NBER WORKING PAPER SERIES

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Working Paper 11357
http://www.nber.org/papers/w11357

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
May 2005

We thank Malcolm Baker, Ken Froot, Bob Merton, André Perold, David Scharfstein, Andrei Shleifer, and Tuomo Vuolteenaho for valuable comments and discussions, and seminar participants at Harvard Business School and the University of Virginia. We also thank Joshua Pollet and Ken French for providing some of the data used in this study. The views expressed herein are those of the author(s) and do not necessarily reflect the views of the National Bureau of Economic Research.

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NBER Working Paper No. 11357
May 2005
JEL No. G14, G32, G20

ABSTRACT

This paper examines asset fire sales, and institutional price pressure more generally, in equity markets, using market prices of mutual fund transactions caused by capital flows from 1980 to 2003. Funds experiencing large outflows (inflows) tend to decrease (increase) existing positions, which creates price pressure in the securities held in common by these funds. Forced transactions represent a significant cost of financial distress for mutual funds. We find that investors who trade against constrained mutual funds earn highly significant returns for providing liquidity when few others are willing or able. In addition, future flow-driven transactions are predictable, creating an incentive to front-run the anticipated forced trades by funds experiencing extreme capital flows.

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This paper assesses the costs of asset fire sales in equity markets. Financial distress is costly whenever a firm's past financing decisions interfere with current operations. One situation where this arises is when capital providers force a firm to quickly sell specialized assets. Because the sale is immediate, the liquidity premium can be large, resulting in transaction prices that are substantially below their fundamental values. Equity markets are relatively liquid, but not perfectly so. Largely because of the high liquidity in equity markets, many firms that specialize in equity investing are willing to allow capital providers to withdraw their capital on demand. Evidence presented in this paper suggests that even in the most liquid of markets, assets sometimes sell at fire sale prices.

Shleifer and Vishny (1992) analyze the equilibrium aspect of asset sales and describe a situation where liquidity can disappear, making it very costly for someone who is forced to sell. They essentially argue that asset fire sales are possible when financial distress clusters through time at the industry level and firms within an industry have specialized assets. When a firm must sell assets because of financial distress, the potential buyers with the highest valuation for the specialized asset are other firms in the same industry, who are likely to be in a similarly dire financial situation, and therefore will be unable to supply liquidity. Instead, liquidity comes from industry outsiders, who have lower valuations for the asset, and thus bid lower prices.

This story can be recast easily in a capital market setting. Here, the firms are professional investors, who follow somewhat specialized investment strategies. In this context, specialization refers to concentrated positions in securities that have limited breadth of ownership, and importantly, have significant overlap with others following a similar strategy.[1] Specialization is common in investment management, with many professional investors focusing on a single or limited number of investment strategies. Merton (1987) and Shleifer and Vishny (1997) present models of investment management that rely on specialization to derive limited arbitrage.

[1] For example, merger arbitrage is a specialized investment strategy followed by many professional investors, requiring relatively large positions in stocks that eventually are held mainly by merger arbitrageurs.

Financial distress occurs when a firm struggles to make payments required by its liabilities, which for a financial firm arises when investors redeem their capital. When capital is immediately demandable, a poorly performing mutual fund without significant cash reserves has no choice but to sell holdings quickly, which will be costly if too many others are selling the same positions at the same time. If immediacy is not required, the seller can wait for better pricing, raise additional funds, or potentially renegotiate existing claims. However, these are not legitimate options for a poorly performing fund. Renegotiation with large numbers of claim holders is infeasible, and raising additional funds from new investors, while existing investors want out, is highly unlikely. Regulations prevent mutual funds from raising funds by short selling other securities, and binding margin constraints are likely to restrict short selling by severely underperforming hedge funds.[2]

Accurate assessment of asset fire sale costs requires considerable transparency in the decisions of the firm and its investors, whereas most settings in which asset fire sales are costly are likely to be highly opaque. The primary challenge in measuring the costs of asset fire sales is that distinguishing financial from economic distress requires identifying asset sales that are a direct consequence of the financing decisions of the firm. In many corporate settings, financial difficulties and economic difficulties coincide over multi-year periods, making causality difficult to assign. Additionally, efficient estimation of costs requires precise measurement of fair asset value, which can be a challenge in environments characterized by illiquidity and declining prices.

The focus of this paper is on the assets held by open-ended mutual funds. The open-ended mutual fund structure produces a highly transparent firm with investment decisions that

[2] The asset fire sale story is similar to the price pressure hypothesis of Scholes (1972), where stock prices can diverge from their information-efficient values because of uninformed shocks to excess demand to compensate those who provide liquidity. The asset fire sale story identifies forced selling by distressed mutual funds as one particular type of uninformed shock, and explains why those who provide liquidity during such a crisis are likely to demand additional compensation.

are easy to identify and monitor. The opened mutual fund is also extremely reliant on outside capital to fund its investment opportunities – only the occasional back-end load stands between outside capital providers and their capital. Monthly reporting of total net assets allows real time measurement of the pressures that outside capital providers place on the firm. Moreover, because of high trading frequency in public markets, deviations in transaction prices from fair values can be accurately assessed via the tracking of post-sale returns. On the other hand, the stock market environment is a relatively hospitable one for asset sales. With high transaction volumes and low execution costs, a distressed seller of a listed equity might expect to find many willing buyers. In addition, mutual funds that select the open-ended organizational form do so precisely because they view the potential costs of this structure to be low.[3] Thus, our focus is on a setting where asset fire sales are unlikely, but where high transparency permits them to be properly detected should they exist.[4]

To examine empirically asset fire sales in equity markets and the effects of institutional price pressure more generally, we construct a sample of situations where we suspect widespread mutual fund trading of individual stocks caused by capital flows. Fundamental value is not immediately observable, but by studying systematic patterns in abnormal returns over time, we can identify deviations between transaction prices and fundamental value *ex post* if we find evidence of significant price reversals following forced transactions. We attempt to disentangle price pressure from information effects by focusing on situations where the fire sale story predicts that mutual fund sales are motivated by necessity, as opposed to opportunistic information-based trading. In particular, we focus on mutual funds stock transactions that are forced by financial distress, and therefore unlikely to reveal much new information about the individual securities being sold, and where there is considerable overlap in the holdings among

[3] Stein (2004) presents a model where competition pushes mutual funds toward the open-end form even though this severely constrains their ability to conduct arbitrage trades.

[4] See Andrade and Kaplan (1998), Asquith, Gertner, and Scharfstein (1994), Gilson (1997) for studies of financially distressed firms. See Pulvino (1998) for a study focusing on asset fire sales in the used aircraft market.

poorly performing funds. The empirical results provide considerable support for the view that concentrated mutual fund sales forced by capital flows exert significant price pressure in equity markets, often resulting in transaction prices far from fundamental value.

We find that poor performance leads to capital outflows for mutual funds, the most serious of which, we consider financial distress. This corroborates previous research, which finds a strong relation between mutual fund flows and past performance.[5] Interestingly, funds who find themselves in the bottom decile of capital flows tend to be less diversified than other funds, holding nearly 25% fewer securities than a typical fund.

The analysis also indicates that flows into and out of mutual funds do indeed force trading. Mutual funds in the bottom decile of capital flows are roughly twice as likely to sell, or eliminate holdings, than funds experiencing normal flows. This forced trading is especially costly for mutual funds when there is significant overlap with the securities held by other funds experiencing outflows, where transactions appear to occur far from fundamental value. We estimate that investors providing liquidity to the distressed funds earn significant abnormal returns over the subsequent months. Moreover, we show that forced transactions are predictable, which creates an opportunity for front-running. An investment strategy, which short sells stocks most likely to be involved in fire sales, and buys ahead of anticipated forced purchases, earns average annual abnormal returns well over 15%.

Interestingly, we find that extreme inflows can be costly for mutual funds too. Funds experiencing large inflows tend to increase their existing positions, creating significant price pressure in the stocks held in common by these funds. Like the asset fire sales, these inflow-driven purchases produce trading opportunities for strategy outsiders. Over the sample period, 1980 to 2003, extreme inflows to mutual funds are considerably more common than outflows, making inflow-driven purchases a more frequent and severe situation.

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[5] See for example, Ippolito (1992), Chevalier and Ellison (1997), and Sirri and Tufano (1998)

Finally, we document that concentrated mutual fund buying and selling caused by capital flows is highly related to the momentum effect found in equity returns, but that a considerable abnormal return remains after controlling for momentum. Because mutual fund flows are sensitive to past performance, the stocks that mutual funds are forced to sell tend to overlap with the stocks identified as good shorts by a momentum strategy.

This paper is organized as follows. Section I describes the data. Section II presents evidence on the existence and magnitudes of price pressure and asset fire sales in equity markets. Section III examines the incentives for providing liquidity during crisis periods and for front-running. Section IV discusses the persistence of institutional price pressure, and Section V concludes.

I. Data Description

A. Mutual Fund Holdings, Returns, & Flows

Most of our analysis relies on a merger of the two major mutual fund databases that have been used extensively in the literature: the Spectrum mutual fund holdings database and the CRSP mutual fund monthly net returns database. Comprehensive descriptions of both can be found in Wermers (1999), who conducts a similar merge.

Our merge procedure is as follows. First, funds are matched by name. To make sure we have identified the timing of changes in holdings accurately, we only include fund-quarter observations reported across adjacent quarters when holdings changes are required. Fund-quarter observations where the value of the holdings differs substantially from that reported in the CRSP database net of the cash position are removed. Because our focus is on US equity funds, we exclude funds with an investment objective code indicating any of the following: international; municipal bonds; bonds and preferred; or metals. Finally, because the number of matched funds is significantly lower in the 1980s than in the 1990s, we often emphasize the subperiod from 1990 through 2003, in our analysis.

Mutual fund flows are estimated using the CRSP series of monthly total net assets (*TNA*s) and returns. The net flow of funds to mutual fund *j*, during month *t* is defined as:

$$FLOW_{j,t} = TNA_{j,t} - TNA_{j,t-1} \cdot (1 + R_{j,t}) \quad (1)$$

$$flow_{j,t} = \frac{FLOW_{j,t}}{TNA_{j,t-1}} \quad (2)$$

where $TNA_{j,t}$ is the CRSP *TNA* value for fund *j* at the end of month *t*, and $R_{j,t}$ is the monthly return for fund *j* over month *t*. In order to match with the quarterly holdings data, we sum monthly flows over the quarter to calculate quarterly flows. Most of the analysis involving mutual fund flows uses the dollar value of *FLOW* as a percentage of beginning of period *TNA* as in equation (2).

B. Measuring the Relation between Fund Performance and Flows

It is well documented that capital flows to and from mutual funds are strongly related to past performance (e.g. Sirri and Tufano (1998)). We use a simple Fama-MacBeth (1973) style regression model to forecast fund flows based on past returns and lagged flows.

$$flow_{j,t} = a + \sum_{k=1}^{4} b_k \cdot flow_{j,t-k} + \sum_{h=1}^{8} c_h \cdot R_{j,t-h} \quad (3)$$

In particular, each quarter or month, *t*, we estimate a cross-sectional regression as in (3). We then calculate the time series average of the coefficients and report *t*-statistics using the time series standard error of the mean. Expected flows are calculated as the fitted values using the time series average of the coefficients.

We estimate the regression coefficients using a sub-sample of the quarterly mutual fund observations that we view as having the most reliable data. In particular, we impose the following data requirements:

- Fund must have at some point had, $TNA_{j,t} > \$1M$

- At some point, fund must have had at least 20 holdings
- Changes in *TNA* cannot be too extreme, in particular: $-0.50 < \frac{\Delta TNA_{j,t}}{TNA_{j,t-1}} < 2.0$
- Data from CRSP and Spectrum cannot be too different: $\frac{1}{1.3} < \frac{TNA_{j,t}^{CRSP}}{TNA_{j,t}^{Spectrum}} < 1.3$

The coefficients from the sub-sample regressions are used to calculate expected flows for all funds, including those excluded from the estimation. Results are not meaningfully altered, if the funds excluded from the regressions are completely dropped from the analysis altogether.

Table 1 reports regression results. As expected from previous research, there is a strong relation between mutual fund flows and both lagged flows and lagged returns. Quarterly mutual fund flows are highly significant in explaining future flows for up to a full year, while quarterly fund returns are important determinants of future flows for two years. The results are largely consistent with pooled regression results. The main distinction is that the explanatory variables in the Fama-MacBeth regression focus on explaining cross-sectional differences in flows whereas the pooled regression coefficients must also account for time-series variation in overall flows. As a result, the Fama-MacBeth coefficients are estimated more precisely, relative to the number of observations.

C. Fund Behavior in Response to Financial Pressure

Our notion of a stock fire sale requires that several different owners, who are each experiencing financial distress, contemporaneously sell the security. Mutual funds experiencing significant outflows have no choice but to sell some of their holdings to cover redemptions unless they have excess cash or can borrow. Typically, borrowing is difficult and, because most funds are evaluated against all-equity benchmarks, few maintain significant cash balances. Moreover, short selling other securities is usually not feasible.[6] Therefore, the immediate selling

[6] The Investment Company Act of 1940 prevents mutual funds from short selling and buying securities on margin.

of some existing holdings is the only option. In addition, it is important that there are many sellers relative to potential buyers. A single fund selling when others are willing and able to provide liquidity is unlikely to produce a fire sale price. Only when many funds are forced to sell the same security should we expect to see significant price pressure.

