance quintile: The worst-performing funds exhibit 2.8 basis points more return reversal and about one-half basis point more portfolio pumping per quarter than funds in the median performance quintile. This result does not support the prediction of Bernhardt and Davies (2008) that poorly-performing funds depress portfolio values in order to start the next quarter ahead of their competitors. The best-performing funds show 9.2 basis points more return reversal and 2.0 basis points more portfolio pumping per quarter than median-performing funds. Our more restrictive measure produces consistent results.

The style indicator variables show that, relative to growth and income funds, small-stock funds and aggressive-growth funds exhibit 32.4 and 13.0 basis points more return reversal, and 8.1 and 4.0 basis points more portfolio pumping, respectively. Other control variables are statistically significant as well, although their economic effects are small: A one-standard deviation increase in quarterly fund turnover or expenses is associated with an increase in quarterly portfolio pumping of about half a basis point.

The model of Bernhardt and Davies (2008) suggests that mutual funds engaging in portfolio pumping continue to do so in subsequent quarters. We thus include a lagged portfolio pumping measure in our regression specification. Consistent with their prediction, the coefficient of the lagged portfolio pumping measure is positive and significant.[13]

In Panel B of Table IV, we display interaction terms of the past fund performance indicators with the Post 2001 indicators. These interaction terms reveal that from 2002 onwards, funds in the best-performing quintile exhibit greater absolute reduction in portfolio pumping, but lower absolute

[13]In unreported robustness checks we repeat this specification with three lags and obtain qualitatively similar results.

reduction in return reversal when compared to funds in the worst-performing quintile.

CKMR (2002) report that the magnitude of annualized price inflation is over 200 basis points for small-cap funds. Panel A of Table IV shows that annualized return reversal for small stock funds in the best-performing quintile prior to 2002 is 178 basis points (obtained by summing the coefficients of Constant, Small, and Past Perf. Q5 and multiplying by four), which is very much in line with their results. Our conservative portfolio pumping measure indicates 69 basis points of annualized price inflation for this group.

To gauge the economic magnitude of portfolio pumping, we construct a daily measure of portfolio pumping, which is the value-weighted average of $\text{Ret30}^*_{j,t}$ in Equation (1) across all stocks j held by a given fund f:

$$\text{Daily Pumping Measure}^f_t = \sum_{j=1}^{n} w^f_{j,q} \text{Ret30}^*_{j,t} \tag{6}$$

We regress this daily measure on a quarter-end dummy, a dummy equal to one on month-ends other than the quarter-end, and control variables that include quarter-fixed-effects, the natural logarithm of the fund's size, and the natural logarithm of the fund family size. The results are displayed in Table V (the control variables are omitted for brevity). Panel A shows that from 1993 to 2001, the average mutual fund increased its quarterly performance by about 9.6 basis points through portfolio pumping. The average small-cap fund reported 21 basis points higher performance during this time period. Since the 2001 total net asset value (TNA) of all funds in our sample exceeds 2.3 trillion dollars, we estimate that quarterly mutual fund portfolios in that year are artificially inflated by about 2.2 billion dollars. Panel B of Table V documents that, for the 2002 through 2006 period, the quarter-end value of the daily pumping measure no longer exceeds its average value for the remaining non-month-end days of the quarter: The quarter-end dummy is only positive and significant for small-cap funds, but even for this investment style, the

magnitude reduced from 21 basis points to less than 2 basis points. The results for the entire sample period in Panel C show that this reduction is not driven by lower daily portfolio volatility in the latter period: The Post 2001 dummy variable equals one for every day in 2002 through 2006 and the coefficients indicate that the daily pumping measure is not much different throughout the two periods of the sample. In contrast, the interaction term between the Post 2001 dummy and the quarter-end dummy clearly shows the significant reduction in portfolio pumping across all four style categories.

To summarize, we provide evidence that portfolio pumping has sharply decreased from 2002 onwards and that managers in both the top and bottom performance quintile mark up stocks more aggressively than managers in the median performance quintile.

B. **Evidence from stock-level regressions**

The previous section measured portfolio pumping by mutual funds as the value-weighted return of stocks in their holdings that appreciate during the last 30 minutes of the quarter and experience price reversal the following day. In this section, we analyze which stocks are most likely to exhibit this return pattern around quarter-ends and investigate whether the level and concentration of mutual fund ownership has marginal explanatory power, as predicted by the theoretical model of Bernhardt and Davies (2008). We also examine whether the magnitude and likelihood of occurrence of these temporary price increases of individual stocks at quarter-ends have diminished after 2001.

Specifically, for every stock j with TAQ transaction data available at quarter-end t, we calculate $\text{Ret30}^*_{j,t}$ as described by Equation (1). This measure is the dependent variable for our Tobit model in Panel A of Table VI. Panel B presents a Probit model with the dependent variable set equal to one if $\text{Ret30}^*_{j,t}$ is strictly positive. Due to the tournament-style industry structure (Brown, Harlow, and Starks, 1996), we expect a non-linear relation between the fraction of shares owned by mutual funds and $\text{Ret30}^*_{j,t}$: Up to a point, a greater fraction of shares owned by mutual funds increases

the likelihood that a given stock will be subject to quarter-end portfolio pumping. The larger this fraction, though, the greater the likelihood that competitors benefit if a fund manager engages in last-minute trading to drive up the stock price. Hence, beyond a certain point larger mutual fund holdings are likely to decrease $\text{Ret30}^*_{j,t}$. We also expect larger and more frequent temporary stock price increases if mutual fund ownership of a given stock is more concentrated.

Table VI shows that these predictions bear out empirically: For low levels of mutual fund ownership, Model 1 shows that a one-percent increase in mutual fund holdings is associated with a 1.3-basis point increase in $\text{Ret30}^*_{j,t}$ and a 0.65% higher probability that a stock exhibits a return pattern consistent with portfolio pumping. For stocks with mutual fund ownership levels of 20% and more, these return patterns are relatively smaller in magnitude and less likely to occur. Consistent with the results in the previous section, $\text{Ret30}^*_{j,t}$ is 123 basis points lower after 2001. Put differently, after 2001 it is about 42% less likely that stocks exhibit temporary price increases at quarter-end.

Of course, other factors are likely to affect $\text{Ret30}^*_{j,t}$ as well. We therefore include additional variables to control for liquidity, volatility, and past performance. Liquidity controls include the number of market makers, an indicator variable equal to one if the firm is traded on Nasdaq, and the average daily share volume (excluding the quarter-end and its four surrounding days). Volatility is measured as the standard deviation of daily returns (again, excluding the same five days). We include cumulative returns from the first day until the penultimate day of the quarter-end to control for the possibility that last-minute temporary price increases are driven by either momentum or window dressing.

We find that $\text{Ret30}^*_{j,t}$ is larger for firms trading on Nasdaq, for firms with higher cumulative returns, and increases in firm size for firms that are roughly below the median NYSE size breakpoint. In contrast, $\text{Ret30}^*_{j,t}$ is decreasing in the number of market makers, volatility, and firm size (for firms above the median NYSE size break point). While these additional variables improve model fit, they do not affect the direction or statistical significance of the mutual fund holdings variables

and the Post 2001 indicator.

