Who Trades Against Mispricing?*

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Abstract

We provide the first direct evidence that redemption risk undermines managerial incentives to trade against mispricing (Shleifer and Vishny, 1997). We examine the extent to which financial institutions with different capital structure trade in mispriced stocks. We start by comparing open-end funds with closed-end funds, which are similarly regulated, but not subject to redemptions. Compared to open-end funds, closed-end funds purchase more underpriced stocks, especially if these involve high arbitrage risk. We then extend the analysis to institutions that are closest to the ideal of "rational arbitrageurs", the hedge funds. We find that hedge funds with higher share restrictions are also more likely to trade against mispricing than other hedge funds. Our results indicate that organizational structures involving less redemption risk better serve the useful social function of bringing prices to their fundamental values.

Keywords: Limits to Arbitrage, Redemption Risk, Capital Structure, Market Efficiency

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In an efficient capital market, rational investors are expected to instantaneously trade when prices deviate from their fundamental values. Plenty of empirical evidence, however, shows that institutional investors do not exert a stabilizing force on stock prices and that consequently, asset prices can deviate from their fundamental value for long periods of time (Lamont and Thaler, 2003; Lamont and Stein, 2004). During financial crises, intermediaries face constraints that prevent them from trading against mispricing (Adrian, Etula, and Muir, 2012; Ben-David, Franzoni and Moussawi, 2012). However, even when they are unconstrained, institutional investors do not appear to trade against mispricing (Mitchell, Pulvino, and Stafford, 2007). For instance, hedge funds increased their exposure to IT stocks during the IT bubble (Brunnermeier and Nagel, 2004) and institutional investors seem to trade in a way that accentuates stock market anomalies (Frazzini and Lamont, 2008; Edelen, Ince and Kadlec, 2013).

We argue that existing literature has failed to consider heterogeneity in the investors' ex ante incentives. In particular, depending on their capital structure, asset managers may be more or less susceptible to redemption risk and may thus have different incentives to trade against mispricing. This argument builds on the seminal paper of Shleifer and Vishny (1997). Asset managers invest other people's money. Since investors in the fund generally lack the specialized knowledge to evaluate a fund manager's strategy, they may simply evaluate him based on his past performance. If the mispricing that a fund manager is exploiting worsens in the short run, investors may decide that the manager is incompetent and withdraw their capital. To avoid redemptions, asset managers may then neglect arbitrage opportunities for which convergence to fundamentals is unlikely to be either smooth or rapid. Only asset managers whose funding is less subject to redemption risk may thus undertake long-term and risky arbitrage opportunities.

To the best of our knowledge, we are the first to show that asset managers less subject to redemption risk indeed exhibit higher propensity to trade against mispricing. In this way, we highlight the features of asset managers' organizational structures that better serve the useful social function of bringing prices to their fundamental value and ultimately lead to an efficient capital allocation.

We begin our analysis by contrasting the trading behavior of open- and closed-end funds. Open- and closed-end funds are subject to similar regulations, but differently from open-end funds, closed-end funds are insulated from redemptions. Therefore, we expect closed-end funds to be more inclined to undertake long-term arbitrage. Next, we explore whether any benefits of the closed-end fund structure may be reproduced by hedge funds' share restrictions, which should also decrease the risk of capital outflows due to poor short-term performance. We believe that it is particularly interesting to explore whether lower redemption risk is associated with stronger incentives to trade against mispricing even among hedge funds because these asset managers are subject to more flexible regulation than any other class of investors and are conceivably closest to the ideal of "rational arbitrageurs" (Brunnermeier and Nagel, 2004). Thus, they may be more inclined to trade against mispricing even in the absence of share restrictions. Furthermore, share restrictions prevent redemptions only for a limited period of time. Therefore, whether share restrictions effectively reduce redemption risk and lead to a trading behavior that is similar to that of closed-end funds is ultimately an empirical question.

Based on existing literature, we identify two types of mispricing that are unlikely to be followed by a smooth and rapid convergence of prices to fundamental values.[1] First, we compare the trading of open- and closed-end funds in "fire sales" stocks – stocks that are

[1] We do not consider other anomalies because the profits from exploiting most of them have been shown to arise on the short leg of the strategy (Stambaugh, Yu and Yuan, 2012). Open- and closed-end mutual funds are restricted from shorting and we do not observe hedge funds' short-sales.

undervalued due to negative price pressure caused by distressed mutual funds. Fire sales have been shown to bring about long-lasting mispricing of financial assets, which can persist because of lack of long-term arbitrage capital, and to experience systematic price reversals (Coval and Stafford, 2007; Duffie, 2010). We find that closed-end funds are more inclined to buy fire sale stocks than open-end funds. The difference in the net purchases of closed-end and open-end funds in fire sale stocks is about half of the standard deviation of all trades, indicating that the effects are not only statistically, but also economically significant.

Differences in trading behavior are more pronounced for smaller stocks and stocks with highly volatile returns, as predicted by Shleifer and Vishny (1997). Importantly, our results appear to be driven by open- and closed-end funds capital structure and its effects on ex ante incentives, rather than by ex post financial constraints. In particular, open-end funds are less likely to purchase fire sale stocks even if we control for their net flows or previous performance. Instead, open-end funds with higher exposure to redemption risk, measured by a higher flow performance sensitivity and a shorter managerial tenure, are more reluctant to purchase fire sale stocks than other open-end funds. We find no evidence that closed-end fund managers' differences in ability (Ross, 2002; Berk and Stanton, 2007), which are often thought to be associated with the closed-end fund premium, may drive our findings.

Second, we identify undervalued securities following Baker and Wurgler (2006) who show that stocks whose valuations are more subjective tend to be underpriced in periods of low investor sentiment. Examples of stocks with subjective valuations include the stocks of companies that are young, unprofitable, distressed and non-dividend paying. For this type of mispricing, the timing of convergence to fundamental value is potentially slow, just like for fire sales, and particularly uncertain due to noise trader risk. Consistent with our earlier results, we find that closed-end funds are more exposed to stocks with subjective valuations during periods of negative sentiment, that is, precisely when they are underpriced. For

instance, closed-end funds appear to have 17% higher exposure to small stocks in period of low sentiment than open-end funds. These tests provide an independent corroboration of our previous findings that closed-end funds are more likely to trade against mispricing than open-end funds.

Finally, we compare the trading of hedge funds with and without high share restrictions in stocks that are mispriced due to fire sales or sentiment shocks. We find that hedge funds with higher share restrictions (share restrictions above the sample median) are more likely to purchase fire sale stocks compared to other hedge funds. Moreover, the portfolios of hedge funds with high share restrictions are more exposed to stocks with subjective valuations during periods of negative market sentiment, when these stocks are undervalued. The differences in trading associated with share restrictions, although statistically and economically significant, are somewhat less pronounced than the ones associated with the closed- and open-end structures. This may suggest that high share restrictions insulate managers from redemption risk to a lower extent. Interestingly, the differences between hedge funds arise in the quarter of the fire sale, when prices bottom out, while differences between open- and closed-end mutual funds are more prominent in the following quarter. This indicates that hedge fund managers are more sophisticated and are able to identify undervalued stocks more promptly.

Not only are our findings robust across different classes of asset managers, but they also survive a battery of robustness checks that aim to rule out that certain fund characteristics that may be correlated with the fund's capital structure (such as the fund's style or the fund manager's ability) drive our findings. Taken jointly, our tests confirm the importance of capital structure for an asset manager's tendency to trade against mispricing.

Our paper is related to a burgeoning literature that explores the determinants of limits to arbitrage. Different theoretical models show how demand shocks may cause persistent

deviations of prices from their fundamental values due to the financing frictions faced by arbitrageurs (see Gromb and Vayanos (2012) for a recent review). The studies that are most relevant for us show that poor returns experienced by a fund could trigger investors' outflows (e.g., Shleifer and Vishny, 1997; Vayanos and Woolley, 2013).

Existing empirical evidence shows that funds experiencing withdrawals trade in a way that exacerbates mispricing and that mispricing can persist for months (Mitchell, Pedersen, and Pulvino, 2007; Ben-David, Franzoni and Moussawi, 2011; Manconi, Massa and Yasuda, 2011). There is surprisingly no direct empirical evidence on how a fund's ex ante incentives affect the fund's willingness to trade against mispricing. However, to explain why arbitrage capital is slow moving (Duffie, 2010), it is crucial to understand why asset managers that do not face immediate financial constraints (e.g., redemptions) are reluctant to trade against mispricing.

The relation between ex ante incentives and propensity to trade against mispricing is also important for the debate on the structure of asset management intermediaries. In the survival-of-the-fittest spirit of Fama and Jensen (1983), the dominance of open-end structures is often considered an optimal response to agency problems. However, Stein (2005) challenges this view and shows that the degree of open-ending may be *socially excessive.* Fund managers may use an open-end structure to commit to good behavior and attract investors, even though this constrains their ability to trade against mispricing.[2] Due to competition, closed-end fund structures may be supplanted by open-end fund structures, even if the latter constitute a serious impediment to long-term arbitrage. We contribute to this debate by providing direct empirical support for one benefit of the closed-end fund structure.

[2] Liu and Mello (2011) also model the link between the structure of an investor's liabilities and the investor's propensity to undertake long-term arbitrage.

Another strand of literature explores the effects of the liability structure on the funds' performance. Aragon (2007) and Agarwal, Daniel, and Naik (2009) find that hedge funds that are less subject to redemptions have higher returns, presumably because they are able to invest in illiquid assets and obtain an illiquidity premium.[3] The evidence is similar for open-end funds with load fees, which also tend to weaken incentives to redeem for the funds' investors (Ippolito, 1986; Chordia, 1996). Relatedly, Hombert and Thesmar (2011) show that the returns of hedge funds with redemptions restrictions are more likely to revert after periods of weak performance, suggesting a tendency to invest in mispriced securities. None of these papers provide direct evidence on asset managers' trading and exposure to stocks with different characteristics.

Finally, our paper is related to the literature on closed-end funds. Most of the contributions have focused on explaining the closed-end fund discount using investor sentiment (Lee, Shleifer, and Thaler, 1991; Pontiff, 1996 and 1997) or management fees (Ross, 2002; Berk and Stanton, 2007). Other papers highlight that the closed-end fund discount can be at least partially explained by the fact that closed-end funds tend to invest in illiquid assets (Cherkes, Sagi, and Stanton, 2008; Ramadorai, 2012). While our analysis has no direct implications for the closed-end fund discount, to the best of our knowledge, we are the first to provide direct evidence on the effect of the closed-end structure, and more in general share restrictions, on trading in mispriced securities. Furthermore, instead of focusing on the funds' tendency to invest in illiquid assets, we highlight that they have stronger incentives to trade against mispricing. We show that this effect is independent from the illiquidity of the assets stressed in previous literature.

[3] Consistently with this empirical evidence Teo (2011) shows that hedge funds experiencing redemptions have lower returns than other hedge funds.

The remainder of this paper is organized as follows. Section 1 provides background information. Section 2 describes the closed- and open-end funds' sample. Sections 3 and 4 provide evidence from closed- and open-end funds' trades and returns, respectively. Section 5 studies hedge funds with and without high share restrictions. Section 6 concludes.

1. Institutional Background

Most investment vehicles, including open-end mutual funds and (most) hedge funds, have an open-end structure. That is, they are funded with redeemable claims, which expose them to withdrawal risk. Closed-end funds and, to a lower extent, hedge funds with redemption restrictions are notable exceptions. We discuss their institutional features below.

1.1. Closed- and Open-end Funds

Closed-end funds are professionally managed investment companies with a fixed number of common shares that can*not* be directly purchased or redeemed from the fund. Closed-end funds' shares are typically listed on a stock exchange or traded in the over-the-counter market. Thus, closed-end funds, differently from open-end funds, are immune from redemption risk.

Closed-end funds are otherwise similar to open-end funds. Both closed- and open-end funds are regulated primarily under the same sections of the Investment Company Act of 1940, and subject to SEC registration and the Securities Act of 1933 and the Securities Exchange Act of 1934.[4] They are allowed to borrow (see Almazan, Brown, Carlson, Chapman, 2004), but in practice only a few closed-end funds use leverage (Dimson, 2002).[5]

[4] See http://www.sec.gov/answers/mfclose.htm for more information.
[5] The debt of closed-end funds is in the form of auction rate securities as opposed to collateralized borrowing, which is the usual form of borrowing for hedge funds. Consistent with Dimson (2002), only about 20% of the closed-end funds report positive leverage in our sample.

While only closed-end funds are allowed to invest in asset classes that cannot be liquidated in less than one week, the rules governing open- and closed-end funds' investment in US equity are similar. We thus focus on the trading of open- and closed-end funds in US stocks to explore the extent to which redemption risk matters.

1.2. Hedge Funds

To evaluate the relevance of redemption risk for a broader class of asset managers, we also explore the effects of share restrictions on hedge fund managers' trading. Thanks to the steep incentives provided by their fee structures, hedge funds are closer to the ideal of "rational arbitrageurs" than any other class of investors (Brunnermeier and Nagel, 2004). They are also subject to much more flexible regulation than open- and closed-end funds, which allows them to use leverage more aggressively and take short positions.

Hedge funds are organized on an open-end basis and are thus subject to redemption risk. However, they can choose to establish share restrictions that limit investors' ability to redeem by requiring advance notification or by restricting redemptions to predetermined periods. Also, some hedge funds have lock up periods that impose a minimum investment time on new investors. These characteristics are set at the fund's inception and do not change during the lifetime of a fund (Aragon, 2007; Agarwal, Daniel and Naik, 2009).

Hedge funds with share restrictions may have higher flexibility to undertake arbitrage opportunities that might take time to become profitable. However, share restrictions may not completely insulate the funds from redemptions, as investors are still able to withdraw their capital (on average, after two quarters in our sample).[6] Furthermore, even hedge funds without share restrictions have the option of raising gates, i.e., temporarily not allowing withdrawals, if massive redemption requests occur. It is thus an empirical question whether

[6] New investor capital can be locked in for a longer period of time. Among funds that impose lock up restrictions, the lock up period is about 200 days on average.

hedge funds with higher share restrictions trade against mispricing more aggressively than other hedge funds.