Table 2 provides an overview of fund behavior in response to financial pressure. In Panels A and B, we sort funds into deciles according to actual and expected quarterly flows. We then calculate the fraction of a given fund's positions that are maintained, expanded, reduced, or eliminated during the given quarter and average these values across funds within each decile. We also report for each decile the average 12-month fund return and the average number of holdings. In Panels C and D, we average at the holding level, reporting the fraction of holdings within each decile that are maintained, expanded, reduced, or eliminated.

As Table 2 makes clear, fund flows have a strong impact on fund trading behavior. In particular, funds experiencing (or expected to experience) large outflows are far less likely to expand or maintain existing positions and far more likely to reduce or eliminate positions. For instance, a holding that ranks in the top decile of fund outflows has a 54.8% chance of being reduced or eliminated by its fund, whereas a holding in the bottom decile has a 20% chance of being reduced or eliminated. A similar pattern exists for holdings of funds that are expected to experience outflows during the current quarter. Holdings of funds in the top decile of expected outflows are 48.4% likely to be reduced or sold versus 27.4% for holdings by funds in the bottom decile. Finally, funds experiencing outflows tend to be less well diversified than those experiencing inflows. Funds in the top decile of outflows average 82.8 holdings, whereas funds in the bottom decile average 102.9. Although the number of holdings is an imprecise measure of diversification, it is consistent with the idea that specialized funds may be more sensitive to the costs of financial distress.

Figure 1 displays the average tendency of net adjustments to existing positions as a function of capital flows. This is merely a graphical representation of some of the data from Table 2. Consistent with the fire sale story, the funds with the most significant outflows are very likely to reduce their existing positions. However, the figure clearly shows that there is a similar effect caused by inflows. Funds in the top decile of capital flows tend to increase their existing positions. This is interesting, because unlike the firms who must sell in the face of outflows, these funds have more options. These funds can accumulate cash or purchase securities that they do not currently own, neither of which is feasible for firms facing outflows.

D. Identifying Fire Sales

A natural measure of asset fire sales might be to determine the number of shares sold due to capital outflows and scale by the number of shares outstanding or trading volume. Initial tests using such a measure delivers results that are economically large, but of mixed statistical reliability. There are two reasons why share-based measures may fail to properly identify asset fire sales. First, as argued above, fund-level responses to outflows are unlikely to result in any significant price pressure unless a stock finds itself with many forced sellers and few willing buyers. A large investor can orderly liquidate a large position, but a large number of small investors cannot orderly liquidate a similar size aggregate position. This makes it important for a measure to emphasize commonality in the capital flows to investors of a particular security. A second weakness of share-based measures of asset fire sales is that they are highly sensitive to reporting errors in fund holdings. Because funds are only required to report their holdings on a semi-annual basis, Spectrum relies on voluntary disclosure to fill in off-quarter holdings. This results in a non-trivial frequency of errors in reported holdings and places a significant burden on share-based measures to identify them as such.

In view of the above considerations, our procedure for classifying mutual fund stock sales as asset fire sales (and purchases) is as follows. First, we identify transactions by funds that are likely forced by capital flows. In particular, we define quarterly forced sales (buys) as decreases (increases) in holdings by funds experiencing concurrent outflows (inflows) greater than 5%.

The difference between forced buys and forced sales is then scaled by the total number of mutual fund owners, to form a variable we call *PRESSURE*.[7]

$$PRESSURE_{i,t} = \frac{\sum_j \left(Buy_{j,i,t} \mid flow_{j,t} > 5\%\right) - \sum_j \left(Sell_{j,i,t} \mid flow_{j,t} < -5\%\right)}{\sum_j Own_{j,i,t-1}} \qquad (4)$$

$Buy_{j,i,t}$ equals one if fund j increased its holding in stock i during quarter t, and zero otherwise. $Sell_{j,i,t}$ is defined similarly based on decreases. $Own_{j,i,t-1}$ equals one if fund j owns stock i at the beginning of quarter t. Stocks with *PRESSURE* ≤ -15% are determined to be fire sale stocks, and those with *PRESSURE* ≥ 25% are determined to be inflow-driven stock purchases.[8]

Table 3 displays summary statistics for the fire sale and inflow-driven purchase samples. One of the most striking patterns from the table is that the number of mutual funds that can be linked to CRSP stock data increases 10-fold over the sample period. Another persistent pattern is that average flows into mutual funds are consistently positive over this period. Average fund flows are positive in all but 2 of the 24 years and increase substantially over the sample period. Average annual flows are about 3.5 times larger in the 1990s than they are in the 1980s, which does not account for the dramatic increase in the number of funds.

Panel A of Table 3 reveals that the number of fire sale stocks varies quite a bit through time, averaging about 2% of the firms listed in CRSP, and ranging from 0.1% in 1983 to nearly 9% in 1999. Average quarterly flows for mutual funds involved in fire sales are consistently around -10% of total net assets. These funds tend to have prior returns that have underperformed the overall market, especially in the 1990s. The stocks themselves do not tell a simple story. In the 1980s, the fire sale stocks tend to have been relatively strong performers prior to the fire sale event, whereas in the 1990s, the fire sale stocks have done about as well as the average holding of the fund.

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[7] We require at least 10 mutual funds owners before we calculate the *PRESSURE* variable.

[8] The cutoffs of -15% and 25% approximately correspond to the 5th and 95th percentiles of the *PRESSURE* variable, respectively.

Panel B of Table 3 reports a sample summary of the inflow-driven purchases. The average quarterly inflows to the mutual funds that are involved in these transactions consistently average around 20% of *TNA*. These funds tend to have outperformed the overall market prior to the event, and tend to increase their holdings that have outperformed by an even larger margin. The individual stocks that comprise the inflow-driven purchases have average annual returns prior to the event of nearly 50%. Again, the number of stocks involved in inflow-driven purchases varies considerably through time, averaging around 6%, and increasing over the sample period.

II. Price Effects of Mutual Fund Sales & Fire Sales

In general, detecting price pressure effects around mutual fund stock transactions is problematic because of the simultaneous effects of price pressure and information revelation. In an attempt to disentangle price pressure and information effects, we examine stock price changes around widespread forced and unforced mutual fund sales, and look for evidence of stock price drops followed by a significant price reversal.[9] If mutual funds bring information into prices through their trading, then we should see a price drop in the period where they are selling heavily, and then no drift in abnormal returns following the trades. However, if mutual fund trading is driven by necessity rather than information, and if this forced trading results in fire sale prices, then we should see a significant price drop over the period where they are being forced to sell, followed by a period of positive abnormal returns compensating those who provided liquidity in the crisis period.

Table 4 displays monthly abnormal returns around various types of mutual fund stock transactions. Monthly abnormal returns are calculated using simple net-of-market returns, where the CRSP value-weighted index proxies for the market portfolio. In the spirit of Fama and

[9] This empirical approach is similar to the one used by Mitchell, Pulvino, and Stafford (2004) who study price pressure around mergers.

MacBeth (1973), we calculate average abnormal returns each month and then use the time series of mean abnormal returns for statistical inference to control for potential cross-sectional dependence in the monthly abnormal returns.[10] The fire sale sample is selected according to the procedure described in the previous section, where stocks with widespread selling by distressed funds are considered fire sale stocks. Table 4 also reports the average abnormal value of our pressure variable for easy comparison to the associated monthly abnormal returns.

In Panel A, the pattern in average abnormal returns around the widespread selling of stocks held by distressed mutual funds is striking (see Figure 2 for a graphical representation). We find significantly negative abnormal returns in the months of forced selling and those immediately surrounding them. Over the quarter where, on net, at least 15% of the owners are distressed sellers of the same stock[11], the average abnormal stock return is -10.1% with a *t*-statistic of -11.52. There is some spillover in stock price performance into the next month, with average abnormal returns of -1.4%, as net forced selling remains high. Over the quarter where fire sales are occurring, roughly 20% of the owners are on average net forced sellers of each stock, and this amount of forced selling pressure continues into the subsequent month.

Importantly, the downward pattern in abnormal returns eventually reverses once the net forced sales dissipate. From months 4 to 12 following the fire sale quarter, average abnormal net forced selling pressure retreats to under 2%, and stock prices for the fire sale stocks rebound 7.74%% over this period, with a *t*-statistic of 4.43. The rebound does not fully cover the losses associated with the initial price drop, but represents a significant cost of a fire sale. This evidence suggests that widespread forced selling by distressed mutual funds exerts significant downward price pressure on the individual stocks sold, well beyond any contemporaneous information effects.

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[10] This procedure gives equal weight to each monthly observation, rather than each individual observation. When individual observations are given equal weight and assumed independent, the patterns are more pronounced with highly significant test statistics.

[11] Months -2, -1, and 0 define the event quarter.

In Panels B and C, we explore the role of each ingredient of the fire sale—widespread net selling pressure, by constrained funds. When there is widespread selling by unconstrained funds, the striking fire sale pattern in abnormal returns is not present. Panel B of Table 4 (see also Figure 3) reports *CAAR*s around similarly widespread mutual fund sales, but by funds that are not necessarily forced to sell. In particular, this sample is again identified using a "pressure" variable, but one altered by removing the condition on *flow* from the calculation. Again, there is a significant price drop over the quarter of widespread selling, with some continuation into the next quarter. However, the reversal is much more modest. In fact, the fire sale stocks that are part of this unconditional sample are driving most of the reversal. This is consistent with voluntary mutual fund trading bringing information into prices, and on average, prices adjusting to an appropriate level.

In Panel C of Table 4 (see also Figure 4), we report results for a sample of mutual fund sales by distressed funds, where the selling is isolated. We identify the sample based on the following condition: -15% < *PRESSURE* < 0. In the case of isolated distressed selling, there is a modest, but statistically significant, average abnormal stock price drop of -2.52% (*t*-statistic = -6.66) over the event quarter, with most of this drop being reversed over the subsequent quarters. Although the pattern in *CAAR*s is statistically significant, the economic magnitudes are fairly small.

The key to the reversal appears to be that the selling is widespread among mutual funds that must immediately sell due to capital outflows. Moreover, the effect seems to be increasing in the number of net sellers and in the level of distress. Figure 5 illustrates the "comparative statics" with nine graphs representing various proportions of net sellers with varying degrees of distress. In particular, the top row displays unconstrained funds, the middle row shows funds with |*flows*| > 5%, and the bottom row reports funds with |*flows*| > 10%. The proportion of net sellers varies across the columns, with at least 5% of owners selling in the first column, at least 15% of owners selling in the second column, and at least 25% of owners selling in the third column. The center graph corresponds to the fire sale sample (results in Panel A of Table 4).

The fire sale pattern becomes more extreme moving down and/or to the right, suggesting that the intensity of fire sales is increasing in both of these factors. For example, when we hold the capital flows threshold constant at |*flows*| >5% and increase the proportion of net sellers threshold from "at least 15%" to "at least 25%" the average abnormal return from month *t*-2 to *t*+3 is -18.13% (*t*-statistic = -7.58) with a reversal of 15.01% (*t*-statistic = 3.84) over the next 3 quarters. Likewise, holding the proportion of net sellers threshold at "at least 15%" and increasing the flows threshold to |*flows*| >10% results in an average abnormal return from month *t*-2 to *t*+3 of -13.02% (*t*-statistic = -6.36) with a full reversal of 14.57% (*t*-statistic = 4.93) over the next 3 quarters.

The results also reveal something about which stocks are sold in response to significant outflows. The abnormal returns for the fire sale stocks prior to the actual sale are close to zero (slightly positive, but statistically insignificant). This suggests that these stocks have performed relatively well when compared to the market, and extremely well relative to the distressed funds' average holdings. For the most part, the distressed funds have been significantly underperforming the market. In particular, the cumulative average abnormal return over the nine months prior to the fire sale quarter for the distressed funds is -4.5% (*t*-statistic = -7.40). Thus, it appears that in crisis periods, struggling funds sell relative "winners" rather than downside momentum stocks. We are presumably observing outcomes from optimized behavior, suggesting that the sale of "loser" stocks during these crisis periods would result in more severe price discounts.

Finally, the persistence in net forced selling is interesting. Not all funds experience outflows at the exact same time. The initial widespread forced sales can create an externality for the marginal funds that would not face capital withdrawals in the absence of this price pressure. However, their performance is sufficiently affected by the fire sales themselves, that they face outflows the subsequent quarter, which forces them to sell with a lag. This is related to an effect described in Mitchell, Pulvino, and Stafford (2002) created by margin requirements. A firm up against a financing constraint (i.e. facing a margin call) may have to sell, and in so doing, adversely impact prices for others following a similar strategy. Here, the financing constraint is not only binding, but also actually tightening, as capital providers withdraw funds. Interestingly, this sequence of events creates persistent mispricing, which can get worse before being eliminated, and does not presuppose irrational investors or managers. This externality can be an important impediment to arbitrage in imperfect capital markets (Shleifer and Vishny (1997)).

III. Incentives for Providing Liquidity & Front-Running

The event-time analysis presented in the previous section suggests that there may be a strong incentive to provide liquidity at times of widespread selling by financially distressed mutual funds. In other words, the buyers in asset fire sales are receiving attractive prices for providing liquidity when few others are able or willing. In addition, because capital flows are predictable, there may also be an incentive to remove liquidity in anticipation of forced sales by front-running the distressed mutual funds. We investigate both of these incentives by studying the portfolio returns to investors following these investment strategies.