In Model 2 we replace mutual fund holdings variables with institutional holdings variables and establish that the results are not sensitive to how we measure intermediated ownership. In Model 3 we test the prediction of Bernhardt and Davies (2008) that mutual funds drive up the stock prices of their largest holdings. Specifically, we count the number of funds for which a given stock constitutes the largest holding and include this as a variable (Top Holding Count) in the regression.[14] Consistent with theoretical predictions, stocks that make up the top holding of more mutual funds exhibit higher price pressure during the last 30 minutes of the quarter. Model 3 also examines whether $\text{Ret30}^*_{j,t}$ is larger for stocks with more concentrated mutual fund ownership, as measured by the Herfindahl concentration index.[15] The coefficient on this concentration measure is not significant, however.

By analyzing stock-level price pressure during the 30 minutes preceding the quarter-end we document three findings: First, the level, and to a lesser extend the concentration, of mutual fund ownership explain temporary stock price increases at the end of the quarter. Second, consistent with previous findings on mutual fund tournaments, the relation between the fraction of shares owned by mutual funds and temporary price increases around the end of the quarter is positive for low levels of mutual fund holdings and negative for higher levels. This result is robust to an alternative specification of ownership. Finally, individual stocks exhibit less end-of-quarter price pressure from 2002 onwards, which mirrors results from the preceding section.

[14] As a robustness check we also measure top holdings by indicating the top 5 and top 10 largest holdings. The results remain unchanged.

[15] For each stock j, the Herfindahl index of mutual fund ownership concentration equals $\sum_{i=1}^{n} s_i^2$, where s_i is the fraction of shares held by fund i, and n is the number of funds. The Herfindahl index of institutional ownership concentration is constructed analogously.

C. What caused the reduction in portfolio pumping?

We reported earlier that our pumping measure indicates significantly lower magnitudes of portfolio pumping for the period from 2002 onwards. One possible explanation for this observation is advanced in Bhattacharyya and Nanda (2006). They develop an equilibrium model where an informed and risk-neutral mutual fund manager trades a risky and a risk-free asset in a batched order market (Kyle, 1985). Their model predicts that fund managers engage in portfolio pumping even if the trading is not expected to generate a price impact in equilibrium. Furthermore, the model addresses the possibility that strategic traders (i.e., market makers, hedge funds, etc.) seek to predict mutual fund trading behavior based on publicly available holdings information and trade against funds attempting to drive up quarter-end stock prices.

An alternate explanation for the reduction in portfolio pumping is that increased regulatory scrutiny and a greater threat of costly litigation led mutual fund managers to significantly reduce the magnitude of their pumping activities. While these two competing hypotheses are both consistent with the observed reduction in portfolio pumping, they have different predictions with regard to trading volume: If mutual fund managers still execute last-minute market orders yet are less successful because sophisticated investors trade against them, we should observe that abnormal trading volume during the last 30 minutes prior to quarter-end stays at at least at similar levels during the later part of our sample period. In contrast, if mutual fund managers are less inclined to engage in last-minute trading due to increased regulatory attention, we should expect a reduction in abnormal volume from 2002 onwards. We empirically distinguish between these two possible explanations by analyzing normalized volume of individual stocks that where with very high probability subject to portfolio pumping during the earlier part of our sample period.

In order to identify these stocks, we rank all stocks by their frequency of return reversal (i.e., positive excess return during the last 30 minutes of the quarter and negative excess return the following day) during all quarters from 1993 through 2001 and set the indicator variable "Pumped"

to one for the top 5 (top 10 in an alternative specification) percent of stocks that exhibit the largest number of return reversals. These stocks are most likely subject to repeated portfolio pumping. For each stock, we calculate normalized quarter-end trading volume by dividing the 30-minute quarter-end volume by the average 30-minute volume measured over all non-month-end days of the same quarter. We then regress normalized 30-minute volume on Pumped, a dummy variable identifying the stocks subject quarter-end price pressure, a dummy equal to one for all quarters from 2002 onwards (Post2001), an interaction term (Post2001 $\times$ Pumped), and control variables. The coefficient on the interaction term (Post2001 $\times$ Pumped) is negative and statistically significant in both column one and column four of Table VII, which is consistent with the regulatory attention hypothesis: Stocks which were most likely subject to portfolio pumping during the earlier part of our sample period exhibit a significant reduction in abnormal volume during the last 30 minutes of trading prior to quarter-end once both the financial media and the Securities and Exchange Commission (SEC) paid closer attention to mutual fund portfolio pumping.

To address the possibility that these results may be driven by self-selection, we also report the results from a two-step Heckman selection model. In the first step, we run a probit regression of Pumped, the dummy variable denoting the stocks most likely pumped prior to 2002, on the control variables shown in Table VII (excluding the time and industry dummies) as well as the fraction of shares outstanding held by mutual funds, its squared value, and the Herfindahl concentration measure of fund holdings. We then calculate the inverse Mills ratio and include it in our second-stage regression, which is displayed in columns two and five. Columns three and six include an additional interaction term between the Pumped indicator and the inverse Mills ratio. The interaction term (Post2001 $\times$ Pumped) maintains its sign and statistical significance in all specifications, suggesting that our results are not driven by self-selection. In summary, the reduction in abnormal last-minute trading volume in stocks that exhibit highly frequent return reversals around quarter-ends prior to 2002 does not support the notion that strategic traders caused the reduction in measured portfolio

pumping. Our finding is, however, consistent with the regulatory attention hypothesis. The next section briefly outlines how regulatory and media scrutiny increased over time.

D. **Increased regulatory scrutiny**

This section documents the increase in media attention and regulatory scrutiny of portfolio pumping activities. Anecdotes and newspaper articles alleging portfolio pumping have been around for a decade (Zweig, 1997). The first academic study, however, that provides strong circumstantial evidence of portfolio pumping was CKMR. After the first draft of their paper was circulated in June of 1999, several media outlets reported fund return reversals around the 2000 year-end and linked them to possible portfolio pumping while refering to the findings of CKMR.[16]

The Ontario Securities Commission brought the first legal action alleging portfolio pumping against Royal Bank of Canada's pension fund unit, RT Capital Management Inc., and several stock brokerage firms. John Cleghorn, Chairman of the Royal Bank, publicly apologized as the scandal unfolded. Economic damages to investors are estimated to be 38 million Canadian dollars (Camp, 2000).

Shortly thereafter portfolio pumping received attention from regulators in the U.S. On October 12, 2000, Paul Roye, director of the SEC's Investment Management Division, mentioned that the SEC had established a task force to study portfolio pumping,[17] and on November 27, 2000, the SEC announced 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."[18]

In 2001, the SEC pursued enforcement actions in cases where phone or written records helped establish that portfolio managers engaged in last-minute trading with the intention to drive up

[16]See, for example, Miriam Hill, "Investors should be weary of last-day fund inflation", January 4, 2000, *Knight Ridder Tribune Business News.*

[17] Phil McCarty, "SEC set to adopt mutual fund name rule by year-end", October 12, 2000, *Dow Jones Newswires.*

[18]Sara Hansard, "SEC probing funds for 'portfolio pumping' : Task force seeks trade records to examine stock purchases", November 27, 2000, *Investment News.*

prices of stocks already held: On June 1, the SEC filed fraud charges against a hedge fund manager, alleging market manipulation and portfolio pumping;[19] on August 10, it brought charges against ABN AMRO, Oechsle International Advisor and two of their employees who engaged in portfolio pumping.[20]

Overall, portfolio pumping started to receive widespread attention from the financial news media, investor advocacy groups, and regulators from early 2000 onwards. As Panel B of Figure 1 shows, this increased attention coincides with a marked decrease in portfolio pumping activities, especially after the SEC pursued several enforcement actions against portfolio managers who engaged in this practice. Table VIII shows that the media attention to portfolio pumping was similar in magnitude to the attention the Christie and Schultz (1994) findings of collusion among Nasdaq market makers garnered. It appears that increased regulatory scrutiny offers a plausible explanation for the documented reduction in portfolio pumping. There are, however, other possible explanations which we examine in the next section.