2. Closed-End Funds' Data and Sample Construction

We obtain data on the entire universe of US closed-end funds from Lipper Inc., distributed by Thomson Reuters. This is a survivorship bias free dataset that provides information on quarterly fund asset holdings, starting from 2005, and a variety of other fund characteristics such as monthly returns, total net assets under management (TNA), annual fees, and allocation schemes, from January 1990 until December 2010. We complement this data with S&P Capital IQ, which provides information on closed-end funds' liabilities (if any).

We obtain the correspondent information on characteristics and quarterly stockholdings for open-end mutual funds from the CRSP Survivorship Bias Free Mutual Fund Database and the Thomson Reuters Mutual Fund Holdings database, respectively. During our sample period, many mutual funds have multiple share classes. Since each share class of a fund has claims to the same portfolio holdings, we aggregate all the observations at the fund level.[7] We exclude index funds by removing funds that are identified by CRSP as index funds and by screening funds' names and eliminating any fund whose name contains the word "index". Finally, we obtain information on firm characteristics and stock prices from COMPUSTAT and CRSP, respectively.

Our tests rely on two samples. The first sample allows us to focus on actual changes in funds' stockholdings in a given firm and quarter, and goes from January 2005 to December

[7] As is common in the literature, for qualitative fund attributes, such as objectives and year when the fund was first offered, we use the attributes of the oldest share class; for the total net assets under management, we sum the net assets of all share classes, and take the TNA-weighted average for the rest of the quantitative attributes (e.g., returns, expenses).

2010. As we explain below, when we use this sample, we concentrate on how funds change their holdings in stocks that experience fire sales (or purchases). Since our objective is to understand the incentives to trade against mispricing, we exclude the mutual funds that cause the mispricing, that is, funds with extreme inflows and outflows (i.e., funds with quarterly flows measured as a percentage of the beginning-of-period TNA in the bottom and top 10%, respectively). Furthermore, for consistency with previous literature, we eliminate the holdings of open- and closed-end funds with TNA less than 1 million or that report less than 10 holdings.

In order to extend the sample period, we also assess fund exposure to different types of mispriced stocks via return regressions. This analysis requires only fund monthly return data, which are available from January 1990 to December 2010. To focus on a more homogeneous set of funds, we only include funds specialized in domestic equity. In particular, we exclude closed-end funds with international specialization or that hold asset classes other than equity from this sample. As a result, our sample includes a total of 406 US-based closed-end funds, specialized in domestic equity. Panel A of Table 1 summarizes the funds' main characteristics.

Since closed-end funds tend to be smaller than open-end funds, we exclude open-end funds in the top TNA quintile from all analyses.[8] Consequently, as shown in Table 1, the average size of the open-end funds in our sample is similar to that of the closed-end funds. Open- and closed-end fund also charge similar annual fees and have similar style-adjusted performance, even though the performance of closed-end funds appears more negatively skewed. On average, closed-end funds have a leverage of 6.8 %.

[8] All results we present hereafter are qualitatively invariant if we include the top quintile of open-end funds in the analysis. We present these results in Table A.1 of the Internet Appendix.

Table 1 also compares the main characteristics of the stocks held by closed- and open-end funds. A number of important patterns immediately emerge. First and foremost, we confirm the conjecture that closed-end funds tend to hold more illiquid stocks (e.g., Cherkes, Sagi and Stanton (2008)); to our knowledge, our paper is the first to provide direct evidence on closed-end funds' preference for illiquid assets using holdings data. Moreover, consistent with our hypothesis, we observe that closed-end funds are in fact more contrarian investors: for instance, they invest more heavily in value stocks and engage less in momentum trading compared to open-end funds. In the next section, we device an empirical strategy that allows us to test whether closed-end funds trade against mispricing more than open-end funds after controlling for the overall differences in their investment styles.

3. Fire Sales and Closed- vs. Open-end Funds' Trades

3.1. Methodology

Our objective is to test whether closed-end funds, being insulated from redemptions, take more aggressive positions against mispricing. We identify mispriced stocks following Coval and Stafford (2007), who show that distressed funds experiencing large outflows create negative price pressure in the stocks they hold. Similarly, funds experiencing large inflows tend to expand their positions in the stocks they already own, causing positive price pressure in these stocks.[9] As in Coval and Stafford (2007), we identify stocks subject to pressure because of extreme inflows and outflows using the following proxy:

$$Pressure_{i,t} = \frac{\sum_f max(0,\Delta Hold_{f,i,t}) | \, flow_{f,t} > P90 - \sum_f max(0,-\Delta Hold_{f,i,t}) | \, flow_{f,t} < P10}{Avg \; Volume_{i,t-12:t-6}}.$$

[9] Duffie (2010), Edmans, Goldstein and Jiang (2012), and Khan, Kogan and Serafeim (2012) use a similar strategy for identifying mispricing.

The pressure experienced by stock *i* in quarter *t* is the difference between flow-induced purchases and flow-induced sales during the quarter, divided by the stock's average trading volume during prior quarters. Flow-induced sales are reductions in shares by mutual funds experiencing severe outflows – that is, flows below the 10th percentile – and similarly, flow-induced purchases are increases in shares by mutual funds experiencing large inflows – that is, flows above 90th percentile.

Mutual funds' flows are computed as is customary from funds' monthly returns (*R*) and total net assets under management (*TNA*). We measure the flows of fund *f* in quarter *t* as: $flow_{f,t} = \left[TNA_{f,t} - TNA_{f,t-1} \times (1 + R_{f,t})\right] / TNA_{f,t-1}$.

In each quarter, stocks with *Pressure* below the 10th percentile are considered to experience fire sales, and stocks with pressure above the 90th percentile are considered to experience fire purchases. Our final sample includes 7,789 episodes of fire sales and 7,599 episodes of fire purchases during the period 2005-2010.

Coval and Stafford (2007) show that stocks subject to fire sales (purchases) experience large price drops (increases), which eventually reverse in the following quarters. The fire sale (purchase) quarter (that is, the quarter when the stock's *Pressure* is in the bottom (top) decile) is the quarter in which fire sales (purchase) stocks' valuations bottom out (are at the top). However, as Coval and Stafford (2007) show, the fire sale (purchase) stock begins experiencing selling (buying) pressure and some price decline (increases) in the previous quarters because mutual funds' flows are correlated over time.[10]

Systematic reversals distinguish forced trading (due to fire sales and purchases) from other potentially information-motivated trading (Coval and Stafford, 2007; Khan, Kogan and Serafeim, 2012). Any discretionary selling (buying) pressure, proxied by the sales

[10] Figure A.1 in the Internet Appendix shows price drops and reversals for the fire sale stocks in our sample.

(purchases) of mutual funds without extreme outflows, predict permanent stock price drops (increases).

Due to the large price reversals, investors who trade against constrained mutual funds can earn substantial returns for providing liquidity. However, fire sales and purchases cause persistent mispricing. For instance, during our sample period, stock prices typically revert to their fundamental value over a horizon of 24 months, suggesting that only few investors are willing to take contrarian positions. One reason for this is that such trades involve risk over the timing of the reversal in the short-run. For instance, one year after the fire sale, the cumulative abnormal returns of fire sale stocks range from over 6% for the top quartile to -1% for the bottom quartile. Thus, funds buying stocks in the fire sale quarter face significant risk of short-term underperformance.

Money managers that do not face the risk of large redemptions following poor short-run performance, like closed-end funds, should be more inclined to purchase (sell) fire sale (purchase) stocks. In what follows, we compare the changes in the positions of open- and closed-end funds in stocks experiencing fire sales or purchases. For each episode, we exclude all funds with extreme inflows or outflows (flows above the top decile or below the bottom decile), that is, the funds that caused the fire sales or purchases.

If the structure of an investor's liabilities affects the investor's willingness to trade against mispricing, we expect differences in trading to emerge only when stocks experience fire sales or purchases. We further explore how this trading behavior varies with stock and fund characteristics (others than the funds' open- or closed-end structures). In this way, we evaluate whether any other differences across funds, such as the fund style, may drive the differences between open- and closed-end funds. More importantly, these tests allow us to further link the theory to our empirical analysis, and shed light on the mechanism behind the main results.

3.2. Fire Sales

Simple descriptive statistics suggest large differences between closed- and open-end funds in the trading of fire sale stocks. In the fire sale quarter, open-end funds (that did not experience extreme outflows) sell in the aggregate 1.4% of the fire sale stock's shares outstanding. On the contrary, the closed-end funds, with much less assets under management, purchase 0.013% of the outstanding fire sale stocks.

To evaluate the differences in trading more systematically, we estimate the following model for all for all fire sale stocks:

$$\Delta shares(t+k)_{f,i,s} = \alpha + \beta_1 Closed_f + \beta_2 X_{i,s} + \beta_3 X_{f,s} + \beta_4 X_s + \varepsilon_{f,i,s},$$

where *k* ranges from -2 to +3, that is, it starts two quarters before the fire sale and ends three quarters after. The dependent variable captures the quarterly changes in shares held by fund *f* in stock *i* between quarter *s* and quarter *s-1*, divided by the total number of shares outstanding of stock *i.* Our sample only includes observations of stock *i* and fund *f* if fund *f* held shares of *i* at *s* or *s-1*. The main variable of interest is the dummy $Closed_f$, which is equal to one if fund *f* is a closed-end fund. The matrices $X_{i,s}$ and $X_{f,s}$ represent time-varying controls for stock and fund characteristics, respectively. Stock characteristics include market capitalization (*Size*), idiosyncratic volatility, measured by the standard deviation of monthly returns in the past 2 years (*VOL*), a proxy for illiquidity, computed following Amihud (2002) (*ILLIQ*), book to market value (*BM*), and cumulative abnormal returns in the past 6 months (*MOM*). We also control for fund size, measured by the natural logarithm of fund TNA (*log TNA*) and include quarter fixed effects to capture aggregate market-wide effects. We cluster

standard errors at the fund level to take into account that fund trades may be correlated for a given fund.[11]

Table 2 shows how the trades of open- and closed-end funds differ in the quarters around the fire sale, that is, quarter *t* when prices bottom out. There is no statistical difference in the purchases of open-end funds and closed-end funds up to quarter *t*. However, we find that closed-end funds buy significantly more than open-end funds in the quarter following the fire sale, *t+1*. The effect is not only statistically, but also *economically* significant. To have a more immediate interpretation of the coefficients, we standardize the dependent variable $\Delta shares(t-k)_{f,i,s}$ using the standard deviation of all trades of open- and closed-end funds. Thus, the coefficient of the dummy *Closed* in column 4 of Table 2 implies that in the quarter following the fire sale, the net purchases of a typical closed-end fund are almost half of a standard deviation larger than that of open-end funds. The coefficient of the dummy *Closed* in column 3 of Table 2 has an analogous interpretation, albeit with a smaller economic magnitude. Thus, it appears that while closed-end funds start purchasing more than open-end funds in the quarter of the fire sale, the bulk of their purchases actually occurs in the following quarter, when the reversal slowly starts and it becomes easier to identify fire sale stocks.

Importantly, we observe no statistical difference in the behavior of closed- and open-end funds in the two following quarters. These findings suggest that the differences in trading behavior between open- and closed-end funds are driven by the fire sales events and the consequent price drops as opposed to differences in unobserved firm characteristics. If the latter were the case, we would have observed differences in trading also in the quarters

[11] Double-clustering standard errors at the fund- and time-level yields results that are similar to the ones we present hereafter (see Table A.2 in the Internet Appendix). The approach of including time effects is preferable in our context because the number of time clusters is relatively small (Angrist and Pischke, 2008). Furthermore, the cross-sectional correlation of trades occurring at a given point in time is unlikely to vary once we control for firm characteristics. Under this condition, time fixed effects are equivalent to time-clustered standard errors (Petersen, 2009).

preceding the fire sale or when prices have clearly started to converge to their fundamental value in quarters *t+2* and *t+3*.

Overall, the evidence in Table 2 suggests that closed-end funds take more aggressive positions against mispricing than open-end funds and that their trades may contribute to the price reversals we observe. However, closed-end funds' capital is likely to be too small to correct mispricing in the short-term.

To better characterize the trading of closed-end funds in stocks experiencing fire sales, we explore the extent to which the differences in trading behavior vary with stock characteristics. Since the differences in behavior are most pronounced in the quarter following the fire sale, we focus the empirical analysis on *t+1*.

If the closed-end structure indeed helps to overcome limits to arbitrage, we would expect the differences between closed- and open-end funds to be more pronounced for stocks with higher arbitrage risk. For instance, small firms are known to attract more individual investors and thus are arguably more subject to noise trader risk. Theory suggests that financial institutions that are more subject to redemption risk, such as open-end funds, should be particularly reluctant to trade against mispricing in these stocks. This is precisely what we find in column 1 of Table 3. Similarly, stocks with higher return volatility involve riskier arbitrage (e.g., Pontiff, 2006). Consistently with our interpretation of the previous finding, closed-end funds purchase fire sale stocks with high return volatility to a larger extent than open-end funds (column 2).

Previous literature highlights the propensity of closed-end funds to invest in illiquid assets. Our finding that the trading behavior of closed-end funds differs from the trading of open-end funds only in the fire sale quarter and the following already indicates that it is unlikely that closed-end funds trade these stocks to a larger extent simply because they are more illiquid. We confirm this interpretation in column 3 where we show that closed-end

funds' trading in fire sale stocks is unrelated to the stocks' liquidity, measured using the price impact ratio of Amihud (2002). Other firm characteristics, such as the book-to-market ratio or the firm's cumulative return over the previous six months, are also unrelated to the trades of closed-end funds in the quarter following a fire sale.

Overall, the results in Table 3 establish that differences in trading behavior between closed- and open-end funds are particularly strong for stocks with higher arbitrage risk, as predicted by Shleifer and Vishny (1997). The differences in trading behavior seem however unrelated to other firm characteristics (such as momentum and illiquidity), suggesting that our findings are not driven by differences in investment styles.

