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The Economics of the Mutual Fund Trading Scandal

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Abstract

I examine the economic incentives behind the mutual fund trading scandal, which made headlines in late 2003 with news that several asset management companies had arranged to allow abusive—and, in some cases, illegal—trades in their mutual funds. Most of the gains from these trades went to the traders who pursued market-timing and late-trading strategies. The costs were largely borne by buy-and-hold investors, and, eventually, by the management companies themselves.

A puzzle emerges when one examines the scandal from the perspective of those management companies. In the short run, they collected additional fee revenue from arrangements allowing abusive trades. When those deals were revealed, investors redeemed shares en masse and revenues plummeted; management companies clearly made poor decisions, ex post. However, my analysis indicates that those arrangements were also uneconomic, ex ante, because—even if the management companies had expected never to be caught—estimated revenue from the deals fell well short of the present value of expected lost revenues due to poor performance in abused funds.

Why some of the mutual fund industry's largest firms chose to collude with abusive traders remains something of a mystery. I explore several possible explanations, including owner-manager conflicts of interest *within* management companies (between their shareholders and the executives who benefitted from short-term asset growth), but none fully resolves the puzzle. Management companies' decisions to allow abuses that harmed themselves as well as mutual fund shareholders convey a broader lesson, that shareholders, customers, and fiduciary clients be cautious about relying too heavily on firms' own self-interest to govern their behavior.

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1 Introduction

The scandal that rocked the mutual fund industry beginning in late 2003 centered on abusive trades that reaped outsized returns for selected investors, particularly hedge funds, at the expense of buy-and-hold mutual fund shareholders. In a September 3, 2003 complaint, New York State Attorney General Eliot Spitzer alleged that several mutual fund firms had arrangements allowing trades that violated terms in their funds' prospectuses, fiduciary duties, and securities laws. Subsequent investigations showed that at least twenty mutual fund management companies, including some of the industry's largest firms, had struck deals permitting improper trading.

One common explanation for this behavior is that management companies had put self-interest ahead of fiduciary responsibilities to shareholders, since the deals that allowed abusive trades boosted revenues. In contrast, I find that, in facilitating trades that cut into their mutual funds' performance, management companies acted *against their own interests*—even if they had thought that they would never be caught.

This conclusion arises from an exploration of the economics of the mutual fund trading scandal from the perspective of the management companies. I compare the expected present value of the revenues and costs associated with deals allowing abusive trades. Costs included the expected consequences of getting caught in violating fiduciary duties—official penalties, civil litigation outlays, and the loss of future fee revenues because investors would likely respond by redeeming shares—weighted by the likelihood of getting caught. But management companies incurred other costs that would have arisen even if the breach of fiduciary duties had *never* been detected, because, as I show, the trading abuses substantially impaired mutual fund returns. Subpar performance would diminish expected future fee revenues that are based on assets under management because lower returns would slow asset growth through capital gains and also reduce projected net inflows from investors.

I find that, in expected present-value terms, the performance-related costs of the trading abuses—costs that management companies would have incurred even if the wrongdoing had never been revealed—easily outweighed the revenues that these companies garnered by allowing abuses. Moreover, professional asset managers should have foreseen these revenues and costs when they struck deals to allow trading abuses. Thus, even if management companies had never expected to be caught, they made self-destructive decisions in allowing improper trading to hurt performance. Of course, the additional expected costs of getting caught should have made the ex ante decision even easier: Working with abusive traders would not pay.

My findings notwithstanding, state officials and the SEC have alleged that at least twenty firms, including some of the industry's largest asset managers, elected to collude

with abusive traders and share in the short-term gains they generated. That decision proved disastrous to many of those firms. Exactly why they made this choice remains something of a puzzle. Previous research has focused on fiduciary conflicts of interest between mutual fund investors and asset management firms, but by showing that these firms acted against their own interests, my results indicate that such conflicts alone cannot explain the scandal. Agency conflicts *within* asset management firms—between their owners and managers—may have been part of the problem, although that explanation falls short in some respects, as some *principals* with substantial ownership interests in their firms chose to allow and facilitate trading abuses that harmed their own interests. Myopia or impatience might have played a role, as the costs of the trading arrangements were incurred with some delay compared with the revenues they generated, but only very high discount rates would have rationalized collusion. It is worth noting that the decisions at issue were not merely the actions of rogue employees; official complaints and settlement documents indicate that senior executives at almost every firm (and board chairs, chief executive officers, or presidents at most) approved of deals with abusive traders, and in many cases, mutual fund executives aggressively sought such arrangements.

My results argue for a reinterpretation of the lessons of the mutual fund scandal; this was not a simple instance of self-interest trumping fiduciary duty. Shareholders, customers, and fiduciary clients should be cautious about relying too heavily on firms' own self-interest to govern their behavior—for example, by assuming that firms will not engage in malfeasance if the expected present value of penalties outweighs any immediate benefit. One salient (and ironic) example of the consequences of overconfidence in private self-interest is the mutual fund scandal itself. According to a U.S. General Accountability Office (GAO) report that examined why the Securities and Exchange Commission (SEC) had not aggressively examined mutual fund companies for trading abuses prior to the New York Attorney General's complaint:

> Prior to September 2003, SEC did not examine for market timing abuses because agency staff viewed market timing as a relatively low-risk area and believed that companies had financial incentives to establish effective controls, that is, by maximizing fund returns in order to sell fund shares (U.S. Government Accountability Office, 2005).

My analysis indicates that the SEC was correct about those incentives but not about their effects on behavior.

2 Background and literature: Market timing and late trading

An investor who purchases mutual fund shares for less than their fair value (a "timer") gains the difference between the actual value and the price paid.[1] Because mutual fund shares are claims on a common pool of assets, the timer's gain is just a transfer of wealth from other mutual fund shareholders. By creating new shares in the common pool and selling them for less than their proportional worth, the management company dilutes the value of existing shares.[2]

The potential for dilution of mutual fund shareholders' wealth has been understood at least since the 1930s, although dilution vulnerabilities and the mechanisms for exploiting them have changed over time. The Investment Company Act of 1940 included provisions intended to curb rampant exploitation—especially by brokers who sold mutual fund shares—of discrepancies between share prices and values that arose because mutual fund net asset values (NAVs) were typically set based on the *previous* day's closing prices (U.S. Securities and Exchange Commission, 1940; United States v. National Association of Securities Dealers, Inc. et al., 1975). In 1968, the SEC adopted rule 22c-1, which mandated "forward pricing," that is, funds had to execute transactions at the *next* net asset value calculated *after* the order was received, to eliminate investors' ability to transact at stale prices that deviated from current market values (Barbash, 1997).

Yet, even with forward pricing, mutual fund NAVs can be stale if they are based on market prices of securities that have not recently traded. World equity funds are particularly vulnerable when they value foreign stocks at their most recent overseas-exchange market-close prices, which can be more than 12 hours old by 4 p.m. Eastern time when most U.S. mutual funds compute their NAVs. But prices for other types of funds, such as those that invest in domestic small-cap stocks or bonds that trade infrequently, can also be stale when the most recent transactions as of market close do not incorporate up-to-date information. Transactions in mutual fund shares to exploit these stale and predictable prices came to be known as "market timing."[3]

[1] This description of the dilutive effects of mispricing mutual fund shares is very brief. For a more detailed analysis of the problem see Chalmers et al. (2001), who explored mutual fund dilution in the context of the broader problem of intermediaries that set prices without full information or strong incentives to maintain prices at fair values; Zitzewitz (2003), who estimated dilution across a broad range of asset classes, analyzed the efficacy of proposed remedies, and first suggested that owner-manager conflicts of interest *within* management companies might be part of the problem; and Kadlec (2004), who briefly outlined the causes of mutual funds' structural vulnerability to dilutive trading (NAV predictability and low or zero transactions costs) and some possible remedies.

[2] A timer who sells mutual fund shares for more than their fair value also benefits, by avoiding a loss, and with the right hedging strategy, she can collect a cash gain equal to the price discrepancy. However, the timer can only exploit overpriced shares if she owns the shares initially, as mutual fund shares themselves cannot be sold short.

[3] Market timing in this context refers to exploiting mutual fund NAVs that do not reflect *current* market values and should be distinguished from the broader use of the term to indicate buying and selling of assets based on predictions of *future* price movements.

Investment management firms have recognized that dilutive trades are possible even with forward pricing at least since 1980, when the Putnam Funds sought and received from the SEC assurance that it would not take action against Putnam for using a "fair value determination" to value foreign stocks if "some extraordinary event" occurred between the daily closing of a foreign stock exchange and 4 p.m. Eastern time (Ropes & Gray, 1980; U.S. Securities and Exchange Commission, 1981). This would, according to Putnam, "avoid the abuses which forward pricing, as set forth in Rule 22c-1, was intended to limit." SEC letters to the Investment Company Institute in 1999 and 2001 went a step further in urging funds to fair value securities to eliminate stale pricing and protect long-term fund investors from dilution (Scheidt, 1999, 2001). By 2000, many mutual funds—including those in families that were later caught up in the scandal—had included prospectus language indicating that they prohibited market timing.

As early as 1995, however, several mutual fund management companies began colluding with market timers to permit extensive dilutive trades, often as part of quid-pro-quo arrangements. For example, asset management firm ABC might stipulate that a hedge fund seeking market-timing access to the ABC international equity fund must maintain a stable investment ("sticky assets") in one of the ABC bond funds. The sticky assets would generate a steady stream of management fee revenue for ABC, and the hedge fund would obtain an agreed-upon "timing capacity," that is, a maximum volume of market-timing transactions for a specified time period. Timing capacity was often a multiple of the sticky assets; multiples of five and ten were common. To improve the profitability of market timing in their mutual funds, some management companies also disclosed non-public portfolio composition data and waived redemption fees—which were designed in part to prevent market timing—for selected customers (see, for example, U.S. Securities and Exchange Commission (2003a, 2004a,b,c); Attorney General of the State of New York (2004a, 2005a,b)).

Worse yet, a handful of portfolio managers and mutual fund executives abusively traded their own mutual funds (Massachusetts Securities Division, 2003; U.S. Securities and Exchange Commission, 2003c; Tufano, 2005; U.S. Securities and Exchange Commission, 2004c). And some mutual fund firms (and several brokers and transactions-processing firms) facilitated "late trading," that is, transactions in mutual fund shares at *previously*-determined NAVs (see, for example, Attorney General of the State of New York (2005a); U.S. Securities and Exchange Commission (2007b)). Late trading, like market timing, seeks to exploit stale prices and dilutes buy-and-hold investors' wealth, but late trading also violates rule 22c-1, and is thus illegal.

Well before the scandal broke, researchers began documenting evidence of widespread market timing, particularly among world equity funds. Bhargava et al. (1998) described the profitability of simple market-timing strategies in international equity funds,

and Chalmers et al. (2001) documented exploitable opportunities in small-cap domestic equity funds as well. Boudoukh et al. (2002) provided detailed strategies for market timing several specific international equity funds and noted: "Currently, we know of at least 16 hedge fund companies covering 30 specific funds whose stated strategy is 'mutual fund timing.'" Although Goetzmann et al. (2001) also documented stale prices in world equity funds, they found that market-timing flows were causing only minor dilution of returns. In contrast, Greene and Hodges (2002) found evidence of substantial dilution in international equity funds, particularly in those with high flow volatility. Zitzewitz (2003) provided estimates of dilution across a broader range of funds, including domestic mid- and small-cap equity funds and precious metals funds, as well as world equity funds. He argued that management companies' sluggish response to a problem as costly and prevalent as abusive trading reflected an owner-manager conflict of interests between the companies and mutual fund shareholders. Moreover, foreshadowing the thesis of this paper, Zitzewitz provided a back-of-the-envelope calculation to suggest that management companies might be acting against their own interests in allowing abusive trades.

Even so, the extent of management companies' collusion with abusive traders was apparently well-concealed before September 3, 2003. On that day, the New York Attorney General issued a complaint against a hedge fund, Canary Capital Partners, which had arrangements permitting extensive market timing and late trading at several mutual funds. The scandal broadened in the following months and eventually ensnared 21 mutual fund firms, which together managed 22 percent of industry assets in late 2003.

The scandal revelations prompted a flurry of research. Several papers surveyed the wrongdoing and offered explanations and remedies. Mahoney (2004), assuming that management companies had acted in their own interests in colluding with abusive traders, attributed the wrongdoing to "basic conflicts of interest between mutual fund investors and the companies and individuals that organize, sell and provide services to mutual funds." Kadlec (2004) provided a brief overview of the vulnerabilities of mutual funds to market timing and a simple framework for addressing them. Greene and Ciccotello (2004) showed that the dilution losses of buy-and-hold investors depend on the cash management policies of portfolio managers, and Zitzewitz (2006) estimated the dilutive impact of late trading, which was not addressed in the academic literature before the scandal broke. Qian (2006) examined the relationship between wrongdoing and fund family attributes, such as governance, and found that families for which net flows were less sensitive to past performance were more likely to have been tainted by the scandal.[4] That conclusion is relevant to my analysis, as it suggests that ex ante costs of colluding might have been lower for families that chose to do so. Nonetheless, I find that even for

[4]Notably, Qian's focus is on governance of *mutual funds* rather than management companies.

the tainted fund families themselves, that choice was a very poor one.

Other research has focused on the penalties that markets and government officials imposed on mutual fund firms that were caught allowing abusive trading. Houge and Wellman (2005) found that in the three days following news of wrongdoing by a management company, its stock price (or that of its parent firm) dropped on average by more than five percent, and that, relative to their untainted competitors, tainted firms' assets under management had fallen by 13 percent in the first six months following the scandal revelations. Choi and Kahan (2006) showed that stiffer official penalties and more press coverage were associated with larger net redemptions from tainted mutual fund families, and that within a year of the scandal revelations, net redemptions from tainted families had reached 19 percent of pre-scandal assets. According to Schwarz and Potter (2006), net outflows continued well into the second year after the scandal broke. Zitzewitz (2007b) found that the New York Attorney General's involvement in settlement negotiations raised the ratio of penalties to dilution damage by roughly three- to four-fold.

3 Data

I employed annual, monthly, and daily data from the Center for Research in Securities Prices U.S. mutual fund database (CRSP) to compute monthly fund flows, returns, and distributions from 1991 to 2007. To compute net new cash flow, that is, flows net of reinvested distributions, I also used data from the Investment Company Institute on the fractions of distributions reinvested by mutual fund investment objective. I obtained daily mutual fund assets information from TrimTabs and share-price and distribution data from CRSP and Yahoo! Finance to compute estimates of the dilution due to trading abuses. Data for calculations of management companies' weighted average costs of capital came from Compustat and CRSP.

4 Identifying mutual funds that were subject to trading abuses

To identify the mutual funds that were subject to arrangements allowing market timing and late trading abuses, I used four types of sources. The first was published lists of firms that were tainted by the scandal, such as *The Wall Street Journal's* "Mutual Fund Scandal Scorecard," which tracked mutual fund complexes, investment advisers, brokers, hedge funds, and others who allegedly benefitted from trading abuses. Houge and Wellman (2005), Qian (2006), and Zitzewitz (2007b) also provide lists of the firms that were caught up in the scandal. The second, most important resource was state and SEC filings, including complaints, cease-and-desist orders, assurances of discontinuance, proposed plans of distribution, and other documents. These filings were essential in identifying the individual mutual funds that were subject to arrangements allowing abusive trades. A

third resource was prospectus updates and published summaries of internal reviews regarding abusive trading that were provided by the mutual fund management companies themselves. Finally, I used press reports to identify an additional handful of funds not mentioned in official documents and to pin down the timing of the revelations about wrongdoing at different fund families.

4.1 "Abused" and "tainted" mutual funds.

I label a mutual fund "abused" if, according to the sources listed above, its management company entered into an arrangement allowing the fund to be market timed or late traded or if the fund was abused by principals or employees at its management company.[5] Abused funds include those that were subject to abusive trades as part of quid-pro-quo arrangements that required investors to park "sticky assets" within the fund family—for example, at another mutual fund or a hedge fund. However, I do not label a fund abused if it received sticky assets or was on the other side of market-timing exchanges (that is, held temporarily between timing "investments"), but was not itself market timed or late traded.

I define as "tainted" any mutual fund that, according to my sources, was *not* itself abused but was operated by a mutual fund family that managed at least one abused fund. Tainted families are those that operated abused and tainted mutual funds. Hence, tainted funds and abused funds are two mutually exclusive sets whose union is all mutual funds operated by tainted mutual fund families.[6]

Table 1 lists tainted mutual fund families, their assets under management at the end of August 2003 (at the eve of the scandal), the dates when they were publicly implicated for wrongdoing, the number of abused mutual funds they operated, and the assets under management in those funds.[7] In total, tainted families managed over $1 trillion in assets in long-term mutual funds—22 percent of the industry's assets under management in long-term mutual funds at that time.[8] Combined, they managed 145 abused

[5] At Putnam, portfolio managers extensively market timed their own mutual funds and other funds in the complex. Their timing activity was widespread and affected about two dozen different Putnam mutual funds, but trading (and the resulting dilution, as estimated in Putnam's distribution plan) was heavily concentrated in 10 funds and was relatively small in the others. I have labeled as "abused" only those 10 funds (Tufano, 2005).

[6] This paper addresses abuses related to market timing and late trading, so I do not consider a mutual fund family to be "tainted" based on allegations about other types of questionable behavior (for example, management companies having undisclosed "shelf-space" arrangements with brokers who sold fund shares).

[7] One additional mutual fund family, Ameriprise (which was previously owned by American Express, and whose mutual funds have carried the brands "AXP" and "Riversource") was implicated for allowing market-timing trades. Ameriprise funds are not included in my analysis, however, because I could find no information about which mutual funds the management company allowed to be abused (U.S. Securities and Exchange Commission, 2005a).

[8] This figure is based on Investment Company Institute data that show that the mutual fund industry

funds with $277 billion in assets—6 percent of the industry total. These funds spanned a broad range of investment objectives, including 81 domestic equity funds, 38 world equity funds, 3 hybrid funds, 14 taxable bond funds, and 9 municipal bond funds.

4.2 Official penalties

The New York Attorney General's complaint in September 2003 not only signaled a sweeping investigation of mutual fund management firms, broker-dealers, abusive traders, intermediaries, and others by his office, but also prompted inquiries by the SEC and states attorneys general from Massachusetts to Colorado. These official actions resulted in a slew of penalties assessed against management companies that were found to have facilitated and profited from trading abuses, as well as fines for many company executives and employees.

Table 2 lists these penalties. They included $2.3 billion in civil penalties and disgorgement levied by the SEC and state officials against mutual fund management companies and their parent firms (columns 1 and 2). An additional $47 million in penalties was self-imposed by four fund families that initiated their own shareholder restitution programs (column 3).[9] Several top executives—management company chairmen, chief executive officers, and presidents—paid a total of about $220 million in disgorgement and civil penalties (columns 4 and 5). Aggregate penalties for other less-senior employees were less than $5 million (columns 6 and 7). Finally, New York Attorney General Eliot Spitzer negotiated very large management fee reductions as part of his settlements with several mutual fund companies. He explained his rationale to *The Wall Street Journal*:

> ... [I]n a context where a company has violated its fiduciary duties and failed to protect shareholders by acquiescing to fees higher than a market permits, a rollback should be an appropriate part of the remedies imposed on a company (Solomon, 2003).

The New York Attorney General's settlements mandated that the fee reductions occur over five years. Cumulative fee reductions for all tainted firms totalled $1.1 billion (column 8). Aggregate penalties, including civil penalties, disgorgement, restitution, and fee reductions, sum to $3.7 billion (column 9).

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managed $4.8 trillion in assets in long-term mutual funds at the end of August 2003. The assets of funds in the CRSP database totaled $4.3 trillion at the eve of the scandal, so tainted families managed 24 percent of industry assets tracked by CRSP.

[9] I include restitution payments because management companies typically made them in advance of official complaints and settlements, and in some cases, disgorgement amounts were reduced by the amounts of the restitution that had previously been paid.

5 Losses to buy-and-hold investors in abused funds

5.1 Previous estimates of losses

Previous studies of the costs of market timing and late trading for buy-and-hold investors fall into two categories. First, in papers mostly completed before the scandal broke, researchers estimated dilution due to trading abuses without any specific knowledge of the funds that were harmed by trading-abuse arrangements. These papers identified investment objectives in which dilution was most problematic, and typically argued for policy changes—by mutual fund management companies and regulators—that would reduce or eliminate dilution due to market timing. A second group of papers, written after the scandal first made headlines in September 2003, focused more specifically on tainted mutual fund families and either estimated dilution in those families or compared the returns of their mutual funds to those of untainted funds to ascertain the costs to investors of the abusive-trading arrangements.

As shown in table 3, papers written before September 2003 employed measures of dilution to estimate losses to buy-and-hold investors. Greene and Hodges (2002) used daily data on fund flows and returns and estimated that dilution in world equity funds with above-median flow volatility averaged 0.94 percentage point of assets per year in the period from February 1998 to March 2001. Their estimates of dilution in other investment objectives were small. Zitzewitz (2003) used futures data to identify timing opportunities more precisely and found substantial dilution in world equity funds, with the worst problems in regionally-focused (Pacific, Japan, and European) equity funds, where annual dilution averaged 1.60 percentage points from 1998 to 2001. General international equity and precious-metals funds also suffered substantial dilution. Zitzewitz's (2006) estimates of dilution due to late trading were considerably smaller than those he computed for market timing, although the late-trading losses are averaged over much broader categories of funds.

After the scandal broke, researchers turned their attention to the tainted fund families. Based on mutual funds' share turnover rates, Zitzewitz (2007b) found average dilution of about one-half percentage point per year from 2000 to 2003 among *all* (both abused and tainted) international equity funds in tainted families—with predicted dilution exceeding three percentage points in a couple of complexes. Other researchers examined differences in fund returns to estimate losses to investors. Houge and Wellman (2005) estimated that simple average returns from 2000 to 2003 for funds at scandal-tainted complexes were 0.15 percentage point per year below those of funds at non-tainted families, but they also did not distinguish funds that were subject to abusive trading and those that were not, and their calculation does not control for the investment objectives and risks of the funds offered at different complexes. Schwarz and Potter (2006) estimated

that the risk-adjusted returns of *domestic equity* funds at tainted complexes lagged those of their peers by an average of 0.83 percentage point from 2000 to 2003. Again, their calculation did not differentiate mutual funds that were subject to dilutive trades and those that were not. Qian (2006) sought to distinguish tainted and abused mutual funds and estimated that abused funds suffered performance penalties of roughly two percentage points from January 2001 through August 2003.

5.2 New estimates of losses

Because the effects of abusive trading on mutual fund performance are central to the thesis of this paper, and since estimates of these effects in previous research have been motivated by questions different from those addressed here, I computed new estimates of the performance losses among abused funds. I used a two-stage approach: First, I computed the risk-adjusted relative performance for every mutual fund in my sample, using methods discussed below; and second, I tested whether the adjusted returns of abused and tainted funds were significantly different from those of other funds in the years before and after the scandal broke.

5.2.1 Stage 1: Estimating each fund's annual risk-adjusted relative performance.

The mutual funds that were abused in the trading-abuse scandal covered the full range of investment objectives and included domestic equity, world equity, taxable bond, municipal bond, and hybrid funds. However, standard measures of risk-adjusted mutual fund performance, such as that employed by Carhart (1997), are generally applicable only to U.S. equity funds and would only be useful for a subset of abused funds. To make industry-wide comparisons, I used three measures of risk-adjusted relative performance that are applicable across all types of mutual funds.