A. Investment Returns following Asset Fire Sales

The results displayed in Table 4 suggest that the buyer in an asset fire sale will, on average, be compensated for providing liquidity. The compensation is realized as prices return to their information-efficient values in the subsequent months, and can be detected in the form of positive abnormal returns. To measure investment performance to buyers in asset fire sales, we calculate the calendar-time portfolio returns to an investment strategy that buys all stocks identified as fire sale stocks within the past year, but not within the most recent quarter. The constraint that the fire sale has not occurred within the most recent quarter ensures that this is a feasible investment strategy in terms of all required information being publicly available. A secondary benefit of this constraint is that it avoids the spillover of fire sales into the subsequent month. Measuring abnormal returns requires a model of expected returns. We report results using three different models: CAPM, Fama-French 3-factor model, and a 4-factor model that includes momentum (see Fama and French (1993) for a description of the construction of the factors).[12]

$$Rp_t - Rf_t = a + b \cdot [Rm_t - Rf_t] + s \cdot SMB_t + h \cdot HML_t + u \cdot UMD_t + e_t \qquad (5)$$

Table 5 reports calendar-time portfolio regressions of the investment strategy described above for both equal-weight and value-weight portfolios. The intercept from these regressions represents the average monthly abnormal return, given the model. The intercepts reported in Panel A, range from a mere 8 basis points (bps) per month (*t*-statistic = 0.14), to just under 1.0% per month (*t*-statistic = 2.12), and are remarkably similar between equal- and value-weighted portfolios. However, only the equal-weight portfolio has a statistically significant intercept, and this only after controlling for momentum. This is an extremely volatile stand-alone investment strategy. The negative loading on momentum is interesting, suggesting that these stocks covary significantly with downside momentum stocks, but are not performing poorly themselves. Another interesting feature of these portfolios is the large estimated coefficient on the market excess return.

The second panel in Table 5 displays performance results for an investment strategy that "piles on" to the distressed selling that occurred in the prior month. This strategy, rather than providing liquidity, is competing for liquidity, and therefore exacerbating the price pressure. This is arguably a less feasible strategy requiring immediate access to the mutual fund holdings data at the end of each quarter, but still conditional only on previous transactions. The economic magnitude of the abnormal returns is very large, and usually associated with strong statistical reliability. Five of the six investment strategies result in statistically significant abnormal returns at traditional significant levels, ranging from -0.79% per month (*t*-statistic = -1.77), to -2.72% per month (*t*-statistic = -3.95). Controlling for momentum reduces the intercepts by roughly half.

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[12] The factors are from Ken French: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

In many regards, this investment strategy is very similar to a momentum strategy. In both cases, the portfolio contains stocks that have performed poorly, and continue to underperform. However, the mechanism that creates the low returns appears to be the continued forced selling by distressed mutual funds in one case, while unspecified in the case of momentum. Again, the beta estimates are very large. In the CAPM regressions, the estimated beta is 1.7 for both the equal- and value-weighted portfolios.

The final panel in Table 5 shows the results from combining the two strategies described above into a long-short investment strategy. The same basic pattern emerges. The returns are somewhat more extreme with the value-weighted portfolios; extremely large in economic terms, with annualized abnormal returns ranging from 27.9% (*t*-statistic = 3.11) to 45.4% (*t*-statistic = 5.23), and fairly strong statistical reliability. Note that because of combining two strategies into a long-short strategy, and requiring at least 10 firms in each of the long and short portfolios, that the number of months that this strategy is feasible drops to only 95 months out of a possible 168 months. Therefore, the abnormal return estimates overstate the true investment returns by ignoring the capital costs of standing idle.[13]

B. Investment Returns following Inflow-Driven Purchases

The evidence in Table 2 and Figure 1 suggest that funds with significant capital inflows tend to increase their existing holdings; much like the funds experiencing significant outflows tend to reduce their existing positions. In other words, funds facing significant inflows behave as if they too are constrained. As in the fire sale story, if many funds are simultaneously forced to buy the same securities when few others are able to sell, transaction prices may occur at a price significantly above fundamental value, what we will call inflow-driven purchases.

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[13] Myron Scholes describes liquidity-related strategies like this as "fire-station" strategies, where much of the time is spent standing around waiting for an event, while costs are incurred continuously.

We identify inflow-driven purchases using the *PRESSURE* variable. In particular, when *PRESSURE* > 25% we consider the stock to be involved in an inflow-driven purchase. To measure investment performance to sellers in inflow-driven purchases, we calculate the calendar-time portfolio returns to an investment strategy that buys all stocks identified as inflow-driven purchase stocks within the past year, but not within the most recent quarter. Again, we also examine the strategy of "piling on" to the forced purchase, and a long-short strategy that combines the two strategies. If asset fire purchases result in significant price pressure, then we should see positive abnormal returns to the piling on strategy, followed by a reversal.

Table 6 reports calendar-time portfolio regressions of the investment strategy described above for both equal-weight and value-weight portfolios. The intercepts reported in Panel A represent the reversal. The average abnormal returns are economically large and all are statistically significant, ranging from -0.47% per month (*t*-statistic = -2.15) to -0.84% per month (*t*-statistic = -3.41). Interestingly, the monthly abnormal returns remain statistically significant after controlling for momentum.

The second panel in Table 6 displays performance results for an investment strategy that "piles on" to the forced buying that occurred over the prior month. Like the earlier piling on strategy, this one competes for liquidity, and therefore intensifies the price pressure. Again, the economic magnitude of the abnormal returns is very large, with mixed statistical reliability. Four of the six investment strategies result in statistically significant abnormal returns, ranging from 0.46% per month (*t*-statistic = 1.55), to 0.97% per month (*t*-statistic = 2.59). The value-weight portfolios tend to produce less extreme abnormal performance, and lower levels of statistical significance.

Panel C of Table 6 reports the results from combining the previous two strategies into a single long-short strategy. This strategy produces very large average abnormal returns, all of which are statistically significant at traditional significance levels. The average abnormal returns range from 1.11% per month (*t*-statistic = 3.00) to 1.76% per month (*t*-statistic = 4.82). The strategy is highly related to momentum, as both the equal- and value-weighted portfolios have large positive coefficients on the momentum factor, but intercepts from these regressions are well over 1% per month, suggesting that this effect is somewhat distinct from the momentum effect.

C. Investment Returns to those Anticipating Asset Fire Sales and Inflow-Driven Purchases

The evidence presented so far, suggest that there is a powerful incentive to try to anticipate widespread forced buying and selling by constrained mutual funds. There is a real possibility that this is feasible because capital flows to mutual funds are reasonably well explained by lagged flows and returns. Using the regression model presented in Table 1, we forecast expected flows to mutual funds and identify anticipated fire sale and inflow-driven purchase stocks using the procedure described in Section II, substituting expected flows for actual flows.[14]

$$E_t\left[PRESSURE_{i,t+1}\right] = \frac{\sum_j \left(Own_{j,i,t} \mid E_t[flow_{j,t+1}] > 95_{percentile}\right) - \sum_j \left(Own_{j,i,t} \mid E_t[flow_{j,t+1}] < 5_{percentile}\right)}{\sum_j Own_{j,i,t}} \quad (6)$$

Table 7 reports calendar-time portfolio regressions for an investment strategy that invests in stocks where a fire sale or inflow-driven purchase is anticipated. Specifically, anticipated fire sale stocks are identified as those with an expected pressure below -5% (reported in Panel A), while anticipated inflow-driven purchase stocks are those with an expected pressure greater than 10% (reported in Panel B).[15] The stocks most likely to be involved in fire sales have low subsequent returns, resulting in negative abnormal returns, although statistical significance is mixed. The stocks that are most likely to be involved in inflow-driven purchases have very high

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[14] Note that expected flow cutoffs are set to the 5th and 95th percentiles of expected flow levels, as opposed to fixed at 5% outflows and inflows.

[15] These cutoffs reflect roughly the 10th and 90th percentiles of the *PRESSURE* variable. We use the more liberal cutoffs to ensure that a sufficient number of stocks are in the anticipated fire sale and inflow-driven purchase portfolios.

subsequent returns, resulting in large abnormal returns, which are generally statistically significant. Finally, the long-short strategy that combines these two strategies produces very large abnormal returns, ranging from 0.96% per month (*t*-statistic = 1.61) to 2.36% per month (*t*-statistic = 3.60), although statistical significance is mixed. Controlling for momentum reduces the abnormal returns by roughly half.

Stocks expected to be involved in inflow-driven purchases are the primary contributors to the anticipative strategy. As a result, the portfolio does not rely heavily on short-selling, increasing the feasibility of implementing the strategy. This is also consistent with previous research documenting that the flow-performance relation for mutual funds is stronger for inflows than for outflows, which allows for more accurate forecasts of expected inflows than the forecasts of expected outflows.

IV. Persistence of Institutional Price Pressure

A. The Role of Information & Agency Costs

Care must be taken in interpreting the calendar-time portfolio regression analysis. The estimates of average abnormal returns ignore two important costs (Merton (1987)). First, the estimates of abnormal performance exclude the costs of generally becoming informed about the investment strategy. Our estimates are based on the period from 1980 to 2003, coinciding with the availability of the necessary data. Importantly, prices were set over this period by investors who did not have access to these data, and therefore, their assessments of the risks and returns associated with the strategy were surely less precise than those presented in the tables. Even now, the results, while economically enticing, are only marginally significant when taken as a whole. Second, once the general strategy is recognized as potentially profitable, there are the information acquisition costs associated with the individual securities, which have not yet been borne by the eventual liquidity providers. These costs too, are not included in the measured abnormal returns.

In some sense, we have documented that equities are in fact specialized assets. The fire sale story begins with the idea that assets are specialized, which, in the short run, fixes the pool of potential buyers and sellers who fully value the asset. In the case of stocks, where the information relevant for pricing is costly to obtain, specialization will arise around who has and collects regularly this information. In extreme situations, when a majority of the funds who are informed about an individual stock are unable to voluntarily trade, price setting may fall on funds who have not yet invested in the relevant information. These costs are surely positive, and potentially quite large. The evidence on funds experiencing significant inflows behaving as if they are constrained is consistent with these costs being large. The fact that these additional costs occasionally apply produces time variation in transaction costs. Market prices may not be perfectly efficient, in that prices do not reflect all available information at every point in time, but they may well be within the bounds of time-varying transaction and information costs (a dynamic version of Grossman and Stiglitz (1980)).

An interesting consequence of significant institutional price pressure in conjunction with a strong fund performance-flow relation is that the price pressure can spillover into subsequent periods (Shleifer and Vishny (1997), Shleifer (2000)). There are actually two spillover effects. One is the own-fund spillover, where a fund's buying or selling its existing positions mechanically improves or degrades its own performance, which affects capital flows in the subsequent period. Another spillover occurs across funds when the initial institutional price pressure affects marginal funds that would not face capital flows in the absence of this price pressure. However, their performance is sufficiently affected by the institutional price pressure, that their capital flows are altered the subsequent quarter, forcing them to transact with a lag. This sequence of events results in persistent mispricing, which can get worse before being eliminated.

B. Implications

An interesting implication of the persistent institutional price pressure relates to performance evaluation of fund managers. Over moderately long periods of several quarters, the evidence suggests that some portion of performance can, at times, be attributed to price pressure, which will eventually reverse. In many applications of performance evaluation, one would want to control for this effect. Additionally, to the extent that fund managers understand these effects, perverse incentives may exist to exploit the own-fund price pressure of trades to "dress," or temporarily enhance, performance, and thereby induce subsequent flows. Since capital flows appear to be more sensitive to good performance than to poor performance,[16] the eventual reversal of the price pressure may not adversely affect capital flows enough to fully offset the initial benefits. The likelihood of a single fund being able to create sufficiently persistent price pressure as to induce meaningful capital inflows is low, but a fund family may well be able to coordinate across its own funds to make such a strategy worthwhile.

The fact that mutual funds cannot easily coordinate with each other their contemporaneous selling of overlapping holdings, combined with an outsider's ability to predict which funds will be forced to transact gives rise to an incentive for predatory trading (Brunnermeier and Pederson (2005)). This can create a situation where arbitrageurs have an incentive to destabilize prices relative to informationally-efficient values by exploiting firms that have chosen a capital structure and organizational form that relies on immediately demandable capital.

C. Possibilities for Future Research

The cycle where capital flows can force widespread trading in individual securities, resulting in institutional price pressure, which in turn affects fund performance and eventually feeds back into capital flows, is intriguing. Two possible extensions may warrant additional

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[16] See for example, Chevalier and Ellison (1997), and Sirri and Tufano (1998).

research. First, the relation to the momentum effect is enticing. This cycle may well describe the mechanics of why stocks that do well or poorly continue to do so. The evidence presented here, suggests that the simple liquidity-motivated strategies we examine are highly correlated with momentum, but offer abnormal returns beyond the momentum factor. A second research avenue is to examine the role of this cycle in explaining the unusual pricing of technology stocks in the late 1990s. At the time, casual empiricism suggests that focused sector funds holding concentrated positions in technology stocks initially outperformed the broader indices, and consequently received large inflows, which they piled into their existing holdings. This, in turn, boosted their performance and led to additional inflows.