Table 4 explores how the difference between closed- and open-end funds' propensity to purchase stocks subject to fire sales vary with fund characteristics. One concern is that even though we exclude open-end funds that experienced extreme outflows, the sample may still include some open-end funds that have experienced large outflows and that are financially constrained. To assess this possibility, we repeat our analysis excluding open-end funds with past flows in the bottom quartile of our sample and include past flows as a control variable. Column 1 shows that open-end funds with large outflows do not drive our findings.

This conclusion is also supported by evidence showing that the differences in trading between open-end and closed-end funds emerge during both good and bad market times. In Table A.3 in the Internet Appendix, we measure market conditions using in turn aggregate (open-end) fund flows, the VIX index capturing aggregate market uncertainty, and a dummy variable capturing the recent financial crisis (which we set equal to one from the third quarter of 2008 to the end of 2009 or alternatively from the third quarter of 2007 to the end of 2009). The higher propensity of closed-end funds to purchase fire sale stocks does not appear to vary with market conditions indicating that the organizational structure of open-end funds and

their different ex ante incentives rather than their outflows and ex post financial constraints drive the differences in behavior we observe.

We further scrutinize the importance of ex ante incentives exploiting the fact that open-end funds may have different exposure to redemption risk. For instance, the flow-performance sensitivity is known to differ across funds for reasons related to the asset managers' reputation and to the fund's customer base. Open-end funds with higher flow-performance sensitivity should be more reluctant to purchase fire sale stocks than other open-end funds. The estimates in column 2 show that this is indeed the case, confirming that ex ante incentives are important.

Open-end funds' strategies are highly heterogeneous and differ greatly in their investment horizons. We expect the trading behavior of open-end funds with short trading horizons to differ most from the trading behavior of closed-end funds. Not only the investment horizon is known to be affected by the flow-performance sensitivity of a fund (Cella, Ellul and Giannetti, 2013), but funds that focus most on short-term performance should be the least likely to undertake long-term arbitrage. In column 3, we measure an open-end fund's investment horizon using its portfolio turnover and find that open-end funds with shorter horizons are particularly reluctant to purchase fire sale stocks.

We also consider that open-end fund managers with longer tenures should have more established reputations. This in turn may translate in a lower sensitivity of flows to performance and lower exposure to redemption risk. As is consistent with this conjecture, in column 4, we find that indeed open-end fund managers purchase more fire sale stocks as their tenure increases.

A possible concern is that the differences in trading behavior between closed- and open-end funds may be related to differences in ability. Higher managerial ability should lead to higher performance. We find no evidence, however, that a fund's past performance, as

measured by the fund's style-adjusted average monthly return during the past year, is associated with larger purchases of stocks that have been subject to fire sales (column 5).

Consistent with this result, we also document that the difference in trading between open- and closed-end funds is unrelated to the closed-end fund discount. Ross (2002) and Berk and Stanton (2012) argue that a closed-end fund discount emerges when the fees charged by the fund are not compensated by the fund manager's ability to generate returns. Ramadorai (2012) provides empirical evidence consistent with this view. If our results were driven by the closed-end fund managers' superior ability to identify fire sales, we should observe that less able fund managers with higher discounts trade against mispricing to a lower extent; however that is not the case (column 6).[12]

This result is relevant also for another reason. Even if closed-end fund managers are not exposed to redemption risk, their willingness to trade against mispricing could be affected by the managerial labor market. The incentives provided by the managerial labor market in turn could make the differences in capital structure we explore less relevant. For instance, an increase in the closed-end funds' discount may lead investor activists to launch campaigns to open the funds (Bradley, Brav, Goldstein and Jiang, 2010). More in general, a higher fund discount has also been related to a higher probability of managerial turnover (Wu, Wemers and Zechner, 2013). Thus, the managers of closed-end funds with high discounts may have a greater focus on short-term performance. The result in column 6, however, indicates that the fund's discount is unrelated to the trading activity of closed-end funds.

Finally, we consider, how other characteristics of closed-end funds may be related to their trading activity. For instance, Tang (2012) argues that closed-end funds could be

[12] In column 6, we use the average discount in the past 12 months. If we use the average discount during the quarter, it appears that funds with higher discounts purchase fire sale stocks to a larger extent, even though the coefficient is not significant at conventional levels. This confirms that differences in ability do not play a role. These results are presented in Table A.4 in the Internet Appendix.

exposed to rollover risk (rather than to redemption risk) because they borrow in the auction rate security market. This could hamper at least some closed-end funds' incentives to trade against mispricing. In column 6, we construct a proxy for the closed-end funds' leverage using Capital IQ. As shown in Table 1, and consistent with Cherkes, Sagi, and Stanton (2008), leverage is low for US domestic equity funds (about 6.8 % on average). Nevertheless, we include an interaction of the closed-end fund dummy with the fund's leverage to evaluate whether funds with higher leverage are less likely to trade against mispricing. We find no evidence that this is the case.

In the same vein, it does not appear that differences in organizational structures capture differences in managerial compensation. Managers with different compensation levels may have different risk taking incentives and this may determine the differences in trading strategy we observe. As is common in the literature (see, for instance, Kacperczyk and Schnabl, 2013), we proxy for compensation using the annual fees. In Table 1, the annual fees appear very similar for closed- and open-end funds and are therefore unlikely to lead to different trading behavior. Nevertheless, in column 8 of Table 4, we evaluate this possibility and show that fees do not have any impact on our findings.

3.3. Fire Purchases

So far we have shown that closed-end funds are more likely to purchase fire sale stocks. Therefore, they trade in a way that corrects undervaluation. It is interesting to know if similar differences emerge also when fire purchases occur. We do not necessarily expect the effects to be symmetric because the correction of overvaluation typically involves short sales. Not only we do not observe this information, but even more crucially open- and closed-end funds are subject to regulatory restrictions that limit their ability to short stocks. However,

we could still observe that open- and closed-end funds reduce their positions in stocks that experience positive price pressure due to large mutual fund inflows.

Closed-end funds could be more inclined to sell than open-end funds because of the uncertainty on the timing of the reversals. Since current fund flows are correlated with future fund flows, stocks subject to fire purchases could still experience flow-driven buying pressure in the near future and short-term price appreciations (Lou, 2012). In order to boost their short-term performance and net flows, open-end funds may want to purchase rather than sell stocks that are likely to experience short-term price appreciations.

Table 5 shows that closed-end funds reduce their positions in fire purchase stocks to a larger extent than open-end funds (which have not been subject to large inflows). The effects however are smaller than the ones we observe for fire sales confirming that short-sale constraints limit mutual funds ability to trade against overvaluation.

In unreported results, we find no evidence that the magnitude of this effect varies across stocks with different characteristics as for fire sales. This is unsurprising as closed-end funds can only sell stocks that they already own and these may not be the stocks that are more difficult to arbitrage.

4. Evidence from Funds' Returns

4.1. Methodology

The analysis of the funds' trades provides direct evidence on the role of investors' capital structure and their willingness to trade against mispricing. However, our holdings data span a relatively short sample period (from 2005 to 2010). To extend the sample period and to broaden the analysis to other sources of mispricing, in this section, we investigate closed- and open-end funds' exposure to mispriced stocks. Similarly in spirit to Sharpe (1992), Brown, Goetzmann, and Park (2000), Brunnermeier and Nagel (2004), and Sialm, Sun and

Zheng (2014), we regress fund returns on the returns of mispriced stocks' factor portfolios and infer the funds' exposure using the portfolio loadings. Thus, we only need data on fund returns, which are available starting from 1990.

Using this methodology, we explore whether closed-end funds increase their exposure to stocks that are undervalued due to negative sentiment shocks. To this end, we follow Baker and Wurgler (2006) who conjecture that changes in investor sentiment, arguably related to uninformed investors' demand for stocks, should have larger effects on stocks whose valuations are highly subjective and difficult to arbitrage, such as young, highly volatile, small, unprofitable, distressed, high R&D and non-dividend paying stocks. Consistent with this prediction, Baker and Wurgler find that when beginning-of-period proxies for sentiment are low, these stocks earn particularly high abnormal returns in subsequent periods. For instance, following periods of negative sentiment, the abnormal monthly returns average 2.37% for stocks in the bottom decile of size, while stocks in the top decile only earn about 0.92%.

In what follows, we test whether closed-end funds' portfolios are more exposed to "sentiment-prone" stocks in periods of negative sentiment. We construct factor portfolios based on these stock characteristics, and regress fund returns on the returns of factor portfolios to assess portfolio exposure. As shown by Brunnermeier and Nagel (2004), each fund's return can be written as the weighted average of the returns on a few asset classes plus some idiosyncratic return. Given the focus of our analysis, we consider each class of stocks prone to sentiment (s) in turn and the market return. Each fund's return ($R_{f,t}$) can thus be written as:

$$R_{f,t} = (b - g)R_{m,t} + gR_{s,t} + \epsilon_{f,t},$$

where $R_{s,t}$ is the return of a portfolio of sentiment-prone stocks and $R_{m,t}$ is the market return. Following Baker and Wurgler (2006), we use equally-weighted portfolio returns of sentiment-prone stocks. A larger g implies that a fund's holdings are more tilted towards sentiment-prone stocks.

We are interested in testing for systematic differences between closed- and open-end funds. Specifically, we expect any differences to vary with market sentiment: closed-end funds should hold portfolios relatively more exposed to sentiment-prone stocks in times of low investor sentiment when these stocks are underpriced. To capture this, we estimate the following equation:

$$R_{f,t} = (b - g_0)R_{m,t} + \left(b - g_1\right)Closed_f \; x \; R_{m,t} +$$

$$g_0 \; R_{s,t} + g_1 \; Closed_{\;f} \; x \; Neg \; Sent_t \; x \; R_{s,t} \; + \mathbf{\Gamma X} + \varepsilon_{f,t},$$

where $Neg\ Sent$ is a dummy that takes value equal to 1 when the sentiment index (defined using the indicators of sentiment orthogonalized to macro-economic conditions of Baker and Wurgler (2006)) is negative;[13] *Closed* is a dummy identifying closed-end funds; and **X** is a matrix of controls that includes the lower-order interaction terms. We allow the exposure of closed- and open-end funds to the market portfolio to vary.[14] We expect that $g_1 > 0$ if closed-end funds are more inclined to purchase undervalued stocks during periods of negative sentiment than open-end funds. Since closed- and open-end funds may have different investment styles, as discussed in Section 2, we consider only funds specialized in domestic equity.

[13] Baker and Wurgler (2006) define sentiment as the first principal component of six different proxies orthogonalized to several macro variables. The sentiment proxies include trading volume as measured by NYSE turnover, the dividend premium, the average closed-end fund discount, the number and first-day returns on IPOs, and the equity share in new issues. Baker and Wurgler (2006) show that the index captures historical accounts of bubbles and crashes.

[14] In robustness tests, we also allow the differences in exposure to the market portfolio to be different in periods of positive and negative sentiment. The results reported in Table A.5 of the Internet Appendix are similar.

4.2. Results

Table 6 relates funds' monthly returns to the monthly returns of portfolios of stocks that are underpriced during periods of negative sentiment. Since the sign of mispricing depends on the prevailing sentiment (stocks are underpriced in times of negative sentiment), we focus on differences between open- and closed-end funds during periods of negative sentiment.

It is evident that during periods of negative sentiment closed-end funds are more exposed to portfolios of underpriced stocks. The differences are not only statistically but also economically significant. For instance, column 1 shows that closed-end funds typically overweigh small stocks in comparison to their weight in the market portfolio (the coefficient of *Portfolio* x *Closed* is positive). However, the rate at which closed-end funds overweigh small stocks increases from approximately 7% in periods of positive sentiment to 17% in periods of negative sentiment.[15] The extent to which closed-end funds overweigh other portfolios of underpriced stocks during periods of negative sentiment is remarkably similar.[16]

In Table 7, we present the results from a number of robustness checks.[17] In column 1, we allow closed- and open-end funds to differ in their exposure to liquidity risk. Our results, if anything, become stronger once we control for different exposure to the Pastor and Stambaugh's (2003) liquidity factor. In column 2, we allow for differences in exposure to the momentum factor. Consistent with Table 1, open-end funds hold portfolios that are more

[15] To obtain these magnitudes we proceed as follows. As shown by Brunnemeier and Nagel (2004), the weight of a given portfolio can be inferred from the estimates in Table 6 using the following formula: $w_p\left(1+\frac{g}{b}\right)$, where b-g is the fund's exposure to the market portfolio and g is the exposure to the portfolio of stocks in consideration. In column 1, for closed-end funds, b is the sum of the coefficients of mktrf and mktrf x closed; g is the coefficient of closed x portfolio during periods of high sentiment and the sum of the latter and the coefficient of closed x portfolio x sent in periods of negative sentiment. In the text, we report the percentage to which a fund overweigh the portfolio relative to the market benchmark, which is $\frac{g}{b}$.

[16] The finding that closed-end funds over-weigh small stocks also during periods of strong market sentiment may depend on the fact that small stocks are more likely to be illiquid and closed-end funds are known to over-weigh illiquid assets.

[17] For expositional purposes, we only present the results for small stocks. Results for the other sentiment-prone stocks are similarly robust and are presented in Table A.5 of the Internet Appendix.

heavily invested in momentum stocks; yet including this control has no bearing for our results in Table 6. In column 3, we also allow the exposure to the market portfolio to vary in periods of high and low sentiment, but we find no statistically significant differences. Overall, it seems unlikely that open- and closed-end funds' exposure to different factors can explain our findings.

Finally, one might be concerned that the sentiment index is the first principal component of six sentiment proxies including the closed-end fund discount. This is unlikely to play an important role in our analysis because closed-end funds' trading behavior in fire sale stocks appears to be unrelated to the funds' discount in Table 4. Nevertheless, to show that our results are unrelated to the dynamics of the closed-end fund discount, we compute an alternative measure of sentiment, which is defined as the first principal component of all proxies in Baker and Wurgler (2006) except the discount. We repeat our analysis using the alternative index. Our results in column 4 are unaffected.