IV. Competing Hypotheses

A. Bull Market in the late 1990s

It is quite apparent that the documented increase and subsequent decrease in portfolio pumping broadly coincides with aggregate equity valuations. It is conceivable that investors are more likely to invest in mutual funds during bull markets, which in turn might increase the competition among fund managers due to the tournament-style organization of the industry (Brown, Harlow, and Starks, 1996). If greater competition for new money flow results in more pronounced portfolio pumping, then the observed portfolio pumping pattern might be driven by changes in overall market performance. To examine this possibility, we include in our analysis the Market Premium,

[19] See www.sec.gov/litigation/litreleases/lr17021.htm

[20] SECs 2001 annual report, page 10, available at http://edgar.sec.gov/pdf/annrep01/ar01full.pdf

calculated as the value-weighted CRSP index return minus the risk-free rate. As shown in the first column of Table IX, the coefficient on Market Premium is negative and not statistically significant, indicating that portfolio pumping is not more pronounced at the end of quarters with stronger market performance.

Next, we examine whether portfolio pumping is more pronounced in quarters with greater investor sentiment by including the sentiment index developed by Baker and Wurgler (2006)[21]. Column two of Table IX shows that this is indeed the case, but the economic magnitude is fairly small: A one-standard-deviation increase in investor sentiment (0.65) is associated with an increase in the portfolio pumping measure of 1.28 basis points.

Two other effects might possibly drive our results: First, Bernhardt and Davies (2005) suggest that portfolio pumping increases in magnitude as a result of intermediated stock ownership. They document a positive relation between quarterly return reversals in the equally weighted CRSP index and the percentage of corporate equity held by mutual funds. Second, returns during the last 30 minutes of the quarter might be correlated with overall market volatility. To account for these two possibilities, we include the percentage of corporate equity held by mutual funds and the CBOE Volatility Index (VIX) level in our regression analysis.

As Table IX shows, the coefficients on both of these variables are positive and statistically significant, although their economic impact is small: a one-standard deviation increase in the percentage of corporate equity held by mutual funds is associated with an increase in the portfolio pumping measure of about 1.27 basis points, while the effect for the VIX is about two basis points. While market sentiment, implied volatility, and the level of intermediated stock ownership are all statistically significant and help to improve model fit, controlling for them does not materially decrease the sign, significance, or magnitude of the coefficient on the Post 2001 indicator variable. It is therefore improbable that the rise and fall in portfolio pumping is a mere byproduct of the

[21]We thank Jeff Wurgler for making the sentiment data available at http://pages.stern.nyu.edu/ jwurgler/

bull market of the late 1990s.

B. **Decimalization**

We now consider the possibility that the decrease in portfolio pumping is driven by the conversion of stock quotations from fractional to decimal basis. On June 8, 2000, the Securities and Exchange Commission (SEC) issued an order directing the securities exchanges and the Nasdaq Stock Market to phase out pricing shares in fractions by April 9, 2001.[22] Several studies such as Bessembinder (2003) and Gibson, Singh, and Yerramilli (2003) find that quoted bid-ask spreads decreased after decimalization, which may result in smaller expected gains from portfolio pumping. Moreover, with the expectation of smaller gains, managers may be less inclined to engage in portfolio pumping.

Since the shift from fractional to decimal prices coincides with increased regulatory scrutiny of portfolio pumping, we cannot easily disentangle these two different effects. But if a reduction in bid-ask spreads reduces the propensity of fund managers to engage in portfolio pumping, we should observe such a reduction as well after stocks began trading in sixteenths ($0.0625) instead of eights ($0.125) on June 24, 1997. We test this hypothesis by including in our analysis the indicator variable "Sixteenth Spread", which is equal to one from the second quarter of 1997 onwards, when stocks no longer trade in eighths.

As column 4 of Table IX shows, the coefficient for Sixteenth Spread is significantly positive at the one-percent level, while the coefficient on the Post 2001 maintains its negative significance. Since the reduction in spreads from trading in sixteenth does not reduce portfolio pumping, we deem it unlikely that the reduction in spreads from trading in decimals drives the documented reduction in portfolio pumping.

[22]See Securities Exchange Act Release No. 42914 (June 8, 2000), 65 FR 38010 (June 19, 2000).

C. **Window Dressing**

Mutual fund managers may alter the composition of their portfolios around quarterly reporting dates to disclose holdings of stocks that have performed well (Musto, 1997; 1999; O'Neal, 2005). If mutual fund managers engage in this kind of "window dressing", they have an incentive to minimize the transaction costs from building up and subsequently unwinding their cosmetic positions. Trades motivated by window dressing should therefore be executed in ways that minimize price impact and guarantee order execution, whereas trades intended to inflate end-of-quarter holdings attempt to maximize price impact. Trades motivated by window dressing are therefore unlikely to be executed during the last 30 minutes of the quarter and we should not expect these trades to confound our findings.

It is, however, conceivable that some mutual fund managers seek to minimize exposure to stocks they hold for only cosmetic reasons. In that case, they might aggressively buy past winners shortly before the end of the quarter and immediately unwind their positions the next trading day. If mutual funds window dress and prefer higher transactions costs over slightly longer exposure to unwanted stocks, our findings may not be evidence of a deliberate attempt to inflate quarter-end holdings, but a mere byproduct of disclosing holdings that are deemed more appealing to investors.

We empirically address this concern by excluding all stocks in the best performance quartile and stocks in the fund's top ten holdings from the construction of our portfolio pumping measure. Results reported in column 6 of Table IX similarly indicate a statistically significant decrease in portfolio pumping after 2001. In conclusion, neither the bull market during the late 1990s, the conversion of stock quotations from fractional to decimal pricing, nor window dressing by mutual funds can adequately explain why portfolio pumping has markedly decreased in recent years.

D. Competition among Market Makers

Table VI shows that, for individual stocks, the number of market makers is negatively associated with price pressure at quarter-end. This finding is consistent with market makers anticipating mutual fund managers' attempts to drive up closing prices and competing for the resulting last-minute order flow (Bhattacharyya and Nanda, 2006): Imagine a stock with a single market maker who receives a large buy order during the last 5 minutes of the quarter from a portfolio manager eager to mark up the close. This is a lucrative opportunity because the trade does not reflect superior information and the portfolio manager is insensitive to costs associated with order execution. With imperfect competition, the price impact of the trade increases as the market maker's profit increases. As more market makers compete for order flow, this price impact is likely to reduce.