V. Conclusion

This paper studies asset fire sales, and institutional price pressure more generally, in equity markets by examining a large sample of stock transactions of mutual funds. We find considerable support for the notion that widespread selling by financially distressed mutual funds leads to fire sale prices. Somewhat surprisingly, we find that funds with large inflows behave as if they too are constrained to quickly transact in their existing positions, on average buying more of what they already own. When inflow-driven purchases are widespread relative to the potential sellers of individual securities, these forced purchases also result in persistent institutional price pressure. These findings suggest that even in the most liquid markets there can be a significant premium for immediacy. The price effects are relatively long-lived, lasting around two quarters and taking several more quarters to reverse. This evidence adds to previous findings of price pressure effects around index additions and stock-financed mergers. Short-run excess demand curves for stocks appear to be less than perfectly elastic.

Asset fire sales and inflow-driven purchases are probably the most significant cost of financial distress for money management firms. Most of these firms have selected an organizational form that allows capital providers to add or withdraw capital on demand, indicating that the expected costs of demanding liquidity are low. However, when many funds are forced to transact the same stocks at the same time, the price impact can be substantial.

The existence of institutional price pressure in equity markets is informative about the organization of money management firms and, in turn, the effect that these organizations have on prices. First, it suggests that the costs associated with being informed about an individual security can be substantial. Merton (1987) argues that large fixed costs of becoming informed about an investment opportunity can initially limit arbitrage investing, and once they are borne, it can take a while to learn how best to exploit the opportunity. Moreover, these costs can lead firms to specialize. Specialization limits their ability to diversify, exposing them to additional risks, which Shleifer and Vishny (1997) describe as limits to arbitrage. It certainly appears that many funds follow highly similar strategies, such that there are times when many face redemptions, and are contemporaneously forced to transact the same securities. In addition, it seems that it takes a while for forced transactions to be understood by strategy outsiders, creating time variation in transaction costs, and allowing prices to remain apart from their fundamental value for several months. Importantly, the asset fire sale story provides a mechanism for rational mispricing. The market is clearly somewhat inefficient, in that market prices are not perfectly reflective of all available information. However, the basis of this mispricing requires neither irrational investors nor managers. Prices eventually reflect available information, but sometimes with a significant delay.

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Table 1
Regressions Explaining Mutual Fund Flows (1980 – 2003)

This table reports results from regressions of mutual fund flows on lagged fund flows and lagged fund returns. Mutual fund flows are measured as a percentage of beginning of period total net assets (*TNA*). Mutual fund flows are estimated as the percentage change in *TNA* over the quarter controlling for capital gains and losses of the initial holdings: $[TNA_t - TNA_{t\text{-}1} \text{ x } (1 + Return_t)] / TNA_{t\text{-}1}$. Quarterly regressions use quarterly observations on flows and returns, while monthly regressions use monthly observations of flows and returns. Fama-MacBeth regression coefficients are the time series average of periodic cross sectional regression coefficients, with *t*-statistics calculated using the time series standard error of the mean. The reported R^2 is the average across all cross sectional regressions. The pooled regression results are based on OLS coefficients, where the mean of each variable has been subtracted. The number of observations is denoted by *N*, and *t*-statistics are in parenthesis.

	Quarterly		Monthly	
	Fama-MacBeth	Pooled	Fama-MacBeth	Pooled
Intercept	-0.0300	0.0000	-0.0042	0.0000
	(-5.88)	(0.00)	(-3.35)	(0.00)
FLOW(*t*-1)	0.2284	0.2018	0.1354	0.1316
	(10.82)	(40.24)	(11.19)	(40.48)
FLOW(*t*-2)	0.1261	0.1058	0.1709	0.1557
	(6.57)	(21.79)	(18.25)	(48.66)
FLOW(*t*-3)	0.1129	0.0811	0.1394	0.1205
	(7.41)	(17.70)	(14.87)	(39.12)
FLOW(*t*-4)	0.0741	0.0310	0.1041	0.0954
	(5.00)	(7.26)	(13.57)	(31.90)
RET(*t*-1)	0.4272	0.2892	0.2063	0.1201
	(12.17)	(26.66)	(10.85)	(24.84)
RET(*t*-2)	0.2602	0.0980	0.1282	0.0642
	(8.46)	(9.08)	(8.48)	(13.23)
RET(*t*-3)	0.2510	0.1168	0.1099	0.0442
	(8.05)	(11.10)	(6.53)	(9.18)
RET(*t*-4)	0.1454	0.0727	0.1044	0.0363
	(4.91)	(7.02)	(6.65)	(7.56)
RET(*t*-5)	0.0000	0.0502	0.0769	0.0270
	(0.00)	(4.97)	(5.15)	(5.67)
RET(*t*-6)	0.0314	0.0333	0.0651	0.0389
	(1.11)	(3.28)	(4.28)	(8.26)
RET(*t*-7)	0.0743	0.0473	0.0797	0.0236
	(2.48)	(4.71)	(4.22)	(5.04)
RET(*t*-8)	0.0683	0.0300	0.0511	0.0244
	(2.80)	(3.07)	(3.43)	(5.26)
R^2	0.3533	0.1929	0.2839	0.1674
N	96	32,856	288	91,734

Table 2

Mutual Fund Trading in Response to Flows & Expected Flows (1980 – 2003)

This table reports how quarterly mutual fund holdings change conditional on actual and expected flows. Mutual fund flows are measured as a percentage of beginning of period total net assets (*TNA*). Mutual fund flows are estimated as the percentage change in *TNA* over the quarter controlling for capital gains and losses of the initial holdings: $[TNA_t – TNA_{t-1} \times (1 + Return_t)] / TNA_{t-1}$. Expected flow is estimated via Fama-MacBeth regressions of quarterly flows on lagged flows and returns, where coefficients are the time series average of periodic cross sectional regression coefficients. In Panels A and B, for each fund in each quarter the fraction of a fund's positions that are maintained, expanded, reduced, or eliminated is calculated. Each of these fund-quarter observations is then sorted into deciles according to the fund's actual (Panel A) and expected (Panel B) quarterly flows. Averages of each variable are reported for each decile. In Panels C and D, holdings are grouped according to the flow (Panel C) and expected flow (Panel D) decile of their associated fund-quarter observation. Within each group, the percentage of holdings that are maintained, expanded, reduced, and eliminated is then calculated. The number of observations is denoted by *N*.

Panel A: Averaging by fund within actual flow deciles

Decile	Flow	Maintain	Expand	Reduce	Eliminate	Prior Fund Return	Average Number of Holdings
1	-13.6%	31.6%	16.1%	33.7%	18.6%	2.5%	82.8
2	-5.7%	39.3%	18.5%	25.9%	16.4%	0.7%	84.9
3	-3.6%	43.2%	19.3%	22.8%	14.6%	2.9%	89.7
4	-2.3%	47.4%	19.6%	19.9%	13.2%	5.9%	87.7
5	-1.1%	48.8%	20.6%	18.0%	12.6%	8.3%	90.2
6	0.2%	48.0%	23.3%	16.5%	12.2%	9.5%	99.9
7	2.0%	45.1%	27.4%	15.2%	12.3%	12.3%	110.9
8	4.8%	41.3%	32.2%	14.0%	12.5%	13.4%	122.5
9	10.6%	36.4%	38.3%	12.4%	12.9%	16.8%	122.2
10	41.8%	26.2%	49.3%	10.0%	14.5%	21.1%	102.9

Panel B: Averaging by fund within expected flow deciles

Decile	E[Flow]	Maintain	Expand	Reduce	Eliminate	Prior Fund Return	Average Number of Holdings
1	-14.1%	29.4%	21.8%	30.5%	18.4%	-26.4%	92.5
2	-7.7%	39.4%	20.9%	24.5%	15.2%	-11.8%	102.2
3	-4.4%	42.9%	21.3%	22.0%	13.8%	-3.3%	93.4
4	-2.1%	46.4%	20.4%	20.0%	13.2%	3.4%	89.6
5	-0.2%	47.1%	21.6%	18.9%	12.4%	8.6%	99.0
6	1.5%	47.4%	22.5%	18.2%	12.0%	13.0%	102.1
7	3.3%	46.5%	24.9%	16.8%	11.9%	17.1%	100.0
8	5.5%	44.1%	28.6%	15.5%	11.9%	21.1%	115.3
9	8.9%	39.7%	32.5%	15.1%	12.7%	26.3%	118.8
10	19.8%	30.9%	39.1%	14.9%	15.1%	35.5%	104.5

Panel C: Averaging by holding within actual flow deciles

Decile	Flow	Maintain	Expand	Reduce	Eliminate	Prior Return	*N*
1	-14.0%	28.2%	17.0%	39.2%	15.6%	23.9%	432,652
2	-5.7%	37.5%	19.5%	29.0%	14.1%	20.2%	436,773
3	-3.6%	39.9%	19.6%	28.0%	12.6%	19.6%	457,031
4	-2.3%	43.0%	21.6%	24.1%	11.3%	20.4%	445,800
5	-1.1%	43.8%	22.9%	22.9%	10.4%	23.3%	456,250
6	0.2%	43.6%	26.9%	19.3%	10.2%	22.4%	504,748
7	2.0%	43.4%	32.1%	14.9%	9.5%	25.8%	560,256
8	4.9%	38.9%	40.0%	11.8%	9.3%	25.7%	619,453
9	10.5%	34.6%	46.8%	9.5%	9.0%	29.5%	625,893
10	40.7%	23.9%	56.1%	9.0%	11.0%	33.6%	547,676

Panel D: Averaging by holding within expected flow deciles

Decile	E[Flow]	Maintain	Expand	Reduce	Eliminate	Prior Return	*N*
1	-13.6%	27.3%	24.4%	33.6%	14.8%	-5.9%	355,529
2	-7.7%	36.7%	24.8%	27.0%	11.6%	1.1%	387,663
3	-4.4%	38.5%	24.1%	25.8%	11.6%	10.8%	357,028
4	-2.1%	42.8%	24.8%	21.6%	10.9%	15.6%	340,206
5	-0.2%	43.6%	25.9%	20.3%	10.2%	20.0%	373,421
6	1.5%	43.1%	26.4%	20.8%	9.7%	23.7%	383,843
7	3.3%	42.8%	30.3%	17.2%	9.7%	29.4%	376,221
8	5.6%	39.3%	35.4%	16.0%	9.3%	33.2%	432,532
9	8.9%	38.4%	38.4%	13.2%	10.0%	40.4%	451,944
10	19.5%	28.9%	43.6%	14.9%	12.5%	59.2%	407,147

Table 3
Stock and Fund Summary Statistics for Fire Sale and Inflow-Driven Purchase Samples

This table reports annual summary statistics for the funds involved in forced transactions related to capital flows and the underlying stocks that are traded. Panel A reports results for the fire sale sample. Stocks with *PRESSURE* ≤ -15% are determined to be fire sale stocks, while funds selling these stocks and experiencing contemporaneous outflows of at least 5% are called fire sale funds. *PRESSURE* is a stock-level variable calculated as the number of mutual funds with inflows of 5% or more who increase their holding, minus the number of mutual funds with outflows of 5% or more who decrease their holding, scaled by the number of mutual fund owners, requiring at least 10 owners. Panel B reports results for the inflow-driven purchase sample. Stocks with *PRESSURE* ≥ 25% are determined to be inflow-driven purchase stocks, while funds buying these stocks and experiencing contemporaneous inflows of at least 5% are called inflow-driven purchase funds. Mutual fund flows are estimated as the percentage change in *TNA* over the quarter controlling for capital gains and losses of the initial holdings: $[TNA_t - TNA_{t-1} \times (1 + Return_t)] / TNA_{t-1}$.