5. Evidence from Hedge Funds

5.1. Data Sources

Hedge funds may provide an independent test for the relevance of redemption risk on asset managers' propensity to trade against mispricing. They are exempt from the regulation that constrain closed- and open-end funds and are believed to attract the most sophisticated asset managers. As Brunnemeier and Nagel (2004) point out, since they face steeper incentive structures and are able to go short, hedge funds are probably closer to the ideal of "rational arbitrageurs" than any other class of investors. Therefore, they may be able to trade against mispricing even in the presence of redemption risk.

Upon inception, hedge funds may choose to have share restrictions, which limit their investors' ability to withdraw their capital. In this section, we ask whether share restrictions

make an important difference in incentivizing hedge fund managers to take long-term risky arbitrage opportunities.

We obtain information on hedge funds' characteristics including returns, assets under management and share restrictions from Lipper Tass, CISDIM/Morningstar, and Hedge Fund Research. As Agarwal, Fos and Jiang (2013) describe, these three commercial datasets provide information on largely different subsets of hedge funds.[18] However, they do not provide information on the hedge funds' stock holdings, which is essential for some of our tests.

We obtain hedge funds' stockholdings from Thomson Financial 13F. Since Thomson Financial 13F and the hedge funds' databases provide no common identifiers that allow us to match the hedge funds to their management companies, we obtain the match between hedge funds' commercial databases and 13F quarterly ownership information from Agarwal, Jiang, Tang and Yang (2013) and Agarwal, Fos and Jiang (2013). As detailed in these papers, the match includes only management companies that are relatively "pure-play" hedge funds, and does not include full-service banks whose investment arms engage in hedge fund business. We focus on the post-1994 period to mitigate potential survivorship bias, as most of the databases start reporting information on "defunct" funds only after 1994.

Share restrictions consist of redemption notice period, payout period and lock up periods. The lockup period represents the minimum number of days an investor must commit the capital. At the end of the lockup period, an investor who wishes to withdraw her capital needs to give advance notice (redemption notice period) and then has to wait some additional time to receive the money (payout period). Panel 8 summarizes the duration of each type of share restrictions. We approximate the payout period assuming that fund investors have uniformly distributed liquidity shocks. Thus, on average an investor will have to wait 45 days

[18] We search fund names and exclude any funds that appear in more than one of the datasets.

before being able to redeem her capital if the hedge fund has a quarterly (90 days) payout period.

Following Agarwal, Daniel, and Naik (2009), we measure share restrictions by adding up the number of days of the lock up period, of the advance notice period, and of the redemption period. There is large variation in the extent of share restrictions: For instance, Panel A of Table 8 shows that the combined number of days associated with share restrictions is 60 days for the bottom quartile and over 300 days for the upper quartile. In what follows, we define funds with share restrictions above the sample median as funds high restrictions, and explore whether the differences in behavior between them and the remaining hedge funds are similar to the differences between open- and closed-end funds.[19]

5.2. Fire Sales

We compare the trading behavior of hedge funds with high and low share restrictions. We focus on fire sales and neglect fire purchases because we observe only long positions. Since hedge funds are able to short-sell, they would presumably short-sell fire purchase stocks in order to trade against mispricing.

We identify a total of 1,157 management companies that can be considered pure-play hedge funds and that trade around fire sales. On average, hedge funds with high share restrictions purchase 0.28% of the outstanding shares, significantly more than other hedge funds, which only purchase 0.15% of the outstanding shares. Although hedge funds with low share restrictions, differently from unconstrained open-end funds, purchase rather than selling fire sale stocks, a lower exposure to redemption risk appears to be associated with stronger incentives to trade against mispricing also in hedge fund industry.

[19] The specific metric we use does not affect our findings. The results are qualitatively invariant if we measure fund share restrictions using a continuous variable as shown in Table A.6 of the Internet Appendix.

Table 9 shows that hedge funds with high share restrictions purchase more fire sale stocks in the quarter of the fire sale (quarter *t*) in comparison to other hedge funds. The net purchases of a hedge fund with high share restrictions increase by over a quarter of a standard deviation. No differences in trading related to the intensity of share restrictions emerge in other quarters.[20]

Furthermore, the cross-sectional effects are fully consistent with our earlier findings on closed-end funds: Hedge funds with higher share restrictions buy fire sale stocks of small firms and of firms with higher volatility to a larger extent than other hedge funds. As noted before, these are precisely the stocks that are riskier to arbitrage in the short-term. This evidence supports the hypothesis that redemption risk affects asset managers' willingness to trade against mispricing.

A few interesting differences emerge from our earlier findings on closed-end funds. First, the difference in trading behavior between closed- and open-end funds is larger than for hedge funds with different intensity of share restrictions. The closed-end fund structure may insulate asset managers from redemption risk to a larger extent than share restrictions. However, all hedge funds, including hedge funds with low share restrictions, appear more inclined to purchase fire sale stocks. This may also contribute to attenuate the differences between hedge funds.

Second, hedge funds appear to buy fire sale stocks more readily than closed-end funds. While closed-end funds' purchases are largest in the quarter following the fire sale *(t+1)*, hedge funds with high share restrictions purchase more in the fire sale quarter *(t)*. This is consistent with the view that hedge funds attract more sophisticated asset managers who may be able to identify mispricing more readily than other institutional investors.

[20] Results are similar if we include further controls for hedge fund characteristics, as we do in Table A.7 of the Internet Appendix.

5.3. Funds' Returns

In this section, we test whether hedge funds with high share restrictions hold portfolios that are more exposed to undervalued stocks during periods of negative sentiment. We conduct the same test that we perform for closed- and open-end funds in Section 4.

In these tests, since we explore funds' exposures to different portfolios of US equities, we focus on 3,400 hedge funds that are specialized in US equity.[21] The estimates in Table 10 are in line with our earlier findings. Hedge funds with high share restrictions overweigh sentiment-prone stocks in times of negative sentiment, that is, when they are undervalued. For instance, we find that hedge funds with high share restrictions overweigh small stocks during periods of negative sentiment by about 11% in comparison to hedge funds with low share restrictions (column 1). We observe the same pattern for the other sentiment-prone stocks (columns 2 to 9). Similarly to what we find for fire sales, the differences in exposure between the two groups of hedge funds are smaller than for open- and closed-end funds (a 11% difference for hedge funds vs a 17% difference for open- and closed-end funds).

Table 11 presents a number of robustness checks.[22] The estimates in column 1 show that results are unaffected if we allow hedge funds to differ in their exposure to liquidity risk (Sadka, 2010). Funds with high share restrictions have higher exposure to the liquidity factor, consistent with our conjecture that they are less concerned about redemptions. In the same vein, our results remain robust if we allow hedge funds with different intensity of share restrictions to have differential exposure to the momentum factor (columns 2). Interestingly, hedge funds with high share restrictions are less exposed to the momentum factor. Thus,

[21] In particular, we select hedge funds with the following styles: long/short equity and multi-strategy hedge funds from Lipper Tass; equity hedge funds, excluding the ones specialized on a particular sector from HFR; and long/short equity, equity market neutral long-only equity hedge funds from CISDM.

[22] For brevity, Table 11 presents the robustness for small stocks. Table A.8 of the Internet Appendix presents the robustness for all remaining sentiment-prone stock portfolios.

consistently with our earlier evidence on closed- and open-end funds, exposure to redemption risk increases fund managers' focus on short-term returns.

Results are equally invariant if we allow the exposure to the market portfolio to vary in periods of high and low sentiment (column 3) and control for the Fung and Hsieh (2004) factor exposures (column 4).

6. Conclusions

This paper provides the first direct evidence that redemption risk weakens managerial incentives to trade against mispricing, as conjectured by Shleifer and Vishny (1997). More specifically, we show that asset managers that are less subject to redemption risk (e.g., closed-end funds and hedge funds with high share restrictions) are more likely to buy stocks that are underpriced due to fire sales or negative sentiment shocks.

To this extent, our paper contributes to the debate on the organization of the asset management industry. Open- and closed-end fund structures involve costs and benefits. Fama and Jensen (1983) argue that open-ending might be an optimal response to agency problems. If a fund is set up on a closed-end basis, dispersed investors have no recourse in the face of managerial misbehavior, and may see their entire investment slowly eaten away. Because of competition, however, too many asset managers may choose an open-end structure and too little capital may be available for long-term arbitrage (Stein, 2005).

This paper highlights one benefit of the closed-end fund structure (and share restrictions) on the asset managers' propensity to trade against mispricing. While our analysis is silent about the potential costs of closed-end fund structures, in a recent paper, Wu, Wermers and Zechner (2013) suggest that managerial career concerns and the labor market may provide discipline to closed-end fund managers. This would suggest that more share

restrictions and close-end structures might be optimal. We leave these questions for future research.

Our findings also suggest a new interpretation for the closed-end fund discount, which could rationalize why funds with a higher discount have higher subsequent returns (Pontiff, 1995). This relation could arise from the closed-end funds' propensity to hold stocks that are unpopular among retail investors. Solomon, Soltes and Sosyura (2013) argue that the demand for open-end funds that hold popular stocks is high even if popular stocks are unrelated to future fund performance. Higher demand translates in inflows for open-end funds, but it can only affect the share price and generates a premium (or a discount when demand is low) in closed-end funds because shares are not redeemable. Changes in investor demand, driven by fund managers' holdings of unpopular stocks, may thus generate a discount. We believe that this is an exciting area for future research.

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Appendix
Variable Definitions

Fund-level Characteristics

Closed	A dummy variable that is equal to 1 for closed-end funds
Open	A dummy variable that is equal to 1 for open-end funds
Share Restrictions	Sum of the days of the lock up period, redemption notice period and payout period, divided by 100; for hedge funds without lock up period, redemption notice period and payout period it is set to zero
High Restrictions	A dummy variable that takes a value equal to 1 if the fund has share restrictions above sample median; set to zero otherwise
Lock up period	Minimum time an investor has to wait for a withdrawal after making his investment
Redemption notice period	Advance notice an investor has to give to the fund before being able to withdraw
Payout period	Time that fund takes to return the capital after the notice period is over
Log TNA	Natural logarithm of TNA as of quarter-end
Flow	Monthly change in TNA less the total returns over the month divided by TNA in the previous month; winsorized at 2.5%
FPS	A fund's flow-performance sensitivity, estimated regressing the fund's monthly net flows on its past 12 month average monthly returns using a 24 month rolling window; winsorized at 2.5%
Past Perf	The fund's 12 month style-adjusted cumulative return; for closed-end funds it is computed as the NAV appreciation
Discount	Average of closed-end discount, (NAV-share price)/NAV in the past 12 months; winsorized at 1%
Annual Fees	The fund's annual expense ratio
Churn Ratio	The average of the portfolio turnover of a fund in the past 4 quarters where the portfolio turnover is defined as the minimum of the absolute values of buys and sells of a fund in a given quarter, divided by the total holdings at the end of previous quarter
Leverage	Closed-end funds' total debt divided by total assets, obtained from Capital IQ, available at annual frequency, populated for the entire year
Past Flows	Average monthly fund flows in the past 12 months, as a proportion of TNA at the beginning of the period
Tenure	Natural logarithm of manager's tenure measured in years; available only for open-end funds
Incentive Fee	Annual incentive fees, if it applies
High-water mark	A dummy variable that is equal to 1 if a fund imposes a high watermark
Min Inv	Minimum investment required (in thousand $)
Leveraged	A dummy variable that is equal to 1 if a fund uses leverage

Stock-level Characteristics

VOL	Standard deviation of monthly returns, calculated over a 2-year window (in %)
ILLIQ	A proxy for illiquidity, computed following Amihud (2002), as the average ratio of the absolute value of daily returns to the stock daily volume in a given quarter; winsorized at 1%
Size	Market capitalization at the quarter-end (in millions)
BM	Ratio of the latest book value from annual statements to the latest market value in a given quarter
MOM	Cumulative monthly returns in the past six months
$\Delta shares(t-k)_{f,i,s}$	The change in number of shares held by fund f in stock i from previous quarter-end as a fraction of stock i's total shares outstanding at the end of the previous quarter, scaled by standard deviation (in %). It varies across firms and funds in a given quarter.

Characteristics-Based Portfolios

Market Equity	Price times shares outstanding as of June of year *t*
Small	A dummy variable that is equal to 1 if market equity is in the bottom decile defined based on NYSE breakpoints
Age	Number of years since the firm's first appearance on CRSP, measured to the nearest month, in June of year *t*
Young	A dummy variable that is equal to 1 if the firm's age is in the bottom decile defined based on NYSE breakpoints
Vol	Standard deviation of monthly returns over the 12 months ending in June of year *t*
High Vol	A dummy variable that is equal to 1 if Vol is in the top decile defined based on NYSE breakpoints
ROE	E+/BE, where E+ is income before extraordinary items (Item 18) plus income statement deferred taxes (Item 50) minus preferred dividends (Item 19) when it is positive and BE is Book Equity; both measured in fiscal year-end in calendar year *t – 1*
BE	Book value of equity at the fiscal year-end of calendar year *t – 1*
Nonprofitable	A dummy variable that is equal to 1 if E<=0, where E is income before extraordinary items (Item 18) plus income statement deferred taxes (Item 50) minus preferred dividends (Item 19)
BM	Book value of equity at the fiscal year-end of calendar year *t – 1* divided by market equity
Low BM	A dummy variable that is equal to 1 if BM is in the bottom decile defined based on NYSE breakpoints
D/BE	Dividends per share at the ex date (Item 26) times Compustat shares outstanding (Item 25) divided by book equity at the fiscal year-end of calendar year *t – 1*

Nonpayer	A dummy variable that is equal to 1 if the company does not pay out dividends
RD	Research and development expenditures (Item 46) over total assets at the fiscal year-end of calendar year *t – 1*
High R&D	A dummy variable that is equal to 1 if research and development expenditures, scaled by the firm's total assets, are in the top decile defined based on NYSE breakpoints
External Finance	Change in assets (Item 6) minus the change in retained earnings (Item 36) divided by total assets at the fiscal year-end of calendar year *t – 1*
High External Finance	A dummy variable that is equal to 1 if External Finance is in the top decile defined based on NYSE breakpoints
Sales Growth	The change in net sales (Item 12) divided by prior-year net sales at the fiscal year-end of calendar year *t – 1*
Low Sales	A dummy variable that is equal to 1 if Sales Growth is in the bottom decile defined based on NYSE breakpoints

Table 1
Descriptive Statistics: Open-end versus Closed-end Funds

Panel A describes the main characteristics of the closed- and open-end funds in the holding sample. The unit of observation is the fund quarter. Panel B compares the characteristics of the stocks held by open- and closed-end funds, respectively, in the holdings sample. The unit of observation is the fund stock quarter. All variables are defined in the Appendix.