While theory and our results in Table VI suggest that competition among market makers counteracts fund managers' ability to engage in portfolio pumping, Christie and Schultz (1994) document that a large number of dealers does not necessarily thwart anticompetitive behavior. Nevertheless, it might be of concern, if our fund-level results stem from stocks with a large number of market makers. In unreported results, we therefore exclude from our portfolio pumping measure all stocks with an above-median number of market makers and verify that this modified measure still indicates a statistically significant decrease in portfolio pumping after 2001.

V. Conclusion

Portfolio pumping, the practice of purchasing stocks already held for the purpose of driving up quarter-end portfolio values, has attracted recent attention from regulators, consumer advocates, and the media, and is the focus of empirical studies (CKMR; Bernhardt and Davies, 2005) as well as theoretical modeling (Bhattacharyya and Nanda, 2006; Bernhardt and Davies, 2008). Disclosing inflated portfolio values at quarter-end benefits mutual fund managers because investors reward

better-performing funds with greater inflows (Ippolito, 1992; Sirri and Tufano, 1998), and because managers of such funds receive larger bonuses and face a lower threat of dismissal (Khorana, 1996; 2001). Portfolio pumping is costly though, because the next-day fund return will be lower as the price impact of the last-minute trades at quarter-end decays. Funds also risk allegations of illegal price manipulation that may result in legal penalties and loss of reputation. We contribute to this emerging literature by first constructing a novel measure that is less susceptible to confounding turn-of-quarter effects (Collins, 2004). This measure allows us to tighten the link between stock return patterns and the likelihood that these patterns result from mutual fund portfolio pumping.

This study is first in taking to the data theoretical predictions by Bhattacharyya and Nanda (2006) and Bernhardt and Davies (2008) about fund manager incentives and portfolio pumping. Specifically, Bernhardt and Davies (2008) predict that mutual funds who engage in portfolio pumping in a given quarter will do so again the following quarter and that stocks that constitute a fund's largest holding will be subject to the most pronounced portfolio pumping. They also suggest that managers who performed well relative to others have greater opportunities to inflate portfolio values, while poor-performing managers temporarily depress their portfolio values by selling off stocks, thereby starting the next quarter ahead of others.

Our quarterly measure of portfolio pumping is indeed positively related to its lagged value, and the more mutual funds have of a given stock as their top holding, the more likely the stock exhibits price pressure around quarter-ends. More generally, the level and concentration of mutual fund ownership significantly affect price pressure in individual stocks. Consistent with previous findings by CKMR, fund managers with better relative performance are more likely to engage in portfolio pumping. Contrary to the predictions of Bernhardt and Davies (2008), however, we find that poorly-performing fund managers, too, engage in portfolio pumping.

We also document a distinctive increase in portfolio pumping during the period 1998–2001, followed by a sharp decrease afterwards. While Bhattacharyya and Nanda (2006) support the

notion that mutual fund managers still execute last-minute market orders but are less successful because sophisticated investors trade against them, the regulatory attention hypothesis suggests that mutual fund managers are less inclined to engage in last-minute trading due to increased regulatory scrutiny. By examining normalized 30-minute trading volume of stocks subject to mutual fund pumping, we are able to discriminate between these competing explanations and to provide evidence that media reports of CKMR's findings resulted in activities by investor advocacy groups and the Securities and Exchange Commission (SEC) that most likely explain the sharp reduction in portfolio pumping.

Since the substantial reduction in portfolio pumping could be driven by effects other than increased regulatory vigilance, we investigate three competing hypotheses. However, we do not find evidence that the documented results are caused by the bull market during the late 1990s, the conversion of stock quotations from fractional to decimal pricing, or window dressing. We also perform extensive robustness checks to assess the reliability of our measure and the sensitivity of our results to alternative specifications. Overall, we document both the rise and fall in portfolio pumping among U.S. mutual funds and show that increased regulatory attention and scrutiny, unaccompanied by changes in the regulatory or legal framework, markedly affected the behavior of mutual fund managers.

REFERENCES

Agarwal, Vikas, Naveen D. Daniel, and Narayan Y. Naik, 2007, Why is santa so kind to hedge funds? the december return puzzle!, Working Paper, London Business School.

Baker, Malcolm, and Jeffrey Wurgler, 2007, Investor sentiment in the stock market, *Journal of Economic Perspectives* 27, 129–151.

Basak, Suleyman, Anna Pavlova, and Alex Shapiro, 2004, Offsetting the incentives: Risk shifting and benefits of benchmarking in money and management, Working Paper, MIT Sloan School of Management.

Bernhardt, Dan, and Ryan J. Davies, 2005, Painting the tape: Aggregate evidence, *Economic Letters* 89, 306–311.

——— , 2008, Smart fund managers? Stupid money?, Working Paper, University of Illinois and Babson College.

Bessembinder, Hendrik, 2003, Execution costs and market quality after decimalization, *Journal of Financial and Quantitative Analysis* 38, 747–777.

Bhattacharyya, Sugato, and Vikram Nanda, 2006, Portfolio pumping, trading activity and fund performance, Working Paper, University of Michigan and Arizona State University.

Brown, Keith C., W.V. Harlow, and Laura T. Starks, 1996, Of tournaments and temptations: An analysis of managerial incentives in the mutual fund industry, *Journal of Finance* 51, 85–110.

Busse, Jeffrey A., 2001, Another look at mutual fund tournaments, *Journal of Finance* 36, 53–73.

Camp, Dalton, 2000, Time for TSE to come clean in this royal 'juicing' scandal, *The Toronto Star* July 19.

Carhart, Mark M., Ron Kaniel, David K. Musto, and Adam V. Reed, 2002, Leaning for the tape: Evidence of gaming behavior in equity mutual funds, *Journal of Finance* 58, 661–693.

Chevalier, Judtih, and Glenn Ellison, 1994, Risk taking by mutual funds as a response to incentives, *Journal of Political Economy* 105, 1167–1200.

Christie, William G., Jeffrey H. Harris, and Paul H. Schultz, 1994, Why did NASDAQ market makers stop avoiding odd-eighth quotes, *Journal of Finance* 49, 1841–1860.

Christie, William G., and Paul H. Schultz, 1994, Why do NASDAQ market makers avoid odd-eighth quotes, *Journal of Finance* 49, 1813–1840.

——— , 1995, Did Nasdaq market makers implicitly collude?, *Journal of Economic Perspectives* 9, 199–208.

Collins, Sean, 2004, Reports of 'portfolio pumping' by mutual funds: A closer look, *Investment Company Institute*.

Gallagher, David R., Peter Gardner, and Peter L. Swan, 2005, Portfolio pumping: An examination of investment manager trading and performance, Working Paper, University of New South Wales.

Gibson, Scott, Rajdeep Singh, and Vijay Yerramilli, 2003, The effect of decimalization on the components of the bid-ask spread, *Journal of Financial Intermediation* 12, 121–148.

Hansard, Sara, 2000, SEC probing funds for 'portfolio pumping': Task force seeks trade records to examine stock purchases, *Investment News* November 27.

Hill, Miriam, 2000, Investors should be wary of last-day fund inflation, *Knight Ridder Tribune Business News* January 4.

Hulbert, Mark, 2004, They did it again, *CBS MarketWatch* July 2.