Panel A: Fire sales

Year	CRSP VW Market Return	Avg. 12-mo. Pre-Event Stock Return	Average Quarterly Event Stock Return	Avg. 12-mo. Post-Event Stock Return	Number of Firesale Stocks	Number of CRSP Firms	Avg. 12-mo. Pre-Event Fund Return	Avg. Quarterly Event Fund Return	Avg. 12-mo. Post-Event Fund Return	Average Quarterly Flows into Firesale Funds	Average Flows into CRSP Funds	Number of Firesale Funds	Average Number of Firesales per Fund	Number of CRSP Funds
1980	33.2%		6.4%	12.6%	30	4,925		13.4%	5.5%	-8.2%	-0.2%	21	1.4	244
1981	-4.0%	57.5%	-2.6%	-0.8%	18	5,328	33.3%	-3.0%	4.6%	-8.5%	-0.3%	13	1.4	243
1982	20.4%	-2.8%	-0.1%	44.0%	49	5,460	-3.3%	4.8%	46.1%	-8.0%	1.0%	25	2.0	262
1983	22.6%	57.2%	2.3%	-8.4%	6	6,055	41.9%	2.5%	-4.1%	-7.9%	3.7%	6	1.0	279
1984	3.2%	13.8%	-6.7%	33.3%	49	6,269	4.0%	-3.2%	19.5%	-9.2%	1.3%	25	2.0	295
1985	31.4%	35.9%	8.2%	21.8%	82	6,259	12.7%	5.0%	28.1%	-9.3%	1.9%	41	2.0	317
1986	15.6%	49.0%	2.5%	16.5%	114	6,547	27.8%	2.6%	17.3%	-9.3%	2.3%	61	1.9	351
1987	1.8%	37.0%	-6.4%	-1.7%	273	7,109	11.2%	-5.4%	-10.8%	-9.4%	2.6%	56	4.9	419
1988	17.6%	7.2%	-1.7%	7.3%	295	6,918	-11.3%	3.2%	22.8%	-8.5%	-0.9%	112	2.6	456
1989	28.4%	30.4%	1.0%	1.1%	37	6,750	16.5%	8.7%	3.4%	-11.1%	1.6%	26	1.4	508
1990	-6.1%	24.7%	-7.7%	12.7%	110	6,678	14.8%	-1.8%	21.4%	-17.0%	1.7%	42	2.6	503
1991	33.6%	53.4%	5.6%	14.7%	13	6,739	12.9%	-1.3%	11.2%	-9.2%	5.7%	10	1.3	597
1992	9.1%	61.5%	-2.2%	19.4%	13	6,873	23.0%	3.9%	24.2%	-12.1%	6.9%	11	1.2	672
1993	11.6%	8.1%	-1.9%	-1.1%	18	7,603	22.0%	2.2%	7.5%	-9.9%	9.4%	10	1.8	859
1994	-0.8%	18.1%	-5.9%	27.2%	72	8,132	2.0%	-1.5%	18.0%	-11.6%	7.0%	38	1.9	1,060
1995	35.7%	17.9%	-2.4%	10.1%	72	8,351	5.1%	4.4%	25.2%	-11.1%	7.7%	36	2.0	1,202
1996	21.2%	14.4%	-3.4%	29.7%	62	8,966	19.0%	4.1%	22.9%	-14.1%	7.7%	41	1.5	1,259
1997	30.3%	14.6%	-0.6%	0.4%	96	9,043	6.0%	3.9%	8.6%	-14.2%	9.0%	49	2.0	1,454
1998	22.3%	9.1%	-7.2%	2.9%	280	8,634	12.5%	-0.8%	17.6%	-12.7%	5.6%	114	2.5	1,569
1999	25.3%	-8.2%	-5.7%	12.5%	735	8,302	-0.5%	8.8%	29.7%	-12.0%	8.0%	308	2.4	2,081
2000	-11.0%	0.2%	-21.6%	22.3%	239	8,106	20.4%	-2.9%	-12.2%	-12.7%	2.9%	128	1.9	2,425
2001	-11.3%	-47.6%	-37.5%	-8.1%	60	7,410	-20.1%	-6.7%	-13.9%	-11.7%	3.5%	42	1.4	2,700
2002	-20.8%	3.5%	-18.6%	60.7%	468	6,993	-10.1%	-5.7%	11.3%	-10.5%	2.2%	144	3.3	2,821
2003	33.1%	-26.0%	-1.3%	91.0%	460	6,641	-12.1%	-1.7%	47.0%	-11.9%	4.5%	62	7.4	2,731
Average	14.3%	18.7%	-4.5%	17.5%	152	7,087	9.9%	1.4%	14.6%	-10.8%	3.9%	59	2.2	1,054
1980-1991	16.5%	33.0%	0.1%	12.8%	90	6,253	14.6%	2.1%	13.7%	-9.6%	1.7%	37	2.0	373
1992-2003	12.1%	5.5%	-9.0%	22.2%	215	7,921	5.6%	0.7%	15.5%	-12.0%	6.2%	82	2.4	1,736

Table 3 (Continued)

Panel B: Inflow-driven purchases

Year	CRSP VW Market Return	Avg. 12-mo Pre-Event Stock Return	Average Quarterly Event Stock Return	Avg. 12-mo Post-Event Stock Return	Number of Inflow-Driven Buy Stocks	Number of CRSP Firms	Avg. 12-mo Pre-Event Fund Return	Average Quarterly Event Fund Return	Avg. 12-mo Post-Event Fund Return	Average Quarterly Flows into Inflow-Driven Buy Funds	Average Flows into CRSP Funds	Number of Inflow-Driven Buy Funds	Average Number of Inflow-Driven Buys per Fund	Number of CRSP Funds
1980	33.2%		43.8%	0.6%	3	4,925		15.6%	8.0%	17.6%	-0.2%	62	0.0	244
1981	-4.0%	112.7%	16.5%	27.0%	5	5,328	36.2%	-0.6%	2.2%	16.2%	-0.3%	71	0.1	243
1982	20.4%	27.2%	20.8%	48.9%	24	5,460	-1.1%	8.3%	50.8%	17.3%	1.0%	110	0.2	262
1983	22.6%	67.6%	13.0%	-11.7%	87	6,055	58.4%	6.3%	-7.0%	17.9%	3.7%	174	0.5	279
1984	3.2%	7.6%	-1.1%	19.1%	43	6,269	3.9%	0.2%	18.7%	15.5%	1.3%	124	0.3	295
1985	31.4%	6.2%	11.0%	17.1%	45	6,259	15.1%	10.5%	27.3%	17.5%	1.9%	169	0.3	317
1986	15.6%	41.1%	8.0%	6.4%	102	6,547	33.3%	3.5%	14.2%	17.4%	2.3%	208	0.5	351
1987	1.8%	18.3%	12.7%	-6.8%	280	7,109	22.7%	-2.5%	-2.1%	18.9%	2.6%	233	1.2	419
1988	17.6%	16.0%	10.0%	24.5%	29	6,918	-0.8%	3.3%	20.5%	17.6%	-0.9%	136	0.2	456
1989	28.4%	25.6%	8.1%	-13.2%	186	6,750	22.5%	6.3%	1.4%	22.3%	1.6%	224	0.8	508
1990	-6.1%	9.2%	14.4%	20.3%	239	6,678	12.5%	0.2%	23.9%	16.2%	1.7%	263	0.9	503
1991	33.6%	24.8%	15.0%	12.9%	405	6,739	17.2%	6.9%	13.5%	23.8%	5.7%	364	1.1	597
1992	9.1%	38.7%	9.3%	21.9%	693	6,873	23.0%	1.4%	17.4%	20.7%	6.9%	433	1.6	672
1993	11.6%	43.6%	9.3%	3.4%	1,147	7,603	20.4%	2.8%	2.9%	23.5%	9.4%	501	2.3	859
1994	-0.8%	21.6%	9.3%	25.0%	453	8,132	9.1%	-0.8%	22.3%	23.0%	7.0%	546	0.8	1,060
1995	35.7%	32.9%	10.6%	22.0%	1,172	8,351	17.4%	7.1%	23.0%	25.7%	7.7%	616	1.9	1,202
1996	21.2%	78.4%	9.6%	12.7%	786	8,966	29.1%	6.1%	22.4%	23.7%	7.7%	699	1.1	1,259
1997	30.3%	30.5%	10.5%	12.9%	1,118	9,043	24.3%	6.1%	16.3%	26.8%	9.0%	838	1.3	1,454
1998	22.3%	48.6%	10.3%	23.4%	488	8,634	23.5%	6.1%	18.9%	23.5%	5.6%	734	0.7	1,569
1999	25.3%	139.3%	55.6%	23.7%	480	8,302	21.9%	6.8%	23.6%	30.8%	8.0%	697	0.7	2,081
2000	-11.0%	157.7%	7.4%	-31.5%	708	8,106	49.9%	-3.8%	-18.1%	23.5%	2.9%	683	1.0	2,425
2001	-11.3%	18.7%	19.0%	2.1%	729	7,410	-0.4%	5.3%	-8.0%	22.6%	3.5%	608	1.2	2,700
2002	-20.8%	74.4%	3.8%	28.0%	556	6,993	0.9%	-3.0%	9.6%	20.6%	2.2%	559	1.0	2,821
2003	33.1%	68.6%	23.2%	56.8%	1,396	6,641	-2.4%	9.7%	36.3%	22.0%	4.5%	619	2.3	2,731
Average	14.3%	48.2%	14.6%	14.4%	466	7,087	19.0%	4.2%	14.1%	21.0%	3.9%	403	0.9	1,054
1980-1991	16.5%	32.4%	14.3%	12.1%	121	6,253	20.0%	4.8%	14.3%	18.2%	1.7%	178	0.5	373
1992-2003	12.1%	62.8%	14.8%	16.7%	811	7,921	18.1%	3.7%	13.9%	23.9%	6.2%	628	1.3	1,736

Table 4

Monthly Cumulative Average Abnormal Returns for Stocks around Mutual Fund Sales

Cumulative average abnormal returns (*CAARs*) are measured monthly as net-of-market returns, using the value-weighted CRSP index as a proxy for market returns. Panel A reports results for fire sale stocks. Stocks with *PRESSURE* ≤ -15% are determined to be fire sale stocks. *PRESSURE* is a stock-level variable calculated as the number of mutual funds with inflows of 5% or more who increase their holding, minus the number of mutual funds with outflows of 5% or more who decrease their holding, scaled by the number of mutual fund owners, requiring at least 10 owners. Panel B reports results for stocks with widespread net selling by funds that are unconstrained by capital flows. These stocks are identified using a "pressure" variable that is calculated as the number of mutual funds who increase their holding, minus the number of mutual funds who decrease their holding, scaled by the number of mutual fund owners. Panel C reports results for stocks with isolated selling by mutual funds forced to trade because of capital flows. These stocks are identified by the following condition: -15% < *PRESSURE* < 0. Abnormal *PRESSURE* is calculated by subtracting the monthly average from each observation. All reported statistics are calculated from the time series of monthly averages (requiring at least 5 monthly observations) of abnormal returns and abnormal *PRESSURE*. Test statistics are calculated using the standard error of the mean, and are in parenthesis. The number of monthly observations is denoted by *N*.

t	*AAR*	*t*-statistic	*CAAR*	*t*-statistic	Avg. Abnormal *PRESSURE*	*t*-statistic	*N*
A. Fire sale stocks—widespread mutual funds selling by constrained funds:							
-12	0.75%	(1.20)	0.75%	(1.20)	-0.13%	(-0.35)	149
-11	0.59%	(0.94)	1.34%	(1.51)	-0.29%	(-0.80)	152
-10	0.32%	(0.52)	1.65%	(1.54)	-0.45%	(-1.29)	155
-9	0.29%	(0.46)	1.94%	(1.56)	-0.63%	(-2.02)	158
-8	0.28%	(0.45)	2.22%	(1.60)	-1.23%	(-3.84)	159
-7	-0.17%	(-0.28)	2.05%	(1.34)	-1.86%	(-5.79)	159
-6	-0.25%	(-0.48)	1.80%	(1.06)	-2.49%	(-8.01)	159
-5	0.09%	(0.17)	1.89%	(1.05)	-3.04%	(-9.79)	165
-4	-0.29%	(-0.53)	1.61%	(0.82)	-3.49%	(-11.46)	172
-3	-1.51%	(-2.84)	0.09%	(-0.12)	-3.88%	(-13.24)	179
-2	-3.09%	(-6.20)	-3.00%	(-1.98)	-11.72%	(-12.96)	183
-1	-3.66%	(-7.21)	-6.66%	(-3.98)	-19.40%	(-20.99)	186
0	-3.32%	(-6.55)	-9.97%	(-5.64)	-26.87%	(-50.50)	189
1	-1.40%	(-2.27)	-11.37%	(-6.04)	-20.64%	(-22.73)	175
2	0.03%	(0.05)	-11.34%	(-5.83)	-13.32%	(-13.75)	161
3	0.93%	(1.43)	-10.41%	(-5.28)	-4.62%	(-12.86)	147
4	0.58%	(1.07)	-9.82%	(-4.87)	-3.77%	(-10.36)	147
5	0.81%	(1.37)	-9.01%	(-4.41)	-2.93%	(-8.22)	147
6	0.67%	(1.18)	-8.35%	(-4.02)	-2.07%	(-6.24)	147
7	0.92%	(1.43)	-7.43%	(-3.60)	-1.88%	(-5.72)	146
8	0.81%	(1.35)	-6.62%	(-3.22)	-1.69%	(-5.20)	145
9	1.31%	(2.17)	-5.32%	(-2.68)	-1.50%	(-4.68)	144
10	0.94%	(1.67)	-4.38%	(-2.27)	-1.30%	(-4.03)	144
11	0.94%	(1.69)	-3.44%	(-1.88)	-1.09%	(-3.40)	144
12	0.78%	(1.38)	-2.66%	(-1.57)	-0.89%	(-2.77)	144
	Event Period [*t*-2, *t*]		-10.07%	(-11.52)			
	Event Period [*t*-2, *t*+3]		-10.50%	(-8.47)			
	Post Event [*t*+4, *t*+12]		7.74%	(4.43)			
	Post Event [*t*+7, *t*+12]		5.68%	(3.95)			