A. Holdings: Fund Characteristics

Fund	N	Variable	Mean	Median	Std Dev
Open	17,493	Log TNA	5.4339	5.6556	1.3921
		Fees	0.0132	0.0125	0.0049
		Past Perf	0.0010	-0.0037	0.0799
		Past Flows	-0.0506	-0.0848	0.2095
		FPS	0.2454	0.1309	0.8111
		Churn Ratio	0.8472	0.6800	0.6853
		Tenure	1.8616	1.9459	0.8300
Closed	4,500	Log TNA	5.6407	5.6657	1.2079
		Fees	0.0136	0.0123	0.0057
		Past Perf	0.0044	-0.0036	0.1608
		Discount	0.0581	0.0737	0.0923
		Leverage	0.0686	0.0000	0.1120

B. Holdings: Stock Characteristics

Fund	N	Variable	Mean	Median	Std Dev
Open	2,081,698	MOM	0.0813	0.0559	0.4024
		Size	8.3588	8.2214	1.8051
		VOL	10.2908	8.9442	6.1638
		ILLIQ	0.0513	0.0004	1.8602
		BM	0.6965	0.4391	4.1375
Closed	220,026	MOM	0.0539	0.0368	0.3358
		Size	9.0699	9.1692	1.7975
		VOL	9.9054	8.5569	5.8256
		ILLIQ	0.1647	0.0001	3.7025
		BM	1.0439	0.5133	5.8344

Table 2
Closed-End Funds' Trades and Fire Sales

We compare the change in holdings of closed- and open-end funds around episodes of fire sales. Quarter t is the quarter of the fire sale identified as in Coval and Stafford (2007). The dependent variable is a fund's change in quarterly holdings ($\Delta shares(t-k)_{f,i,s}$) in the quarters preceding, during or following the fire sale, as indicated on top of each column, divided by the firm's number of shares outstanding at the beginning of the quarter. We divide $\Delta shares(t-k)_{f,i,s}$ by the standard deviation of all $\Delta shares(t-k)_{f,i,s}$ of closed- and open-end funds during the sample period. All remaining variables are defined in the Appendix. All equations include time fixed effects and a constant whose coefficients are not reported. We present ordinary least squares estimates with errors clustered at the fund level and corrected for heteroskedasticity. ***, **, * denote significance at 1%, 5%, and 10% levels, respectively.

	(1) Δ Shares (t-2)	(2) Δ Shares (t-1)	(3) Δ Shares (t)	(4) Δ Shares (t+1)	(5) Δ Shares (t+2)	(6) Δ Shares (t+3)
Closed	-0.3891	-0.3166	0.1089*	0.4041**	0.1888	0.0584
	(0.348)	(0.253)	(0.058)	(0.176)	(0.229)	(0.286)
Size	-0.5439***	-0.4650***	-0.0384**	0.3003***	0.4310***	0.3025***
	(0.073)	(0.065)	(0.015)	(0.061)	(0.082)	(0.056)
VOL	0.1127***	0.0705***	-0.0057	-0.0732***	-0.0813***	-0.0389**
	(0.021)	(0.019)	(0.004)	(0.022)	(0.029)	(0.015)
ILLIQ	-0.0735	0.0273	0.0166	0.1366**	-0.0690	0.1348
	(0.073)	(0.054)	(0.015)	(0.057)	(0.094)	(0.108)
BM	0.0878*	0.0095	-0.0168	-0.0098	-0.0878	0.0055
	(0.048)	(0.073)	(0.012)	(0.039)	(0.088)	(0.023)
MOM	-0.6955	-0.7388**	0.1883*	0.8551***	1.1541**	0.4167
	(0.519)	(0.331)	(0.096)	(0.272)	(0.470)	(0.262)
Log TNA	0.4423***	0.3819***	0.0314*	-0.2121***	-0.2248**	-0.1795***
	(0.099)	(0.078)	(0.016)	(0.080)	(0.091)	(0.062)
N	60,204	77,268	97,786	73,722	56,227	48,296
R-squared	0.009	0.008	0.002	0.004	0.004	0.006

Table 3
Closed-End Funds Trades, Fire Sales, and Firm Characteristics

We compare the change in holdings of closed- and open-end funds around episodes of fire sales in stocks with different characteristics. The dependent variable is a fund's change in quarterly holdings ($\Delta shares(t-k)_{f,i,s}$) in the quarter following the fire sale identified as in Coval and Stafford (2007), divided by the firm's number of shares outstanding at the beginning of the quarter. We divide $\Delta shares(t-k)_{f,i,s}$ by the standard deviation of all $\Delta shares(t-k)_{f,i,s}$ of closed- and open-end funds during the sample period. All remaining variables are defined in the Appendix. All equations include time fixed effects and a constant whose coefficients are not reported. We present ordinary least squares estimates with errors clustered at the fund level and corrected for heteroskedasticity. ***, **, * denote significance at 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
	Δ Shares (t+1)	Δ Shares (t+1)	Δ Shares (t+1)	Δ Shares (t+1)	Δ Shares (t+1)
Closed	2.6188***	-0.3562	0.4165**	0.3552*	0.4167**
	(1.007)	(0.286)	(0.177)	(0.189)	(0.179)
Closed x Size	-0.2777**				
	(0.110)				
Closed x VOL		0.0747***			
		(0.026)			
Closed x ILLIQ			-0.1046		
			(0.069)		
Closed x BM				0.0554	
				(0.063)	
Closed x MOM					-0.3442
					(0.297)
Size	0.3202***	0.2976***	0.3006***	0.3002***	0.3001***
	(0.066)	(0.061)	(0.061)	(0.061)	(0.061)
VOL	-0.0726***	-0.0787***	-0.0732***	-0.0732***	-0.0732***
	(0.022)	(0.023)	(0.022)	(0.022)	(0.022)
ILLIQ	0.1332**	0.1366**	0.1685**	0.1366**	0.1366**
	(0.058)	(0.057)	(0.071)	(0.057)	(0.057)
BM	-0.0113	-0.0100	-0.0100	-0.0173	-0.0101
	(0.039)	(0.039)	(0.039)	(0.044)	(0.039)
MOM	0.8524***	0.8547***	0.8565***	0.8546***	0.8823***
	(0.271)	(0.272)	(0.272)	(0.272)	(0.285)
Log TNA	-0.2126***	-0.2120***	-0.2123***	-0.2119***	-0.2119***
	(0.081)	(0.080)	(0.080)	(0.080)	(0.080)
Observations	73,722	73,722	73,722	73,722	73,722
R-squared	0.004	0.004	0.004	0.004	0.004

Table 4
Fund Cross-Sectional Differences

We compare the change in holdings of closed- and open-end funds around fire sales events. Quarter *t+1* is the quarter following the fire sale identified as in Coval and Stafford (2007). The dependent variable is a fund's change in quarterly holdings ($\Delta shares(t-1)_{f,i,s}$) in divided by the stock's total number of shares outstanding. We divide $\Delta shares(t-k)_{f,i,s}$ by the standard deviation of all $\Delta shares(t-k)_{f,i,s}$ of closed- and open-end funds during the sample period. All remaining variables are defined in the Appendix. All equations include controls for the stock characteristics (Size, VOL, ILLIQ, BM, and MOM), time fixed effects, and a constant whose coefficients are not reported. We present ordinary least squares estimates with errors clustered at the fund level and corrected for heteroskedasticity. ***, **, * denote significance at 1%, 5%, and 10% levels, respectively.

	(1) Δ Holding (t+1)	(2) Δ Holding (t+1)	(3) Δ Holding (t+1)	(4) Δ Holding (t+1)	(5) Δ Holding (t+1)	(6) Δ Holding (t+1)	(7) Δ Holding (t+1)	(8) Δ Holding (t+1)
Open	-0.3735**	-0.3833**	0.0761	-1.0219***				
	(0.179)	(0.175)	(0.216)	(0.321)				
Closed					0.5609***	0.5296**	0.3462*	0.4310**
					(0.165)	(0.200)	(0.185)	(0.175)
Open x Past Flows	0.5988							
	(0.547)							
Open x FPS		-0.1625**						
		(0.083)						
Open x Churn			-0.5192***					
			(0.162)					
Open x Tenure				0.2797**				
				(0.133)				
Open x Past Perf					-0.2052			
					(1.180)			
Closed x Discount						-0.0128		
						(0.949)		
Closed x Leverage							1.7506	
							(1.914)	
Expenses								-24.3631
								(26.034)
Past Perf					1.4135			
					(1.026)			
Log TNA	-0.2233***	-0.2092**	-0.2498***	-0.2940***	-0.2108**	-0.2103***	-0.2120***	-0.2323***
	(0.085)	(0.084)	(0.084)	(0.092)	(0.083)	(0.048)	(0.080)	(0.078)
Stock Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	55,807	72,913	73,242	50,707	72,746	73,141	73,722	73,392
R-squared	0.004	0.004	0.005	0.005	0.004	0.004	0.004	0.004

Table 5
Fire Purchases

We compare the change in holdings of closed-and open-end funds around episodes of fire purchases. Quarter t is the quarter of the fire purchase, identified as in Coval and Stafford (2007). The dependent variable is a fund's change in quarterly holdings ($\Delta shares(t-k)_{f,i,s}$) in the quarters preceding, during or following the fire purchase, as indicated on top of each column, divided by the firm's number of shares outstanding at the beginning of the quarter. We divide $\Delta shares(t-k)_{f,i,s}$ by the standard deviation of all $\Delta shares(t-k)_{f,i,s}$ of closed- and open-end funds during the sample period. All remaining variables are defined in the Appendix. All equations include time fixed effects and a constant whose coefficients are not reported. We present ordinary least squares estimates with errors clustered at the fund level and corrected for heteroskedasticity. ***, **, * denote significance at 1%, 5%, and 10% levels, respectively.

	(1) Δ Shares (t-2)	(2) Δ Shares (t-1)	(3) Δ Shares (t)	(4) Δ Shares (t+1)	(5) Δ Shares (t+2)	(6) Δ Shares (t+3)
Closed	-1.6811	-0.2954	-0.1690***	0.1744	0.2091	0.2621
	(1.024)	(0.199)	(0.049)	(0.171)	(0.159)	(0.169)
Size	-0.9696**	-0.3603***	-0.1428***	0.1974***	0.2864***	0.3391***
	(0.416)	(0.073)	(0.015)	(0.072)	(0.051)	(0.055)
VOL	0.2227**	0.0927**	0.0112***	-0.0753*	-0.0186	-0.0230*
	(0.096)	(0.046)	(0.004)	(0.044)	(0.012)	(0.013)
ILLIQ	-0.0894***	-0.0141	0.0013	-0.0156	-0.0724	-0.0555
	(0.034)	(0.010)	(0.004)	(0.030)	(0.089)	(0.067)
BM	0.2362	0.1018	0.0189***	-0.0596*	-0.0687**	-0.0373
	(0.183)	(0.087)	(0.006)	(0.034)	(0.030)	(0.039)
MOM	-9.4693	-0.4881	0.1514**	0.8234**	0.1885	0.5017**
	(6.680)	(0.343)	(0.070)	(0.359)	(0.246)	(0.249)
Log TNA	0.3000	0.2939***	0.1439***	-0.1623***	-0.2144***	-0.1480***
	(0.292)	(0.053)	(0.018)	(0.055)	(0.047)	(0.051)
N	62,910	80,457	105,895	83,824	65,796	56,867
R-squared	0.001	0.008	0.011	0.003	0.005	0.004

Table 6
Exposures of Closed- and Open-end Funds to Mispriced Stocks

The dependent variable is the monthly return of fund *f*. On top of each column we indicate the portfolio of potentially undervalued stocks we consider in that specification. Portfolios are formed once per year using market equity, age, and volatility at the end of June of year *t*, and accounting data at the fiscal year-end of calendar year *t – 1*. Portfolios are constructed based on NYSE decile breakpoints. Portfolio is the equally weighted monthly return of a given portfolio of stocks. Market is the value-weighted excess market return of all NYSE, AMEX, and NASDAQ stocks, which we obtain from Ken French's website. *Neg Sent* is a dummy variable that takes value equal to 1 during periods of negative sentiment, defined as in Baker and Wurgler (2007). All remaining variables, including the definition of firm characteristics used for the portfolio construction, are defined in the Appendix. We present ordinary least squares estimates with errors clustered at the fund and time levels and corrected for heteroskedasticity. ***, **, * denote significance at 1%, 5%, and 10% levels, respectively.