My primary method employs asset-weighted mean returns for different categories of mutual funds as risk factors; that is, it controls for the degree of category-specific risk (as well as broader market risks) that each fund exhibits. I computed two additional measures of risk-adjusted returns to show that my estimates of the losses due to trading abuses are robust to different methods of adjusting returns for risk. One is just the difference between a fund's return and the average return of all other funds in its category. The other method uses a set of standard market-risk factors.

1. Relative return. A simple, if primitive, measure of risk-adjusted returns is a fund's return less the average return of funds sharing its investment objective. I define a mutual fund's "category return" as the asset-weighted mean return of all funds that share its S&P investment objective,[10] and its "relative return" as its total return less its

[10] I used the Standard & Poor's detailed objectives to identify each mutual fund's investment category.

category return.

2. Alphas based on category-return risk factors. A second method adjusts relative return for risk by employing three risk factors for each fund: The fund's own category excess return, the asset-weighted mean excess returns of all funds sharing its broader asset class, and the asset-weighted mean excess return of all mutual funds.[11] A mutual fund's loading onto the category-return risk factor is a measure of its sensitivity to the risk common to all funds that share its specific investment objectives, while loading onto the returns of its broader asset class picks up exposure to risks from related fund categories due, for example, to a management strategy that encompasses multiple objectives or to misclassification by S&P. And loading onto the returns of all funds indicates a fund's exposure to general market risk, controlling for its comovement with its narrower asset classes. I estimated risk-adjusted return, α_i, in the following regression:

$$r_{it} = \alpha_i + \beta_i^C r_t^{C_i} + \beta_i^B r_t^{B_i} + \beta_i^M r_t^M + \varepsilon_{it}. \quad (1)$$

Here, r_{it} is fund i's excess return (return less the mean money market fund yield) in month t, $r_t^{C_i}$ is the asset-weighted excess mean return for i's category, $r_t^{B_i}$ is the excess mean return of fund i's broader asset class, and r_t^M is the excess mean return of all long-term mutual funds. (Relative return is α_i estimated in equation (1) subject to the constraints that $\beta_i^C = 1$ and $\beta_i^B = \beta_i^M = 0$.)

3. Alphas based on market risk factors. I also computed risk-adjusted performance using a common set of more-standard risk factors, namely: (1) the S&P 500 index return, (2) the Russell 2000 index return less the S&P 500 index return (a size premium), (3) the Nasdaq index return less the S&P 500 index return (a technology premium), (4) the MSCI excluding-US value-weighted index return, (5) changes in constant-maturity off-the-run 10-year Treasury bond yields, and (6) changes in spreads on 10-year BBB corporate bonds over Treasuries (a credit spread).

In general, the category-return risk factors explain slightly more of the variance in mutual fund returns over the sample periods I studied. For example, the median adjusted R^2 from the category-return risk-factor regressions described by equation (1) for the three years ending August 2003 is 0.92, while that for the standard risk-factor regressions is 0.87. For the three years following the scandal revelations, the median adjusted R^2s are 0.92 and 0.88 respectively.

Gross and net returns. Because mutual fund investors earn returns net of fees,

S&P classifies long-term mutual funds into 155 objectives (93 of them are tax-exempt categories). I merged categories with less than 10 funds (e.g., S&P maintains separate categories for short-term, intermediate-term, and general Maryland municipal bond funds, but I combined the three) and finished with 102 categories.

[11] Broader asset classes are domestic equity, world equity, hybrid, taxable bond, and tax-exempt bond funds. "Excess" returns in a given month are returns less the industry-average money-market fund yield for the month (not annualized).

rather than gross returns, fund performance is usually reported net of fees, and most research focuses on net returns. However, the effects of trading abuses on performance should be seen most clearly in gross returns, because variation in net returns would reflect not only the effects of trading abuses but also any differences in fee structures.[12] Hence, I used gross returns in my baseline calculations of risk-adjusted performance, but I also report results using net returns.

Sample periods. To estimate the losses to the shareholders of abused and tainted mutual funds, I initially examined the performance of these funds in the three years before the scandal broke (September 2000 through August 2003) and in the three years afterward (January 2004 through December 2006) relative to that of untainted mutual funds. While there is evidence that some abusive-trading arrangements were in effect well before September 2000, I did not find (as discussed below) statistical evidence of an aggregate performance loss among abused funds prior to 2000.

5.2.2 Stage 2: Estimating the effects of trading abuses on risk-adjusted annual performance.

To capture the performance effect of the trading abuses, I estimated a cross-sectional regression of each fund's alpha (from stage 1) on two dummies—one for abused funds and a second for tainted funds. I also included the natural log of each fund's assets under management in the regression, because other researchers have predicted or found that risk-adjusted excess returns, timing-related dilution, and the likelihood of collusion with abusive traders varied with fund size.[13]

$$\alpha_i = c_0 + \gamma_1 \text{AbusedFund}_i + \gamma_2 \text{TaintedFund}_i + \xi\left(\ln(assets_i)\right) + \eta_i \tag{2}$$

Here, AbusedFund_i is equal to one if and only if fund i is an abused fund, TaintedFund_i is equal to one if and only if fund i is a tainted fund, and $assets_i$ is the mean assets of fund i over the period in question.

Estimated losses for buy-and-hold investors. My results are shown in table 4, which reports regression coefficients γ_1, γ_2, and ξ obtained using five different performance measures and two different sample periods: the three years before and the three years after the mutual fund trading scandal broke. Columns 1, 2, and 3 show results

[12] One complication, however, is that gross return data is generally not observed directly, and can only be calculated as the sum of net returns and the expense ratio. But *assessed* expenses may not be reported accurately, if data vendors miss fee waivers that reduce assessed fees from levels published in prospectuses (for example, Christoffersen (2001) found that fee waivers were common among money market funds). So, gross returns data may be less accurate than net returns data.

[13] For example, Berk and Green (2004) developed a model that predicts that larger funds earn smaller excess returns. Qian (2006) found that larger mutual funds were more likely to be involved in the scandal. On the other hand, Zitzewitz (2007b) found that dilution due to abusive trading was *negatively* correlated with fund size.

for the three performance measures discussed above: relative returns, alphas based on category-return risk factors, and alphas based on six market-risk factors. A fourth measure uses the category-return risk factors but includes Nasdaq excess returns as an additional factor to control for the possibility that some mutual funds had loaded heavily on technology-stock risks. Finally, column 5 shows estimated coefficients based on alphas computed using *net* returns, rather than gross returns, and category-return risk factors.

The results reported in panel A of the table indicate that estimated performance losses for abused funds in the three years prior to September 2003 are statistically significant and enormous. The relative returns of abused funds were, on average, 4.9 percentage points lower than those of their untainted counterparts each year. More sophisticated controls for risk result in somewhat lower estimated performance penalties, in the range of 3.6 to 4.4 percentage points per year, but these effects are still very large—much larger than estimates from previous research.

Costs to buy-and-hold investors in abused funds implied by these figures are stunning. The smallest of the performance penalties shown on the table (3.6 percentage points per year) represents losses of approximately $10.4 billion per year, given that the total assets under management in abused funds over the three years before the scandal broke averaged $321 billion, and assuming, conservatively, that 90 percent of the dilution was suffered by shareholders who were not abusing the funds.[14]

In addition, tainted funds sustained statistically significant hits to performance in the three years prior to the scandal revelations, with risk adjusted returns of 60 to 90 basis points below those of their untainted peers. The relatively poor returns of tainted funds probably reflect several factors that weighed on performance. First, the costs of rapid exchanges of abusive traders' money among funds at a tainted family affected not only abused funds but also funds on the other side of these exchanges. Second, because some tainted mutual fund families earned reputations for being "timer friendly"—that is, broadly accessible to market timers—dilution and the other costs of trading abuses were not necessarily confined to the funds I have identified as abused (see, for example, U.S. Securities and Exchange Commission 2004b; Attorney General of the State of New York 2003). Third, the legal documents and other sources I have used to identify abused mutual funds likely missed some mutual funds that were subject to abusive arrangements, so the poor performance of tainted funds may, in part, reflect a misclassification

[14]There is little direct evidence about abusive traders' share of assets under management in abused mutual funds, but it probably averaged well under 10 percent in most fund complexes. Official documents indicate that the *peak* levels of market timers' assets in abused funds in all but one fund family were below 10 percent of those funds' assets. Abusive traders' dilution losses likely would have been smaller than their share of assets, however, as market timers were less likely to be holding shares on days when substantial dilution occurred. For example, abusive traders probably held more than 1 percent of assets in Janus' abused funds at one point, but estimated dilution suffered by abusive traders at Janus was only 0.08 percent of total dilution (James, 2007).

of abused funds as tainted funds.

Risk-adjusted relative returns for the three years *after* the scandal broke are reported in panel B of table 4. The performance of abused funds was, by most measures I employed to adjust for risk, statistically indistinguishable from that of untainted funds. Other funds at tainted families—the "tainted" mutual funds—outperformed their peers by 20 to 30 basis points by most risk-adjustment measures, although the performance advantage disappeared when I used alphas based on category-return risk factors and Nasdaq returns.

Figure 1 shows smoothed histograms of relative returns and estimated alphas in the three years before and the three years after the scandal broke. For the three years prior to September 2003, the distributions of performance measures for abused funds (the thick, red curves) lie noticeably to the left of the those for all funds (the thin black curves) and for tainted funds (the blue curves). Clearly, the estimated differences between abused and other mutual funds are not just due to a few outliers. In the three years after the scandal, despite some statistically significant differences reported in table 4 for tainted and abused funds, their histograms line up fairly closely with those for all funds.

Year-by-year estimates of performance losses. To pin down the timing of the performance losses in abused funds more precisely, I estimated each mutual fund's risk-adjusted relative performance on an annual basis using a rolling 36-month regression of the fund's monthly returns on the three risk factors:

$$r_{it} = \alpha_{0i} I_t^0 + \alpha_i I_t + \beta_i^C r_t^{C_i} + \beta_i^B r_t^{B_i} + \beta_i^M r_t^M + \varepsilon_{it}. \tag{3}$$

This is similar to equation (1), but in equation (3), I estimated two different intercepts: one for the first 24 months of the rolling sample period (α_{0i}), and the alpha of interest (α_i) for the last 12 months of the sample period. That is, I_t^0 is an indicator variable equal to 1 for the first 24 months of each rolling sample period (and zero otherwise), and I_t is equal to one only for the last 12 months of the sample period (and zero otherwise). To maintain comparable annual sample periods while examining the effects of a scandal that was revealed to the public in early September 2003, my rolling regressions end in August of each year.

Figure 2 shows the annual relative returns of abused and tainted funds in the upper left and lower left panels, respectively. By the metric of relative returns—which do not control for within-category variation in risk—abused funds *outperformed* their peers from 1998 to 2000, underperformed in the three years prior to the scandal revelations, and recorded mixed performance after 2003. Among tainted funds, relative returns were substantially less volatile, but they were better than average in 1998 and 2000 and worse than average in 2001.

Risk-adjusted excess returns provide a somewhat cleaner picture of the relative

performance of abused and tainted funds. Abused funds' alphas based on the category-return risk factors, which are plotted in the upper right panel of figure 2.A, are significantly better than those of their peers in 1996 and 2000, but a period of substantial underperformance begins in 2001 and lasts through 2004. Thereafter, alphas are roughly zero. Alphas for tainted funds, shown in the lower right panel, are for the most part statistically indistinguishable from zero.

Other measures of risk-adjusted performance are shown in figure 2.B. The left panels depict alphas computed using the six market-risk factors, which are quite volatile, and the right panels show alphas based on category-return and Nasdaq risk factors. All four measures of adjusted returns indicate abnormally poor performance for the period from 2001 through 2004 (although by one measure—relative returns—performance was not significantly below average in 2003). On the other hand, abused funds experienced relatively good performance in a couple of years, notably 1996 and 2000. Among tainted funds, no particular pattern emerges. For example, three of the measures show statistically significant underperformance in one of the years between 2001 and 2003, but the bad year is different for each measure.

Comparison with previous studies. The estimated performance penalty for abused funds in the three years prior to the scandal revelations is substantially larger than what previous studies have found. For example, performance losses of 3.6 percentage points per year far exceed pre-scandal estimates of dilution losses for even the most-abused investment objectives (such as Asian equity funds). This is not surprising, for several reasons.

First, losses at abused funds are likely to be have been larger than those at other funds that shared the same investment objective, but dilution studies done before the scandal broke pooled funds that were traded abusively and those that were not. Thus, these studies likely understated dilution at abused funds.[15]

Second, dilution only accounted for a portion of the losses at abused funds, so the hit to performance suffered by these funds probably exceeded dilution considerably. Other costs were largely deadweight losses: They cut into the returns of mutual funds without generating any gains for timers. These costs included the portfolio-asset trading costs and administrative costs due to the heavy inflows and outflows associated with abusive trading. These massive inflows and outflows also reportedly forced portfolio managers to hold sub-optimal asset allocations (for example, large cash positions) that could be a drag on performance. These problems compounded one another: Managers who held large cash positions sometimes made significant asset purchases at month-end to show that they were fully invested. And large cash flows were also an enormous

[15]Some researchers examined variation within categories to pinpoint dilution at the most vulnerable funds. Greene and Hodges (2002), for example, found that among funds sharing an investment objective, those with the most daily flow volatility suffered the most dilution.

distraction for portfolio managers. For example, a Seligman portfolio manager wrote in a 2001 email message to the firm's chief investment officer:

> . . . By my reckoning, we've had 14 round trips of massive flows in and out meaning 28 trading days I have either been scrambling to get invested or raising liquidity. There were only 49 trading sessions over this period, so this is how I've spent about 60% of my time.
>
> Given that we cannot employ futures and our systems for notifying me of activity do not allow me to get invested on a timely basis, the execution costs are huge to our existing shareholders (Attorney General of the State of New York, 2006, Exhibit 2).

The chief compliance officer at Invesco complained in a memo to the firm's president and CEO:

> In short, market timers can and do interfere with a portfolio manager's decision-making process. Virtually every portfolio manager at INVESCO would concede that he or she has had to manage Funds differently to accommodate market timers. Certainly, the amount of time spent managing volatile cash flows could be better spent picking securities and developing long-term strategies (Attorney General of the State of New York, 2003, Exhibit A).

Even without abusive trading, mutual fund portfolio trading costs, which include brokerage costs, spread costs, and the price impacts of large trades, can be quite large. Using data from 1984 to 1991, Chalmers et al. (1999) found that reported brokerage fees plus estimated spread costs exceeded 1.37 percent of assets per year for funds in the 90th percentile, compared to just 0.70 percent per year for the median fund. Their estimates likely understated trading costs, however, because they excluded the price impacts of trades, missed the costs of some trades, and used reported brokerage fees, which probably understate actual fees (Cassidy, 2004). Even so, Cassidy reported brokerage fees as high as 8 percent of assets per year in some extreme cases. It is plausible that some of the highest trading costs were those borne by funds that saw heavy abusive-trading flows.

Edelen (1999) showed that "liquidity-motivated trading," that is, portfolio-asset trades that are prompted by net flows to and from mutual funds, on average cost equity mutual funds 1.4 percentage points of risk-adjusted performance per year in the late 1980s—presumably well before the massive flows associated with market timing became a problem. Moreover, he found that an annual rate of liquidity-motivated trading equal to a fund's assets cost it, on average, 1.5 to 2 percentage points of return per year. Liquidity-motivated trading was probably a major drag on performance at many abused mutual funds; Zitzewitz (2007b) reported that international equity fund share

turnover exceeded 100 percent of assets at most tainted mutual fund families in the period from 2000 to 2003, and share turnover was reportedly many multiples of assets in some abused mutual funds. For example, Invesco's own chief compliance officer computed share turnover rates of 6,000 percent at one of the family's abused funds (which was marketed to unsuspecting children!) and more than 22,000 percent at another. Worse yet, the timing of cash flows from abusive traders made their impact especially deleterious. The senior portfolio manager at Invesco complained at one point, "I had to buy into a strong rally yesterday, and I know I'm negative cash this morning because of these bastards and I have to sell into a weak market" (Attorney General of the State of New York, 2003).

Losses not captured in my estimates. The loss estimates presented here may be biased *downward* because they are based on a comparison of the returns of abused funds and those of their untainted competitors. Underlying this comparison is the assumption that trading abuses did not reduce returns at mutual funds in untainted families. But even for management companies that aggressively worked to prevent abusive trading in their funds, market timing was often difficult to detect and stamp out, so abuses may have been more widespread among funds than was reflected in official complaints and settlements, news reports, and fund disclosures. To the extent that untainted funds suffered losses from trading abuses, my estimates of the effects of these abuses on performance would be too small.[16]

6 Comparing the revenues and costs of abusive-trading arrangements

My primary finding in this paper is that mutual fund management companies made poor economic decisions in striking deals that allowed abusive trading of their funds. To make my argument as precise as possible, I analyzed the decision whether or not to enter into arrangements to allow market timing (or late trading) as of three years before each mutual fund family's arrangements became public. For example, for the firms that were named in the New York Attorney General's first September 2003 complaint, the analysis was done from the perspective of the end of August 2000; for firms whose wrongdoing was detected later, the perspective was adjusted accordingly.

Because the revenues and losses from facilitating abusive trading cannot be esti-

[16]My estimates do not include two additional forms of losses that might have been important to buy-and-hold investors. First, I do not consider capital-gains tax liabilities generated by heavy portfolio asset trading. Chalmers et al. (1999) estimated that such tax liabilities—at least over the sample period they analyzed—were small relative to the typical mutual fund's expense ratio and trading costs. Still, such costs might have been more substantial in funds with high past returns, particularly for investors who planned to hold fund shares for long periods in taxable accounts, and who expected to wait many years before realizing capital gains. Second, I did not attempt to compute the opportunity costs of losses that erode investors' capital: Lost returns deprive investors of future capital gains (losses) when future returns are positive (negative).

mated with any precision for most individual management companies, I measured the *aggregate* revenues and costs of this behavior for all tainted fund families. While my analysis does not address some of the margins on which this decision might be made (for example, allowing timing only in certain types of funds), the finding that average costs of trading arrangements so outweighed the average revenues suggests that a marginal analysis would be even more unfavorable to these deals.[17]

The revenues that mutual fund management companies reaped from abusive trading arrangements were mostly increased management fees, including those assessed on "sticky assets" and on traders' investments in the funds they were abusing, although that money often stayed in the funds only for brief intervals. In addition, fund portfolio managers and senior executives at some companies profited directly from abusive trading of their own funds. To the extent that these individuals kept their trading gains, management companies did not benefit directly. Nonetheless, the trading gains represented additional compensation for company personnel, and I include estimates of these individuals' gains from trading abuses in my tally of company revenues.[18]

By facilitating trading abuses, a management company incurred two types of expected future costs: those that would accrue regardless of whether the arrangements were detected and those that would be incurred only if the firm were caught. Even if deals to allow abusive trading were *never* discovered, the depressing effect of the trades on performance would be expected to cut into assets under management and reduce fee revenue. Once arrangements were revealed, a management company would anticipate incurring three types of additional costs: official penalities, including fines and disgorgement; civil litigation costs; and a damaged fiduciary reputation that would result in net outflows from the company's funds.

Discounting revenues and costs. Both the revenues and the costs of a decision to allow and facilitate trading abuses would accrue over time, so a comparison of revenues and costs requires an appropriate discount rate. For each tainted mutual fund manage-

[17]There is reason to believe that the marginal costs of allowing abusive trades increase, and the marginal revenues decrease, with the magnitude of trading allowed. Mutual fund investors respond non-linearly to past returns, suggesting that the flow penalty for abuse-related performance losses may increase more than proportionally with those losses. Moreover, small amounts of timing would be difficult to detect in performance or other measures, but larger-scale abuses would eventually be observable in increased share turnover statistics and ultimately, despite the considerable noisiness of returns, in reduced performance. Hence, the chance that a mutual fund company would eventually be caught by prosecutors or identified by researchers or industry monitors as "timer friendly" likely increases nonlinearly in the magnitude of the abuses. And as the aftermath of the scandal indicates, the resulting damage to an asset manager's reputation from such revelations would be extremely costly. Moreover, dilution gains to traders diminish as abusive trading flows become a larger fraction of a mutual fund's total assets under management (in the limit, if an investor accounts for all of a fund's assets, she cannot reap any gains from abusive trading).

[18]For example, even after senior executives at Putnam became aware that portfolio managers were market timing their own funds, the managers were allowed to continue their abusive trading—*while managing the funds*—and to retain their timing gains (Massachusetts Securities Division, 2003; U.S. Securities and Exchange Commission, 2003c).

ment firm (or its parent) with publicly traded debt or equity, I computed a weighted-average cost of capital (WACC) equal to the weighted mean of the tax-adjusted yield on publicly traded debt and an expected return on equity based on the market beta of the firm's stock. The debt and equity components are each weighted by their market value. Since I focused on investment management companies' decision whether or not to collude with abusive traders as of the end of August 2000—three years before the scandal broke—all of the WACC computations are based on yields and betas measured in 2000, although using data for 2000 through 2002 has no material effect on the average. The WACCs I computed for tainted mutual fund firms ranged from 9.0 percent to 15.2 percent per year. The mean WACC of the tainted firms in 2000, weighted by their mutual fund assets under management, was 11.6 percent per year.

Revenues, costs, and profits. My analysis compares the revenues obtained through arrangements with abusive traders and revenues foregone because of future reductions in assets under management, rather than reviewing the arrangements' profitability, per se. Since the benefits to mutual fund companies that colluded with abusive traders came mostly in the form of asset management fees assessed on "sticky assets" as well as on short-lived "investments" in abused funds, the comparisons drawn here are reasonable.[19]

7 Management company revenue from abusive-trading arrangements

Mutual fund firms that sought to benefit from trading abuses had no reason to tally up those gains, and there are no comprehensive data on their revenues. To fill this gap, I used three methods to derive very rough estimates of scandal-related revenue. Where precision in estimating revenues was particularly difficult to obtain, I attempted to err on the side of overstating them in order to make a convincing case that revenues from trading arrangements fell far short of the costs of abusive trading.