Ippolito, Richard A., 1992, A consumer reaction to measures of poor quality: Evidence from the mutual fund industry, *Journal of Law and Economics* 35, 45–70.

Kempf, Alexander, and Stefan Ruenzi, 2005, Tournaments in mutual fund families, forthcoming, Review of Financial Studies.

Khorana, Ajay, 1996, Top management turnover: An empirical investigation of mutual fund managers, *Journal of Financial Economics* 40, 403–427.

——— , 2001, Performance changes following top management turnover: Evidence from open-end mutual funds, *Journal of Financial and Quantitative Analysis* 36, 371–393.

Kyle, Albert S., 1985, Continuous auctions and insider trading, *Econometrica* 53, 1315–1335.

Labate, John, and Elizabeth Wine, 2000, SEC probes mutual funds, *Financial Times* November 30.

McCarty, Phil, 2000, SEC set to adopt mutual fund name rule by year-end, *Dow Jones Newswires* October 12.

McFarland, Janet, Karen Howlett, and Dawn Walton, 2000, Signs point to mutual fund high-closing: Many routinely post strong gains on the final day of the year and far outstrip the performance of the TSE 300, the globe finds, *The Globe and Mail* July 5.

Musto, David K., 1997, Portfolio disclosures and year-end price shifts, *Journal of Finance* 52, 1563–1588.

——— , 1999, Investment decisions depend on portfolio disclosures, *Journal of Finance* 54, 935–952.

O'Neal, Edward S., 2001, Window dressing and equity mutual funds, Working Paper, Wake Forest University.

Petersen, Mitchell A., 2007, Estimating standard errors in finance panel data sets: Comparing approaches, forthcoming, Review of Financial Studies.

Schwert, G. William, 1981, Using financial data to measure effects of regulation, *Journal of Law and Economics* 24, 121–158.

Wermers, Russ, 2003, Is money really 'smart'? New evidence on the relation between mutual fund flows, manager behavior, and performance persistence, Working Paper, University of Maryland.

Zheng, Lu, 1999, Is money smart? A study of mutual fund investors' fund selection ability, *Journal of Finance* 54, 901–933.

Zweig, Jason, 1997, Watch out for the year-end fund flimflam, *Money Magazine* November, 130–133.

Table I

Variables List

Variable Name	Description
Pumping Measures	**(in basis points)**
Pumping Measure	Portfolio Pumping Measure defined in Eq. (4)
Restr. Pump. Measure	Restrictive Portfolio Pumping Measure defined in Eq. (6)
Return Reversal	Return on last trading day of quarter t minus return on first trading day of quarter t+1 divided by 2 - see Eq. (7)
Pump. Measure Window Dress	Pumping Measure excluding stocks in top quarterly performance quartile (25%) or in top 10 holdings
Fund Characteristics	
ln(Fund Size)	Natural logarithm of fund size in millions
ln(Family Size)	Natural logarithm of family size in millions
Fund Age	Fund age in months
Expenses	Quarterly expense ratio in percentage
Turnover	Quarterly portfolio turnover in percentage
Index	=1 if fund is an index fund
Aggressive Growth	=1 if fund's style is Aggressive Growth
Growth	=1 if fund's style is Growth
Growth & Income	=1 if fund's style is Growth & Income
Small	=1 if fund's style is Small
Past Perf. Q1 (Worst)	Past 11 month Performance Quintile 1 (Worst)
Past Perf. Q2	Past 11 month Performance Quintile 2
Past Perf. Q3	Past 11 month Performance Quintile 3
Past Perf. Q4	Past 11 month Performance Quintile 4
Past Perf. Q5 (Best)	Past 11 month Performance Quintile 5 (Best)
Quarterly Series	
Market Premium	Quarterly CRSP Value-Weighted return in excess of risk-free rate in percent
Sentiment Index	Constructed from the monthly Baker and Wurgler (2007) Sentiment Index
Pctn. Eq. in MF	Aggregate mutual fund holdings of corporate equity divided by total Market Value of domestic companies in percent
VIX	CBOE Volatilty Index in percent
Time Dummies	
Year-End	=1 if observation is the last trading day of year
Quarter-End	=1 if observation is the last trading day of quarter
Post 2001	=1 if observation is after 2001
Sixteenth Spread	=1 for periods when stocks are quoted in sixteenths ($0.0625)

Table II

Fund Characteristics, Pumping Measures and Quarterly Series

This table provides summary statistics for fund characteristics and portfolio pumping measures. The sample consists of 64,952 fund-quarter observations between 1993 and 2006, except for Sentiment Index, which is only available until the end of 2005. Panel A shows summary statistics for fund characteristics, and Panel B displays summary statistics for the quarterly market premium, the Sentiment Index, the percentage of total equity held by mutual funds, and the CBOE Volatility index (VIX). Fund Size is in $M, Expenses is in percents, Turnover is in percents, Fund Age is in months, and Pumping Measures are in basis points

Panel A

	N	Mean	SD	Q1	Median	Q3
Fund Size	64952	1198.88	4386.10	56.67	198.10	727.53
Expenses	64952	0.33	0.12	0.25	0.31	0.39
Turnover	64952	23.74	30.19	9.25	17.25	29.50
Fund Age	64952	150.89	165.00	51.00	93.00	167.00
Pumping Measure	64952	3.57	16.20	-4.66	-0.95	6.27
Restr. Pump. M.	64952	0.53	5.24	0.00	0.00	0.00
Return Reversal	56591	0.53	104.86	-52.10	-1.31	46.69

Panel B

	N	Mean	SD	Q1	Median	Q3
Market Premium	56	1.99	8.13	-1.84	2.79	6.70
Sentiment Index	52	0.28	0.65	-0.13	0.28	0.54
Pcnt. Eq. in MF	56	19.68	5.75	15.77	20.16	22.59
VIX	56	19.20	6.96	13.14	18.97	23.53

Table III

Spearman Rank Correlations

This table reports Spearman Rank Correlations for NAV return reversals, two measures of portfolio pumping, the quarterly market premium, the Sentiment Index, the percentage of total equity held by mutual funds, and the CBOE Volatility index (VIX). P-values are displayed in parentheses.