Table 4 (Continued)

t	*AAR*	*t*-statistic	*CAAR*	*t*-statistic	Avg. Abnormal *PRESSURE*	*t*-statistic	*N*
B. Widespread mutual fund sales by unconstrained funds:							
-12	0.91%	(3.88)	0.91%	(3.88)	0.07%	(0.93)	273
-11	0.70%	(3.03)	1.60%	(4.88)	0.02%	(0.23)	274
-10	0.43%	(2.15)	2.04%	(5.23)	-0.05%	(-0.63)	275
-9	0.49%	(2.41)	2.52%	(5.73)	-0.12%	(-1.73)	276
-8	0.39%	(1.94)	2.91%	(6.00)	-0.23%	(-3.45)	277
-7	0.34%	(1.61)	3.25%	(6.13)	-0.34%	(-5.17)	278
-6	0.17%	(0.86)	3.42%	(6.00)	-0.44%	(-7.04)	279
-5	0.23%	(1.04)	3.65%	(5.98)	-0.59%	(-8.46)	280
-4	-0.07%	(-0.31)	3.58%	(5.53)	-0.72%	(-9.90)	281
-3	-0.57%	(-2.39)	3.02%	(4.49)	-0.86%	(-11.56)	282
-2	-1.44%	(-6.09)	1.58%	(2.45)	-1.95%	(-14.62)	283
-1	-1.78%	(-7.53)	-0.20%	(0.17)	-3.07%	(-20.95)	284
0	-1.91%	(-7.96)	-2.11%	(-2.04)	-4.20%	(-33.25)	285
1	-1.21%	(-4.95)	-3.31%	(-3.29)	-3.20%	(-22.32)	284
2	-0.51%	(-2.07)	-3.82%	(-3.71)	-2.20%	(-16.31)	283
3	-0.07%	(-0.29)	-3.89%	(-3.67)	-1.19%	(-12.85)	282
4	0.06%	(0.25)	-3.83%	(-3.50)	-0.99%	(-10.75)	281
5	0.11%	(0.50)	-3.72%	(-3.28)	-0.79%	(-8.78)	280
6	0.11%	(0.51)	-3.61%	(-3.08)	-0.58%	(-6.81)	279
7	0.27%	(1.08)	-3.35%	(-2.76)	-0.53%	(-6.22)	278
8	0.32%	(1.22)	-3.03%	(-2.43)	-0.48%	(-5.60)	277
9	0.41%	(1.59)	-2.62%	(-2.03)	-0.42%	(-4.98)	276
10	0.35%	(1.51)	-2.27%	(-1.67)	-0.44%	(-5.17)	275
11	0.23%	(1.11)	-2.04%	(-1.41)	-0.46%	(-5.36)	274
12	0.29%	(1.47)	-1.75%	(-1.09)	-0.48%	(-5.58)	273
	Event Period [*t*-2, *t*]		-5.12%	(-12.45)			
	Event Period [*t*-2, *t*+3]		-6.91%	(-11.79)			
	Post Event [*t*+4, *t*+12]		2.14%	(3.08)			
	Post Event [*t*+7, *t*+12]		1.86%	(3.26)			

Table 4 (Continued)

t	*AAR*	*t*-statistic	*CAAR*	*t*-statistic	Avg. Abnormal *PRESSURE*	*t*-statistic	*N*
C. Isolated mutual fund selling by constrained funds:							
-12	0.57%	(2.17)	0.57%	(2.17)	-0.71%	(-4.38)	270
-11	0.52%	(1.96)	1.09%	(2.92)	-0.80%	(-5.01)	271
-10	0.38%	(1.66)	1.47%	(3.34)	-0.93%	(-5.82)	272
-9	0.55%	(2.33)	2.02%	(4.06)	-1.05%	(-6.66)	273
-8	0.37%	(1.62)	2.39%	(4.36)	-1.45%	(-8.72)	274
-7	0.18%	(0.78)	2.57%	(4.30)	-1.84%	(-10.75)	275
-6	0.06%	(0.27)	2.63%	(4.08)	-2.21%	(-12.68)	276
-5	0.23%	(0.87)	2.86%	(4.12)	-2.57%	(-14.44)	277
-4	0.16%	(0.62)	3.02%	(4.09)	-2.94%	(-16.45)	278
-3	-0.19%	(-0.73)	2.83%	(3.65)	-3.33%	(-19.26)	279
-2	-0.63%	(-2.91)	2.21%	(2.61)	-7.14%	(-16.28)	281
-1	-0.91%	(-4.25)	1.29%	(1.27)	-10.90%	(-21.86)	283
0	-0.98%	(-4.38)	0.32%	(0.00)	-14.63%	(-32.34)	285
1	-0.61%	(-2.51)	-0.29%	(-0.67)	-11.28%	(-23.46)	283
2	-0.16%	(-0.73)	-0.45%	(-0.83)	-7.87%	(-18.75)	281
3	0.07%	(0.32)	-0.38%	(-0.72)	-4.42%	(-23.76)	279
4	0.03%	(0.15)	-0.35%	(-0.67)	-3.94%	(-22.17)	277
5	-0.02%	(-0.08)	-0.37%	(-0.67)	-3.46%	(-21.11)	275
6	0.00%	(0.02)	-0.37%	(-0.65)	-2.97%	(-20.90)	273
7	0.26%	(1.11)	-0.10%	(-0.38)	-2.85%	(-20.04)	272
8	0.50%	(1.88)	0.40%	(0.04)	-2.72%	(-19.22)	271
9	0.56%	(2.16)	0.95%	(0.50)	-2.60%	(-18.48)	270
10	0.43%	(1.96)	1.38%	(0.90)	-2.46%	(-16.96)	269
11	0.25%	(1.33)	1.64%	(1.15)	-2.31%	(-15.58)	268
12	0.32%	(1.71)	1.96%	(1.47)	-2.16%	(-14.32)	267
	Event Period [*t*-2, *t*]		-2.52%	(-6.66)			
	Event Period [*t*-2, *t*+3]		-3.22%	(-5.90)			
	Post Event [*t*+4, *t*+12]		2.34%	(3.41)			
	Post Event [*t*+7, *t*+12]		2.33%	(4.14)			

Table 5
Calendar Time Portfolio Regressions of Fire Sale Stocks (1990 – 2003)

Dependent variables are event portfolio returns, *Rp*, in excess of the one-month Treasury bill rate, *Rf*, observed at the beginning of the month. Each month we form equal and value-weight portfolios of all sample firms that have completed the event within the specified window. The event portfolio is rebalanced quarterly to drop all stocks that reach the end of their event period and add all companies that have recently been involved in a fire sale transaction. The three Fama-French factors are zero-investment portfolios representing the excess return of the market, *Rm - Rf*; the difference between a portfolio of "small" stocks and "big" stocks, SMB; and the difference between a portfolio of "high" book-to-market stocks and "low" book-to-market stocks, HML. The fourth factor, UMD, is the difference between a portfolio of stocks with high past one-year returns minus a portfolio of stocks with low past one-year returns. Fire sales are identified as stocks with substantial net selling by funds constrained by capital flows (*PRESSURE* < -15%). A minimum of 10 firms in the event portfolio is required. The number of monthly observations is denoted by *N* and *t*-statistics are in parenthesis.

$$Rp_t - Rf_t = a + b(Rm_t - Rf_t) + sSMB_t + hHML_t + uUMD_t + e_t$$

Equally-Weighted						Value-Weighted					
Intercept	Rm –Rf	SMB	HML	UMD	R^2 / N	Intercept	Rm – Rf	SMB	HML	UMD	R^2 / N
A. Stocks that have been fire sold within past year, but not most recent quarter											
0.50%	1.4215				0.4731	0.37%	1.1932				0.5452
(0.88)	(11.17)				141	(0.91)	(12.91)				141
0.08%	1.5140	0.7761	0.4628		0.5596	0.12%	1.2461	0.4687	0.2729		0.5968
(0.14)	(10.84)	(5.18)	(2.48)		141	(0.31)	(11.93)	(4.18)	(1.95)		141
0.96%	1.2437	0.9022	0.3073	-0.6937	0.7079	0.62%	1.0941	0.5396	0.1855	-0.3900	0.6735
(2.12)	(10.48)	(7.32)	(2.00)	(-8.31)	141	(1.66)	(11.15)	(5.29)	(1.46)	(-5.65)	141
B. Stocks that have been fire sold within most recent quarter											
-1.86%	1.6655				0.5790	-2.64%	1.6173				0.5673
(-2.74)	(12.07)				108	(-3.92)	(11.79)				108
-1.97%	1.6874	0.3843	0.1581		0.5970	-2.72%	1.6750	0.1107	0.1537		0.5694
(-2.90)	(10.07)	(2.09)	(0.69)		108	(-3.95)	(9.85)	(0.59)	(0.66)		108
-0.79%	1.2924	0.4763	-0.1977	-0.9331	0.8347	-1.76%	1.3527	0.1857	-0.1367	-0.7613	0.7337
(-1.77)	(11.47)	(4.02)	(-1.31)	(-12.17)	108	(-3.16)	(9.64)	(1.26)	(-0.73)	(-7.97)	108
C. Long stocks that have been fire sold within past year, but not most recent quarter and short stocks that have been fire sold within most recent quarter											
3.02%	-0.3466				0.0531	3.78%	-0.5206				0.1250
(3.93)	(-2.28)				95	(5.23)	(-3.65)				95
2.68%	-0.1177	0.5198	0.6353		0.1354	3.58%	-0.4259	0.4480	0.3344		0.1766
(3.56)	(-0.65)	(2.65)	(2.54)		95	(4.98)	(-2.46)	(2.39)	(1.40)		95
2.33%	0.0241	0.4895	0.7533	0.2903	0.1849	3.08%	-0.2204	0.4041	0.5052	0.4205	0.2849
(3.11)	(0.13)	(2.55)	(3.02)	(2.34)	95	(4.48)	(-1.28)	(2.29)	(2.21)	(3.69)	95

Table 6

Calendar Time Portfolio Regressions of Inflow-Driven Purchase Stocks (1990 – 2003)

Dependent variables are event portfolio returns, *Rp*, in excess of the one-month Treasury bill rate, *Rf*, observed at the beginning of the month. Each month we form equal and value-weight portfolios of all sample firms that have completed the event within the specified window. The event portfolio is rebalanced quarterly to drop all stocks that reach the end of their event period and add all companies that have recently been involved in an inflow-driven transaction. The three Fama-French factors are zero-investment portfolios representing the excess return of the market, *Rm - Rf*; the difference between a portfolio of "small" stocks and "big" stocks, SMB; and the difference between a portfolio of "high" book-to-market stocks and "low" book-to-market stocks, HML. The fourth factor, UMD, is the difference between a portfolio of stocks with high past one-year returns minus a portfolio of stocks with low past one-year returns. Inflow-driven purchases are identified as stocks with substantial net buying by funds facing extreme capital flows (*PRESSURE* > 25%). A minimum of 10 firms in the event portfolio is required. The number of monthly observations is denoted by *N* and *t*-statistics are in parenthesis.

$$Rp_t - Rf_t = a + b(Rm_t - Rf_t) + sSMB_t + hHML_t + uUMD_t + e_t$$

Equally-Weighted						Value-Weighted					
Intercept	Rm –Rf	SMB	HML	UMD	R^2 / N	Intercept	Rm – Rf	SMB	HML	UMD	R^2 / N
A. Stocks that have been involved in an inflow-driven purchase within past year, but not most recent quarter											
-0.73%	1.3634				0.7438	-0.79%	1.3280				0.8003
(-2.56)	(20.94)				153	(-3.35)	(24.60)				153
-0.84%	1.3129	0.5153	0.0459		0.8250	-0.62%	1.2177	0.0087	-0.2407		0.8149
(-3.41)	(20.41)	(7.58)	(0.55)		153	(-2.59)	(19.60)	(0.13)	(-2.96)		153
-0.47%	1.2120	0.5565	-0.0259	-0.2894	0.8686	-0.65%	1.2254	0.0056	-0.2353	0.0218	0.8152
(-2.15)	(20.99)	(9.36)	(-0.35)	(-7.01)	153	(-2.63)	(19.05)	(0.08)	(-2.86)	(0.47)	153
B. Stocks that have been involved in an inflow-driven purchase within most recent quarter											
0.97%	1.3095				0.6086	0.77%	1.2840				0.5444
(2.59)	(15.32)				153	(1.83)	(13.43)				153
0.92%	1.1302	0.9108	-0.1178		0.8747	0.91%	1.0298	0.7043	-0.3461		0.7490
(4.14)	(19.56)	(14.90)	(-1.56)		153	(2.81)	(12.14)	(7.85)	(-3.12)		153
0.73%	1.1819	0.8896	-0.0810	0.1484	0.8849	0.46%	1.1539	0.6537	-0.2578	0.3557	0.8033
(3.32)	(20.60)	(15.06)	(-1.10)	(3.62)	153	(1.55)	(14.84)	(8.17)	(-2.59)	(6.40)	153
C. Long stocks that have been involved in an inflow-driven purchase within most recent quarter and short stocks that have been in an inflow-driven purchase within past year, but not most recent quarter											
1.70%	-0.0539				0.0025	1.56%	-0.0440				0.0013
(4.46)	(-0.62)				153	(3.56)	(-0.44)				153
1.76%	-0.1827	0.3954	-0.1637		0.1619	1.53%	-0.1879	0.6956	-0.1054		0.2966
(4.82)	(-1.92)	(3.93)	(-1.32)		153	(3.98)	(-1.87)	(6.56)	(-0.80)		153
1.20%	-0.0301	0.3331	-0.0550	0.4378	0.3804	1.11%	-0.0715	0.6481	-0.0225	0.3339	0.3927
(3.71)	(-0.35)	(3.82)	(-0.51)	(7.22)	153	(3.00)	(-0.74)	(6.53)	(-0.18)	(4.84)	153

Table 7

Calendar Time Portfolio Regressions of Anticipated Mutual Fund Forced Transactions (1990 – 2003)