Broadly speaking, I computed revenues by multiplying an estimate of management companies' share of the profits from abusive trading by the total gains from such trading. This can be done in one of two ways, beginning with either shareholders' losses due to the trading or an estimate of the aggregate gains from such trades:

[19]Several aspects of the scandal complicate matters somewhat, but probably do not affect the main points of this paper. First, to the extent that company insiders gained directly from market timing, their earnings could be seen as "pure" profit, although such trading represented only a tiny share (less than 2 percent) of estimated aggregate management company revenues from abusive-trading arrangements. Second, to the extent that quid-pro-quo arrangements required abusive traders to park assets in hedge funds, rather than mutual funds, operating margins may have been higher on some of the assets garnered from abusive trading than for the assets lost due to poor performance. On the other hand, official penalties, which eventually amounted to a very substantial cost to the firms that were caught, came straight out of the bottom line, so direct comparisons of these costs to other costs and revenues understate the importance of the penalties.

$$
\begin{aligned}
&\text{Management Company Revenue from Collusion with Abusive Traders} \\
&\quad = \text{Total losses to mutual fund shareholders} \\
&\qquad \times (1 - \text{deadweight loss share}) \\
&\qquad \times \text{management companies' share of gains} \qquad (4) \\
&\quad = \text{Total gains from abusive trades} \\
&\qquad \times \text{management companies' share of gains.} \qquad (5)
\end{aligned}
$$

7.1 Management companies' share of abusive-trading gains

Legal documents arising from the scandal provide some evidence about management companies' share of the gains from trading abuses, net of deadweight losses. Complaints, settlements, and distribution plans often report the gains to both abusive traders and management companies from specific arrangements; the figures listed in table 5 are drawn from these reports. The data are limited in scope and do not represent a comprehensive accounting of the share of abusive-trading gains collected by any of the management companies listed, so shares for individual firms should only be viewed as suggestive. Taken together, however, they are quite informative. While management companies obtained as little as 2 percent and as much as 43 percent of the profits from abusive trading, most management companies earned relatively small shares—under 10 percent—of the gains from abusive trading.[20]

Even these figures probably exaggerate management companies' typical share of abusive trading gains, because the records documenting quid-pro-quo deals probably captured the most favorable distributions for mutual fund firms. Many tainted fund families tolerated trading abuses by timers who did not have special arrangements, and

[20]The two outliers on table 5—the shares for Banc of America and Waddell Reed—are probably not representative, but for different reasons. The 43 percent share for Banc of America reflects the fact that it was collecting revenue for much more than facilitating trading abuses in its own mutual funds (the Nations Funds). The firm's asset management affiliate, Banc of America Capital Management, only received 2.2 percent of the revenues from the deals that allowed abusive trading in its funds and that were memorialized in official documents. But other affiliates, including Banc of America Securities (BAS), profited more handsomely. BAS helped Canary Capital Partners, a hedge fund that engaged in widespread trading abuses, set up *in Canary's offices* a trading platform that used Banc of America's proprietary trading network and enabled Canary to market time and late trade funds in a broad array of mutual fund families. BAS also earned fees for creating hedges that allowed abusive traders to market time other mutual funds more profitably. Indeed, the distribution to injured parties of penalties and disgorgement paid by Banc of America indicated that its own mutual fund investors suffered only 6 percent of the total estimated damages from its arrangements with abusive traders (see U.S. Securities and Exchange Commission, 2005b, 2007a). The share for Waddell & Reed, at 31 percent, represents estimated gains and fees from arrangements with just three market timers, one of whom *lost* over $6 million by trading Waddell & Reed funds. This company's share of the revenue from arrangements with the other two traders was a still-high 19 percent (U.S. Securities and Exchange Commission, 2006a).

management companies likely obtained smaller shares of their gains. Moreover, traders who had struck agreements with tainted families frequently overstepped the bounds of those arrangements—far exceeding agreed-upon "timing capacity," for example—so stated terms of the deals may overstate the portion of the gains going to management companies.

On the other hand, the management company executives and portfolio managers who market timed their own mutual funds reaped considerably larger shares—usually *all*—of the abusive-trading profits. Altogether, these insiders collected approximately $11 million in net gains from abusive trading over several years. As noted above, I assume that management companies reaped all the gains from such internal abuse.

Table 5 indicates that management companies' share of the gains from abusive trading averaged 12.0 percent. Adjusting this figure for the portion of dilution due to internal market timing—which is not reflected in the data on the table—brings the share up to 12.4 percent. Applying a range of different weights to these family-level observations, including assets in abused funds, total dilution estimates from Zitzewitz (2007b), and total penalties, results in share estimates ranging from 8.6 percent to 16.6 percent. Below, I used the highest figure in that range.

7.2 Revenues estimated from total shareholder losses

In section 5.2.2, I estimated that mutual fund shareholders' losses due to abusive trading arrangements totaled $10.4 billion per year. This money would have been split among abusive traders, management companies, and a "deadweight loss" that was absorbed in fund administrative costs, portfolio trading costs, and the opportunity costs of managing flows due to abusive trades and holding suboptimal asset allocations.

Although the deadweight losses associated with abusive trading—as discussed above—were probably substantial, I have little direct evidence on their magnitude. By assuming that deadweight loss was *zero,* however, I can derive an *upper bound* for management companies' revenues from collusion with abusive traders, conditional on the share of abusive-trading profits derived above. Using equation (4), I multiply shareholder losses of $10.4 billion per year by 16.6 percent and obtain an estimate of $1.7 billion per year.

7.3 Revenues estimated from abusive-trading gains and dilution

A more direct approach to assessing the revenues from abusive-trading arrangements begins with estimates of the wealth transferred from buy-and-hold investors to abusive traders. As described in sections A.1 and A.2 of the Appendix, abusive traders' gains and buy-and-hold investors' *dilution* losses (one component of their total losses) are roughly

equivalent under a range of circumstances—for example, when timers hold mutual fund shares for just one day at a time, or when timers hold mutual fund shares for longer periods but fully hedge those positions (and fund portfolio managers invest timers' flows immediately). This suggests that off-the-shelf methods of measuring dilution might be modified to estimate abusive traders' gains. By multiplying these gains by management companies' share of the profits, one can approximate the additional revenue the companies collected by colluding with timers.

To estimate abusive traders' gains in abused funds, I used a modified version of a method employed by Greene and Hodges (2002) to estimate dilution.[21] Consider a mutual fund with assets A_{t-1} on day $t-1$. Suppose that, on day t, the fund adjusts its NAV by fraction r_t to reflect returns to its portfolio, but fails to incorporate a second component of return, π_t, which investors can either predict or observe. For example, π_t might be post-Nikkei-close appreciation of Japanese stocks that is not incorporated in a fund's NAV. Define π_t such that, had the fund incorporated this component of return in computing its NAV, total return to mutual fund shares on day t would have been $(1+r_t)(1+\pi_t)$. Let r_{t+1} be the return recorded (in terms of change to NAV) on the following day.

Suppose that abusive traders purchase $g_t A_{t-1}$ worth of shares on day t to exploit the fund's pricing error (presumably, when $\pi_t > 0$, $g_t > 0$, and vice versa). At the same time, buy-and-hold investors, whose trades the portfolio manager anticipates, purchase $\phi_t A_t$ worth of shares. Then, in year T, abusive traders gains, G_T, are, for each mutual fund:[22]

$$G_T \approx \sum_{t \in T, g_t \geq 0} A_{t-1} g_t r_{t+1} + \sum_{t \in T, g_t < 0} A_{t-1} g_t \left(\frac{r_{t+1}}{1+r_{t+1}} \right) \left(1 + \frac{g_t}{1+r_t+\phi_t} \right) \tag{6}$$

In estimating equation (6), I assume that $\phi_t A_{t-1}$ is the expected component of daily flow, conditional on information available on day $t-1$, and that abusive traders' flow, $g_t A_{t-1}$, is the surprise component. Under the null hypothesis that there are no abusive-trading gains, flow surprises, g_t, are uncorrelated with next-day returns, r_{t+1}, and estimated gains are zero. But when inflows anticipate positive returns and outflows anticipate price declines—because traders are exploiting stale NAVs by market timing or late trading mu-

[21] Because it is based on the correlation between mutual fund flow and next-day changes in NAV, the method that Greene and Hodges (2002) use to compute dilution has been called "next-day-NAV" method. Researchers, as well as consultants determining how to distribute "Fair Funds" (penalties and disgorgement collected from tainted management companies) to shareholders who suffered losses, have also used three other methods to estimate dilution: One based on correlations of flows and predicted mutual fund pricing errors, one based on abusive traders' holding-period profits, and one that explicitly takes into account how portfolio managers handle cash from abusive traders (Zitzewitz, 2003, 2007b; Greene and Ciccotello, 2004). I discuss these methods, and my reasons for using an approach similar to the next-day-NAV method, in sections A.1 and A.2 of the Appendix.

[22] Equation (6) is derived in section A.3 of the Appendix.

tual fund shares—estimated abusive-trading gains will be positive.

I estimate (6) using daily assets data from TrimTabs and returns data from CRSP, TrimTabs, and Yahoo! Finance.[23] The TrimTabs data, described extensively by Greene and Hodges (2002) and Zitzewitz (2003), include daily observations on assets under management and NAVs for 84 of the 145 abused mutual funds that I have identified. To compute daily returns, I adjusted changes in NAVs as appropriate using data on splits and distributions from CRSP and Yahoo! Finance. Net new cash flows are flows net of reinvested distributions, which I estimated using monthly data from the Investment Company Institute on the reinvestment rates for distributions made by different types of mutual funds.

Since TrimTabs data covered only 84 of the abused funds, I applied the asset-weighted average rates of abusive-trading gains for each investment objective in the TrimTabs sample to aggregate assets under management for all abused funds sharing the same investment objective. Summing over all objectives, estimated gains from market timing and late trading among abused funds amounted to $2.68 billion in the three years before the scandal broke (from September 2000 to August 2003), an average of $894 million per year. Multiplied by management companies' 16.6 percent share of the revenue, this implies that these firms received $148 million per year.

There are some drawbacks to using this measure of abusive-trading gains as a basis for estimating revenue. Calculations using equation (6) are imprecise, in part because the daily flows for each fund are notoriously noisy (Greene and Hodges, 2002; Zitzewitz, 2003; see also section A.4 of the Appendix), but also because this method does not precisely distinguish abusive-trading flows and other types of flow.[24] Moreover, trading gains measured in this manner may substantially overstate timers' actual gains because equation (6) captures the potential gains from *sales* of shares at above their true value (when $g_t < 0$ and $\pi_t < 0$) as well as the more straightforward losses due to timers' purchases of mutual fund shares at below their fair value. As discussed in section A.3.2 of the Appendix, such timed redemptions do cause losses for other shareholders, but unless timers employ hedging strategies, their redemptions do not reap cash gains—they only avoid losses. Hence, if abusive traders time their redemptions but do not hedge their mutual fund positions, estimates of revenues based on (6) will be biased upward.

Zitzewitz (2007b) dilution estimates. Zitzewitz's estimates of dilution at scandal-

[23]Section A.4 of the Appendix discusses some of the challenges posed in using these daily data to estimate abusive traders' gains, as well as some of the assumptions and filters I employed in processing the data.

[24]The "predicted-NAV" method of estimating dilution aims to identify abusive-trading flows more precisely by using the signals—such as changes in index futures prices—that market timers and late traders employed to trigger dilutive trades. The choice between the next-day-NAV and predicted-NAV methods is probably not important for my purposes, however, as Zitzewitz (2007b) employs both methods to calculate dilution for mutual funds in tainted families and obtains very similar estimates using either approach. See section A.1 of the Appendix.

tainted fund families offer a useful check on my estimates of abusive-trading gains. To be sure, his objectives and measures are different from mine: He estimated *dilution* for all *abused and tainted* world equity funds and small- and mid-cap equity funds at scandal-tainted mutual fund families, while I examined *gains to abusive traders* from timing trades involving *only abused* mutual funds, which included bond and hybrid funds as well as equity funds. Zitzewitz employed the predicted-NAV method to compute dilution, whereas I used next-day-NAVs, and there are minor differences in our coverage of fund families and time periods.

Nonetheless, my estimates of abusive-trading gains are quite close to the dilution estimates that Zitzewitz reported. As indicated above, I estimated that abusive traders' gains from timing mutual funds from September 2000 through August 2003 amounted to $2.68 billion, while Zitzewitz reported dilution of $2.56 billion for January 2000 to June 2003 at the 20 mutual fund complexes I analyzed.[25]

7.4 Revenues estimated from official penalties

Official penalties imposed on management companies provide some additional clues about the magnitude of the revenues from arrangements that allowed trading abuses. The penalties (excluding fee reductions negotiated by the New York Attorney General) appear, in practice, to have been an upper-bound for prosecutors' and regulators' estimates of the dilution damage done to mutual fund shareholders. Furthermore, SEC rules indicate that disgorgement—a portion of the total penalites—should itself be a direct measure of the ill-gotten gains of management companies.

7.4.1 Total penalties

In assessing the penalties imposed on mutual fund management companies and their employees, state officials and the SEC appear to have jointly aimed for totals that approximated or exceeded the *total* dilution-related damages to mutual fund shareholders.[26] The primary evidence for this comes from distribution plans which allocate the penalties paid by tainted mutual fund management companies to shareholders based on damages—primarily dilution losses—they incurred. For nine of the ten companies for which distribution plans are available, plan authors indicated that shareholders would receive pay-

[25] Zitzewitz reported a total of $2.58 billion in dilution damages, but the figure included estimated dilution of $20 million in the Ameriprise (or "AXP") funds, which I did not analyze (see note 7). He did not provide dilution estimates for Seligman or Wachovia's Evergreen funds. An SEC settlement with Wachovia and an Attorney General of New York complaint against Seligman indicate that dilution at these families' mutual funds totaled roughly $110 million. With these adjustments, Zitzewitz's figures suggest that total dilution at the 20 mutual fund families I analyzed would be $2.67 billion.

[26] Negotiated fee reductions were a major exception to this rule. The New York Attorney General made it clear that the fee reductions were essentially rebates for "excessive" fees charged by firms that had violated fiduciary duties, rather than a measure of the damages caused by abusive trading.

ments that exceeded estimated damage (and for the remaining firm, Columbia, estimated damage was approximately equal to the penalty payments plus interest). Among the seven distribution plans that quantified damages to shareholders, aggregate penalties exceeded total estimated damage to shareholders by 52 percent.[27]

Moreover, damage estimates usually included costs to shareholders that could not have been gains for abusive traders or management companies. Five of the distribution plans that quantified damages included estimates of some deadweight losses due to abusive trading, such as the transactions or administrative costs caused by heavy timing flows and the massive redemptions that followed the scandal revelations.

On the other hand, Zitzewitz (2007b) suggested caution in interpreting penalties as upper bounds for dilution damage. He reported that the ratio of penalties to dilution ranged from 0.1 to 10, so penalties do not necessarily correlate strongly with, and sometimes fell far short of, total dilution in tainted mutual fund families. Zitzewitz argues that the wide range in this ratio reflected, in part, the New York Attorney General's tendency to negotiate particularly large settlements. The range may also reflect heterogeneity in the scope of damages examined by the SEC and state officials; in some cases, they focused narrowly on damage from abusive-trading arrangements and in others they estimated damage due to *all* dilutive trades in a family's funds, regardless of the management company's culpability in allowing those trades to occur. Zitzewitz's estimate encompasses dilution in all (abused and tainted) equity funds.

7.4.2 Baseline estimates of revenues from collusion with abusive traders: Maximum of penalties paid and estimated dilution

One way to exploit the information in the penalties assessments while incorporating the caveats suggested by Zitzewitz is to use, for each management company, the maximum of the penalties it paid (shown in column 10 of table 2) and an independent estimate of abusive traders' gains in its mutual funds. My estimates of those gains are incomplete and do not include figures for many of the tainted firms, but Zitzewitz (2007b) provides dilution estimates for mutual funds at almost every tainted family, as shown in column 13 of table 2. Moreover, as indicated in section 7.3, my estimates of abusive traders' gains are quite similar to Zitzewitz's dilution estimates. So, one practical approach to estimating the total gains from abusive trades is to use the maximum, for each management com-

[27] For the other three firms, distribution plans merely stated qualitatively that funds to be distributed exceeded estimated damage. One reason that penalties may have systematically exceeded shareholder damages was the New York Attorney General's claim that management companies had committed fraud in making arrangements to facilitate abusive trading and thus were not entitled to keep advisory fees collected while the abuse was occurring. This argument appears to have motivated language in many distribution plans that stipulated that "Fair Funds" be distributed first to compensate mutual fund shareholders for losses due to abusive trading, and then—if funds remained—to rebate shareholders for a portion of the fees that they (through their funds) had paid to management companies that were allowing trading abuses.

pany, of the penalties it paid and Zitzewitz's estimates of dilution in its funds. Column 14 shows these maxima, which total $3.55 billion.

Using this figure to estimate an annual revenue stream requires some knowledge of the timing of the malfeasance for which firms paid penalties, but that is rarely clear in settlement documents. Some management companies evidently had initiated arrangements to allow trading abuses before 2000, with several agreements beginning as early as 1998 and at least one firm's arrangements dating back to 1995. Nonetheless, I assumed that the penalties were for malfeasance lasting just three years.[28] Annual gains to abusive traders reflected in the penalties and dilution estimates would therefore be $1.18 billion. Applying a management-company share of revenues of 16.6 percent, I obtained a revenue estimate of $196 million per year, which I used as my baseline figure for management companies' annual revenues from collusive agreements with abusive traders.

7.4.3 Disgorgement

According to the *SEC Rules of Practice* (2003b), "the purpose of the Commission's administrative disgorgement remedy is to deprive violators of ill-gotten gains and thus serve as a deterrent to violations, rather than to compensate injured investors."[29] Taken literally, this implies that disgorgement totals (plus fund restitution payments) should be a measure of management company revenues from collusive arrangements. Table 2 summarizes disgorgement and restitution amounts: $1.35 billion in disgorgement paid by management companies (column 2); $151 million and $3 million in disgorgement paid by senior executives and employees, respectively (columns 5 and 7); and $47 million in restitution payments (column 3).[30] As shown in column 11 , the twenty tainted mutual fund firms and their executives and employees paid a total of $1.6 billion in disgorgement and restitution. Dividing that figure over three years yields a revenue estimate of $528 million per year.[31]

This estimate likely substantially overstates the revenues of mutual fund management companies. Settlement documents are generally silent on the derivation of disgorgement amounts, and make no claims that these figures represent ill-gotten gains, *per se*. On the other hand, as discussed above, the *total* penalties imposed generally exceeded

[28]This likely biases upward the annual revenue estimates, but the assumption is consistent with my finding that shareholder losses were concentrated in the three years prior to the breaking of the scandal and with my bias toward overstating revenues.

[29]The *Rules* go on to cite the Senate Report accompanying the Securities Law Enforcement Remedies and Penny Stock Reform Act of 1990: "disgorgement forces a defendant to give up the amount by which he was unjustly enriched" (U.S. Senate, 1989).

[30]See note 9.

[31]Seligman has not yet settled with any state agency or the SEC, so the company has not paid any disgorgement. I imputed disgorgement of $36 million for Seligman based on estimated dilution of $80 million in Seligman funds (Attorney General of the State of New York, 2006) and the ratio of other firms' aggregate disgorgement penalties (column 11 of table 2) to the maximum of total penalties and dilution (column 14).

estimated *total* dilution profits shared by abusive traders and management companies. Although management companies probably collected less than 20 percent of that total, as indicated in table 5, disgorgement represented 60 percent of total penalties imposed. Nonetheless, I used this disgorgement-based figure of $528 million per year as a high estimate for the revenues that management companies obtained through their agreements with abusive traders.

8 The costs of abusive-trading arrangements

A mutual fund management company that sought revenues by allowing and abetting trading abuses faced costs that would be incurred with some uncertainty and delay compared with the realization of revenues. Most obvious, in retrospect, were the disastrous consequences of getting caught, and with the benefit of hindsight, one can catalogue these costs: The brand-destroying headlines of September 2003, the wave of mutual fund share redemptions that followed the scandal news, the enormous official penalties that were imposed by prosecutors and regulators, and the private civil litigation that continues to this day. But a second form of costs—those arising from impaired performance of mutual funds that were subject to abusive arrangements—would have been borne by mutual fund families even if those arrangements had never been revealed. Had mutual fund management companies fully taken into consideration these costs, which could have been foreseen long before public officials learned about the trading abuses, there might never have been a mutual fund scandal.

8.1 Costs arising from impaired performance

Any reduction in a mutual fund's performance will cut into expected future assets under management, and hence into the fee revenue that is proportional to managed assets, through two channels. First, since mutual fund shareholders automatically reinvest most of their capital gains, poor returns will diminish future assets directly. Second, because mutual fund shareholders make purchase decisions based on past returns, poor performance also weighs on future assets by depressing net inflows.

I begin with an analysis of the expected losses through these two channels from a strategy of facilitating market timing for three years, beginning roughly (for most tainted mutual fund families) in September 2000 and ending in August 2003. This corresponds approximately to what actually happened; dilution due to abusive trading appears to have risen dramatically around 2000 and diminished considerably after the New York Attorney General's initial complaint (see figure 2 and Zitzewitz, 2007a). Consider a mutual fund that in period $t-1$ has assets A_{t-1}, earns a return net of fees r_t in period t, and attracts net inflow, f_t, expressed as a fraction of previous-period assets. If the fund im-

mediately distributes capital gains to investors, who automatically reinvest fraction θ_t, fund assets grow to $A_t = A_{t-1}(1 + \theta_t r_t + f_t)$ by the end of period t.[32] If the fund allows abusive trading that reduces returns by Δr and causes a loss of net flows Δf_t, assets grow only to

$$A_t^L = A_{t-1}\big(1 + \theta_t(r_t - \Delta r) + f_t - \Delta f_t\big). \tag{7}$$

Therefore, a fund that allows trading abuses from period T_0 to T will "lose" managed assets

$$\begin{aligned}\Delta A_{T_0,T} &= A_T - A_T^L \\ &= A_{T_0} \prod_{t=T_0+1}^{T} (1 + \theta_t r_t + f_t) \\ &\quad - A_{T_0} \prod_{t=T_0+1}^{T} \Big(1 + \theta_t(r_t - \Delta r) + f_t - \Delta f_t\Big).\end{aligned} \tag{8}$$

Expected revenue losses in period T are the predicted change in assets from equation (8) multiplied by the fund's expense ratio, net of any 12b-1 fee (since such fees are typically passed on to third-party distributors). Applying a discount factor, δ, the discounted value of expected revenue losses from period-T_0 perspective is:

$$E_{T_0}\left(\Delta R_{T_0,T}\right) = \sum_{t=T_0+1}^{T} \delta^{t-T_0}\, x_t\, \Delta A_{T_0,T}. \tag{9}$$

I estimated the expected revenue losses using asset-weighted aggregate data for abused funds for the period from three years before the scandal revelations to three years after. x_t is the asset-weighted mean expense ratio (net of 12b-1 fees), and A_{T_0} is the total assets of abused funds three years before wrongdoing was first reported (about $490 billion).[33] The reinvestment rate for distributions, θ_t, varies by fund type, but the asset-weighted average among abused funds was about 85 percent. The performance effect of the trading abuses, Δr, is as estimated above; to maintain a conservative stance on the costs of

[32] In reality, capital gains are distributed and reinvested with sometimes considerable delays that would be difficult to model, but I assumed that gains were distributed immediately. Also, while θ_t effectively should be larger when r_t is negative than when it is positive (losses are not distributed), I assumed an extreme value of $\theta_t = 1$ for capital losses. Both assumptions cause some downward bias to my estimates of the costs of impaired performance by understating baseline mutual fund growth.

[33] Total assets of abused funds fell sharply over the period from 2000 to 2006—more sharply than would be predicted by the asset-evolution equation (7), which does not capture all changes in assets (for example, fund closures). While it is arguable whether or not such "lost" assets should be included in an ex ante analysis of decisions made in 2000, doing so would clearly raise estimates of losses. Hence, in estimating equations (8) and (9), I used assets observed each month, rather than using initial assets and the asset-evolution path suggested by (7). That is, I computed asset losses each month using *observed* assets under management at the beginning of the month, and cumulated these losses (which include the opportunity cost of foregone capital appreciation on assets lost in previous months), rather than using equation (7) to predict assets.

the trading arrangements, I used the smallest value of alpha shown on table 4 (an annual logarithmic return of -0.036, converted to monthly return). The *observed* monthly asset-weighted mean return of abused funds, which includes the performance impact of abusive trading, is $r_t - \Delta r$, so r_t itself is estimated. The discount factor, δ, is based on an annual WACC of 11.6 percent. Finally, I had to estimate the effect of the performance losses on net flow, Δf_t, as described below.