Variables	Return Reversal	Pumping Measure	Restr. P. M.	Market Prem.	Sentiment Index	Pcnt. Eq. in MF	VIX
Return Reversal	1.000						
Pumping Measure	0.308	1.000					
	(0.000)						
Restr. Pump. Measure	0.064	0.392	1.000				
	(0.000)	(0.000)					
Market Premium	-0.039	-0.128	-0.021	1.000			
	(0.000)	(0.000)	(0.000)				
Sentiment Index	0.269	0.368	0.071	-0.285	1.000		
	(0.000)	(0.000)	(0.000)	(0.000)			
Pcnt. Eq. in MF	-0.096	-0.151	-0.035	-0.055	-0.321	1.000	
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)		
VIX	-0.009	0.207	0.043	-0.399	0.225	-0.164	1.000
	(0.030)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	

Table IV

How Relative Fund Performance Pre/Post 2001 impacts Portfolio Pumping

This table displays OLS regressions of three different portfolio pumping measures defined in Section I.A. Columns 1 and 4 display regressions of quarterly NAV return reversals, Columns 2 and 5 show regressions for the portfolio pumping measure, and Columns 3 and 6 provide regressions for a stricter measure that ties price pressure in stocks to a unique fund. Independent variables include an indicator variable for all quarters from 2002 onwards (Post 2001), style-adjusted, relative past performance quintiles (Q1 – Q5), and interaction terms between past performance and the Post 2001 indicator. Lagged Pump. Measure is the previous quarter value of the respective pumping measure. All remaining variables are defined in Table I. Robust standard errors are clustered by funds and provided in brackets. Superscripts ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	Panel A			Panel B		
	Return Reversal	Pumping Measure	Restr. Pump. Measure	Return Reversal	Pumping Measure	Restr. Pump. Measure
Post 2001	-43.3443***	-8.9905***	-0.6692***	-40.9409***	-8.0520***	-0.5537***
	[0.98]	[0.21]	[0.06]	[1.85]	[0.25]	[0.07]
Past Perf. Q1 (Worst)	2.7847**	0.5872***	0.3203***	5.6813***	0.8632***	0.5088***
	[1.30]	[0.18]	[0.07]	[2.13]	[0.29]	[0.11]
Past Perf. Q2	-1.1465	0.0106	-0.0210	-0.0891	0.1336	-0.0243
	[1.32]	[0.16]	[0.04]	[2.17]	[0.25]	[0.07]
Past Perf. Q4	0.9159	0.5289***	-0.0214	0.2296	0.8182***	-0.0712
	[1.21]	[0.16]	[0.04]	[1.97]	[0.25]	[0.07]
Past Perf. Q5 (Best)	9.2498***	1.9886***	0.3043***	12.4041***	3.2102***	0.4382***
	[1.26]	[0.21]	[0.09]	[2.05]	[0.33]	[0.15]
Past Perf. Q1 x P2001				-5.4656**	-0.7067**	-0.4138***
				[2.70]	[0.34]	[0.12]
Past Perf. Q2 x P2001				-2.1740	-0.3340	0.0013
				[2.61]	[0.29]	[0.08]
Past Perf. Q4 x P2001				1.4818	-0.7068**	0.1182
				[2.44]	[0.29]	[0.07]
Past Perf. Q5 x P2001				-6.5088***	-2.9218***	-0.3214**
				[2.44]	[0.38]	[0.15]
Lagged Pump. Measure	0.0818***	0.2544***	0.1060***	0.0813***	0.2530***	0.1055***
	[0.01]	[0.01]	[0.03]	[0.01]	[0.01]	[0.03]
Year-End	-28.8970***	-0.4956***	-0.0630	-28.9446***	-0.5157***	-0.0650
	[1.18]	[0.12]	[0.04]	[1.18]	[0.12]	[0.04]
ln(Fund Size)	0.8934***	-0.0480	-0.1317***	0.8901***	-0.0553	-0.1321***
	[0.29]	[0.05]	[0.02]	[0.29]	[0.05]	[0.02]
Expenses	28.8580***	4.1087***	1.1424***	28.8654***	4.1069***	1.1416***
	[4.93]	[0.83]	[0.40]	[4.93]	[0.84]	[0.40]
Turnover	0.0599**	0.0177***	-0.0018*	0.0596**	0.0171***	-0.0018
	[0.03]	[0.01]	[0.00]	[0.03]	[0.01]	[0.00]
Fund Age	-0.0119***	-0.0018***	0.0002	-0.0118***	-0.0018***	0.0002*
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Aggressive Growth	13.0311***	3.9724***	0.8414***	12.9608***	3.9534***	0.8340***
	[2.59]	[0.52]	[0.21]	[2.59]	[0.52]	[0.21]
Growth	-3.9941***	-0.3896**	0.0331	-4.0135***	-0.4178**	0.0312
	[1.19]	[0.17]	[0.05]	[1.19]	[0.18]	[0.05]
Small	32.3656***	8.0689***	0.4160***	32.3561***	8.0669***	0.4129***
	[1.37]	[0.30]	[0.10]	[1.37]	[0.30]	[0.10]
Constant	2.8296	7.1068***	0.8418***	1.6802	6.8067***	0.7982***
	[2.94]	[0.46]	[0.18]	[3.13]	[0.48]	[0.18]
Adj. R^2	0.0996	0.2578	0.0241	0.0998	0.2587	0.0244
Observations	52462	61620	61620	52462	61620	61620

Table V

Economic Magnitude of Portfolio Pumping

This table displays OLS regressions of the daily portfolio pumping measure on a quarter-end dummy, a dummy indicating other month-ends, a constant, and controls that include quarter fixed-effects, and the natural logarithms of fund TNA and fund family TNA. These control variables are omitted to preserve space. Columns 1–4 report results for funds with the indicated investment style, while column 5 reports results for all funds. Robust standard errors are clustered by funds and provided in brackets. Superscripts ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Panel A: 1993-2001

	Aggressive Growth	Growth	Small Cap	GrowthIncome	All
Quarter-End	15.8325***	5.0489***	21.1500***	6.0640***	9.5798***
	[1.28]	[0.42]	[0.67]	[0.43]	[0.31]
Other Month-End	2.0428***	1.7426***	2.9148***	1.6769***	1.9889***
	[0.24]	[0.15]	[0.14]	[0.06]	[0.07]
Constant	7.0649***	1.1808	5.1842***	5.4262***	4.1184
	[0.99]	[5.28]	[0.79]	[0.46]	[2.29]
Observations	49881	267641	149156	251379	718057

Panel B: 2002-2006

	Aggressive Growth	Growth	Small Cap	GrowthIncome	All
Quarter-End	-1.5870***	-2.1253***	1.8108***	-1.6794***	-0.9709***
	[0.24]	[0.06]	[0.14]	[0.07]	[0.06]
Other Month-End	0.8490***	0.8124***	1.6201***	0.5915***	0.9366***
	[0.15]	[0.05]	[0.09]	[0.04]	[0.03]
Constant	6.7157***	7.2797***	7.4203***	5.0086***	5.8185***
	[0.73]	[0.23]	[0.40]	[0.27]	[0.20]
Observations	34932	192097	126452	180206	533687

Panel C: Entire Period

	Aggressive Growth	Growth	Small Cap	GrowthIncome	All
Post 2001	-1.3068**	0.3567	3.6257***	-0.5415	-0.9665***
	[0.43]	[0.61]	[0.38]	[0.28]	[0.22]
Post 2001 x Quarter-End	-17.4156***	-7.3603***	-19.3289***	-7.7496***	-10.6031***
	[1.28]	[0.39]	[0.67]	[0.42]	[0.29]
Quarter-End	15.8308***	5.0440***	21.1434***	6.0639***	9.5761***
	[1.28]	[0.42]	[0.67]	[0.43]	[0.32]
Other Month-End	1.5549***	1.3613***	2.3241***	1.2241***	1.5415***
	[0.16]	[0.09]	[0.09]	[0.04]	[0.04]
Constant	7.4699***	3.4636	6.4835***	5.5053***	5.3921***
	[0.78]	[3.03]	[0.56]	[0.39]	[1.27]
Observations	84813	459738	275608	431585	1251744

Table VI

Price Pressure in Individual Stocks around Quarter-Ends Pre/Post 2001

The dependent variable is $\text{Ret30}^*_{j,t}$, the measure of price pressure defined in Eq. (3) for the Tobit model, and an indicator variable equal to one if Ret30* is greater than zero for the Probit model. Fund Hold (Inst. Hold) are the fraction of shares outstanding held by all actively managed mutual funds (all institutions). Fund Hold Sq. and Inst. Hold Sq. are the squared values and the Herfindahl indices measure the concentration of these holdings. 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. Quarterly Return exclude the quarter-end day. Average Daily Volume and the standard deviation of daily returns (Std. Dev. Daily Ret.) are calculated excluding the 5 days surrounding the quarter-end. Industry dummies and quarter dummies are included in some Models, 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.