Portfolio	(1) Small	(2) High Vol	(3) Young	(4) Low BM	(5) High R&D	(6) High External	(7) Low Sales	(8) Nonpayer	(9) Nonprofitable
Portfolio x Neg Sent x Closed	0.0684***	0.0612***	0.1026***	0.0859***	0.0629**	0.0751***	0.0594**	0.0952***	0.0764***
	(0.016)	(0.020)	(0.031)	(0.032)	(0.025)	(0.022)	(0.023)	(0.027)	(0.021)
Portfolio x Closed	0.0465***	-0.0010	0.0022	-0.0497	-0.0278	0.0031	0.0199	0.0019	0.0128
	(0.012)	(0.018)	(0.024)	(0.031)	(0.021)	(0.019)	(0.022)	(0.026)	(0.018)
Portfolio x Neg Sent	0.0326	0.0200	0.0464	0.0867***	0.0351	0.0311	0.0088	0.0398	0.0315
	(0.037)	(0.025)	(0.040)	(0.033)	(0.024)	(0.025)	(0.031)	(0.040)	(0.028)
Portfolio	0.0546	0.0420*	0.0551	0.0702**	0.0521***	0.0408*	0.0644**	0.0786**	0.0438*
	(0.034)	(0.024)	(0.038)	(0.030)	(0.020)	(0.023)	(0.028)	(0.037)	(0.026)
Neg Sent	0.0026*	0.0027*	0.0029*	0.0029*	0.0028*	0.0030*	0.0023	0.0026*	0.0029*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Closed	-0.0076***	-0.0071***	-0.0073***	-0.0071***	-0.0070***	-0.0074***	-0.0073***	-0.0073***	-0.0075***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Market	0.9721***	0.9926***	0.9478***	0.9362***	0.9376***	0.9486***	0.9516***	0.9476***	0.9482***
	(0.017)	(0.021)	(0.019)	(0.018)	(0.019)	(0.018)	(0.017)	(0.017)	(0.018)
Market x Closed	-0.2940***	-0.2722***	-0.3018***	-0.2756***	-0.2818***	-0.2998***	-0.3065***	-0.3005***	-0.3063***
	(0.026)	(0.029)	(0.025)	(0.024)	(0.023)	(0.025)	(0.026)	(0.025)	(0.025)
Constant	0.0018***	0.0022***	0.0023***	0.0025***	0.0018***	0.0021***	0.0020***	0.0018***	0.0021***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
N	272,373	272,373	272,373	272,373	272,373	272,373	272,373	272,373	272,373
R-squared	0.568	0.567	0.567	0.568	0.567	0.567	0.568	0.570	0.568

Table 7
Controlling for Additional Factor Exposures

The dependent variable is the monthly return of fund *f*. Small is the equally weighted monthly return of the portfolio of small stocks. The portfolio is formed once per year using market equity at the end of June of year t and constructed using NYSE decile breakpoints. Stocks with market capitalization below this breakpoint are considered small. Market is the value-weighted excess market return of all NYSE, AMEX, and NASDAQ stocks, which we obtain from Ken French's website. Neg Sent is a dummy variable that takes value equal to 1 during periods of negative sentiment, defined as in Baker and Wurgler (2007). Neg (Alt) Sent is a dummy variable that takes value equal to 1 during periods of negative sentiment, defined as the first principal component of trading volume as measured by NYSE turnover; the dividend premium; the number and first-day returns on IPOs; and the equity share in new issues. Momentum is the return of the momentum portfolio from Ken French's website. All remaining variables are defined in the Appendix. We present ordinary least squares estimates with errors clustered at the fund and time levels and corrected for heteroskedasticity. ***, **, * denote significance at 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
Small x Neg Sent x Closed	0.0767***	0.0525***	0.0481***	
	(0.017)	(0.013)	(0.014)	
Small x Neg (Alt) Sent x Closed				0.0610***
				(0.020)
Small x Closed	0.0426***	0.0394***	0.0410***	0.0446*
	(0.009)	(0.015)	(0.015)	(0.027)
Small x Neg Sent	0.0320	0.0435***	0.0438***	
	(0.037)	(0.005)	(0.005)	
Neg Sent	0.0026*	0.0026***	0.0026***	
	(0.002)	(0.000)	(0.000)	
Small	0.0548	0.0565***	0.0563***	0.0848***
	(0.034)	(0.006)	(0.006)	(0.021)
Closed	-0.0080***	-0.0074***	-0.0080***	-0.0069***
	(0.001)	(0.000)	(0.000)	(0.001)
Market	0.9722***	0.9802***	0.9822***	0.9542***
	(0.017)	(0.007)	(0.009)	(0.019)
Market x Closed	-0.2949***	-0.3120***	-0.3198***	-0.3452***
	(0.026)	(0.026)	(0.031)	(0.031)
PS LIQ	-0.0024	-0.0016	-0.0022	
	(0.017)	(0.002)	(0.002)	
PS LIQ x Closed	0.0513***	0.0524***	0.0537***	
	(0.018)	(0.010)	(0.009)	
Mom		0.0273***	0.0271***	
		(0.005)	(0.004)	
Mom x Closed		-0.0578***	-0.0569***	
		(0.012)	(0.012)	
Small x Neg (Alt) Sent				-0.0408
				(0.039)
Neg (Alt) Sent				0.0001**
				(0.000)
Market x Neg Sent			-0.0049	
			(0.006)	
Market x Neg Sent x Closed			0.0143	
			(0.022)	
Neg Sent x Closed			0.0012**	
			(0.001)	
Constant	0.0019***	0.0015***	0.0016***	0.0009
	(0.001)	(0.000)	(0.000)	(0.001)
Observations	272,373	272,373	272,373	272,373
R-squared	0.568	0.569	0.569	0.532

Table 8
Descriptive Statistics: High and Low Redemption Restrictions Hedge Funds

Panel A provides the duration in days of different types of share restrictions for the hedge funds in the holding sample. Panel B describes the characteristics of the stocks held by hedge funds with share restrictions above and below the median in the holding sample. Panel C describes the characteristics of the funds with share restrictions above and below the median in the holding sample. All variables are defined in the Appendix.

Panel A: Share Restrictions

Variable	25th Pctl	Mean	Median	75th Pctl	Std Dev
Redemption notice period	30	43.8320	37.5	60	24.0942
Payout period	15	46.5878	30.4167	67.5	42.1577
Lockup period	0	120.5533	12.0000	194.0000	174.6018
Share Restrictions	60	197.94	120	308.50	190.96

Panel B: Stock Characteristics

Restrictions	**< Median**			**Median>**		
Variable	Mean	Median	Std	Mean	Median	Std
MOM	0.1178	0.0657	0.4993	0.1081	0.0621	0.4966
Size	7.4885	7.4329	2.0117	7.5379	7.4707	2.0118
VOL	12.4975	10.4155	8.1664	12.6312	10.5091	8.3067
ILLIQ	0.3019	0.0014	4.3424	0.2844	0.0012	4.1760
BM	0.6939	0.4073	1.3503	0.6625	0.3926	1.2701

Panel C: Fund Characteristics

Restrictions	**< Median**			**Median>**		
Variable	Mean	Median	Std	Mean	Median	Std
Log TNA	15.1352	16.1257	3.6609	14.4820	14.2660	3.4527
Annual Fees	0.0138	0.0125	0.0051	0.0137	0.0150	0.0042
Incentive Fee	0.1796	0.2000	0.0533	0.1914	0.2000	0.0313
High-water mark	0.7832	1.0000	0.3386	0.8970	1.0000	0.2550
Leveraged	0.5802	0.6364	0.4372	0.6352	0.8000	0.4135
Min Inv	1,546,350	1,000,000	2,939,394	1,492,286	1,000,000	1,573,602

Table 9
Hedge Funds and Fire Sales

We explore how the change in holdings of hedge funds varies around episodes of fire sales depending on the redemption risk faced by the hedge fund. High Restrictions is a dummy variable that is equal to 1 if the fund has share restrictions above sample median; share restrictions is the sum of the number of days in the lock up, redemption notice and payout periods, divided by 100. Quarter t is the quarter of the fire sale identified as in Coval and Stafford (2007). The dependent variable is a fund's change in quarterly holdings ($\Delta shares(t-k)_{f,i,s}$) in the quarters preceding, during or following the fire sale, as indicated on top of each column, divided by the firm's number of share outstanding at the beginning of the quarter. We divide $\Delta shares(t-k)_{f,i,s}$ by the standard deviation of all $\Delta shares(t-k)_{f,i,s}$ of hedge funds during the sample period. All remaining variables are defined in the Appendix. All equations include time fixed effects and a constant whose coefficients are not reported. We present ordinary least squares estimates with errors clustered at the fund level and corrected for heteroskedasticity. ***, **, * denote significance at 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Δ Shares (t-2)	Δ Shares (t-1)	Δ Shares (t)	Δ Shares (t+1)	Δ Shares (t+2)	Δ Shares (t)	Δ Shares (t)
High Restrictions	0.0492	0.1283	0.2781***	-0.1466	-0.5034	0.9292***	-0.0491
	(0.048)	(0.078)	(0.099)	(0.116)	(0.391)	(0.329)	(0.101)
High Restrictions x Size						-0.0896***	
						(0.034)	
High Restrictions x VOL							0.0274***
							(0.009)
Size	-0.1056***	-0.1801***	-0.2447***	0.1080**	0.3452***	-0.1878***	-0.2429***
	(0.007)	(0.011)	(0.018)	(0.049)	(0.132)	(0.027)	(0.018)
VOL	0.0098***	0.0142***	0.0225***	-0.0344***	-0.0236*	0.0222***	0.0050
	(0.002)	(0.002)	(0.003)	(0.005)	(0.013)	(0.003)	(0.006)
ILLIQ	-0.0099**	-0.0191***	-0.0228***	0.0192*	-0.0070	-0.0215***	-0.0228***
	(0.005)	(0.004)	(0.006)	(0.010)	(0.029)	(0.007)	(0.006)
BM	0.0047*	-0.0033	0.0008	0.0112	-0.0210	0.0010	0.0009
	(0.003)	(0.004)	(0.005)	(0.010)	(0.016)	(0.005)	(0.005)
MOM	0.0147	0.1158	0.0299	-0.0376	1.4610**	0.0294	0.0299
	(0.046)	(0.095)	(0.048)	(0.159)	(0.638)	(0.048)	(0.048)
Log TNA	0.0091	0.0190	0.0328***	0.0225	-0.0222	0.0346***	0.0326***
	(0.007)	(0.012)	(0.013)	(0.015)	(0.045)	(0.013)	(0.012)
Observations	45,463	52,564	70,868	68,704	51,996	70,868	70,868
R-squared	0.060	0.058	0.052	0.010	0.004	0.052	0.053

Table 10
Exposures of Hedge Funds to Mispriced Stocks

The dependent variable is the monthly return of hedge fund *f*. On top of each column we indicate the portfolio of potentially undervalued stocks we consider in that specification. Portfolios are formed once per year using market equity, age, and volatility at the end of June of year *t*, and accounting data at the fiscal year-end of calendar year *t – 1*. Portfolios are constructed based on NYSE decile breakpoints. Portfolio is the equally weighted monthly return of a given portfolio of stocks. Market is the value-weighted excess market return of all NYSE, AMEX, and NASDAQ stocks, which we obtain from Ken French's website. *Neg Sent* is a dummy variable that takes value equal to 1 during periods of negative sentiment, defined as in Baker and Wurgler (2007). *High Restrictions* is a dummy variable that is equal to 1 for hedge funds with Share Restrictions above the sample median. All remaining variables, including the definition of firm characteristics used for the portfolio construction, are defined in the Appendix. We present ordinary least squares estimates with errors clustered at the fund and time levels and corrected for heteroskedasticity. ***, **, * denote significance at 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Portfolio	Small	High Vol	Young	Low BM	High R&D	High External	Low Sales	Nonpayer	Nonprofitable
Portfolio x Neg Sent x High Restrictions	0.0497*	0.0520**	0.0609**	0.0801**	0.0646***	0.0577***	0.0538*	0.0660**	0.0565**
	(0.026)	(0.022)	(0.026)	(0.031)	(0.022)	(0.022)	(0.028)	(0.030)	(0.024)
Portfolio x High Restrictions	0.0064	-0.0162	-0.0042	-0.0386	-0.0310	-0.0187	-0.0117	-0.0048	-0.0140
	(0.024)	(0.021)	(0.023)	(0.029)	(0.021)	(0.021)	(0.026)	(0.027)	(0.021)
Portfolio x Neg Sent	-0.0731	-0.0807**	-0.0570	-0.0205	-0.0741**	-0.0642	-0.1250***	-0.0938	-0.0719*
	(0.057)	(0.039)	(0.054)	(0.050)	(0.037)	(0.039)	(0.047)	(0.059)	(0.044)
Portfolio	0.1453***	0.1204***	0.1207**	0.1672***	0.1330***	0.1194***	0.1637***	0.1688***	0.1237***
	(0.050)	(0.039)	(0.051)	(0.049)	(0.032)	(0.038)	(0.045)	(0.056)	(0.042)
Neg Sent	0.0016	0.0022	0.0028*	0.0032*	0.0022	0.0028	0.0013	0.0017	0.0026
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
High Restrictions	-0.0001	-0.0001	-0.0001	-0.0000	0.0000	-0.0001	0.0000	-0.0001	-0.0001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Market	0.4487***	0.3982***	0.4171***	0.3883***	0.3942***	0.4033***	0.4182***	0.4117***	0.4057***
	(0.024)	(0.025)	(0.026)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.025)
Market x High Restrictions	0.0023	0.0055	0.0007	0.0205	0.0164	0.0083	0.0008	0.0004	0.0040
	(0.022)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
Constant	0.0065***	0.0072***	0.0073***	0.0074***	0.0068***	0.0070***	0.0069***	0.0068***	0.0071***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
N	220,122	220,122	220,122	220,122	220,122	220,122	220,122	220,122	220,122
R-squared	0.154	0.154	0.150	0.155	0.155	0.155	0.156	0.155	0.154