8.1.1 The effect of performance losses on expected net inflows.

The literature that explores the relationship between mutual fund flows and performance is extensive and predates the mutual fund scandal by several decades (see, for example, Wharton School, University of Pennsylvania (1962), Friend et al. (1970), Smith (1978), Ippolito (1992), Chevalier and Ellison (1997), Sirri and Tufano (1998), Del Guercio and Tkac (2002)). This research indicates that flows vary nonlinearly with past returns measured over a range of frequencies. For example, investors respond independently to returns in recent months and to returns measured over the previous several years, and flows are especially sensitive to the returns of funds at the top of the performance distribution. Because my objective is to estimate the effects of individual abused mutual funds' poor relative performance on their subsequent cash flows, I also distinguished between funds' relative returns, which were depressed by trading abuse, and category returns, which I assumed were not.[34]

To estimate the effects of reduced performance on expected future revenues, I employed an empirical model of mutual fund flow as a function of current and past returns:

$$\begin{aligned} f_{it} = & \sum_{p \in P} \left(\pi^p r_{it}^p + \pi^{pH} r_{it}^{pH} + \pi^{pL} r_{it}^{pL} + \gamma^p c_{it}^p + \gamma^{pH} c_{it}^{pH} + \gamma^{pL} c_{it}^{pL} \right) \\ & + b_i + m_t + \Gamma X_{it} \\ & + \sum_{s=-12}^{35} \beta_s^{Scandal} D_{ist}^{Scandal} + \sum_{s=-12}^{35} \beta_s^{Abused} D_{ist}^{Abused} + \varepsilon_{it}. \end{aligned} \tag{10}$$

The unit of observation is the mutual fund share class i in month t, and the dependent variable in the regression, f_{it}, is 100 times the log of one plus cash flow over lagged assets. The model includes relative returns, r_{it}^p, and category returns, c_{it}^p, measured over

[34]Market timing was not confined to abused funds at scandal-tainted complexes, and the pre-scandal literature that examined the dilutive effects of market timing by investment objective showed that category returns *were* affected by market timing. Hence, poor category performance likely affected flows to broad investment objectives that were heavily traded, such as Japan-equity funds. However, in studying the decision by some mutual fund families to accommodate abusive traders, my focus was on the *relative* performance penalty that these funds suffered and how it affected future revenues. To that end, I analyzed only the effects of abuse on relative performance and other measures of risk-adjusted returns that control for category performance.

different intervals, p, in the set P, which includes the current month, each of the three previous months, the past year, and the past three years.[35] To capture the nonlinear response to performance, I separately included for each performance period and type of return (relative and category) a fund's returns conditional on those returns being in the top and bottom quintiles.[36] That is:

$$r_{it}^{pH} = \begin{cases} r_{it}^{p} & \text{if } r_{it}^{p} \text{ is in the top quintile among mutual funds in } i\text{'s category.} \\ 0 & \text{otherwise.} \end{cases}$$

$$r_{it}^{pL} = \begin{cases} r_{it}^{p} & \text{if } r_{it}^{p} \text{ is in the bottom quintile among mutual funds in } i\text{'s category.} \\ 0 & \text{otherwise.} \end{cases}$$

$$c_{it}^{pH} = \begin{cases} c_{it}^{p} & \text{if } c_{it}^{p} \text{ is in the top quintile among all mutual fund categories.} \\ 0 & \text{otherwise.} \end{cases}$$

$$c_{it}^{pL} = \begin{cases} c_{it}^{p} & \text{if } c_{it}^{p} \text{ is in the bottom quintile among all mutual fund categories.} \\ 0 & \text{otherwise.} \end{cases}$$

The regressors b_i and m_t are share-class and monthly time fixed effects, respectively. The vector X_{it} is a set of controls, including the logarithm of the assets in each share class, its expense ratio excluding 12b-1 fees, its 12b-1 fee (if any), and a dummy variable for load funds. Finally, $D_{ist}^{Scandal}$ and D_{ist}^{Abused} are dummy variables used to control for the large net redemptions of scandal-tainted families' mutual fund shares after the scandal revelations. These are discussed in more detail in section 8.2.1.

I estimated equation (10) using monthly CRSP data from January 1993 to May 2007. Results are reported in table 6. Estimated linear coefficients on relative and category returns (columns 2 and 5) are positive and significant over every performance interval in the model. There is also evidence of nonlinear responses to performance, but the patterns are not uniform. At short horizons, responses to relative performance among the bottom fifth of funds (column 1) are significantly smaller than responses to relative performance in the rest of the distribution. Investors are especially responsive to relative returns among the best performers over one- and three-year horizons (column 3). Responses to lowest-quintile category returns (column 4) are muted compared with responses to returns in the middle and upper parts of the distribution.

The model indicates that single month's poor performance has repercussions for

[35] Returns over overlapping intervals are net of one another. That is, annual returns are returns over the previous 12 months less returns over the past three months. And returns over the previous three years are net of returns in the previous 12 months. All returns are expressed in logarithmic terms.

[36] Other forms of nonlinearity, such as separate intercepts for top- and bottom-quintile returns, and a combination of separate slopes and intercepts, yielded similar results; the differences were not important for my conclusions.

net flows to the fund for three years. Consider a change in returns, Δr_t, in month t, defined as:

$$\Delta r_t = \begin{cases} \Delta r & \text{if fund is facilitating trading abuses in month } t \\ 0 & \text{otherwise.} \end{cases}$$

If we denote the estimated coefficient on relative return s months ago π^{t-s}, previous-year returns $\pi^{(t-4,t-5,\ldots,t-12)}$, and the past three-years' returns $\pi^{(t-13,t-14,\ldots,t-36)}$, changes in flow, Δf, resulting from Δr_t are:[37]

$$\begin{aligned}
\Delta f_{t+1} &= \Delta r_t \times \pi^{t-1} & \Delta f_{t+13} &= \Delta r_t \times \pi^{(t-13,\,t-14,\,\ldots,\,t-36)} \\
\Delta f_{t+2} &= \Delta r_t \times \pi^{t-2} & \Delta f_{t+14} &= \Delta r_t \times \pi^{(t-13,\,t-14,\,\ldots,\,t-36)} \\
\Delta f_{t+3} &= \Delta r_t \times \pi^{t-3} & & \\
\Delta f_{t+4} &= \Delta r_t \times \pi^{(t-4,\,t-5,\,\ldots,\,t-12)} & & \\
&\vdots & &\vdots \\
\Delta f_{t+12} &= \Delta r_t \times \pi^{(t-4,\,t-5,\,\ldots,\,t-12)} & \Delta f_{t+36} &= \Delta r_t \times \pi^{(t-13,\,t-14,\,\ldots,\,t-36)}.
\end{aligned}$$

If the poor performance persists another month, Δr_{t+1} will affect flows in months $t+2$ through $t+37$, and so forth. Hence, the cumulative effect of past changes in returns on flow in month t is:[38]

$$\begin{aligned}
\Delta f_t = \sum_{s=1}^{3} \Delta r_{t-s} \times \pi^{t-s} + \sum_{s=4}^{12} \Delta r_{t-s} \times \pi^{(t-4,\,t-5,\,\ldots,\,t-12)} \\
+ \sum_{s=13}^{36} \Delta r_{t-s} \times \pi^{(t-13,\,t-14,\,\ldots,\,t-36)}. \qquad (11)
\end{aligned}$$

I plugged this estimated change in net flow into equations (8) and (9) to estimate lost fee revenue. Again, I assumed an annual performance loss (Δr) of 3.6 percent, the lowest estimate among the risk-adjusted figures from table 4.[39]

[37] I compute baseline estimates of flow effects using the linear relative-return coefficients, π^p. Since abused funds were disproportionately likely to fall in the lowest-performing quintiles in their categories, I also estimated flow effects using the relative-return coefficients that would apply to bottom-quintile funds, that is, $\pi^p + \pi^{pL}$. These coefficients yield performance-related revenue losses that are 4 to 6 percent smaller than the baseline estimates. See section 9.2.3.

[38] This omits any contemporaneous effect of performance on flows (Δf_t is not included in the summation). Returns and flows in a given month are likely simultaneously determined, and particularly in the presence of heavy market timing flows, the estimated coefficient on current-month returns reflects more than just the response of investors to past performance. Of course, that response is most likely positive, so setting the coefficient to zero for the purpose of estimating costs almost certainly understates them.

[39] More precisely, the loss is a logarithmic annualized return of -0.036, converted to monthly return. The returns used in estimating equation (10) are relative returns, which were substantially larger—at 4.8 percent per year—than this estimated alpha. While it would be preferable to estimate equation (10) using returns that have been fully adjusted for risk in the manner described in section 5.2, the range of past-performance

The lasting effect of performance losses implied by (10) is striking. Once incurred, poor returns can be expected to weigh on net flows for several years (three years, in the model I estimate, although the literature features models with even longer lasting effects). But the effects on revenue last even longer than the impact on flow, because a dollar of lost assets is, all else equal, lost *forever.* Of course, a management company could take other actions—advertising or (perhaps) hiring talented portfolio managers, for example—to boost flows and bring assets back, but such actions could have been taken even if performance had never suffered.[40]

8.1.2 Comparing revenues from abusive-trading arrangements to performance-related losses.

Table 7 lists cumulative revenues and costs for a couple of trading-abuse scenarios. Panel A reports the consequences of a decision to facilitate the abuses for exactly three years—a choice akin to those made by management companies three years before the scandal revelations finally made the arrangements untenable. Estimated revenues, discussed in section 7, are shown in columns 1 and 2. According to my baseline revenue estimate, management companies would collect $196 million per year for each of the three years and—in this scenario—nothing thereafter. Revenues cumulate to about $600 million (and a present value of $500 million) for time horizons of three or more years. Column 2 shows cumulative fees based on the high-revenue estimate (based on disgorgement amounts), which have a present value of $1.3 billion for time horizons of three years or more.

The performance-related losses, which appear in column 3, accrue slowly at first; their persistence, not their short-run magnitudes, makes them important. After one year of trading abuses, expected revenue losses due to impaired performance would have cumulated to only about $80 million. After two years, the expected total would have been $0.3 billion, and after three, $0.7 billion. In this scenario, the trading abuses end (by assumption) after the third year, but the losses would continue to grow. By the end of the sixth year, *flow* would no longer be impaired by poor past performance, but a permanently lower asset base would continue to generated diminished fee revenue. By the tenth year, total expected revenue losses would add up to $5 billion, with a present value of $2.7 billon.[41] The expected present value of these costs over an infinite horizon

intervals captured in the model makes this infeasible.

[40]Moreover, advertising and performance interact positively: Fund families advertise their best-performing funds, not losers (Sirri and Tufano, 1998). So, advertising would presumably be less effective in attracting flows to a fund that had suffered poor performance due to trading abuses than in boosting the flows of an untainted, better-performing fund.

[41]In order to project costs beyond the sample period, which extends approximately three years after the scandal revelations for most firms, I had to make assumptions about expected net returns and flows in the absence of trading abuses. The results I report here imbed the most conservative assumptions—namely, that rates of return and flow would be equal to those that would have occurred in the period from roughly three

would have been $5 billion.

The top panel of figure 3 plots the same results: The thick solid (green) line represents the present value of baseline revenues as a function of time horizon, and the thick dotted (green) line traces the high-revenue estimate. The thick dashed (black) line shows performance-related costs. Perhaps a very myopic management-company executive might view collusion with abusive traders as attractive, as estimated revenues ($196 million or $528 million) garnered in the first year would easily exceed the expected performance-related loss of $80 million. But as poor performance continued and investors' responses cumulated, collusion eventually would have begun to look far less enticing. Depending on the estimated revenue stream, after three to five years, discounted cumulatived costs already would have exceeded discounted cumulative revenues. The present value of infinite-horizon costs ($4.7 billion) would exceed the present value of baseline revenues ($0.5 billion) by nearly an order of magnitude, and would exceed even the high estimate of revenues ($1.3 billion) by a factor of three. Even without consideration of the consequences of getting caught, which include both official and market penalties (discussed below, and shown in columns 4, 5, and 6 of table 7), the deals with abusive traders should have been very unattractive.

And what if management companies had expected that their abusive-trading arrangements would remain confidential? If so, as shown in panel B of table 7 (and plotted in the lower panel of figure 3), they might have anticipated accommodating market timers indefinitely and collecting annual revenues of $196 million (or $528 million), with a present value of $1.8 billion ($4.8 billion). However, the present value of performance-related costs would have exceeded $8 billion. Collusion with abusive traders is a puzzle; this analysis indicates that if management companies had acted in their own interests, the trading-abuse scandal would never have happened.

8.1.3 Performance-related revenue losses and agency conflicts between management companies and mutual fund investors

My results do *not* imply that the possibility of performance-related asset losses can resolve all agency conflicts between mutual fund investors and management companies. The abusive trading arrangements were uneconomical in part because the companies claimed only a small share of the investors' lost wealth. The estimated gains to abusive traders were a small portion of the damage they did to fund returns, and management companies collected small shares of the gains from abusive trading.

years before the scandal revelations to about three years afterwards, had there been no trading abuses. Even adjusting for the effects of the abuses, however, returns and net flows over this period were quite paltry. Had I based expected returns and flows on a longer history—say, ten years of data—expected asset growth would have been much more solid, so the costs of poor performance, which are computed as a fraction of assets, would have been *considerably* larger in dollar terms.

However, if management companies had been able to claim a larger share of mutual fund shareholders' losses, the companies' financial incentives might have been different. Consider an extreme counterfactual example: Had a management company just secretly skimmed 1 percent of its mutual funds' assets each year, revenues would have exceeded the performance-related costs, as estimated in this paper, by almost an order of magnitude. Figure 4 shows the discounted cumulative revenues and costs from such a hypothetical scenario, under the assumption that the asset-skimming went undetected forever. Thus, leaving ethical and legal considerations aside, if a management company could skim investors' wealth secretly, it would have a financial incentive to do so, despite the effects on fund performance and expected future inflows.

8.2 The costs of getting caught

8.2.1 Reputation-related outflows following the scandal revelations

Management companies' arrangements with abusive traders, which *should* have been unattractive even if the collusion had been undetectable, began to look quite ugly indeed in September 2003 as the deals made regular headlines. The news prompted a swift, sharp reaction from investors who held shares in tainted mutual fund families. Heavy redemptions—above and beyond the response to impaired performance—began immediately and continued for several *years*. To estimate the magnitude of the shareholder reaction, and its effect on mutual fund revenues, I included in equation (10) two sets each of 48 monthly dummy variables, indexed by $s \in [-12, 35]$, which at date t take the values:

$$D_{ist}^{Scandal} = \begin{cases} 1 & i \text{ is tainted } \textit{or} \text{ abused and } s = t - V_i \\ 0 & \text{otherwise} \end{cases}$$

$$D_{ist}^{Abused} = \begin{cases} 1 & i \text{ is } \textit{abused} \text{ and } s = t - V_i \\ 0 & \text{otherwise.} \end{cases}$$

Here, V_i is the scandal-revelation date for i's family. In month t, the dummy variable D_{ist} is zero unless month t is exactly s months after the initial revelations that i's family had made arrangements with abusive traders.[42]

Estimated coefficients $\beta_s^{Scandal}$ and β_s^{Abused} are plotted in figure 5, along with 95-percent confidence intervals. In the 12 months prior to the scandal revelations, net flows to tainted mutual funds (shown in the top panel of the figure) were not statistically distinguishable from those to their peers. However, news that a family had struck deals to allow abusive trades in some of its mutual funds prompted an immediate decline in net flows to its *other* (tainted) mutual funds. Controlling for other determinants of net flows,

[42] In this framework, estimated coefficients $\beta_s^{Scandal}$ measure abnormal net flows to tainted funds, and $\beta_s^{Scandal} + \beta_s^{Abused}$ measure the total abnormal effect on abused funds.

one month after the news, the flows to tainted funds were 1.1 percentage points of assets less than flows to their untainted rivals. While net flows rose to more typical magnitudes over the remainder of the year, on the whole they remained abnormally low for the three years following the scandal. Although individual monthly dummy coefficients for tainted funds are not all significantly less than zero, annualized net flow for these funds averaged a statistically significant 2.5 percentage points below normal even in the third year—months 24 through 35—following the scandal revelation.

The abused mutual funds fared much worse. The lower panel plots the *additional* impact of news that a particular fund was itself abused through arrangements with timers: Net flows were a further 1.7 percentage points below average in the first month after the scandal revelations, and remained significantly below even those of their tainted peers in every month for three years following the news. Annualized net flows to abused funds in the third year following the scandal news were 10.4 percentage points below those to tainted funds and 12.6 percentage points below those to untainted mutual funds.[43]

Figure 6 plots the *cumulative* effects of the scandal revelations on net flows. I cumulate flows from 12 months prior to the scandal revelations to highlight any abnormal flows prior to the news of illicit behavior. Among tainted funds, controlling for past performance and other correlates of flow, there is little evidence of abnormal flow prior to the scandal news. But by the end of the third year after that news broke, reputation-related outflows had reduced net assets under management in tainted funds by 8 percent on average compared with assets in funds at non-tainted families.

As shown by the red line in figure 6, abused funds attracted abnormally low net flows in the year prior to the scandal news, but once the scandal broke, outflows accelerated dramatically. Abnormal flows cumulated from one year before the scandal broke to the end of the third year afterwards averaged 39 percent of assets under management. Abnormally low flow *after* the scandal broke cut assets under management by a cumulative 37 percent.

To compute the revenue losses due to the reputation-related outflows, I added the predicted impact on net flows, estimated in equation (10), to Δf_t in equation (8), and recalculated equation (9).[44] Results are shown in column 4 of the top panel of table 7 and plotted as the very thick (red) line in the top panel of figure 3. Outflows prompted by the scandal revelations cost management companies an estimated $2.3 billion in rev-

[43]Because all flow effects are estimated in logarithmic terms, the reputation-related outflows for abused funds are computed multiplicatively, based on the 2.5 percentage-point loss for tainted funds and the additional 10.4 percentage-point loss for abused funds: 12.6 percent $= 1 - (1 - 0.104)(1 - 0.025)$.

[44]Because net flows to abused funds were approximately 0.3 percentage points below average even in the year before the scandal news, I subtract the average abnormal net flow over the 12 months prior to the scandal from each estimated dummy coefficient, β_s^{Abused}, to obtain the estimated *scandal-news* effect for each month.

enues in the first three years after the scandal broke (that is, through year six after the initial decision to collude with market timers). To estimate the cost of reputation-related outflows beyond the sample period, I assumed that outflow four years after the scandal revelations is half the average that prevailed in the third year, that outflow five years afterward is one-quarter that of the third year, and so forth (that is, that outflows after three years have a half-life of one year).[45] Using this approach, I estimated that the reaction of shareholders to the scandal will cost management companies $8.6 billion over the first seven years following the scandal news—a figure far in excess of the revenues that abusive trading generated for management companies, and substantially greater than even the performance-related losses. The discounted present value of the lost revenue due to reputation-related outflows over an infinite horizon would be nearly $10 billion.

8.2.2 Official penalties

As discussed in section 4.2, management companies' arrangements with abusive traders ultimately prompted a slew of official investigations by several state prosecutors, the SEC, and other government agencies. The civil penalties, disgorgement, and mandated fee reductions that followed are summarized in table 2. As Zitzewitz (2007b) points out, the net cost of a government-imposed fee reduction for a profit-maximizing firm may be considerably smaller than the nominal amount of the cut; at the margin, profits should be unaffected by changes in fees. Thus, penalties excluding the $1.1 billion in mandated fee reductions (column 8) are probably most relevant to an analysis of the costs of the abusive-trading deals. Also, for the purposes of tallying up the costs of trading arrangements for management companies, I subtracted off the $5 million in penalties levied on non-executive employees (columns 6 and 7). I do include penalties paid by senior executives, however.[46] Adjusted penalties, shown in column 12, sum to $2.6 billion.

Penalties and fee reductions are also summarized in columns 5 and 6 of table 7 and plotted in the upper panel of figure 3. While the present value of the penalties alone surpassed that of the estimated revenues generated by the abusive-trading arrangements, the market penalties—revenues lost because of poor performance and reputation-related net redemptions—dwarfed the official penalties.

[45] Also see note 41.

[46] As the primary decision makers—and sometimes the largest shareholders—in their firms, these principals made decisions that simultaneously affected their individual fortunes and those of their firms, and an analysis of their decisions to profit from trading abuse probably cannot cleanly segregate expected revenues and costs for individuals and firms. As discussed above, I include in company-revenue estimates the gains that management company executives *and employees* obtained by abusing their own mutual funds. In considering costs, however, I only include the penalties assessed against individuals who were the primary decision makers at their firms: chairmen, chief executive officers, and presidents.

8.2.3 Private civil litigation

Mutual fund management companies that colluded with market timers have faced private lawsuits, in addition to official and market penalties. As of this writing, 17 mutual fund firms were embroiled in private litigation, and none has yet settled with plaintiffs (Isbister, 2008). Settlement amounts under discussion are confidential, so I cannot include those costs in my estimates.

9 Why did they do it?

The management companies that struck deals to benefit from abusive trades in their mutual funds made what turned out to be very poor decisions. The costs of getting caught—official penalties (with or without the mandated fee reductions) and reduced fee revenue due to reputation-related redemptions—exceeded my high estimate of revenues from these deals by nearly an order of magnitude (compare columns 4 through 6 in table 7 with column 2). But if these had been the only possible costs of the abusive-trading arrangements, such deals still might have made sense ex ante if management companies had either placed very low odds on detection or underestimated its consequences. What they expected is a matter of conjecture, although there is some evidence that management company insiders were well aware of the potential fallout from getting caught. One Seligman employee warned, in a 2002 memo to the company president:

> I write this memo to bring to your attention an escalating problem that threatens the performance of our funds, and therefore our livelihood. It is the practice of NAV arbitrage by professional traders (usually hedge funds), which loots percentage points in total return from the funds these traders utilize. The practice threatens the future of fund companies that don't understand its effect on their long-term returns. In addition, it is a ticking time bomb for the entire mutual fund industry, set to go off the day the press realizes that fund companies routinely sell the returns earned by the shareholders of their funds to short-term traders (Attorney General of the State of New York, 2006, Exhibit 1).

But as the memo suggests, and this paper confirms, the "ticking time bomb" of possible detection was not the only deleterious consequence of abusive-trading arrangements. The harmful effects of trading abuses on mutual-fund performance and the resulting costs to management companies would have been incurred without any revelations in the press. In light of these costs, deals with abusive traders did not make economic sense for management companies, even if they had correctly assumed that they would *never* be caught. Adding the potential costs of detection to the performance-related losses

makes the decision to collude with abusive traders look quite puzzling indeed. Why did management companies do it?