	Tobit			**Probit**		
COEFFICIENT	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Post2001	-123.0218***	-73.0241***	-118.0390***	-0.4203***	-0.3942***	-0.6214***
	[6.80]	[5.84]	[6.74]	[0.03]	[0.03]	[0.03]
Fund Hold	132.9864***			0.6487***		
	[15.04]			[0.07]		
Fund Hold Sq.	-339.3687***			-1.3845***		
	[37.14]			[0.17]		
Inst. Hold		127.5719***			0.5457***	
		[7.82]			[0.04]	
Inst. Hold Sq.		-139.4742***			-0.5565***	
		[9.15]			[0.04]	
Top Holding Count			0.3109***			0.0012***
			[0.07]			[0.00]
Fund Herfindahl			83.3398			0.7172
			[87.23]			[0.50]
No. Market Maker	-0.9116***	-0.8992***	-0.9101***	-0.0040***	-0.0039***	-0.0039***
	[0.09]	[0.09]	[0.09]	[0.00]	[0.00]	[0.00]
NASDAQ	54.0150***	51.8402***	54.2682***	0.1655***	0.1570***	0.1665***
	[2.56]	[2.53]	[2.56]	[0.01]	[0.01]	[0.01]
Quarterly Return	17.7681***	17.9159***	17.2507***	0.1297***	0.1297***	0.1261***
	[2.31]	[2.30]	[2.30]	[0.01]	[0.01]	[0.01]
Avg. Daily Volume	0.0000**	0.0000*	0.0000	0.0000	0.0000	-0.0000
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
ln(Size)	565.0835***	556.1159***	577.3315***	2.3912***	2.3581***	2.4472***
	[18.24]	[18.12]	[18.32]	[0.05]	[0.05]	[0.05]
ln(Size) Sq.	-13.3277***	-13.1174***	-13.6201***	-0.0560***	-0.0552***	-0.0572***
	[0.44]	[0.43]	[0.44]	[0.00]	[0.00]	[0.00]
Std. Dev. Daily Ret.	-392.5746***	-367.8899***	-392.1088***	-5.6070***	-5.5040***	-5.6179***
	[48.02]	[47.86]	[48.02]	[0.20]	[0.20]	[0.20]
Constant	-6169.0451***	-6081.7324***	-6294.5939***	-26.1704***	-25.8530***	-26.7689***
	[214.13]	[211.95]	[214.80]	[0.59]	[0.58]	[0.58]
Industry Dummies	Included	Included	Included	Included	Included	Included
Quarter Dummies	Included	Included	Included	Included	Included	Included
Wald Test χ^2	2804.69	2895.43	2779.80	32825.35	32841.18	32614.82
Observations	435668	435668	435668	428852	428852	428852
Wald Test χ^2 Hold Vars	85.131978	266.02009	22.789999	89.169036	252.28922	21.542883

Table VII

Stock Volume in the Last 30 Minutes of Quarters Pre/Post 2001

The dependent variable is the normalized volume in the last 30 minutes of quarters, defined as the volume in the last 30 minutes of quarters divided by the average volume in the last 30 minutes of all non month-end days of the same quarter. Pumped equals to one for stocks that are among the top 5 (top 10) percent of stocks most frequently pumped between 1993 and 2001. Inv. Mills is the inverse Mills ratio calculated using the two-step Heckman selection model as described in section III.C. Post2001 × Pumped and Inv. Mills × Pumped are interaction terms. Other controls are defined as in Table VI. Industry dummies and quarter dummies are included in some Models, 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.

	5 Percent			**10 Percent**		
COEFFICIENT	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Pumped	0.0194	3.9399***	2.0654***	0.0380	3.5357***	2.5350***
	[0.06]	[0.47]	[0.47]	[0.05]	[0.44]	[0.41]
Post2001 x Pumped	-0.3272***	-0.2973***	-0.2039**	-0.3744***	-0.3643***	-0.2582***
	[0.09]	[0.09]	[0.09]	[0.08]	[0.08]	[0.08]
Inv. Mills		-2.4731***	-2.9599***		-2.1941***	-3.1187***
		[0.29]	[0.32]		[0.27]	[0.33]
Inv. Mills x Pumped			2.6175***			2.3795***
			[0.38]			[0.29]
Post2001	0.3636*	0.2696	0.2685	0.3966*	0.3066	0.2942
	[0.22]	[0.22]	[0.22]	[0.22]	[0.22]	[0.22]
No. Market Maker	-0.0048**	-0.0046**	-0.0047**	-0.0048**	-0.0046**	-0.0048**
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
NASDAQ	0.4986***	0.4149***	0.4091***	0.4967***	0.4190***	0.4034***
	[0.07]	[0.07]	[0.07]	[0.07]	[0.07]	[0.07]
Quarterly Return	-0.0574	-0.2669***	-0.2951***	-0.0597	-0.2497***	-0.3042***
	[0.04]	[0.05]	[0.05]	[0.04]	[0.05]	[0.05]
ln(Size)	2.4415***	0.9116***	0.6352**	2.4368***	1.0817***	0.5405*
	[0.16]	[0.29]	[0.30]	[0.16]	[0.28]	[0.30]
ln(Size) Sq.	-0.0617***	-0.0276***	-0.0214***	-0.0615***	-0.0313***	-0.0190***
	[0.00]	[0.01]	[0.01]	[0.00]	[0.01]	[0.01]
Std. Dev. Daily Ret.	1.0956	2.4970***	2.7200***	1.1283	2.3685***	2.8183***
	[0.75]	[0.80]	[0.80]	[0.76]	[0.79]	[0.80]
Constant	-23.6345***	-8.0340***	-5.2691*	-23.6168***	-9.7854***	-4.4063
	[1.58]	[2.90]	[3.02]	[1.59]	[2.78]	[3.06]
Industry Dummies	Included	Included	Included	Included	Included	Included
Quarter Dummies	Included	Included	Included	Included	Included	Included
Adj. R^2	0.0288	0.0292	0.0293	0.0289	0.0292	0.0293
Observations	430016	430016	430016	430016	430016	430016

Table VIII

Factiva News Stories Count

This table reports the number of news stories by year that cover portfolio pumping and the number of news stories that cover collusion by Nasdaq market makers. Specifically, Panel A reports the news story count for the Factiva search "portfolio pumping," while Panel B reports results for the search "Christie AND Schultz AND Nasdaq AND Collu*."