Dependent variables are event portfolio returns, *Rp*, in excess of the one-month Treasury bill rate, *Rf*, observed at the beginning of the month. Each month we form equal and value-weight portfolios of all sample firms that are expected to complete the event within the specified window. The three Fama-French factors are zero-investment portfolios representing the excess return of the market, *Rm - Rf*; the difference between a portfolio of "small" stocks and "big" stocks, SMB; and the difference between a portfolio of "high" book-to-market stocks and "low" book-to-market stocks, HML. The fourth factor, UMD, is the difference between a portfolio of stocks with high past one-year returns minus a portfolio of stocks with low past one-year returns. Anticipated fire sales are identified as stocks with $E_t[PRESSURE_{t+1}] \leq -5\%$. Anticipated inflow-driven purchases are identified as stocks with $E_t[PRESSURE_{t+1}] \geq 10\%$. $E_t[PRESSURE_{t+1}]$ is a stock-level variable, calculated each month as the number of mutual funds holding the stock with expected flows above the 95th percentile, minus the number of mutual funds with flows below the 5th percentile, scaled by the number of mutual fund owners, requiring at least 10 owners. A minimum of 10 firms in the event portfolio is required. The number of monthly observations is denoted by *N* and *t*-statistics are in parenthesis.

$$Rp_t - Rf_t = a + b(Rm_t - Rf_t) + sSMB_t + hHML_t + uUMD_t + e_t$$

Equally-Weighted						Value-Weighted					
Intercept	Rm –Rf	SMB	HML	UMD	R^2 / N	Intercept	Rm – Rf	SMB	HML	UMD	R^2 / N
A. Stocks expected to be in a fire sale over the next month											
-0.83%	1.5520				0.6497	-1.46%	1.5033				0.6427
(-1.44)	(13.55)				101	(-2.57)	(13.35)				101
-0.89%	1.5728	0.2429	0.1095		0.6588	-1.33%	1.4459	-0.3093	-0.2014		0.6578
(-1.52)	(11.02)	(1.58)	(0.58)		101	(-2.34)	(10.39)	(-2.06)	(-1.09)		101
-0.12%	1.3344	0.3301	-0.0539	-0.5143	0.7536	-0.92%	1.3191	-0.2629	-0.2883	-0.2736	0.6860
(-0.24)	(10.42)	(2.50)	(-0.33)	(-6.08)	101	(-1.63)	(9.37)	(-1.81)	(-1.59)	(-2.94)	101
B. Stocks expected to be in an inflow-driven purchase over the next month											
1.93%	1.4956				0.4981	1.10%	1.4463				0.5145
(3.42)	(11.31)				131	(2.09)	(11.69)				131
2.17%	1.1472	0.9289	-0.4015		0.7587	1.47%	1.1041	0.6242	-0.4860		0.6910
(5.17)	(10.09)	(8.26)	(-2.72)		131	(3.25)	(9.02)	(5.16)	(-3.06)		131
1.47%	1.2542	0.8727	-0.2652	0.4334	0.8127	0.61%	1.2352	0.5553	-0.3189	0.5312	0.7806
(3.78)	(12.28)	(8.74)	(-2.00)	(6.03)	131	(1.52)	(11.75)	(5.40)	(-2.34)	(7.17)	131
C. Long stocks expected to be in an inflow-driven purchase over the next month and short stocks expected to be in a fire sale over the next month											
2.21%	-0.0985				0.0026	1.91%	-0.0871				0.0019
(3.19)	(-0.63)				152	(2.69)	(-0.54)				152
2.36%	-0.3630	0.7288	-0.3614		0.1814	1.96%	-0.3162	0.8583	-0.2437		0.1975
(3.60)	(-2.13)	(4.04)	(-1.62)		152	(2.95)	(-1.83)	(4.70)	(-1.08)		152
1.18%	-0.0428	0.5969	-0.1358	0.9181	0.4749	0.96%	-0.0459	0.7469	-0.0532	0.7751	0.3975
(2.16)	(-0.30)	(4.10)	(-0.75)	(9.07)	152	(1.61)	(-0.30)	(4.68)	(-0.27)	(6.99)	152

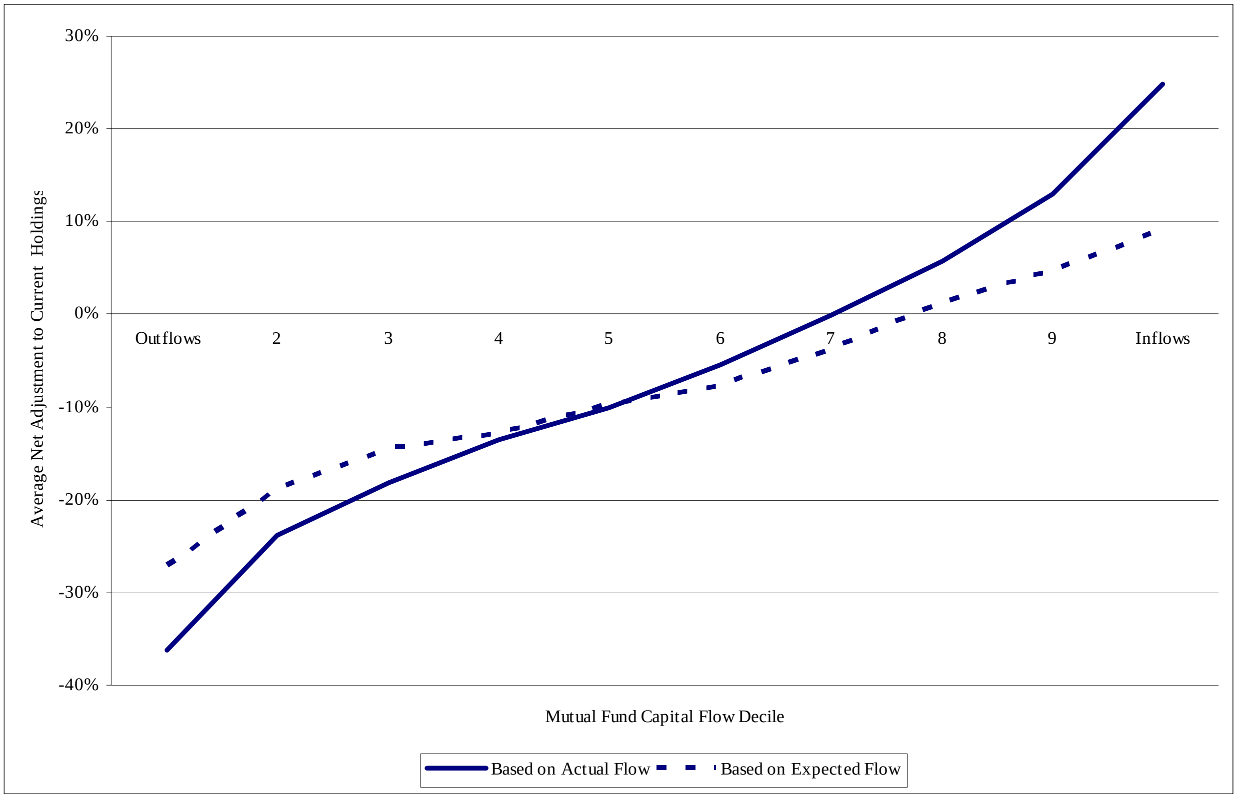

Figure 1. Relation between mutual fund flows and average tendency to adjust current holdings.
Mutual fund flows are measured as a percentage of beginning of period total net assets (*TNA*). Mutual fund flows are estimated as the percentage change in *TNA* over the quarter controlling for capital gains and losses of the initial holdings: $[TNA_t - TNA_{t\text{-}1} \text{ x } (1 + Return_t)] / TNA_{t\text{-}1}$. Expected flow is estimated via Fama-MacBeth regressions of quarterly flows on lagged flows and returns, where coefficients are the time series average of periodic cross sectional regression coefficients. For each fund, in each quarter, the fraction of a fund's positions that are expanded minus the fraction of positions reduced or eliminated is calculated. Each of these fund-quarter observations is then sorted into deciles according to the fund's actual and expected quarterly flows. Averages are reported for each mutual fund capital flow decile.

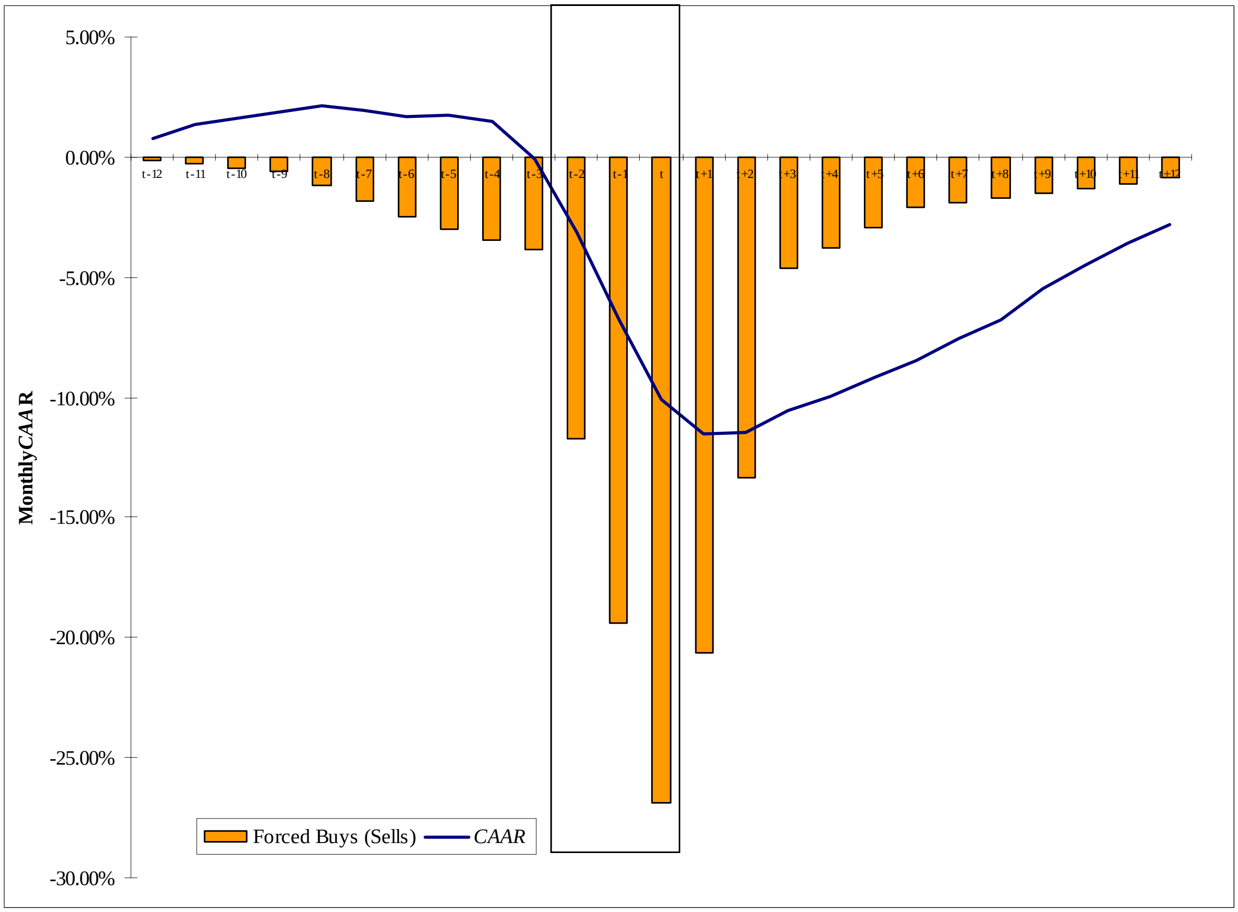

Figure 2. Cumulative average abnormal returns around mutual fund fire sales.
Monthly abnormal returns are calculated using simple net-of-market returns, where the CRSP value-weighted index proxies for the market portfolio. Each month the average of monthly abnormal return is calculated, and then the time series mean and standard error of the mean are used for statistical inference. Net selling pressure is defined as the difference in forced sellers and forced buyers divided by the total number of institutional owners. Transactions are identified as "forced," based on their capital flows as a percentage of their beginning-of-period total net assets. Fire sales are identified at the stock level based on net selling pressure below -15%.

$$PRESSURE_{i,t} = \frac{\sum_j \left(Buy_{j,i,t} \mid flow_{j,t} > 5\%\right) - \sum_j \left(Sell_{j,i,t} \mid flow_{j,t} < -5\%\right)}{\sum_j Own_{j,i,t-1}}$$

$Buy_{j,i,t}$ equals one if fund j increased its holding in stock i during quarter t, and zero otherwise. $Sell_{j,i,t}$ is defined similarly based on decreases. $Own_{j,i,t\text{-}1}$ equals one if fund j owns stock i at the beginning of quarter t.