9.1 An agency problem—*within* management companies

Management companies themselves did not choose to collude with abusive traders; some principals and employees of those companies did. Management company executives who struck such deals hurt their firms and the owners of those firms. Yet, evidence presented in official complaints, cease-and-desist orders, and similar documents indicates that in justifying arrangements with abusive traders, executives typically argued that trading arrangements would boost assets under management and fee income—and they were right, but only in the short run. To the extent that managerial contracts rewarded executives for *short-run* asset growth, their decisions would have been less mysterious. That is, a classic agency problem arising from the different objectives of the owners and managers of asset management firms might have been partly to blame for the mutual fund scandal.

Interestingly, in the wake of the scandal, this form of agency conflict has drawn relatively little attention from policy makers and researchers, who have mostly focused on the fiduciary conflicts of interest between *mutual fund* shareholders and management companies, rather than the owner-manager conflicts between *management company* shareholders and the managers of those firms.[47] Because the regulatory oversight of management companies centers on their fiduciary responsibilities to mutual fund investors, the policy response to the scandal naturally addressed the breach of fiduciary duty evident in the trading-abuse arrangements. For example, after the scandal erupted, the SEC proposed rules to increase the fraction of independent members on the boards of mutual funds (not on those of management companies) and require that board chairs be independent (U.S. Securities and Exchange Commission, 2006b).[48] Academic studies of the role of governance and incentives in the mutual fund scandal have generally focused on governance of mutual funds, rather than that of management companies (Mahoney, 2004; Tkac, 2004; Qian, 2006).[49] A notable exception is Zitzewitz (2003), who—writing before the scandal broke—argued that "fund management companies have a substantial interest in reducing dilution," largely because of the response of future flows to the poor performance of abused funds. Observing rampant dilution problems in mutual funds,

[47] The distinction is important but can be lost in the ambiguity of "shareholder" in this context. A management company must serve the interests of two types of shareholders: investors in the the mutual funds that the company operates and the owners of the management company itself. I generally refer to conflicts between mutual fund investors and management companies as external or fiduciary conflicts, and conflicts between management companies' owners and executives as internal or owner-manager conflicts.

[48] The proposed rules were rejected twice by the U.S. Court of Appeals and have not been adopted.

[49] Qian, for example, studies governance by looking at the composition of mutual fund boards but not the boards of the management companies.

Zitzewitz concluded that "there is another layer of agency problems inside management companies."

To be sure, the fiduciary conflicts between mutual fund shareholders and management companies are important; their regulation is the objective of many of the provisions of the Investment Company Act of 1940. Moreover, as discussed in section 8.1.3, the primary channel by which these conflicts are governed in the marketplace, through the effects of performance on assets under management, is *insufficient* to discourage mutual fund managers from simply expropriating assets from investors—hence the importance of regulation. But this paper's results indicate that the incentives should have been strong enough to prevent management companies from expropriating investors' wealth indirectly by arranging deals with abusive traders. Thus, the fiduciary conflict between mutual fund shareholders and management companies should not have been a problem when the latter were offered small shares of the gains from dilutive trades. The owner-manager conflict between *management company* shareholders and executives, however, appears to have played a crucial role in the mutual fund scandal.

Owner-manager conflicts are more difficult to square with some of the behavior in the scandal, however. For example, several principals who owned substantial shares of their asset management firms, including PBHG, RS Investments, Seligman, and Strong, nonetheless chose to accommodate abusive traders, and even to market time their own funds.[50] And several of the management companies were affiliates of much larger financial corporations, which presumably would have understood the conflicts facing asset managers and prevented them from risking a parent firm's fiduciary reputation by building assets through deals with abusive traders.

9.2 Other explanations?

Below, I consider some alternative explanations for my empirical findings and for management companies' decisions to collude with abusive traders.

9.2.1 The actions of rogue employees?

An alternative explanation for the scandal might be that the trading arrangements were the unauthorized work of a few rogue employees who sought strictly personal gain. However, collusion was hardly the work of isolated low-level employees acting in secret:

[50] The gains from one's own market timing far exceeded the revenues obtained by accommodating others' trading abuses, so the fact that Richard Strong and Gary Pilgrim benefitted directly from the trading abuses may help explain why they chose to allow them. Even so, it is hard to imagine that the $1.6 million that Strong himself netted through his timing activity could possibly have outweighed the risk to the value of his 85 percent stake in Strong Financial Corporation (Attorney General of the State of New York, 2004b; U.S. Securities and Exchange Commission, 2004c).

Evidence presented in official documents indicates that at 15 of the 20 tainted firms, decisions to facilitate abusive trading were made or approved by top executives (chairmen, chief executive officers, and presidents), and senior executives were culpable at most of the other firms. Top executives at half of the tainted firms paid substantial penalties for their parts in the scandal (see table 2). Executives chose to accommodate market timers in most cases despite warnings from portfolio managers, compliance officers, and others that the abusive trading was hurting fund performance and, ultimately, the management company.

9.2.2 Endogeneity of performance and abusive-trading arrangements

Another possible interpretation of the link between abusive-trading arrangements and the poor performance of abused mutual funds is that lousy returns *led to* bad decisions. If so, attributing the abnormal returns of mutual funds to trading abuse would be wrong. Instead, it might be the case that executives at mutual fund families with unattractive funds inked arrangements with abusive traders because those executives thought they had little to lose.

The timing of the abusive-trading arrangements, estimated dilution, and the deterioration of performance among abused mutual funds suggests otherwise: Trading arrangements typically preceded poor returns. Most of the mutual fund families that struck deals with abusive traders first did so in early 2000 or before, when they were still, on average, *outperforming* their peers (see figure 2).[51]

Moreover, dilution—which is unambiguously *caused* by abusive trading and which contributed to poor performance—increased substantially at the same time that abusive trading by arrangement, as recorded in official documents, was ramping up. Part of the story behind the surge in market timing activity around 2000 may have been the dissemination of information about the profitability of market timing. For example, Zitzewitz (2003) argues that the circulation of several academic papers in 1999 and 2000 that highlighted the potential profitability of market timing prompted an increase in dilution. My estimates of dilution in abused funds—computed independently of relative returns and unambiguously related to abusive trading—doubled between 1999 to 2000 and then doubled again in 2001.

[51] To be sure, there were instances in which declining managed assets prompted collusion with market timers. One noteworthy case was Fred Alger, which had offices in the World Trade Center and tragically lost many employees in the September 2001 terrorist attacks. Concerns about the firm's ability to continue operations (not poor performance) apparently prompted shareholder redemptions of its mutual funds. Although Alger Management already had arrangements with selected market timers before September 2001, the decline in assets after the tragedy convinced senior executives to court market timers more aggressively (U.S. Securities and Exchange Commission, 2007b).

9.2.3 Smaller losses for poor performers?

A related possibility is that I have overstated the effects of poor performance on flow by using estimated coefficients, π^p, from equation (10) that apply to the middle of the returns distribution. However, abused funds were disproportionately likely to fall in the lowest-performing quintiles in their categories, and as shown in column 1 of table 6, the flow response to relative returns in the bottom quintile was on average smaller than the response to relative returns in the middle quintiles (column 2). Performance-related losses computed from estimated coefficients that would apply to low-quintile funds ($\pi^p + \pi^{pL}$, the sum of columns 1 and 2) are indeed smaller, but only by 4 to 6 percent—not nearly enough for a management company with poorly performing funds to justify collusion with abusive traders. It appears that the managers of even the poorest-performing mutual funds had a lot to lose in making arrangements with abusive traders.

9.2.4 Were investors at tainted families less responsive to past performance?

Qian (2006) argued that the investors who held mutual funds at tainted families were less sensitive to past performance and so provided less effective monitoring and disincentives for arrangements with abusive traders. However, when I estimated equation (10) using *only* data for tainted mutual fund families through August 2000, I found that the estimated flow sensitivity to relative returns was *larger* for these funds than for the full sample. Thus, the expected performance losses for the tainted families should have provided strong incentives against arrangements with abusive traders.

9.2.5 High discount rates?

One possible explanation for management companies' behavior is that they simply failed to recognize the long-term consequences of impaired performance on their own future revenues. While internal communications show that managers and executives at most tainted families were well aware that trading abuses cut into returns, I am not aware of any that analyzed the magnitude of potential losses in assets under management due to poor returns.

Evidence from the literature on the economics of crime indicates that violent offenders tend to have high subjective discount rates (see, for example, Lee and McCrary, 2005). The applicability of this finding to white-collar crime and financial malfeasance is not clear, but with sufficiently high discount rates, the more immediate benefits of arrangements with abusive traders would outweigh the expected costs, which are incurred with some delay. For example, discount rates exceeding 36 percent at an annual rate would rationalize management companies' decisions to accommodate abusive traders permanently, under the assumptions that the abusive-trading arrangements would never

be revealed and that fund companies collected high-estimate revenues ($528 million annually) from the arrangements. Even higher discount rates would be needed to rationalize shorter-duration arrangements; three-year deals would have made sense only for discount rates exceeding 42 percent (and a zero ex ante probability of getting caught).

10 Conclusion

Conflicts of interest between asset management firms and buy-and-hold mutual fund investors seldom have been as apparent as in the mutual fund scandal that made headlines in late 2003. The asset management firms that sought to share in the gains from abusive trading breached their fiduciary duties to mutual fund shareholders and, in the aggregate, cost them billions of dollars. Prosecutors were quick to frame the scandal as the outcome of such conflicts; a State of New York assurance of discontinuance provided a typical description of the problem:

> By placing their own interest in generating compensation from short-term or excessive trading above the interests of long-term shareholders to whom this trading posed a risk of harm, and by failing to disclose these arrangements and trading and the conflicts of interest they created, [the management company] engaged in fraudulent conduct . . . (Attorney General of the State of New York, 2005b).

Regulators responded with reform proposals intended to reinforce mutual fund investors' interests vis-a-vis those of management companies. The scandal also has prompted academic research on the link between mutual fund governance and abusive-trading arrangements.

This paper shows, however, that the fiduciary conflicts between mutual fund shareholders and the firms that manage their funds were unlikely to have been the only explanation for the mutual fund scandal. A particularly salient aspect of this scandal is that asset management companies struck deals that harmed mutual fund investors *and the management companies themselves*. Even if the companies had correctly assumed that their transgressions would never be detected, they made decisions that were not in their own long-term interests. Why they did so remains something of a puzzle. Agency conflicts *within* the management companies—between their owners and executives—may have played an important role; executives may have cut deals that furthered their own short-term interests to the detriment of their firms. Some executives may have been simply unaware of the full costs of abusive trading to their firms, or they may have discounted too heavily the long-term costs of the abuse.

My results suggest a new interpretation of the lessons of the mutual fund scandal, as this was not a simple example of profitability outweighing fiduciary duties. The

scandal and its consequences remind shareholders, customers, fiduciary clients, and policy makers not to rely solely on firms' own self-interest to govern their behavior and, in particular, to be aware that firms may not always shun malfeasance when the immediate proceeds fall short of the present value of future penalties.

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Table 1. Tainted mutual fund families.

Fund Complex	(1) Assets under management (billions of dollars)*	(2) Date publicly implicated	(3) Number of abused funds	(4) Assets under management in abused funds (billions of dollars)*
Alliance	51.8	Sep 2003	10	22.2
Bank One - One Group	40.6	Sep 2003	3	2.2
Banc of America - Nations	30.3	Sep 2003	13	12.0
Columbia - Fleet - Liberty	49.1	Jan 2004	18	22.1
Deutsche - Scudder - Kemper	61.0	Jan 2004	22	12.7
Federated	47.8	Oct 2003	8	17.3
Franklin Templeton	124.4	Feb 2004	4	30.5
Fred Alger	3.1	Oct 2003	4	1.8
Fremont	2.9	Nov 2003	2	1.5
Invesco/AIM	76.1	Nov 2003	7	13.1
Janus	98.3	Sep 2003	7	24.8
Massachusetts Financial Services	73.1	Dec 2003	9	44.4
Pilgrim Baxter (PBHG)	6.4	Nov 2003	5	2.7
PIMCO	132.3	Feb 2004	6	18.5
Putnam	143.6	Oct 2003	10	37.5
RS Investments	4.1	Mar 2004	1	1.5
Seligman	9.1	Jan 2004	7	6.6
Strong	24.8	Sep 2003	5	3.1
Wachovia - Evergreen	46.2	Aug 2004	3	1.7
Waddell & Reed	19.4	Jul 2006	1	0.8
Industry Totals	1044.3		145	277.0

* Assets under management as of August 30, 2003. Data for long-term mutual funds only (money market funds are excluded).

Table 2. Official penalties and mandated fee reductions (millions of dollars)

Fund Complex	(1) Management company civil penalties	(2) Management company disgorgement	(3) Fund restitution	(4) Executive civil penalties	(5) Executive disgorgement	(6) Other employee civil penalties	(7) Other employee disgorgement	(8) State-mandated fee reductions	**(9) Total penalties**
Alliance	100	150	0	0.7	0.0	0.2	0.0	350	**601**
Bank One - One Group	40	10	0	0.1	0.0	0.0	0.0	40	**90**
Banc of America - Nations	125	250	0	0.0	0.0	0.2	0.0	160	**535**
Columbia - Fleet - Liberty	70	70	0	0.0	0.0	0.3	0.0	0	**140**
Deutsche - Scudder - Kemper	26	103	0	0.0	0.0	0.1	0.1	86	**215**
Federated	45	27	8	0.0	0.0	0.0	0.0	20	**100**
Franklin Templeton	25	30	0	0.0	0.0	0.0	0.0	0	**55**
Fred Alger	10	30	0	0.0	0.0	0.4	0.0	5	**45**
Fremont	2	2	0	0.1	0.0	0.0	1.0	0	**5**
Invesco/AIM	142	235	0	0.6	0.0	0.4	0.0	75	**453**
Janus	51	50	32	0.0	0.0	0.0	0.0	125	**258**
Massachusetts Financial Services	50	175	0	0.5	0.1	0.0	0.0	125	**351**
Pilgrim Baxter (PBHG)	50	40	0	40.0	120.0	0.0	0.0	10	**260**
PIMCO	58	8	2	0.5	0.3	0.0	0.0	0	**69**
Putnam	100	54	0	0.0	0.0	0.8	0.7	0	**155**
RS Investments	14	12	0	0.3	0.0	0.0	0.0	5	**30**
Seligman	0	0	6	0.0	0.0	0.0	0.0	0	**6**
Strong	40	40	0	30.0	30.0	0.4	0.4	35	**176**
Wachovia - Evergreen	4	29	0	0.2	0.0	0.0	0.0	0	**33**
Waddell & Reed	12	40	0	0.0	0.0	0.0	0.0	25	**77**
Industry Totals	963	1,354	47	72.9	150.5	2.7	2.2	1,061	**3,654**

Table 2 (continued). Official penalties and mandated fee reductions (millions of dollars)

Fund Complex	**(9)** **Total penalties**	(10) Penalties excluding fee reductions (column 9 less column 8)	(11) Total disgorgement and restitution (columns 2, 3, 5, 7)	(12) Penalties excluding fee reductions and employee fines (column 10 less columns 6 & 7)	(13) Estimated dilution (Zitzewitz, 2007b)	(14) Maximum of penalties and dilution*
Alliance	**601**	251	150	251	64	251
Bank One - One Group	**90**	50	10	50	20	50
Banc of America - Nations	**535**	375	250	375	117	375
Columbia - Fleet - Liberty	**140**	140	70	140	89	140
Deutsche - Scudder - Kemper	**215**	129	103	129	268	268
Federated	**100**	80	35	80	96	96
Franklin Templeton	**55**	55	30	55	479	479
Fred Alger	**45**	40	30	40	43	43
Fremont	**5**	5	3	4	19	19
Invesco/AIM	**453**	378	235	377	378	378
Janus	**258**	133	82	133	255	255
Massachusetts Financial Services	**351**	226	175	226	35	226
Pilgrim Baxter (PBHG)	**260**	250	160	250	282	282
PIMCO	**69**	69	10	69	41	69
Putnam	**155**	155	54	154	246	246
RS Investments	**30**	25	12	25	70	70
Seligman	**6**	6	6	6	none	80
Strong	**176**	141	70	140	14	141
Wachovia - Evergreen	**33**	33	29	33	none	33
Waddell & Reed	**77**	52	40	52	45	52
Industry Totals	**3654**	2593	1554	2588	2561	3553

*Maximum of columns 10 and 13. Figure for Seligman comes from NYAG complaint.

Table 3. Some estimates of losses to buy-and-hold investors

Type/Study	Group of interest	Period	Losses estimated	Losses (percent, annual rate)
Pre-scandal studies				
1. Greene & Hodges (2002)	World equity funds with highest flow activity	1998-2000	Dilution	0.94
2. Zitzewitz (2003)	Regionally focused world equity funds	1998-2001	Dilution	1.60
	General international funds	1998-2001	Dilution	0.81
	Precious-metal funds	1998-2001	Dilution	1.17
3. Zitzewitz (2006)*	International equity	1998-2000	Dilution due to ***late trading***	0.06
	Domestic equity	1998-2000	Dilution due to ***late trading***	0.02
Post-scandal studies				
4. Zitzewitz (2007b)	Scandal-tainted ***families*** (international equity)	2000-2003	Dilution	0.49
5. Houge & Wellman (2005)	Scandal-tainted ***families*** (only equity funds affected)	2001-2003	Raw returns	0.15
6. Schwartz & Potter (2006)	Scandal-tainted ***families*** (domestic equity)	2000-2003	Risk-adjusted returns	0.83
7. Qian (2006)	Scandal-tainted ***funds***	2000-2003	Risk-adjusted returns	0.34
	Abused ***funds***	2000-2003	Risk-adjusted returns	1.95
8. This study	Abused ***funds*** (all types)	2000-2003	Risk-adjusted relative returns	3.62

*Written after mutual fund scandal broke, but similar to pre-scandal papers in that dilution was estimated by investment objective rather than by whether a fund had been identified as having allowing late trading.

Table 4. Abnormal performance of scandal-tainted and abused mutual funds

Dependent variable	(1) Relative return	(2) Alpha based on category-performance risk factors	(3) Alpha based on market risk factors (incl. Nasdaq)	(4) Alpha based on category performance plus Nasdaq	(5) Alpha based on category performance, using *net* returns
Panel A. September 2000 to August 2003 (three years before the scandal broke)					
Constant (c_0)	0.90	0.64	2.73	0.57	0.30
	(7.74)	(7.26)	(31.09)	(6.62)	(3.47)
Abused (γ_1)	-4.86	-3.69	-4.37	-3.62	-3.62
	(-6.57)	(-6.83)	(-8.05)	(-6.89)	(-6.77)
Tainted (γ_2)	-0.83	-0.62	-0.89	-0.60	-0.63
	(-3.33)	(-3.35)	(-4.71)	(-3.37)	(-3.44)
Log of assets x 10^{-5} (ξ)	2.24	1.81	1.14	2.02	4.04
	(0.88)	(1.06)	(0.68)	(1.19)	(2.22)
R-squared	0.013	0.013	0.019	0.013	0.013
Number of obs.	5040	5040	5040	5040	5040
Panel B. January 2004 to December 2006 (three years after the scandal broke)					
Constant (c_0)	-0.57	-0.69	2.29	-0.52	-0.99
	(-12.95)	(-15.13)	(42.11)	(-11.98)	(-21.43)
Abused (γ_1)	0.05	-0.57	-0.02	-0.18	-0.49
	(0.17)	(-2.03)	(-0.07)	(-0.72)	(-1.76)
Tainted (γ_2)	0.18	0.28	-0.12	0.22	0.27
	(2.05)	(3.03)	(-1.04)	(2.56)	(2.91)
Log of assets x 10^{-5} (ξ)	2.94	3.68	2.57	2.71	5.26
	(4.32)	(5.30)	(3.80)	(4.82)	(6.06)
R-squared	0.003	0.006	0.001	0.003	0.009
Number of obs.	4984	4986	4986	4986	4986

Notes. Unit of observation for each regression is a mutual fund. Dependent variable units are 100 times logarithm of annual returns. Figures in parentheses are t-statistics based on robust standard errors. See text for discussion of risk factors used to derive each dependent variable.

Table 5. Mutual fund companies' share of abusive-trading revenues from selected arrangements

Fund Complex	(1) Net gains of market timers ($ millions)	(2) Fees earned by management company ($ millions)	(3) Management company share (percent)
Alliance	64.0	4.8	7.0
Banc of America - Nations*	16.7	12.5	42.8
Columbia - Fleet - Liberty	30.4	0.5	1.6
Deutsche - Scudder - Kemper	32.7	1.3	3.7
Federated	4.4	0.4	8.8
Janus	15.7	0.8	5.0
Pilgrim Baxter (PBHG)	9.0	0.7	7.1
Wachovia - Evergreen	0.4	0.0	6.2
Waddell & Reed	8.2	3.6	30.8
Industry Totals	181.4	24.6	12.0
Adjusted for internal trading abuse			12.4
Weighted by:			
Assets in abused funds			8.6
Total dilution			10.2
Total penalties			16.6

* Management company fees include revenues of affiliates, such as Banc of America Securities. The share of revenues captured by the management company itself (Banc of America Capital Management) was 2.2 percent.

Table 6. Flow response to relative and category returns

	Relative returns			Category returns		
	(1) *bottom-quintile increment*	(2) *mid-distribution*	(3) *top-quintile increment*	(4) *bottom-quintile increment*	(5) *mid-distribution*	(6) *top-quintile increment*
current month	-3.06	11.46	1.62	-6.77	14.80	0.22
	(-2.67)	(12.49)	(1.30)	(-10.25)	(23.71)	(0.35)
monthly, 1 lag	-2.70	12.26	2.19	-2.39	9.78	1.37
	(-2.44)	(13.74)	(1.85)	(-3.80)	(16.91)	(2.36)
monthly, 2 lags	-1.02	10.09	-0.96	-4.16	8.95	-0.08
	(-0.93)	(11.75)	(-0.79)	(-6.81)	(16.36)	(-0.14)
monthly, 3 lags	-1.54	10.54	0.14	-1.20	5.58	2.54
	(-1.55)	(13.35)	(0.12)	(-1.95)	(10.67)	(4.49)
annual	-0.11	6.05	2.27	-1.99	5.17	-0.79
	(-0.29)	(20.80)	(5.00)	(-6.42)	(23.43)	(-4.51)
3-year	-0.29	3.32	0.90	-0.41	0.88	0.49
	(-1.12)	(16.35)	(3.18)	(-2.13)	(6.22)	(4.39)
	Number of observations		918,407	Adjusted R^2	0.180	

Notes. Dependent variable is 100*ln(1+flow/lagged assets). *t*- statistics in parentheses are based on robust standard errors for data clustered by mutual fund. Regression includes time and share-class fixed effects.