Panel A: Portfolio Pumping		**Panel B: Nasdaq Dealers Collusion**	
Year	News Count	Year	News Count
2000	22	1994	52
2001	63	1995	71
2002	6	1996	39
2003	10	1997	12
2004	6	1998	8
2005	6	1999	10
2006	13	2000	4

Table IX

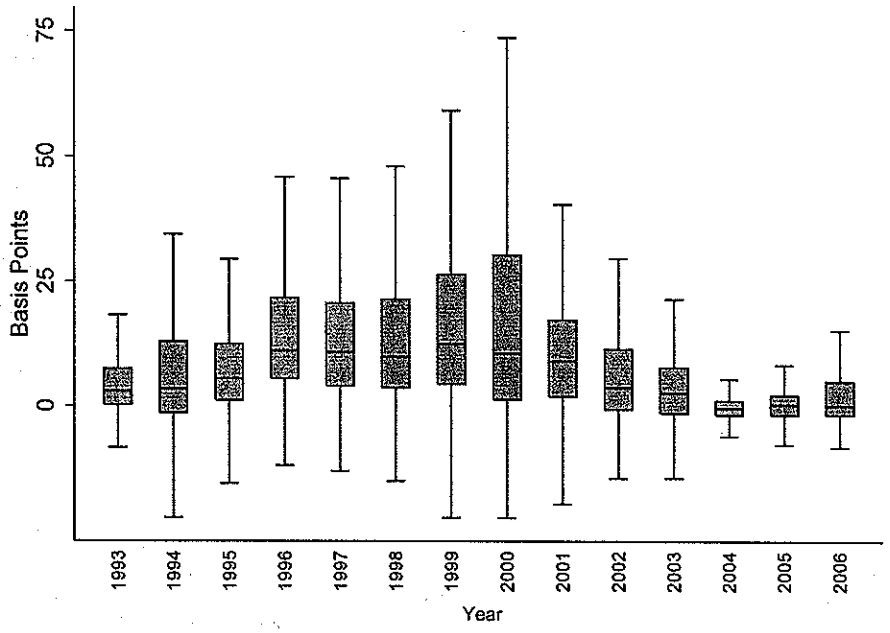
Competing Hypotheses for the Decrease in Portfolio Pumping after 2001

This table displays OLS regressions of the portfolio pumping measure (Model 1 – 5) and a modified pumping measure that controls for window dressing (Model 6) on an indicator variable for all quarters from 2002 onwards (Post 2001) and four additional variables associated with competing hypotheses. All variables are defined in Table I. Robust standard errors are clustered by funds and provided in brackets. Superscripts ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

COEFFICIENT	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Market Premium	-0.0004					
	[0.01]					
Sentiment Index		1.9629***				
		[0.15]				
Pcnt. Eq. in MF			0.2190***			
			[0.02]			
Sixteenth Spread				2.3762***		
				[0.19]		
VIX					0.3205***	
					[0.01]	
Lagged Pump. Measure	0.2568***	0.2547***	0.2537***	0.2486***	0.2308***	0.1166***
	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]
Post 2001	-8.9736***	-6.8827***	-10.6955***	-9.9196***	-8.1255***	-4.3292***
	[0.21]	[0.22]	[0.29]	[0.26]	[0.19]	[0.10]
Year-End	-0.4664***	-0.4524***	-0.4867***	-0.5583***	-0.4525***	-0.7849***
	[0.13]	[0.13]	[0.12]	[0.13]	[0.12]	[0.07]
ln(Fund Size)	-0.0126	-0.0372	-0.0585	-0.0617	-0.0168	-0.0313
	[0.05]	[0.05]	[0.05]	[0.05]	[0.05]	[0.03]
Expenses	4.3180***	4.0491***	4.1378***	4.0536***	4.2095***	2.0030***
	[0.84]	[0.84]	[0.83]	[0.83]	[0.84]	[0.42]
Turnover	0.0188***	0.0181***	0.0183***	0.0177***	0.0166***	0.0055**
	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.00]
Fund Age	-0.0021***	-0.0021***	-0.0019***	-0.0017***	-0.0017***	-0.0006**
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Aggressive Growth	3.8855***	4.1242***	3.9274***	3.9799***	4.1209***	1.6783***
	[0.52]	[0.54]	[0.52]	[0.52]	[0.52]	[0.25]
Growth	-0.4042**	-0.3731**	-0.3851**	-0.3702**	-0.3523*	-0.1109
	[0.18]	[0.18]	[0.18]	[0.18]	[0.18]	[0.09]
Small	8.0291***	8.3287***	8.0338***	8.1165***	8.3722***	3.5301***
	[0.31]	[0.32]	[0.31]	[0.31]	[0.31]	[0.13]
Constant	7.4963***	6.3693***	3.9686***	6.3957***	0.9414**	1.9750***
	[0.46]	[0.47]	[0.47]	[0.43]	[0.45]	[0.24]
Adj. R^2	0.2559	0.2527	0.2576	0.2584	0.2716	0.1798
Observations	61620	57792	61620	61620	61620	61620

Figure 1: **Changes in Portfolio Pumping over Time**

Panel A: Portfolio Pumping by Year



Panel B: Decrease in Portfolio Pumping by Quarter

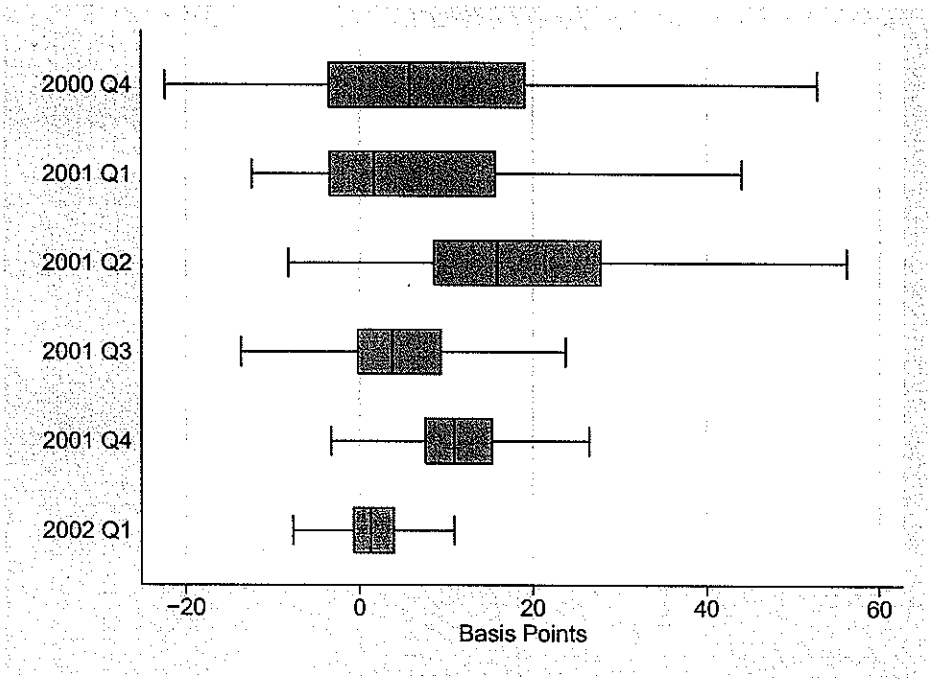


Figure 2: **Portfolio Pumping by Investment Style and Period**