Table 11
Controlling for Additional Factor Exposures

The dependent variable is the monthly return of hedge fund *f*. Small is the equally weighted monthly return of the portfolio of small stocks. The portfolio is formed once per year using market equity at the end of June of year *t* and constructed using NYSE decile breakpoints. Stocks with market capitalization below this breakpoint are considered small. Market is the value-weighted excess market return of all NYSE, AMEX, and NASDAQ stocks, which we obtain from Ken French's website. *Neg Sent* is a dummy variable that takes value equal to 1 during periods of negative sentiment, defined as in Baker and Wurgler (2007). Momentum is the return of the momentum portfolio from Ken French's website. Fung and Hsieh Factors are the 7 hedge fund factors in Fung and Hsieh (2004). *High Restrictions* is a dummy variable that is equal to 1 for hedge funds with Share Restrictions above sample median. All remaining variables are defined in the Appendix. We present ordinary least squares estimates with errors clustered at the fund and time levels and corrected for heteroskedasticity. ***, **, * denote significance at 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
Small x Neg Sent x High Restrictions	0.0540**	0.0357**	0.0398**	0.0411**
	(0.027)	(0.018)	(0.019)	(0.019)
Small x High Restrictions	0.0034	0.0014	0.0007	-0.0013
	(0.024)	(0.020)	(0.020)	(0.021)
Small x Neg Sent	-0.0708	-0.0137	-0.0101	-0.0110
	(0.057)	(0.041)	(0.041)	(0.039)
Small	0.1439***	0.1511***	0.1499***	0.1437***
	(0.050)	(0.029)	(0.030)	(0.031)
Neg Sent	0.0016	0.0016	0.0015	0.0000
	(0.002)	(0.001)	(0.001)	(0.001)
High	-0.0003	0.0001	0.0002	0.0005
	(0.000)	(0.000)	(0.001)	(0.001)
Market	0.4477***	0.4875***	0.5287***	0.5253***
	(0.024)	(0.024)	(0.029)	(0.029)
Market x High	0.0012	-0.0108	-0.0214	-0.0198
	(0.022)	(0.023)	(0.029)	(0.029)
PS LIQ	0.0122	0.0049	-0.0065	-0.0042
	(0.019)	(0.020)	(0.018)	(0.019)
PS LIQ x High	0.0217*	0.0216*	0.0251**	0.0228**
	(0.012)	(0.012)	(0.011)	(0.011)
MOM		0.1074***	0.1017***	0.0963***
		(0.025)	(0.025)	(0.026)
MOM x High		-0.0336**	-0.0315**	-0.0320**
		(0.015)	(0.015)	(0.015)
Market x High			-0.1039***	
			(0.033)	
Market x Neg Sent x High Restrictions			0.0340	
			(0.025)	
Neg Sent x High			-0.0008	
			(0.001)	
Constant	0.0064***	0.0054***	0.0061***	0.0059**
	(0.001)	(0.001)	(0.001)	(0.003)
Observations	220,122	220,122	220,122	220,122
R-squared	0.154	0.161	0.163	0.163
Fung and Hsieh Factors	No	No	No	Yes

Internet Appendix
(not for publication)

Figure A.1
Average Cumulative Abnormal Returns of Fire Sale Stocks

This figure presents the average cumulative abnormal returns of fire sale stocks, defined as in Coval and Stafford (2007). Following Coval and Stafford (2007), we start cumulating the abnormal returns 12 months before the fire sale event. The fire sale quarter is *t=0*.

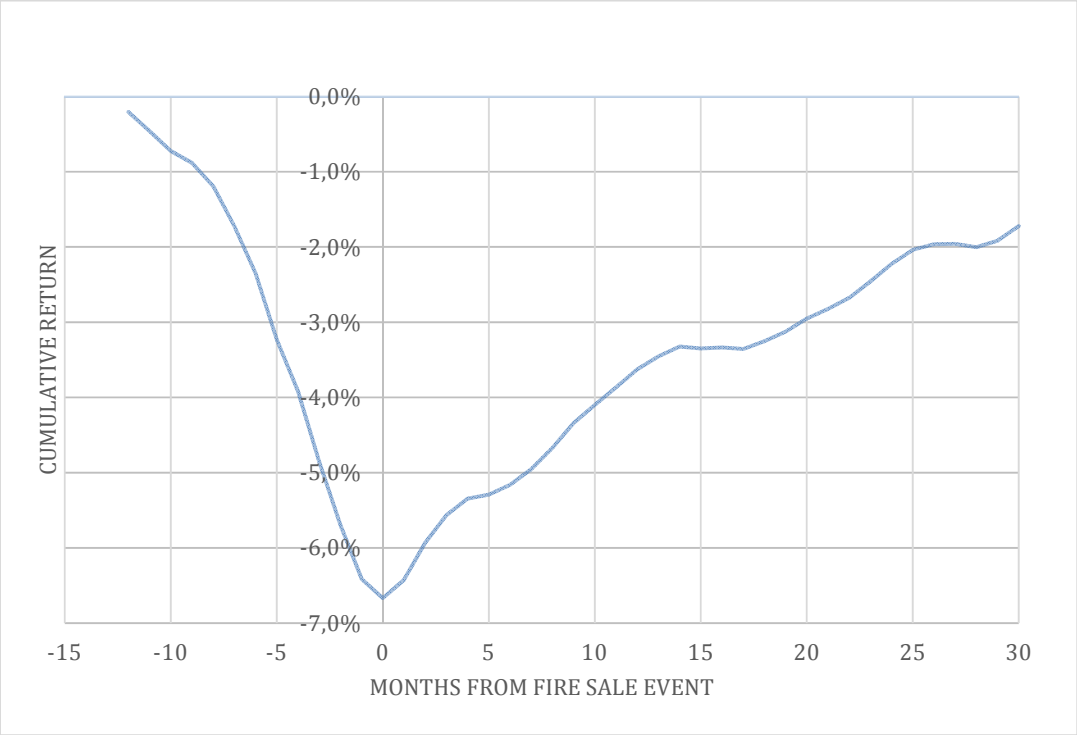


Table A.1
Including the Largest Open-End Fund

Panel A. Closed-End Funds' Trades and Fire Sales

This table reproduces the results of Table 2 in the paper, but includes also open-end funds in the top TNA quintile. We compare the change in holdings of closed- and open-end funds around episodes of fire sales. Quarter t is the quarter of the fire sale identified as in Coval and Stafford (2007). The dependent variable is a fund's change in quarterly holdings ($\Delta shares(t-k)_{f,i,s}$) in the quarters preceding, during or following the fire sale, as indicated on top of each column, divided by the firm's number of shares outstanding at the beginning of the quarter. We divide $\Delta shares(t-k)_{f,i,s}$ by the standard deviation of all $\Delta shares(t-k)_{f,i,s}$ of closed- and open-end funds during the sample period. All remaining variables are defined in the Appendix. All equations include time fixed effects and a constant whose coefficients are not reported. We present ordinary least squares estimates with errors clustered at the fund level and corrected for heteroskedasticity. ***, **, * denote significance at 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Δ Shares (t-2)	Δ Shares (t-1)	Δ Shares (t)	Δ Shares (t+1)	Δ Shares (t+2)	Δ Shares (t+3)
Closed	-0.2495	-0.3499	0.0825	0.4017**	0.0460	0.1105
	(0.355)	(0.276)	(0.060)	(0.202)	(0.251)	(0.323)
Size	-0.5881***	-0.4239***	-0.0692***	0.4008**	0.5758***	0.3261***
	(0.106)	(0.060)	(0.011)	(0.157)	(0.183)	(0.067)
VOL	0.1024***	0.0667***	-0.0064**	-0.0773**	-0.0328	-0.0682**
	(0.031)	(0.013)	(0.003)	(0.038)	(0.040)	(0.034)
ILLIQ	-0.0454**	-0.0385*	-0.0023	0.0805***	0.0011	0.0339
	(0.019)	(0.022)	(0.005)	(0.026)	(0.023)	(0.030)
BM	0.2031***	0.2700***	-0.0151	0.0109	-0.0573	-0.0597
	(0.075)	(0.079)	(0.010)	(0.094)	(0.071)	(0.071)
MOM	-0.7610**	-0.3676	0.2935***	1.7976***	0.9338***	0.7575*
	(0.383)	(0.264)	(0.082)	(0.364)	(0.296)	(0.442)
Log TNA	0.8086***	0.7808***	0.0567***	-0.5102***	-0.6248***	-0.6509***
	(0.089)	(0.069)	(0.012)	(0.075)	(0.100)	(0.093)
Observations	200,019	251,434	312,796	240,693	188,455	165,730
R-squared	0.001	0.009	0.001	0.001	0.001	0.003

Panel B. Exposures of Closed- and Open-end Funds to Mispriced Stocks

This table reproduces the results of Table 6 in the paper, but includes also open-end funds in the top TNA quintile. The dependent variable is the monthly return of fund *f*. On top of each column we indicate the portfolio of potentially undervalued stocks we consider in that specification. Portfolios are formed once per year using market equity, age, and volatility at the end of June of year *t*, and accounting data at the fiscal year-end of calendar year *t – 1*. Portfolios are constructed based on NYSE decile breakpoints. Portfolio is the equally weighted monthly return of a given portfolio of stocks. Market is the value-weighted excess market return of all NYSE, AMEX, and NASDAQ stocks, which we obtain from Ken French's website. *Low Sent* is a dummy variable that takes value equal to 1 during periods of negative sentiment, defined as in Baker and Wurgler (2007). All remaining variables, including the definition of firm characteristics used for the portfolio construction, are defined in the Appendix. We present ordinary least squares estimates with errors clustered at the fund and time levels and corrected for heteroskedasticity. ***, **, * denote significance at 1%, 5%, and 10% levels, respectively.

	(1) Small	(2) High Vol	(3) Young	(4) Low BM	(5) High RD	(6) High Ext	(7) Low Sales	(8) Nonpayer	(9) Nonprofitable
Portfolio x Neg Sent x Closed	0.0683***	0.0746***	0.1118***	0.1124***	0.0750***	0.0832***	0.0679***	0.1024***	0.0857***
	(0.005)	(0.017)	(0.024)	(0.023)	(0.019)	(0.018)	(0.017)	(0.019)	(0.016)
Portfolio x Closed	0.0475***	-0.0055	-0.0016	-0.0508*	-0.0284	-0.0021	0.0187	0.0038	0.0073
	(0.008)	(0.019)	(0.021)	(0.027)	(0.019)	(0.018)	(0.020)	(0.022)	(0.017)
Portfolio x Neg Sent	0.0250	0.0037	0.0329	0.0571**	0.0174	0.0192	-0.0049	0.0254	0.0184
	(0.033)	(0.022)	(0.034)	(0.029)	(0.021)	(0.022)	(0.027)	(0.034)	(0.025)
Portfolio	0.0571**	0.0484**	0.0595*	0.0710***	0.0538***	0.0465**	0.0679***	0.0795**	0.0499**
	(0.028)	(0.020)	(0.031)	(0.025)	(0.016)	(0.020)	(0.024)	(0.032)	(0.022)
Neg Sent	0.0010	0.0011	0.0014	0.0014	0.0011	0.0014	0.0007	0.0010	0.0013
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Closed	-0.0075***	-0.0072***	-0.0071***	-0.0070***	-0.0070***	-0.0073***	-0.0072***	-0.0073***	-0.0074***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Market	0.8911***	0.8621***	0.8671***	0.8589***	0.8601***	0.8669***	0.8711***	0.8669***	0.8663***
	(0.016)	(0.019)	(0.018)	(0.018)	(0.019)	(0.018)	(0.017)	(0.016)	(0.018)
Market x Closed	-0.2161***	-0.2237***	-0.2238***	-0.2011***	-0.2072***	-0.2210***	-0.2291***	-0.2231***	-0.2272***
	(0.019)	(0.013)	(0.016)	(0.014)	(0.011)	(0.016)	(0.018)	(0.017)	(0.016)
Constant	0.0019***	0.0022***	0.0023***	0.0025***	0.0020***	0.0021***	0.0021***	0.0019***	0.0021***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Observations	725,851	725,851	725,851	725,851	725,851	725,851	725,851	725,851	725,851
R-squared	0.561	0.561	0.561	0.562	0.561	0.562	0.562	0.563	0.562

Table A.2
Closed-End Funds' Trades and Fire Sales—With Time Clustering

We compare the change in holdings of closed- and open-end funds around episodes of fire sales. Quarter *t* is the quarter of the fire sale identified as in Coval and Stafford (2007). The dependent variable is a fund's change in quarterly holdings ($\Delta shares(t-k)_{f,i,s}$) in the quarters preceding, during or following the fire sale, as indicated on top of each column, divided by the firm's number of shares outstanding at the beginning of the quarter. We divide $\Delta shares(t-k)_{f,i,s}$ by the standard deviation of all $\Delta shares(t-k)_{f,i,s}$ of closed- and open-end funds during the sample period. All remaining variables are defined in the Appendix. All equations include time fixed effects and a constant whose coefficients are not reported. We present ordinary least squares estimates with errors double-clustered at the time and fund level and corrected for heteroskedasticity. ***, **, * denote significance at 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Δ Shares (t-2)	Δ Shares (t-1)	Δ Shares (t)	Δ Shares (t+1)	Δ Shares (t+2)	Δ Shares (t+3)
Closed	-0.3891	-0.3166	0.1089	0.4041**	0.1888	0.0584
	(0.368)	(0.273)	(0.067)	(0.195)	(0.231)	(0.298)
Size	-0.0735	0.0273	0.0166	0.1366**	-0.0690	0.1348
	(0.068)	(0.048)	(0.019)	(0.055)	(0.110)	(0.118)
VOL	-0.6955	-0.7388**	0.1883*	0.8551	1.1541**	0.4167
	(0.639)	(0.360)	(0.113)	(0.533)	(0.576)	(0.303)
ILLIQ	-0.5439***	-0.4650***	-0.0384*	0.3003***	0.4310***	0.3025***
	(0.081)	(0.076)	(0.021)	(0.060)	(0.094)	(0.052)
BM	0.1127***	0.0705**	-0.0057	-0.0732*	-0.0813*	-0.0389**
	(0.031)	(0.032)	(0.007)	(0.038)	(0.046)	(0.018)
MOM	0.0878	0.0095	-0.0168	-0.0098	-0.0878	0.0055
	(0.069)	(0.082)	(0.012)	(0.040)	(0.093)	(0.020)
Log TNA	0.4423***	0.3819***	0.0314	-0.2121***	-0.2248**	-0.1795***
	(0.093)	(0.075)	(0.020)	(0.077)	(0.089)	(0.064)
Observations	60,204	77,268	97,786	73,722	56,227	48,296
R-squared	0.009	0.008	0.002	0.004	0.004	0.006