Table 7. Revenues and costs of cheating (billions of dollars)

	Revenues		Costs			
	(1)	(2)	(3)	(4)	(5)	(6)
Time Horizon (years)	Based on penalties and dilution	Based on disgorge-ment	Performance-related losses	Reputation-related outflows	Official penalties	Mandated fee reductions
Panel A. Trading abuses allowed for three years and are then detected						
	Cumulative revenues and costs (not discounted)					
1	0.2	0.5	0.1	0.0	0.0	0.0
2	0.4	1.1	0.3	0.0	0.0	0.0
3	0.6	1.6	0.7	0.0	0.0	0.0
6	0.6	1.6	2.6	2.3	2.6	0.5
10	0.6	1.6	5.0	8.6	2.6	1.1
	Discounted present value*					
1	0.2	0.5	0.1	0.0	0.0	0.0
2	0.4	0.9	0.3	0.0	0.0	0.0
3	0.5	1.3	0.6	0.0	0.0	0.0
6	0.5	1.3	1.7	1.3	1.8	0.3
10	0.5	1.3	2.7	4.0	1.8	0.6
∞	0.5	1.3	4.7	9.9	1.8	0.6
Panel B. Trading abuses allowed forever and are never detected						
	Cumulative revenues and costs (not discounted)					
1	0.2	0.5	0.1	0.0	0.0	0.0
2	0.4	1.1	0.3	0.0	0.0	0.0
3	0.6	1.6	0.7	0.0	0.0	0.0
6	1.2	3.2	3.3	0.0	0.0	0.0
10	2.0	5.3	8.5	0.0	0.0	0.0
	Discounted present value*					
1	0.2	0.5	0.1	0.0	0.0	0.0
2	0.4	0.9	0.3	0.0	0.0	0.0
3	0.5	1.3	0.6	0.0	0.0	0.0
6	0.9	2.3	2.1	0.0	0.0	0.0
10	1.2	3.2	4.3	0.0	0.0	0.0
∞	1.8	4.8	8.3	0.0	0.0	0.0

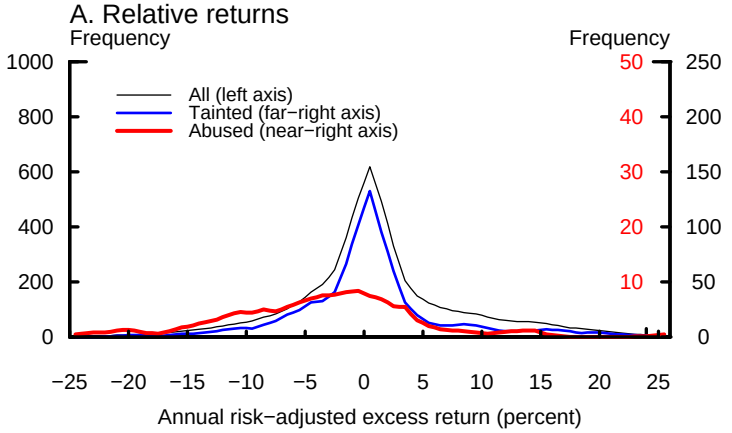
Notes. Based on a 3.6 percentage-point reduction in relative return due to trading abuses.

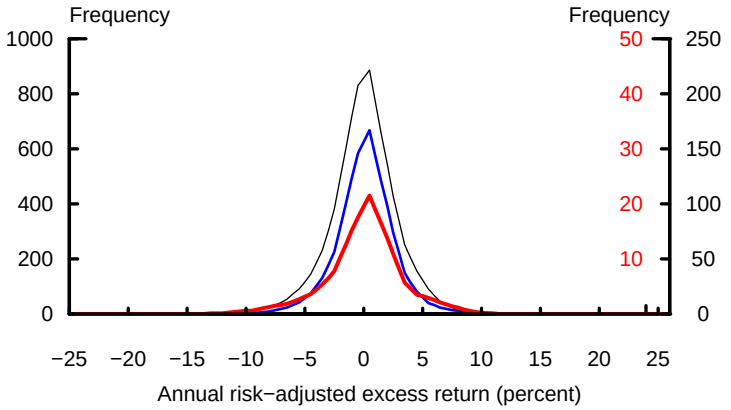
*As of the beginning of the period in which trading abuses are allowed, using a weighted average cost of capital of 11.6 percent.

Figure 1. Distributions of Risk−Adjusted Excess Returns

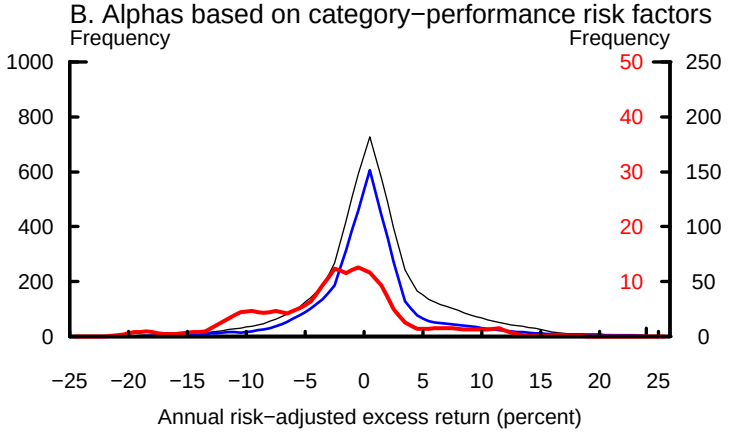
September 2000 − August 2003 | **January 2004 − December 2006**

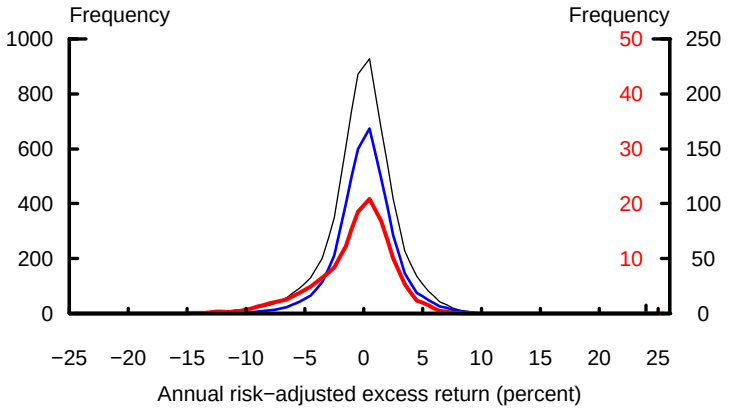
A. Relative returns



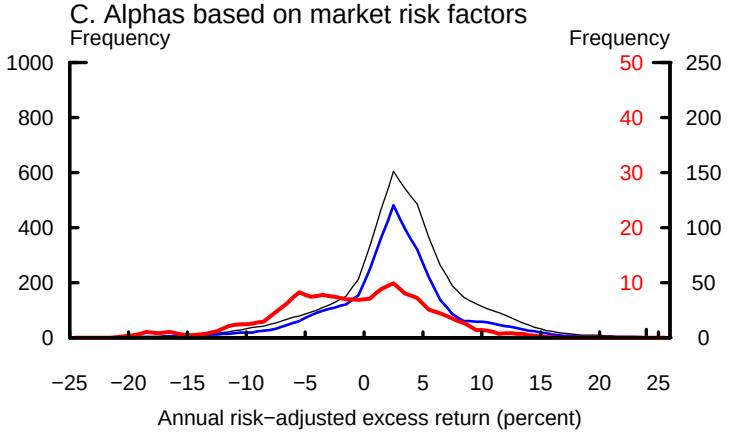


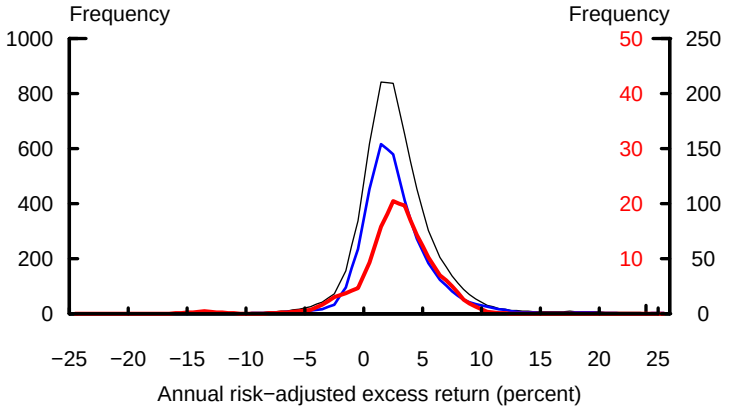
B. Alphas based on category−performance risk factors



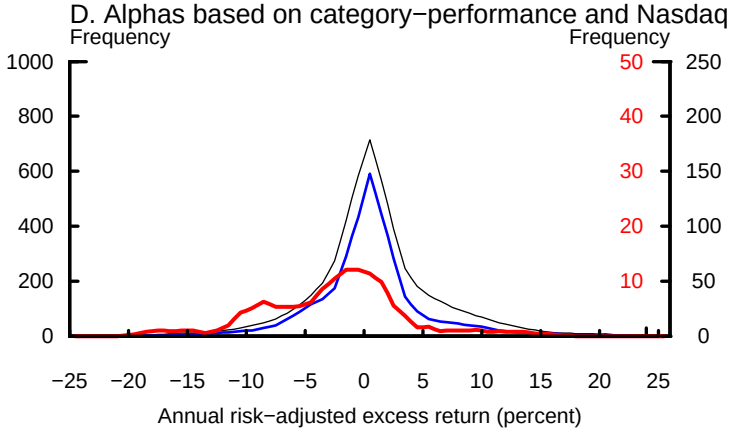


C. Alphas based on market risk factors





D. Alphas based on category−performance and Nasdaq risk factors



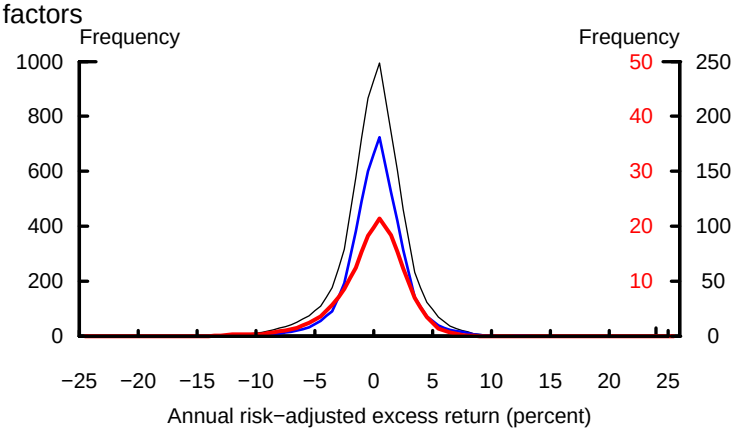
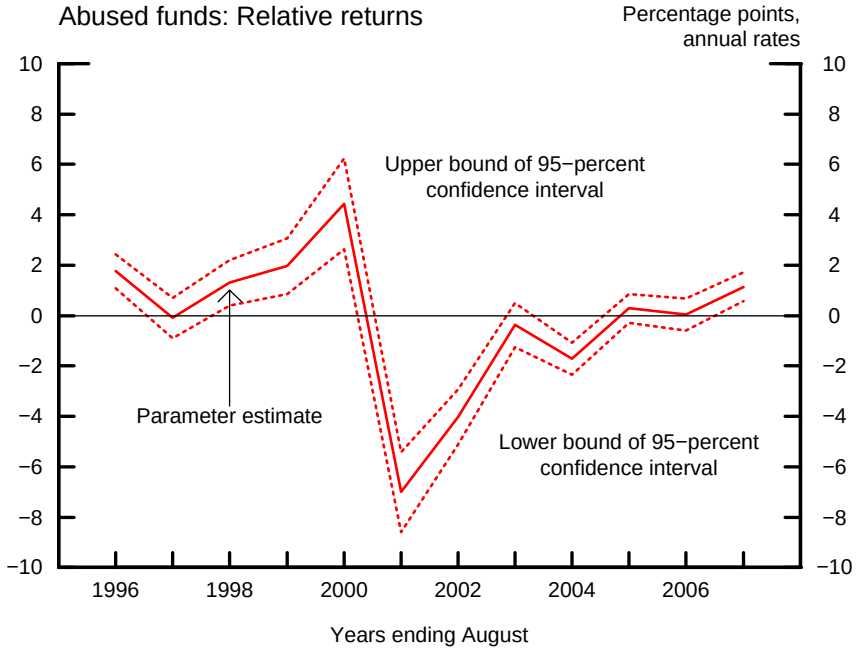
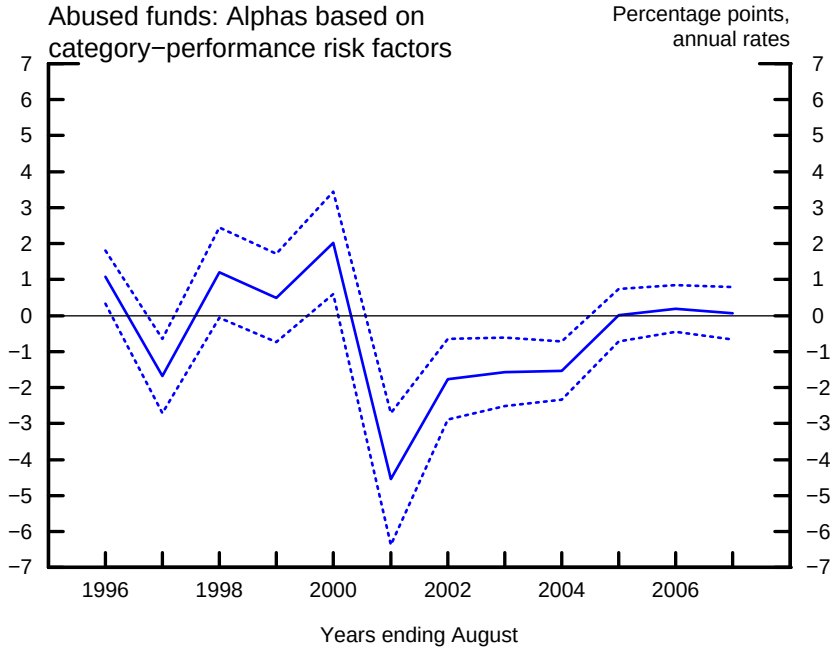
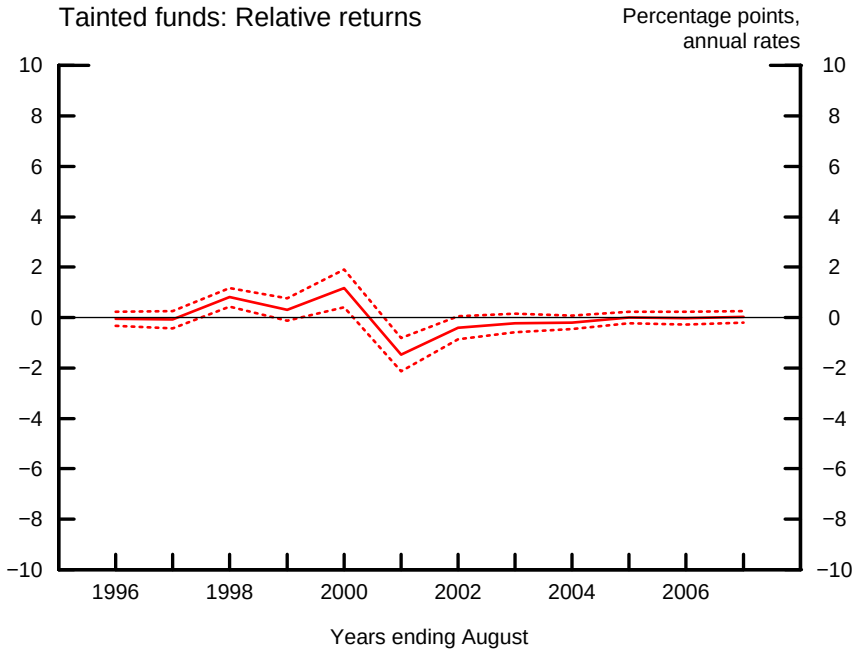
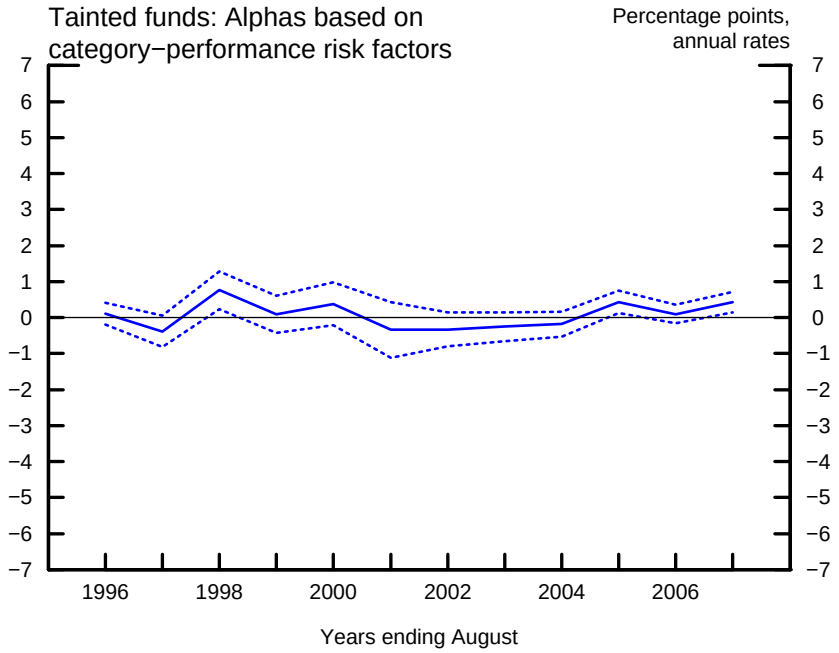


Figure 2.A. Relative Performance of Abused and Tainted Mutual Funds
Deviations from Industry Averages



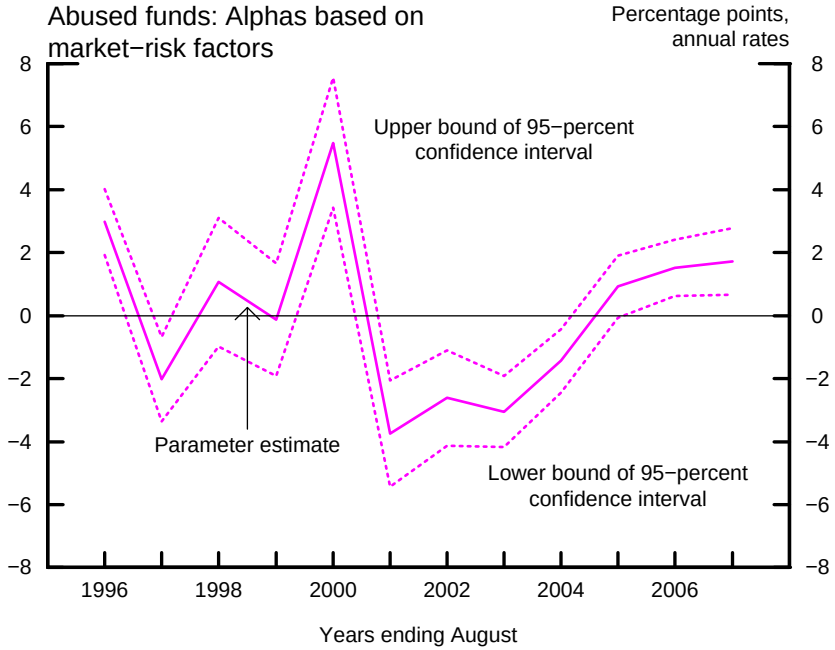


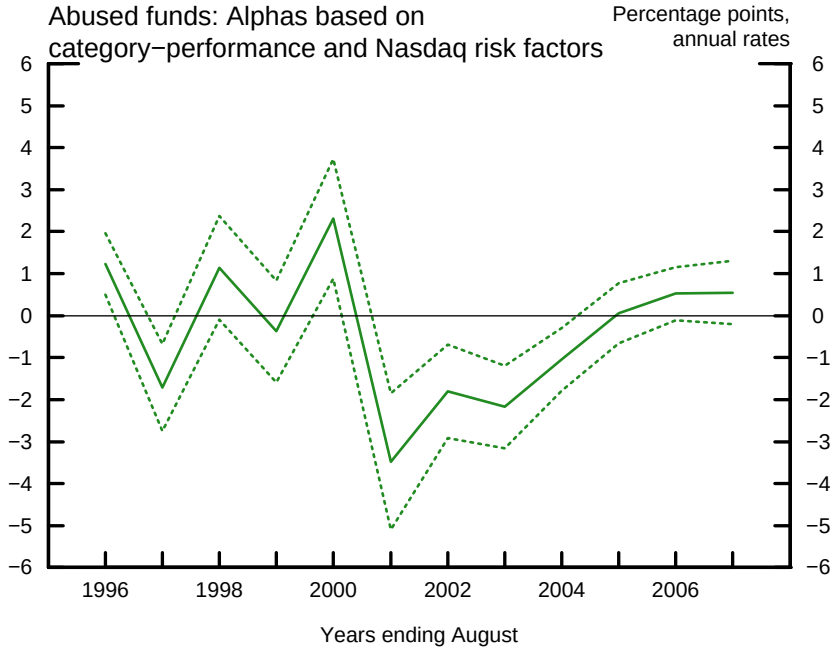


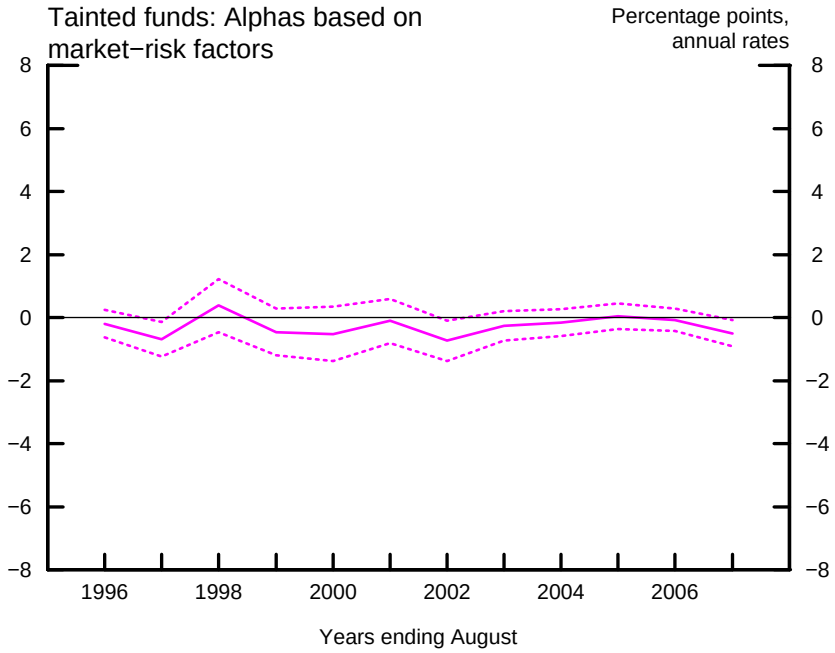


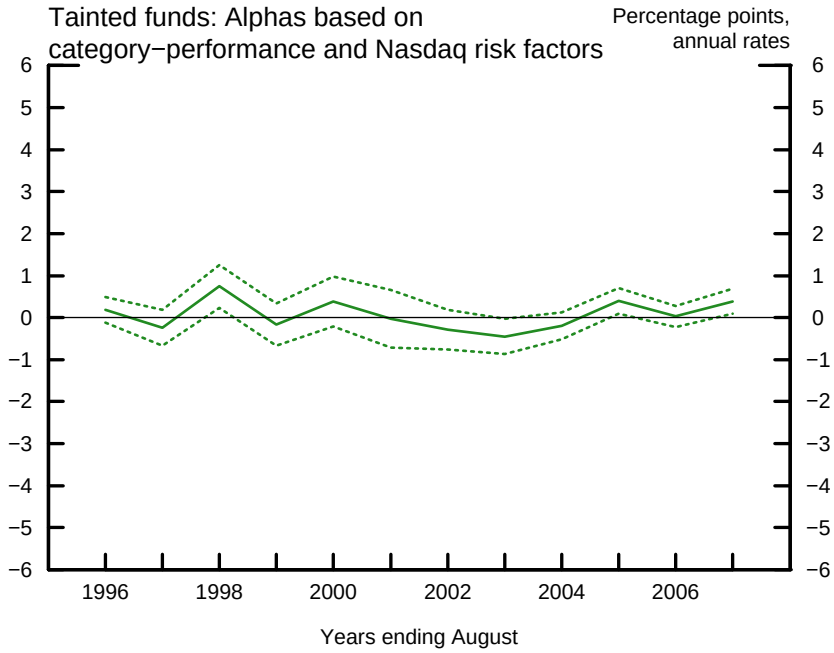
Note. All estimates control for mutual fund assets under management.