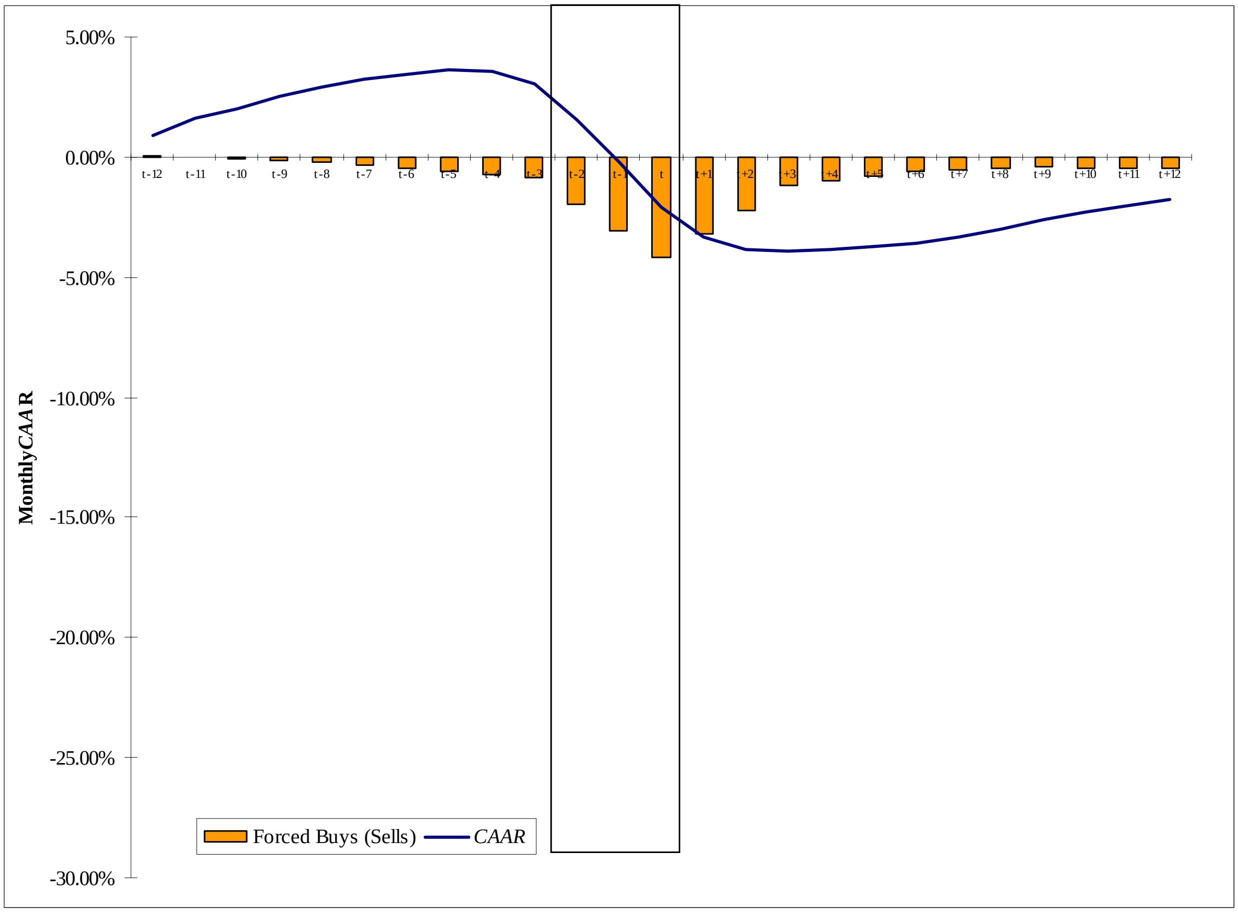

Figure 3. Cumulative average abnormal returns around voluntary mutual fund sales.
Monthly abnormal returns are calculated using simple net-of-market returns, where the CRSP value-weighted index proxies for the market portfolio. Each month the average of monthly abnormal return is calculated, and then the time series mean and standard error of the mean are used for statistical inference. Net selling pressure is defined as the difference in sellers and buyers divided by the total number of institutional owners. Transactions are not conditioned on the capital flows into the fund. Voluntary sales are identified at the stock level based on net selling pressure below -15%.

$$PRESSURE_{i,t} = \frac{\sum_j \left(Buy_{j,i,t}\right) - \sum_j \left(Sell_{j,i,t}\right)}{\sum_j Own_{j,i,t-1}}$$

$Buy_{j,i,t}$ equals one if fund j increased its holding in stock i during quarter t, and zero otherwise. $Sell_{j,i,t}$ is defined similarly based on decreases. $Own_{j,i,t\text{-}1}$ equals one if fund j owns stock i at the beginning of quarter t.

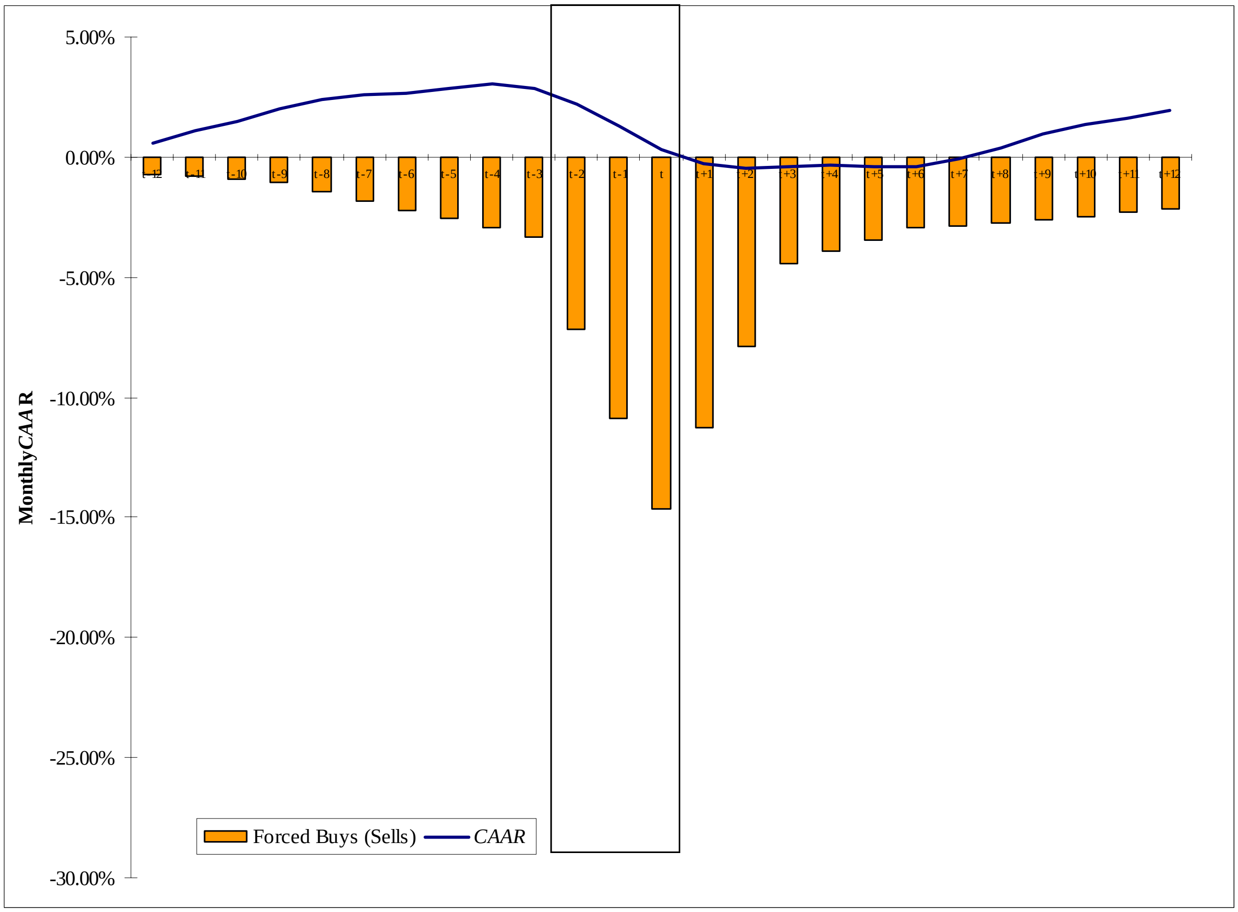

Figure 4. Cumulative average abnormal returns around isolated forced mutual fund sales.
Monthly abnormal returns are calculated using simple net-of-market returns, where the CRSP value-weighted index proxies for the market portfolio. Each month the average of monthly abnormal return is calculated, and then the time series mean and standard error of the mean are used for statistical inference. Net selling pressure is defined as the difference in sellers and buyers divided by the total number of institutional owners. Transactions are not conditioned on the capital flows into the fund. Isolated forced sales are identified at the stock level based on net selling pressure between -15% and 0%.

$$PRESSURE_{i,t} = \frac{\sum_j \left(Buy_{j,i,t} \mid flow_{j,t} > 5\%\right) - \sum_j \left(Sell_{j,i,t} \mid flow_{j,t} < -5\%\right)}{\sum_j Own_{j,i,t-1}}$$

$Buy_{j,i,t}$ equals one if fund j increased its holding in stock i during quarter t, and zero otherwise. $Sell_{j,i,t}$ is defined similarly based on decreases. $Own_{j,i,t-1}$ equals one if fund j owns stock i at the beginning of quarter t.

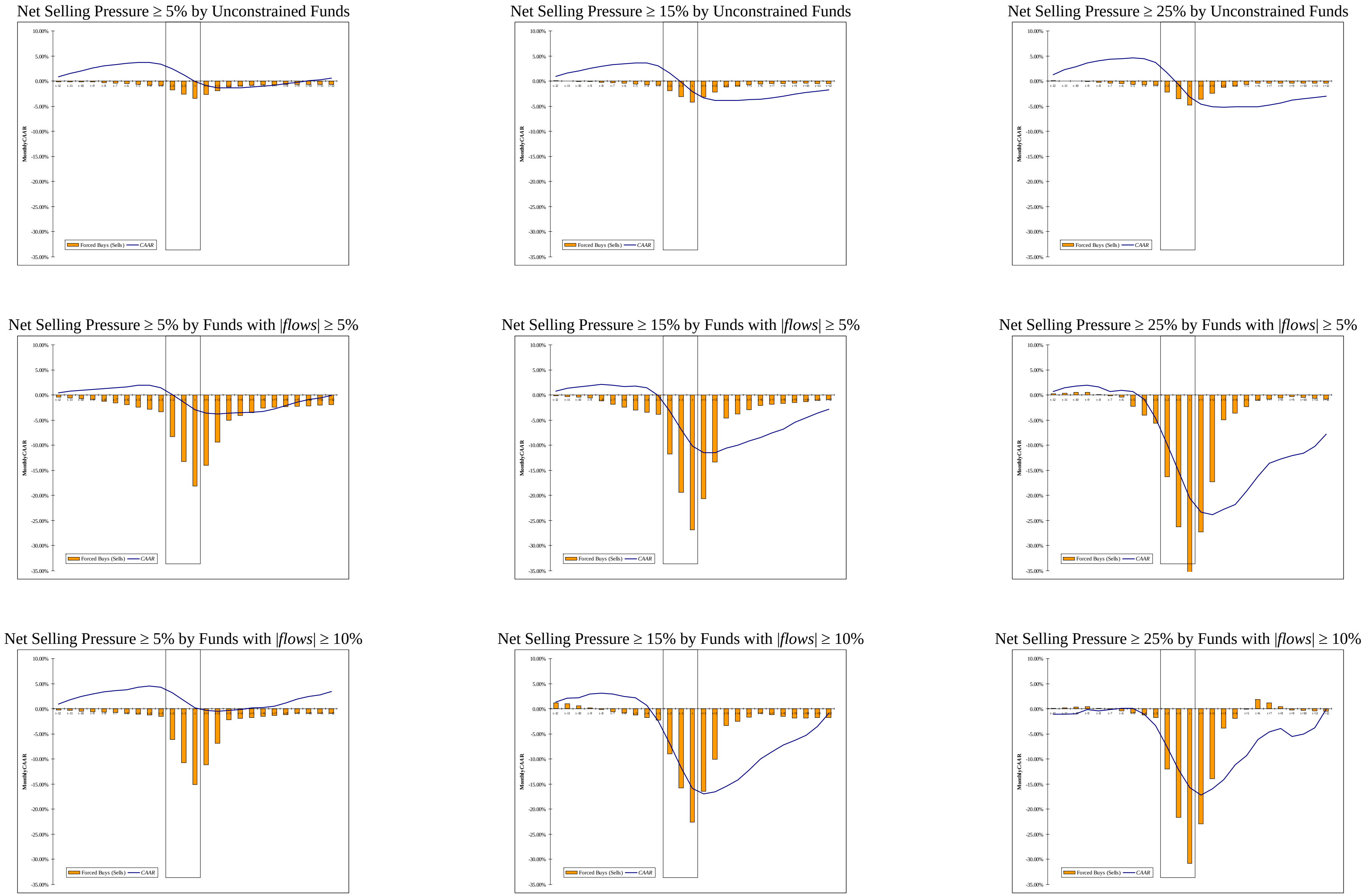

Figure 5. Cumulative average abnormal returns around mutual fund sales.

Monthly abnormal returns are calculated using simple net-of-market returns, where the CRSP value-weighted index proxies for the market portfolio. Each month the average of monthly abnormal return is calculated, and then the time series mean and standard error of the mean are used for statistical inference. Net selling pressure is defined as the difference in forced sellers and forced buyers divided by the total number of institutional owners. Transactions are identified as "forced," based on their capital flows as a percentage of their beginning-of-period total net assets.