Figure 2.B. Relative Performance of Abused and Tainted Mutual Funds
Deviations from Industry Averages



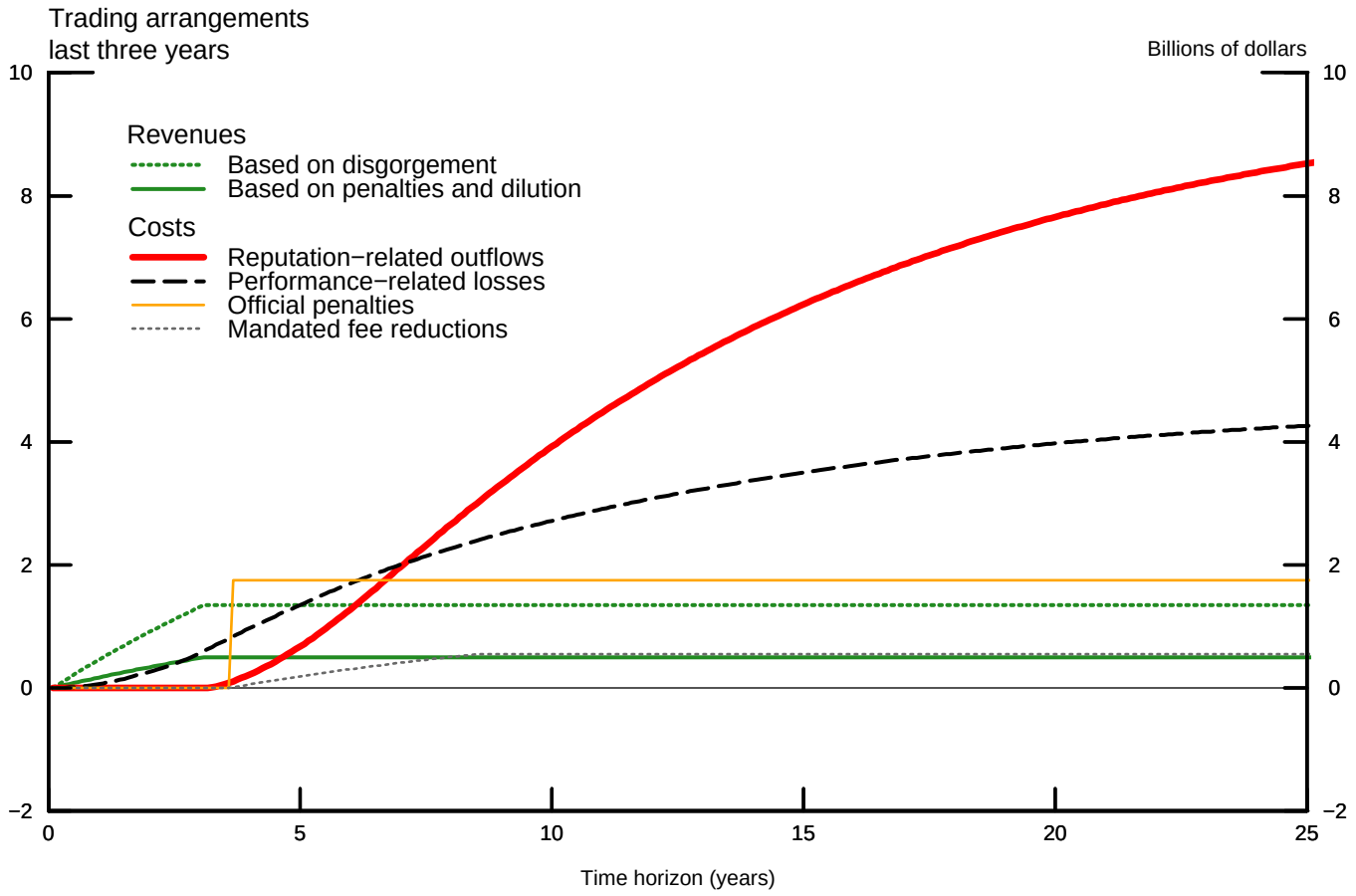






Note. All estimates control for mutual fund assets under management.

Figure 3. Discounted Cumulative Revenues and Costs



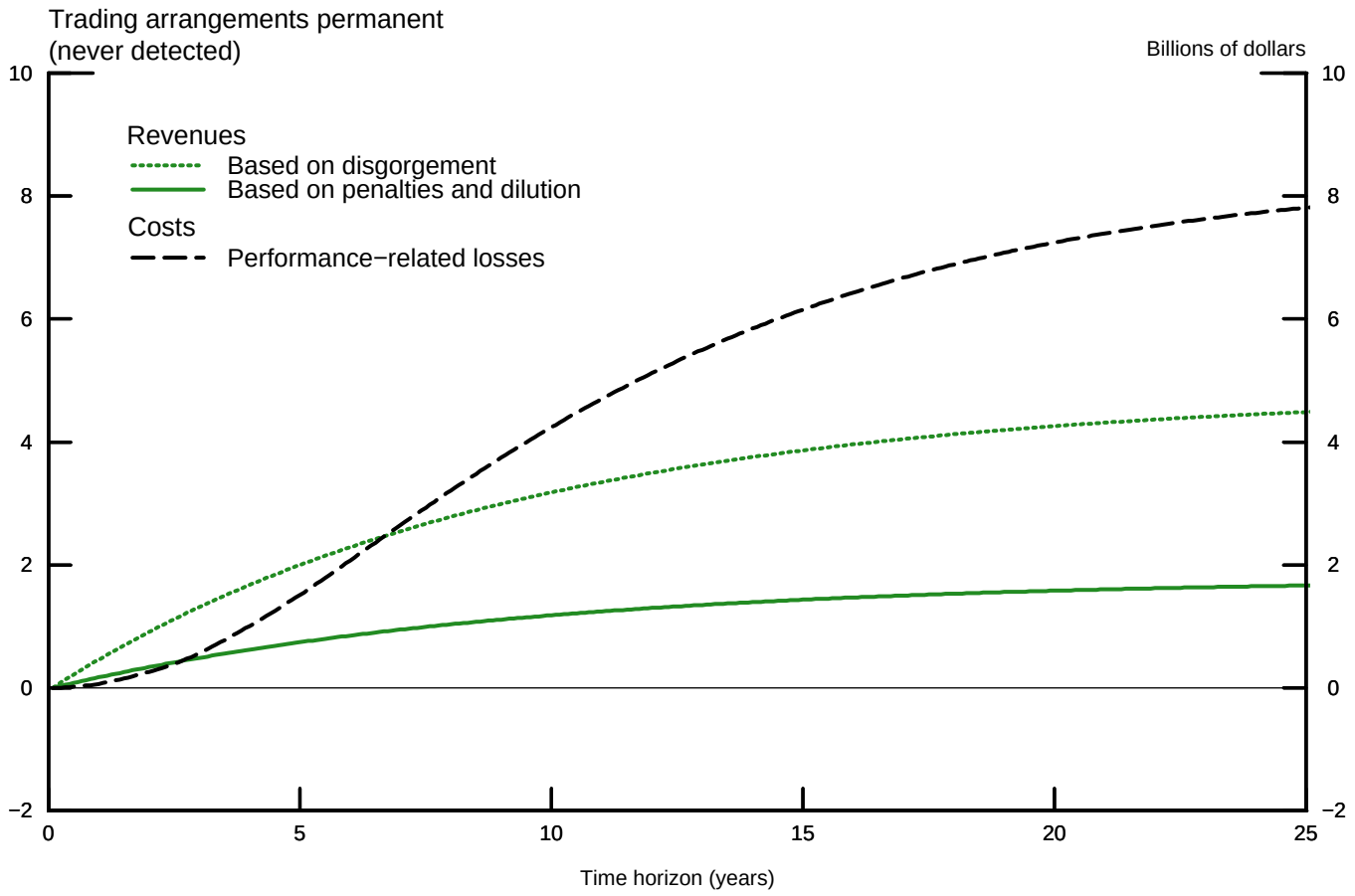


Figure 4. Discounted Cumulative Revenues and Costs

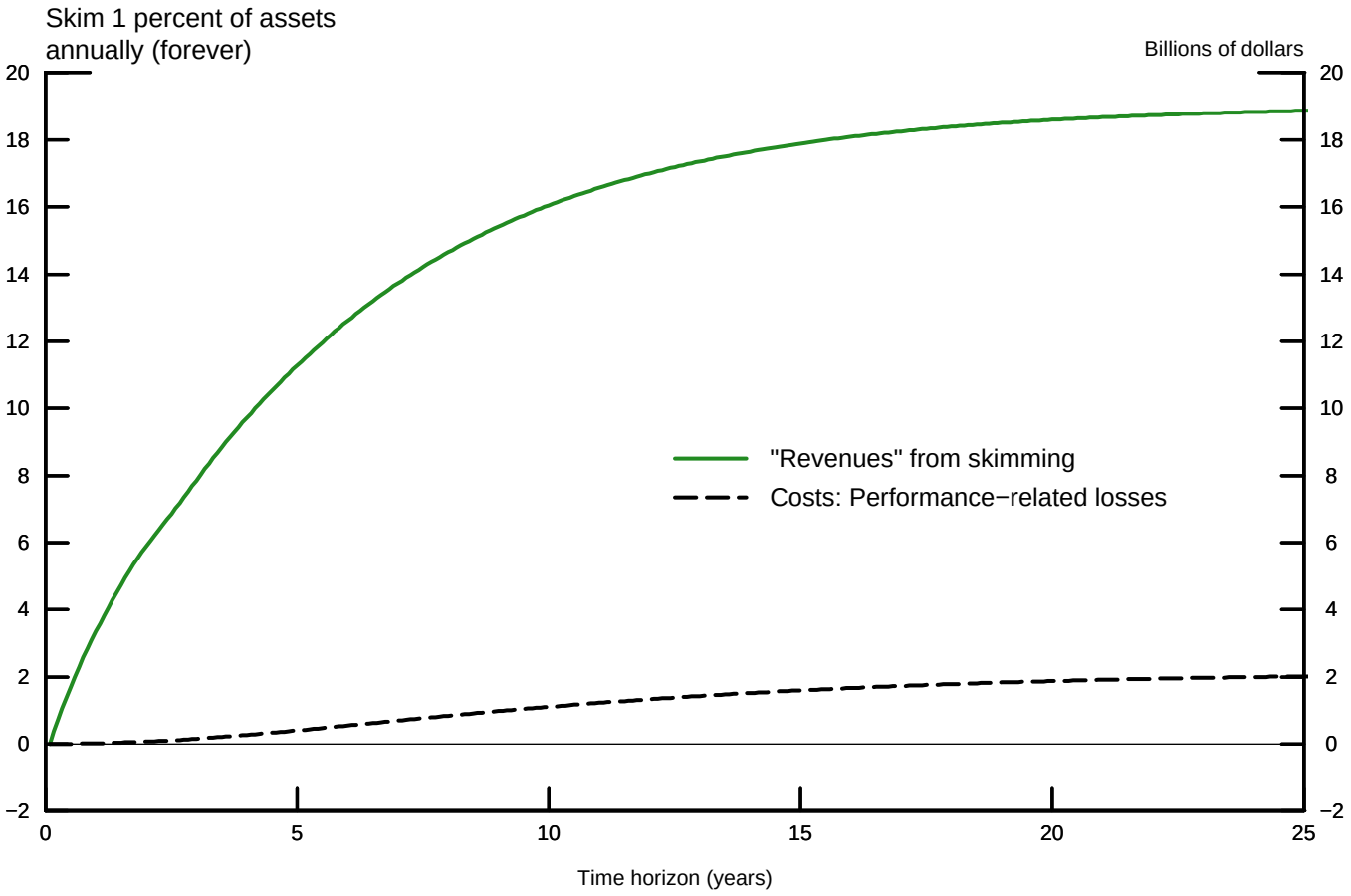


Figure 5. Abnormal Flows to Scandal−Tainted Mutual Fund Families

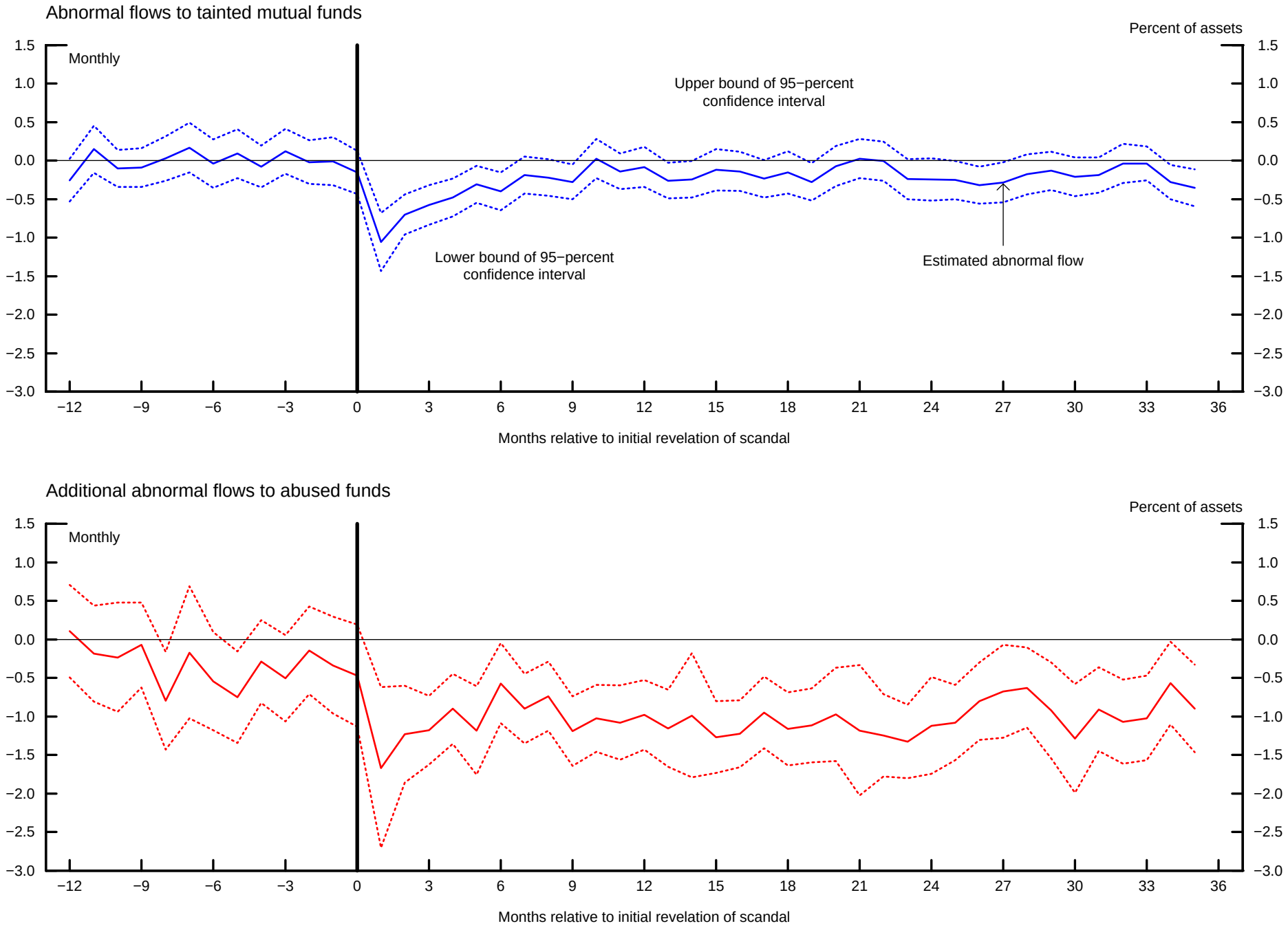
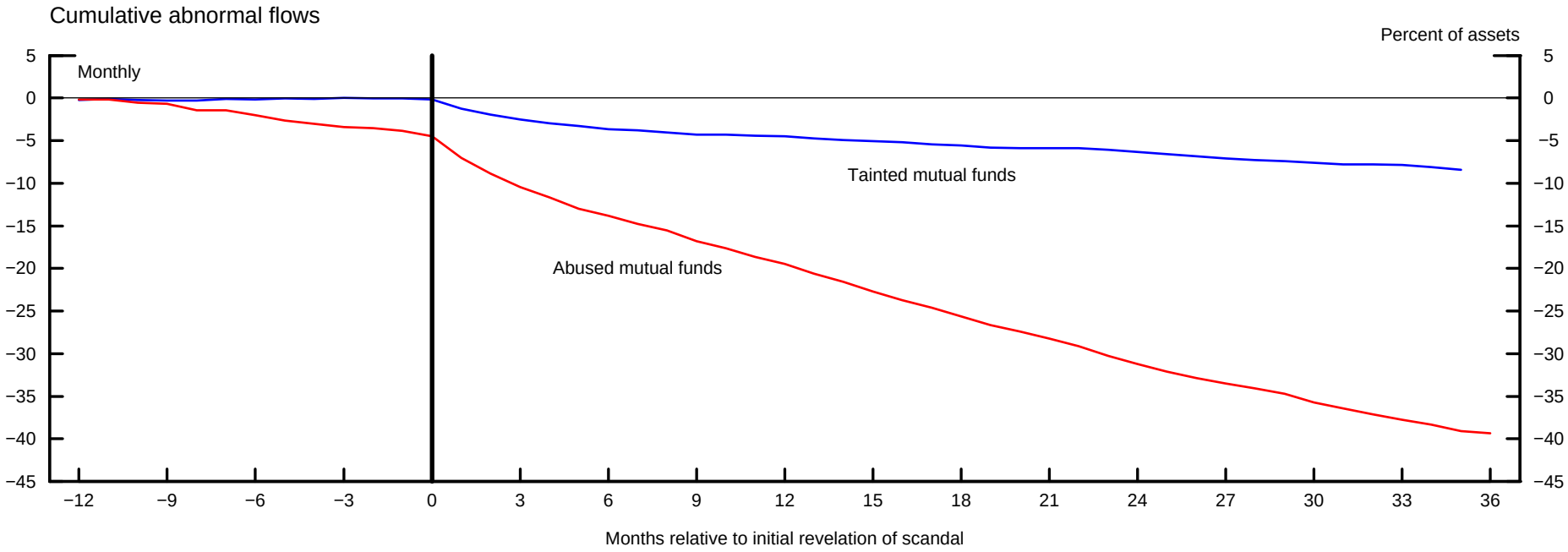


Figure 6. Cumulative Abnormal Flows to Scandal−Tainted Mutual Fund Families



Appendix: Estimating abusive-trading gains and dilution

A.1 Methods of estimating dilution

As Greene and Ciccotello (2004) and Zitzewitz (2007b) have outlined, researchers—and consultants working on mutual fund litigation—have employed three basic approaches to estimating dilution from trading abuse. The first might be called the "flow-correlation" approach, as it is based on correlations between daily net flows and either predicted pricing errors (the "predicted-NAV" method) or realized next-day returns (the "next-day-NAV" method).[52] The second ("profits" or "consulting") approach looks at holding-period gains for abusive traders. The third ("cash-model") approach, proposed by Greene and Ciccotello, combines the other two but also explicitly takes into account how portfolio managers handle cash from abusive traders, since realized dilution may depend importantly on these cash-management policies.

Early estimates of dilution caused by trading abuses employed the flow-correlation approaches.[53] Goetzmann et al. (2001) used the predicted-NAV method with pricing errors modelled using same-day S&P 500 index returns. Zitzewitz (2003, 2007b) used a similar strategy, but added several other predictors of pricing errors, including Nikkei futures, returns on speciality indexes, and category-average NAV changes for some types of funds. Greene and Hodges (2002) introduced the next-day-NAV approach in estimating dilution in world equity funds. This is the approach I used to derive (6), as described in section A.3 below.

The predicted-NAV and next-day-NAV methods are especially useful in estimating dilution with fund-level net-flows data but without information about individual abusive traders' transactions. Each method has its benefits. The predicted-NAV approach aims to pinpoint abusive-trading flows by using the signals—such as changes in index futures prices—that market timers and late traders employed to trigger dilutive trades. This gives it a precision advantage over the next-day method, which infers the trading signals from noisier next-day-NAV changes. On the other hand, the next-day-NAV method is simple to employ, requires no modeling assumptions about pricing errors, and provides a more direct measure of *realized* gains from abusive trades and dilution to buy-and-hold investors' wealth. Also, the next-day-NAV method—unlike the predicted-NAV approach—will capture dilution from trading opportunities that timers

[52] Greene and Ciccotello labelled these the "one-day" methods, while Zitzewitz called them the "academic" methods.

[53] Much earlier, Lyon (1984), who documented evidence that market timers were exploiting stale prices in *money market funds*, also estimated dilution by examining the correlation of net flows and estimated pricing errors. The pricing errors he estimated, however, were persistent discrepancies between money market fund yields and yields on other money market instruments, rather than the one-day pricing errors that have been the primary problem among long-term mutual funds.

observe but an econometrician does not. For example, some management companies provided detailed non-public information about their mutual funds' portfolio holdings to market timers, so they could identify profitable trading opportunities even more precisely than index futures might indicate.

In any case, the choice between the next-day-NAV and predicted-NAV methods is probably not important for my purposes. Zitzewitz (2007b) employed both methods to calculate dilution for mutual funds in tainted families and obtained very similar estimates from each method.

The second major approach to estimating dilution—the "profits" or "consulting" method—is based on the holding-period gains of abusive traders. Abusive traders' gains are equal (or approximately equal) to buy-and-hold investors' dilution losses in several circumstances: (1) if timers hold mutual fund shares for only one day at a time, and thus do not market-time their redemptions; (2) if portfolio managers hold flows from timers in cash and timers do not hedge their positions or market-time their redemptions; and (3) if portfolio managers fully invest flows from timers in regular portfolio assets as soon as possible, and the timers fully hedge their positions. The profits method capitalizes on the close relationship between timers' profits and other investors' dilution losses.

Greene and Ciccotello (2004) developed a third approach to estimating dilution, which they dubbed the "cash-model" method, that allows for a more flexible set of portfolio-management policies on investing abusive traders' inflows. For example, this method could be used to measure dilution accurately if a portfolio manager invested new cash flows into portfolio assets gradually over several days. When detailed data on the net flows and cash-management practices of individual mutual funds are available, the cash-model approach should generally provide the most accurate estimates of dilution. But when high-frequency data on mutual funds' cash holdings cannot be obtained, researchers and consultants are left with a choice between the flow-correlation and profits methods.

The profits approach has both advantages and disadvantages in comparison to the flow-correlation method. Consider the three scenarios listed above in which gains are roughly equal to dilution. In the first—when traders hold mutual fund shares for just one day at a time—both methods should accurately measure dilution to incumbent investors as well as timers' gains. In the second scenario, however, the profits method is a more accurate measure of dilution, because the flow-correlation method only picks up that portion of the timer's gain (and incumbent investors' losses) that occurs on the first day of the timer's investment. But in this scenario, the timers' net gain on his mutual fund shares over the entire holding period is, dollar for dollar, a loss to incumbent investors.[54]

[54]Since the fund holds the timer's inflow in cash, any return he earns on his shares while invested in the fund—abstracting from returns on cash—comes straight out of the pockets of other investors.

In the third scenario, the flow-correlation method is the superior measure of both dilution and abusive traders' gains, because this method captures just the dilution and gains that occur when the timer purchases and redeems mutual fund shares. The profits method, in contrast, also picks up holding-period gains that occur between the timed purchase and the (possibly timed) redemption. If the fund portfolio manager has invested the timer's initial flow, these holding-period gains do not dilute incumbent investors' returns, and the holding-period gains do not contribute to the timer's net profits (because he has hedged his position). Furthermore, in the same scenario, the flow-correlation method captures the net gain from timed redemptions, which *do* cause dilution, but the profits method misses this type of profit and dilution.[55]

The profits method has a couple of additional drawbacks relative to the flow-correlation method. The profits method requires detailed data on *all* abusive traders' transactions, and estimates of dilution (or abusive traders' gains) will be biased downward to the extent that such traders cannot be identified. Also, as Zitzewitz (2007b) points out, the profits method is sensitive to swings in market returns; for example, poor market returns will depress timers' "profits" and, therefore, estimated dilution. These problems do not affect dilution or gains computed using flow-correlation method. Moreover, Zitzewitz finds that, in practice, cash holdings among international equity funds varied little with fund share turnover in the period from 2000 to 2003. This result suggests that portfolio managers *did* invest abusive traders' inflows promptly and weakens the argument for using the profits method (or even the cash-model approach).[56]

The tradeoffs in using the different methods are apparent in the plans for distributing the penalties and disgorgement that were collected by government agencies from tainted management companies. Because these plans aim to allocate money to the mutual fund shareholders who were harmed by abusive trades in proportion to the losses they suffered, the plans require detailed fund-level estimates of dilution. Every method discussed here has been used in at least one distribution plan, and several plans employed more than one method to accommodate varying circumstances among abused funds (such as differences in portfolio managers' cash-management policies).

[55] Redemptions are timed to occur when the mutual fund's NAV fails to incorporate an observable or predictable *negative* component of return (in terms of the model described in section A.3, when $\pi_t < 0$). The profits method only records gains on the timer's *mutual fund* position, but the timer's closing of this position just avoids a loss. The gain occurs when the trader closes the hedge, which is a short position in a portfolio that replicates the mutual fund's portfolio. See note 58.

[56] On the other hand, evidence (such as that presented in some distribution plans) that portfolio managers in specific mutual funds or fund families did *not* invest timers' inflows would strengthen the argument for using the profits or cash-model method, at least for those funds or families.

A.2 Estimating abusive traders' gains

As described above, abusive traders' gains are equal (or approximately equal) to buy-and-hold investors' dilution losses in several types of scenarios. In the circumstances in which dilution deviates significantly from abusive traders' gains, the differences arise either from market fluctuations over timers' holding periods (which can generate gains for a timer without causing dilution of other shareholders' wealth) or from dilution due to timed redemptions, which can cause losses for other shareholders without generating gains for timers.

The close relationship between dilution and abusive traders' gains suggests that the best methods for measuring dilution and gains should be similar. Indeed, for my purposes, and given the constraints on available data, the flow-correlation methods are best-suited to capturing those gains. Flow-correlation methods will not capture capital gains or losses that abusive traders experience when holding mutual fund shares for longer than one day without hedges, but such profits were not central to the mutual fund scandal. And flow-correlation methods may overstate trader gains due to timed redemptions, but that would be consistent with the general bias in this paper toward overstating revenues.[57]

In deriving my baseline estimates of revenues from abusive trading, I sidestepped (to some extent) the problem of choosing the "right" method of computing gains by using a hybrid approach. As described in section 7.4.2, I assumed that the gains from trading abuses in each management company's funds were the maximum of the penalties it paid and Zitzewitz's (2007b) estimate of total dilution in its mutual funds. Penalties paid were, as noted in section 7.4.1, generally larger than dilution estimated in distribution plans using the method or methods that plan authors deemed most appropriate. And Zitzewitz's dilution estimates are very close to the estimates of abusive traders' gains that I computed using the flow-correlation method (see section 7.3 and section A.3 of this appendix).

[57] The profits method might seem to be the most appropriate approach for computing abusive traders' gains. And when abusive traders hold onto mutual fund shares for more than one day at a time without hedging their positions, the profits method has an advantage over the flow-correlation method in that only the former picks up holding-period gains and losses on top of any dilution gain at purchase. As outlined above, however, there are some important drawbacks to the profits method for measuring dilution. An additional problem arises in estimating the abusive traders' gains, because the profits method captures only the returns realized from purchases and sales of mutual fund shares and not any profits from other investments made as part of a timing strategy. In particular, the profits method would not pick up gains from hedging positions designed to offset the market risk of a long position in mutual fund shares and to set up arbitrage-profit opportunities for timed redemptions (see also section A.3.2). Finally, it is worth noting that the innovations in the cash-model approach, while well-suited for measuring dilution, are not aimed at measuring abusive traders' gains.

A.3 Derivation of equation (6)

Consider a mutual fund with assets A_{t-1} on day $t-1$. Let shares outstanding be A_{t-1}, so the price (NAV) per share is 1. On day t, in computing its new NAV, the fund records a return on portfolio assets r_t, but fails to incorporate a second component of return, π_t, which investors can either predict or observe. For example, π_t might be post-Nikkei-close appreciation of Japanese stocks that is not incorporated in a fund's NAV. Define π_t such that, had the fund incorporated this component of return in computing NAV, gross return to mutual fund shares on day t would have been $(1+r_t)(1+\pi_t)$.

In such a circumstance, some dilution may occur if the fund has net flows on day t, even without abusive trades designed to exploit the fund's pricing error. In the course of normal operations, the fund receives flow $F_t = f_t A_{t-1}$, creates new shares $\frac{f_t A_{t-1}}{1+r_t}$, and records assets under management at the end of day t of $A_{t-1}(1+r_t) + f_t A_{t-1}$.

On the following day, $t+1$, the fund's portfolio earns an additional return, ϵ_{t+1}, which is unpredictable and uncorrelated with the previous day's flow. In addition, the fund "catches up" with market developments on the previous day and marks up the portfolio assets it held before day-t flow by π_t. For simplicity, suppose that there is no additional predictable but unrecorded return ($\pi_{t+1} = 0$) and the fund attracts no net new cash flow. At the end of day $t+1$, assets under management are $A_{t-1}(1+r_t)(1+\pi_t)(1+\epsilon_{t+1}) + f_t A_{t-1}(1+\epsilon_{t+1})$. Dilution has occurred because the flow $f_t A_{t-1}$ arrived after returns $(1+r_t)(1+\pi_t)$ were realized on day t, but the pricing of shares purchased with this flow only reflected appreciation $(1+r_t)$.

At the end of day $t+1$, with the number of shares unchanged from day t:

$$\begin{aligned} NAV_{t+1} = \frac{Assets_{t+1}}{Shares_{t+1}} &= \frac{A_{t-1}(1+r_t)(1+\pi_t)(1+\epsilon_{t+1}) + f_t A_{t-1}(1+\epsilon_{t+1})}{A_{t-1} + \frac{f_t A_{t-1}}{1+r_t}} \\ &= \left(1 + \pi_t - \frac{\pi_t f_t}{1+r_t+f_t}\right)(1+r_t)(1+\epsilon_{t+1}). \end{aligned}$$

Since $NAV_t = 1 + r_t$, the gross return on day $t+1$ is:

$$1 + r_{t+1} = \left(1 + \pi_t - \frac{\pi_t f_t}{1+r_t+f_t}\right)(1+\epsilon_{t+1}). \tag{A-1}$$

Without dilution, the fund would record gross returns of $(1+\pi_t)(1+\epsilon_{t+1})$ on day $t+1$. Let d_{t+1} be dilution *to returns* realized on day $t+1$, that is:

$$1 + r_{t+1} = (1+\pi_t)(1+\epsilon_{t+1}) - d_{t+1}. \tag{A-2}$$

$$d_{t+1} = \frac{\pi_t f_t}{1+r_t+f_t}(1+\epsilon_{t+1}). \tag{A-3}$$

The delayed component of day-t return, π_t, is not directly observable; substitution yields:

$$d_{t+1} = \frac{f_t(r_{t+1} - \epsilon_{t+1})}{1 + r_t}. \tag{A-4}$$

Dilution can be either positive or negative and can be caused by either net inflows or net redemptions; equation (A-4) measures dilution to returns in any scenario. For example, when a fund receives positive net flows on day t and records $r_{t+1} < \epsilon_{t+1}$ on the following day, dilution is *negative* because the new shares earn a smaller return on day $t+1$ than that earned by the fund's portfolio assets (so, incumbent shareholders have earned *more* than the fund's portfolio). On the other hand, when $r_{t+1} < \epsilon_{t+1}$, outflows cause positive dilution (more descriptively, a concentration of losses) among shareholders who do not redeem.

Equation (A-4) might be useful in estimating dilution, even though the unpredictable component of return, ϵ_{t+1}, is not observable, if one assumes that $E(f_t\epsilon_{t+1}) = 0$. If so, then summing $d_{t+1} = \frac{f_t r_{t+1}}{1+r_t}$ over a period of interest would give an unbiased estimate of dilution (to returns) over that period. However, for a growing (shrinking) fund with positive (negative) average returns over the estimation period, the expected product of net flow and next-day return may positive even in the absence of any pricing inefficiencies (that is, even if $\pi_t = 0, \forall t$). So, estimates of dilution using this summation may be biased.

One means of correcting for this problem is to split flow into two components, $f_t = \phi_t + g_t$, where $\phi_t \equiv E_{t-1}(f_t)$. The expected component of flow, ϕ_t, might be interpreted as flow from buy-and-hold investors, while g_t might be timer flow. One might also argue that the predictable component of return, ϕ_t, could be invested by the portfolio manager in advance of any unpriced appreciation of assets, π_t. This eliminates the possibility of dilution due to buy-and-hold investors' transactions and simplifies interpretation without affecting the basic results, so I use this assumption in my calculations here.

As before, consider a fund with initial assets A_{t-1} on day $t-1$, shares outstanding A_{t-1}, and an NAV of 1. On day t, the fund records a return on portfolio assets r_t, but fails to incorporate a second component of return, π_t. Flow on day t is $F_t = (\phi_t + g_t)A_{t-1}$, as outlined above. The portfolio manager invests $\phi_t A_{t-1}$, but not $g_t A_{t-1}$, in advance of the realization of return π_t. Neither component of flow is invested before return r_t is realized.

At the end of day t, the fund records an NAV of $(1 + r_t)$, assets of $A_{t-1}(1 + r_t) + A_{t-1}(\phi_t + g_t)$, and shares $A_{t-1} + \frac{A_{t-1}(\phi_t+g_t)}{(1+r_t)}$. On day $t+1$, with additional return ϵ_{t+1} but no net flow, recorded assets are $A_{t-1}\left((1 + r_t + \phi_t)(1 + \pi_t) + g_t\right)(1 + \epsilon_{t+1})$. The fund

records a day-$t+1$ gross return of:

$$1 + r_{t+1} = \frac{NAV_{t+1}}{NAV_t} = \left(1 + \pi_t - \frac{\pi_t g_t}{1 + r_t + \phi_t + g_t}\right)(1 + \epsilon_{t+1})$$
$$= (1 + \pi_t)(1 + \epsilon_{t+1}) - d_{t+1}.$$

Dilution to returns is:

$$d_{t+1} = \left(\frac{g_t \pi_t}{1 + r_t + \phi_t + g_t}\right)(1 + \epsilon_{t+1})$$
$$= g_t \left(\frac{r_{t+1} - \epsilon_{t+1}}{1 + r_t + \phi_t}\right). \tag{A-5}$$

Dilution in dollar terms, D_{t+1}, is equal to the dilution to returns, d_{t+1}, times "diluted assets," that is, the assets of buy-and-hold investors who do not trade on day t. But the measure of diluted assets depends on whether the dilution is caused by inflows or outflows.

A.3.1 Dilution and market-timing gains due to timing inflows

When market timers purchase mutual fund shares (in advance of expected $\pi_t > 0$), diluted assets are those held by investors net of the timers' purchases on day t, that is, $A_{t-1}(1 + r_t + \phi_t)$, so:

$$D^{inflow}_{t+1} = d_{t+1} A_{t-1}(1 + r_t + \phi_t) = g_t \left(\frac{r_{t+1} - \epsilon_{t+1}}{1 + r_t + \phi_t}\right) A_{t-1}(1 + r_t + \phi_t)$$
$$= A_{t-1} g_t (r_{t+1} - \epsilon_{t+1}). \tag{A-6}$$

Equation (A-6) also records the timer's gain from dilution. She purchases $A_{t-1}g_t$ worth of mutual fund shares on day t. Absent any pricing error, with $\pi_t = 0$, the one-day return she earns on day $t+1$ is $A_{t-1}g_t\epsilon_{t+1}$, but a consequence of the fund's lagged recognition of $\pi_t \neq 0$ is that $r_{t+1} \neq \epsilon_{t+1}$. Her timing gain from trades made on day t, G^{inflow}_t, is the additional return given by (A-6):

$$G^{inflow}_t = A_{t-1} g_t (r_{t+1} - \epsilon_{t+1}) = D^{inflow}_{t+1}. \tag{A-7}$$

To estimate timer gains due to inflows, we can sum equation (A-7) over an interval of interest (such as a calendar year) for days on which $g_t \geq 0$. Assets, A_{t-1}, and returns, r_{t+1}, can be observed directly. To obtain the surprise component of daily flow, g_t, I simply assumed that a fund's expected flow in a given year was its mean daily flow for that year, as estimates of timer gains were not sensitive to the methods used to compute expected flow. Finally, although ϵ_{t+1} is not observed, g_t and ϵ_{t+1} are uncorrelated and $E(g_t) = 0$, so

$E(g_t\epsilon_{t+1}) = 0$. As long as $E\left(A_{t-1}g_t\epsilon_{t+1}|g_t \geq 0\right) \approx 0$ also holds, timer gains from inflows in period T can be estimated by:

$$G_{t\in T}^{inflow} \approx \sum_{t\in T, g_t \geq 0} A_{t-1}g_t r_{t+1}. \tag{A-8}$$

A.3.2 Dilution and market-timing gains due to timing outflows

Market timers may also *sell* mutual fund shares in advance of expected $\pi_t < 0$. Here, $g_t < 0$, and diluted assets are those held by investors *after* the timers' sales on day t, that is, $A_{t-1}(1 + r_t + \phi_t + g_t)$, so:

$$\begin{aligned} D_{t+1}^{outflow} = d_{t+1}A_{t-1}(1 + r_t + \phi_t + g_t) &= g_t \left(\frac{r_{t+1} - \epsilon_{t+1}}{1 + r_t + \phi_t}\right) A_{t-1}(1 + r_t + \phi_t + g_t) \\ &= A_{t-1}g_t(r_{t+1} - \epsilon_{t+1}) \left(1 + \frac{g_t}{1 + r_t + \phi_t}\right). \end{aligned} \tag{A-9}$$

While equation (A-9) captures losses for buy-and-hold investors, it does not exactly measure the timer's gains. The timer sells $\frac{A_{t-1}(-g_t)}{1+r_t}$ shares at a price of $1 + r_t$ per share. If the mutual fund's NAV had reflected all available information at time t, the price would have been $(1 + r_t)(1 + \pi_t)$, and she would have have received $A_{t-1}(-g_t)(1 + \pi_t)$ for her shares.

Her gain, $A_{t-1}g_t\pi_t$ (which is positive for $g_t < 0$ and $\pi_t < 0$), is actually a loss avoided; she obtains no cash flow from the timed redemption itself. However, the timer can use a hedging strategy to obtain the equivalent cash gain.[58] Although π_t is not observed, we can substitute using:

$$\pi_t = \left(\frac{r_{t+1} - \epsilon_{t+1}}{1 + \epsilon_{t+1}}\right) \left(1 + \frac{g_t}{1 + r_t + \phi_t}\right).$$

[58] That strategy would begin on day t_0 with her initial market-timing purchase of S mutual fund shares. She would simultaneously sell short a portfolio of assets that replicates S shares worth of the mutual fund's portfolio assets. Since she buys the mutual fund shares for less than their value, the cash she obtains from the short sale exceeds the cost of the shares she purchases; the difference is her gain, which is approximately $G_{t_0}^{inflow}$, as defined in equation (A-8). (If she were able to exactly anticipate the return on day $t_0 + 1$, she would sell short just enough of the portfolio to match her long position in the mutual fund on day $t_0 + 1$, and her net gain on day t_0 would be $\frac{G_{t_0}^{inflow}}{1+\epsilon_{t_0+1}}$). When, on day t, she observes a predictable negative return that is not reflected in NAV, she sells her fund shares at a price that exceeds their fair value, simultaneously closes the short position at its fair value, and pockets the difference, $G_t^{outflow}$.

Market timers apparently employed such schemes to exploit mutual fund pricing inefficiencies; several official documents refer to the use of replicating portfolios. Indeed, Banc of America Securities' derivatives desk apparently structured such portfolios specifically for hedge funds that were engaged in abusive trading (U.S. Securities and Exchange Commission, 2005b).

And the timer's avoided losses (or gains, if she has employed the hedging strategy) are:

$$\begin{aligned} G_t^{outflow} &= A_{t-1} g_t \left(\frac{r_{t+1} - \epsilon_{t+1}}{1 + \epsilon_{t+1}} \right) \left(1 + \frac{g_t}{1 + r_t + \phi_t} \right). \\ &= \frac{D_{t+1}^{outflow}}{1 + \epsilon_{t+1}}. \end{aligned} \tag{A-10}$$

Since the timer's flow, g_t, should be uncorrelated with the *unpredictable* component of the following day's return, ϵ_{t+1}, I assume that $E\left\{ A_{t-1} g_t \left(\frac{\epsilon_{t+1}}{1+\epsilon_{t+1}} \right) \left(1 + \frac{g_t}{1+r_t+\phi_t} \right) \middle| g_t < 0 \right\} \approx 0$. If so, then we can sum (A-10) over days on which $g_t < 0$ to estimate market-timing gains (or losses avoided) due to outflows in an interval T:

$$G_{t \in T}^{outflow} \approx \sum_{t \in T, g_t < 0} A_{t-1} g_t \left(\frac{r_{t+1}}{1 + \epsilon_{t+1}} \right) \left(1 + \frac{g_t}{1 + r_t + \phi_t} \right). \tag{A-11}$$

One complication in estimating (A-11) is that we do not observe ϵ_{t+1}. Since

$$r_{t+1} = \epsilon_{t+1} + \pi_t + \pi_t \epsilon_{t+1} - d_{t+1} \approx \epsilon_{t+1} + \pi_t - d_{t+1},$$

and π_t will be negative for outflow dilution, $r_{t+1} < \epsilon_{t+1}$. Replacing ϵ_{t+1} with r_{t+1} in (A-11) would thus bias our estimate of timer gains upward, but this would be consistent with the general bias in this paper toward overstating revenues. Hence,

$$G_{t \in T}^{outflow} \approx \sum_{t \in T, g_t < 0} A_{t-1} g_t \left(\frac{r_{t+1}}{1 + r_{t+1}} \right) \left(1 + \frac{g_t}{1 + r_t + \phi_t} \right). \tag{A-12}$$

A.3.3 Abusive-trading gains and dilution losses

By combining (A-8) and (A-12), we obtain the formula for abusive-trading gains in equation (6):

$$\begin{aligned} G_{t \in T} &= G_{t \in T}^{inflow} + G_{t \in T}^{outflow} \\ &\approx \sum_{t \in T, g_t \geq 0} A_{t-1} g_t r_{t+1} + \sum_{t \in T, g_t < 0} A_{t-1} g_t \left(\frac{r_{t+1}}{1 + r_{t+1}} \right) \left(1 + \frac{g_t}{1 + r_t + \phi_t} \right) \end{aligned} \tag{A-13}$$

Equation (A-13) is valid only if abusive traders use hedging strategies, as discussed in note 58; otherwise, abusive-trading gains are only those measured by the first term (the sum for days on which $g \geq 0$). Under the assumption that timers do employ hedging strategies, the dilution caused by abusive trading is almost identical to the gains it gen-

erates:

$$D_{t\in T} \approx \sum_{t\in T, g_t \geq 0} A_{t-1} g_t r_{t+1} + \sum_{t\in T, g_t < 0} A_{t-1} g_t r_{t+1} \left(1 + \frac{g_t}{1 + r_t + \phi_t}\right) \tag{A-14}$$

A.4 Daily data used to compute dilution

As described in section 7.3, I used a combination of data sources to estimate daily flows and dilution in abused mutual funds, including: TrimTabs daily assets data; CRSP, Yahoo! Finance, and TrimTabs price (NAV) data; distributions data from CRSP and Yahoo! Finance; and Investment Company Institute data on reinvestment rates. The daily assets data are notoriously noisy and subject to a timing problem of their own: Daily assets are almost always reported on a "preflow" basis—that is, assets for day t are usually recorded before any day-t net purchases of shares are added in. The problem is documented in detail in Greene and Hodges (2002) and Zitzewitz (2003). Following Zitzewitz, I assumed that all assets were reported on a "preflow" basis except those for selected families (Rightime and Rydex, for example) that specifically catered to high-frequency traders. (To the extent that I have incorrectly reassigned the timing of assets observations, my estimates of dilution would be biased upward.)

TrimTabs and other daily data require extensive cleaning to be useful in research. Some of the problems are reparable. For example, reported assets on some days are zero but can be inferred because TrimTabs also reports daily net flow, and all observations for July 2002 were reported with a one-day lag. Other problems are less tractable, so I employed a variety of filters. For each mutual fund share class (ticker), I dropped daily observations for which: changes in assets, shares, or NAV exceeded five standard deviations of that ticker's mean change (in a given year) for that particular variable; changes in assets, shares, or NAV exceeded 10 percent; "flip-flop" observations in which a variable had opposite-sign changes of more than 2.5 standard deviations each on two consecutive days; and "flip-flop" observations in which a variable had opposite-sign changes of more than 5 percent each on two consecutive days. I also dropped from the analysis tickers for which more than 3 percent of the daily flow estimates exceeded (in absolute value) 5 percent of assets and tickers for which more than 1 percent of the daily flow estimates exceeded (in absolute value) 10 percent of assets.

Finally, in estimating gains to abusive traders using equation (A-13), I found *negative* values for a few investment objectives in some years. While negative gains and dilution are certainly plausible, I dropped the negative observations in aggregating the dilution figures. Again, this will contribute to an upward bias in my estimates, consistent with a general bias toward overstating revenues.