Table A.3
Closed-End Funds' Trades and Fire Sales in Different Market Conditions

We compare the change in holdings of closed- and open-end funds around episodes of fire sales and assess how the effects of the closed-end fund structure vary across different market conditions, captured by the following proxies: AggFlow measuring the aggregate flows in open-end funds, defined as the sum of all the open-end fund flows, divided by the aggregate open-end fund assets at the beginning of the quarter; the VIX index, capturing aggregate market uncertainty; the Crisis 1 dummy that takes value equal to 1 from the third quarter of 2007 to the fourth quarter of 2009; and the Crisis 2 dummy that takes value equal to 1 from the third quarter of 2008 to the fourth quarter of 2009. Quarter t is the quarter of the fire sale identified as in Coval and Stafford (2007). The dependent variable is a fund's change in quarterly holdings ($\Delta shares(t-k)_{f,i,s}$) in the quarters preceding, during or following the fire sale, as indicated on top of each column, divided by the firm's number of shares outstanding at the beginning of the quarter. We divide $\Delta shares(t-k)_{f,i,s}$ by the standard deviation of all $\Delta shares(t-k)_{f,i,s}$ of closed- and open-end funds during the sample period. All remaining variables are defined in the Appendix. All equations include time fixed effects and a constant whose coefficients are not reported. We present ordinary least squares estimates with errors double-clustered at the time and fund level and corrected for heteroskedasticity. ***, **, * denote significance at 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
	Δ Shares (t+1)	Δ Shares (t+1)	Δ Shares (t+1)	Δ Shares (t+1)
Closed	0.6242***	0.8066*	0.5874***	0.6381***
	(0.214)	(0.436)	(0.201)	(0.208)
Closed x AggFlow	-0.5239			
	(0.496)			
AggFlow	-0.3214*			
	(0.185)			
Closed x VIX		-0.0114		
		(0.016)		
VIX		0.0034		
		(0.006)		
Closed x Crisis1			-0.1260	
			(0.265)	
Crisis1			0.1275	
			(0.111)	
Closed x Crisis2				-0.3701
				(0.324)
Crisis2				0.2074
				(0.173)
Log TNA	-0.1965**	-0.1986***	-0.1979***	-0.1946**
	(0.077)	(0.077)	(0.076)	(0.077)
Size	0.3564***	0.3541***	0.3596***	0.3577***
	(0.066)	(0.066)	(0.066)	(0.066)
VOL	-0.0449***	-0.0430**	-0.0415**	-0.0440**
	(0.017)	(0.017)	(0.017)	(0.017)
ILLIQ	0.1430**	0.1434**	0.1433***	0.1430**
	(0.056)	(0.056)	(0.055)	(0.056)
BM	0.0096	0.0110	0.0109	0.0102
	(0.039)	(0.039)	(0.040)	(0.039)
MOM	0.7474***	0.7402***	0.7691***	0.7926***
	(0.228)	(0.230)	(0.236)	(0.231)
Observations	73,518	73,722	73,722	73,722
R-squared	0.003	0.003	0.003	0.003

Table A.4
Fire Sales and Contemporaneous Fund Discount

This table reproduces specification (6) in Table 4. It uses the average closed-end fund discount during the quarter, instead of the average discount over the past year. We compare the change in holdings of closed- and open-end funds around fire sales events. Quarter *t+1* is the quarter following the fire sale identified as in Coval and Stafford (2007). The dependent variable is a fund's change in quarterly holdings ($\Delta shares(t-1)_{f,i,s}$) in divided by the stock's total number of shares outstanding. We divide $\Delta shares(t-k)_{f,i,s}$ by the standard deviation of all $\Delta shares(t-k)_{f,i,s}$ of closed- and open-end funds during the sample period. All remaining variables are defined in the Appendix. The equation includes controls for the stock characteristics (Size, VOL, ILLIQ, BM, and 6monthret), time fixed effects, and a constant whose coefficients are not reported. We present ordinary least squares estimates with errors clustered at the fund level and corrected for heteroskedasticity. ***, **, * denote significance at 1%, 5%, and 10% levels, respectively.

	(1) Δ Shares (t+1)
Closed	0.4097**
	(0.198)
Discount Alt	1.9103
	(1.254)
Size	0.3004***
	(0.048)
VOL	-0.0721*
	(0.037)
ILLIQ	0.1352**
	(0.049)
BM	-0.0150
	(0.038)
MOM	0.8544
	(0.579)
Log TNA	-0.2108***
	(0.048)
Observations	73,419
R-squared	0.004

Table A.5
Robustness for Closed-End Funds Return Regressions

Panel A. Differences in the Exposure to the Market Portfolio Between Periods of Positive and Negative Sentiment

This table reproduces the results in column 3 of Table 7 in the paper, considering other portfolio of sentiment prone stocks. For comparison, we reproduce column 3 of Table 7 in column 1 of the present table. The dependent variable is the monthly return of fund *f*. On top of each column we indicate the portfolio of potentially undervalued stocks we consider in that specification. Portfolios are formed once per year using market equity, age, and volatility at the end of June of year *t*, and accounting data at the fiscal year-end of calendar year *t – 1*. Portfolios are constructed based on NYSE decile breakpoints. Portfolio is the equally weighted monthly return of a given portfolio of stocks. Market is the value-weighted excess market return of all NYSE, AMEX, and NASDAQ stocks, which we obtain from Ken French's website. Sent is a dummy variable that takes value equal to 1 during periods of negative sentiment, defined as in Baker and Wurgler (2007). Momentum is the return of the momentum portfolio from Ken French's website. All remaining variables are defined in the Appendix. We present ordinary least squares estimates with errors clustered at the fund and time levels and corrected for heteroskedasticity. ***, **, * denote significance at 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Portfolio	High Vol	Young	Low BM	High RD	High Ext	Low Sales	Nonpayer	Nonprofit
Portfolio x Neg Sent x Closed	0.0490***	0.0832***	0.0574***	0.0244*	0.0487***	0.0346**	0.0668***	0.0532***
	(0.012)	(0.016)	(0.020)	(0.013)	(0.012)	(0.014)	(0.017)	(0.013)
Portfolio x Closed	-0.0069	-0.0201	-0.0542***	-0.0245	0.0010	0.0192	-0.0079	0.0072
	(0.014)	(0.019)	(0.021)	(0.016)	(0.014)	(0.016)	(0.018)	(0.014)
Portfolio x Neg Sent	0.0295***	0.0660***	0.0948***	0.0486***	0.0438***	0.0259***	0.0596***	0.0476***
	(0.004)	(0.005)	(0.007)	(0.004)	(0.004)	(0.005)	(0.006)	(0.004)
Portfolio	0.0432***	0.0635***	0.0707***	0.0500***	0.0403***	0.0624***	0.0813***	0.0441***
	(0.005)	(0.007)	(0.008)	(0.006)	(0.005)	(0.006)	(0.007)	(0.005)
Neg Sent	0.0028***	0.0030***	0.0030***	0.0029***	0.0031***	0.0025***	0.0027***	0.0030***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Closed	-0.0078***	-0.0078***	-0.0079***	-0.0075***	-0.0078***	-0.0079***	-0.0076***	-0.0078***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.0019***	0.0019***	0.0023***	0.0016***	0.0018***	0.0017***	0.0015***	0.0018***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Market	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Market x closed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PS LIQ	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PS LIQ x closed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MOM	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MOM x closed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sent x closed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Market x sent	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Market x sent x closed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	272,373	272,373	272,373	272,373	272,373	272,373	272,373	272,373
R-squared	0.568	0.569	0.569	0.568	0.568	0.569	0.571	0.569

Panel B. Alternative Sentiment Measure

This table reproduces column 4 of Table 7 for the other "sentiment prone" stock portfolios. The dependent variable is the monthly return of fund *f*. On top of each column we indicate the portfolio of potentially undervalued stocks we consider in that specification. Portfolios are formed once per year using market equity, age, and volatility at the end of June of year *t*, and accounting data at the fiscal year-end of calendar year *t – 1*. Portfolios are constructed based on NYSE decile breakpoints. Portfolio is the equally weighted monthly return of a given portfolio of stocks. Market is the value-weighted excess market return of all NYSE, AMEX, and NASDAQ stocks, which we obtain from Ken French's website. Neg (Alt) Sent is a dummy variable that takes value equal to 1 during periods of negative sentiment, defined as the first principal component of trading volume as measured by NYSE turnover; the dividend premium; the number and first-day returns on IPOs; and the equity share in new issues. Momentum is the return of the momentum portfolio from Ken French's website. All remaining variables are defined in the Appendix. We present ordinary least squares estimates with errors clustered at the fund and time levels and corrected for heteroskedasticity. ***, **, * denote significance at 1%, 5%, and 10% levels, respectively.

VARIABLES	(1) High Vol	(2) Young	(3) Low BM	(4) High RD	(5) High External	(6) Low Sales	(7) Nonpayer	(8) Nonprofit
Portfolio x Neg Sent x Closed	0.0254***	0.0356***	0.0220**	0.0240***	0.0221***	0.0294***	0.0459***	0.0261***
	(0.006)	(0.009)	(0.009)	(0.006)	(0.006)	(0.007)	(0.009)	(0.006)
Portfolio x Closed	0.0163	0.0249	-0.0305	-0.0167	0.0227	0.0364	0.0214	0.0331
	(0.022)	(0.033)	(0.028)	(0.021)	(0.023)	(0.026)	(0.030)	(0.025)
Portfolio x Neg Sent	-0.0450*	-0.0963**	-0.0615	-0.0395	-0.0423	-0.0451	-0.0753*	-0.0480
	(0.026)	(0.040)	(0.042)	(0.027)	(0.028)	(0.032)	(0.042)	(0.031)
Portfolio	0.0720***	0.1313***	0.1145***	0.0758***	0.0696***	0.0888***	0.1295***	0.0774***
	(0.016)	(0.026)	(0.021)	(0.013)	(0.016)	(0.018)	(0.020)	(0.018)
Neg Sent	0.0026*	0.0030**	0.0026*	0.0024*	0.0027*	0.0023*	0.0024*	0.0027*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Closed	-0.0070***	-0.0070***	-0.0068***	-0.0067***	-0.0070***	-0.0072***	-0.0071***	-0.0071***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Market	0.9482***	0.9535***	0.9398***	0.9433***	0.9532***	0.9564***	0.9531***	0.9533***
	(0.020)	(0.019)	(0.019)	(0.020)	(0.019)	(0.018)	(0.018)	(0.019)
Market x closed	-0.3058***	-0.3056***	-0.2787***	-0.2841***	-0.3044***	-0.3085***	-0.3047***	-0.3105***
	(0.025)	(0.026)	(0.025)	(0.025)	(0.026)	(0.027)	(0.026)	(0.026)
Constant	0.0023***	0.0026***	0.0027***	0.0021***	0.0023***	0.0020***	0.0021***	0.0023***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Observations	272,373	272,373	272,373	272,373	272,373	272,373	272,373	272,373
R-squared	0.567	0.568	0.568	0.567	0.567	0.568	0.570	0.567

Table A.6.
Hedge Funds and Fire Sales

This table reproduces Table 9 in the paper, but uses the actual number of days implied by share restrictions divided by 100, as captured by the variable Restrictions, instead of the High Restrictions dummy. We explore how the change in holdings of hedge funds varies around episodes of fire sales depending on the redemption risk faced by the hedge fund. High Restrictions is a dummy variable that is equal to 1 if the fund has share restrictions above sample median; the variable Restrictions is the sum of the number of days in the lock up, redemption notice and payout periods, divided by 100. Quarter t is the quarter of the fire sale identified as in Coval and Stafford (2007). The dependent variable is a fund's change in quarterly holdings ($\Delta shares(t-k)_{f,i,s}$) in the quarters preceding, during or following the fire sale, as indicated on top of each column, divided by the firm's number of share outstanding at the beginning of the quarter. We divide $\Delta shares(t-k)_{f,i,s}$ by the standard deviation of all $\Delta shares(t-k)_{f,i,s}$ of hedge funds during the sample period. All remaining variables are defined in the Appendix. All equations include time fixed effects and a constant whose coefficients are not reported. We present ordinary least squares estimates with errors clustered at the fund level and corrected for heteroskedasticity. ***, **, * denote significance at 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Δ Shares (t-2)	Δ Shares (t-1)	Δ Shares (t)	Δ Shares (t+1)	Δ Shares (t+2)	Δ Shares (t)	Δ Shares (t)
Restrictions	0.0201*	0.0414**	0.0088**	0.0082	-0.1143	0.0275**	0.0012
	(0.012)	(0.020)	(0.004)	(0.034)	(0.159)	(0.012)	(0.003)
Restrictions x Size						-0.0026**	
						(0.001)	
Restrictions x VOL							0.0006**
							(0.000)
Size	-0.1055***	-0.1796***	-0.0291***	0.1066**	0.3410**	-0.0249***	-0.0290***
	(0.007)	(0.011)	(0.002)	(0.050)	(0.133)	(0.003)	(0.002)
VOL	0.0098***	0.0143***	0.0027***	-0.0350***	-0.0245*	0.0027***	0.0017**
	(0.002)	(0.002)	(0.000)	(0.005)	(0.013)	(0.000)	(0.001)
ILLIQ	-0.0098**	-0.0191***	-0.0027***	0.0198*	-0.0067	-0.0027***	-0.0027***
	(0.005)	(0.004)	(0.001)	(0.010)	(0.029)	(0.001)	(0.001)
BM	0.0047*	-0.0033	0.0001	0.0112	-0.0211	0.0001	0.0001
	(0.003)	(0.004)	(0.001)	(0.010)	(0.016)	(0.001)	(0.001)
MOM	0.0152	0.1161	0.0033	-0.0316	1.4636**	0.0035	0.0035
	(0.045)	(0.095)	(0.006)	(0.160)	(0.636)	(0.006)	(0.006)
Log TNA	0.0103	0.0208*	0.0043***	0.0273	-0.0221	0.0044***	0.0043***
	(0.007)	(0.012)	(0.001)	(0.017)	(0.055)	(0.001)	(0.001)
Observations	45,463	52,564	70,868	68,704	51,996	70,868	70,868
R-squared	0.061	0.058	0.051	0.010	0.004	0.052	0.052

Table A.7
Hedge Funds and Fire Sales—Further Robustness Checks

This table includes further controls in the specification presented in column 3 of Table 9. Definitions for all the additional control variables are provided in the Appendix of the paper. We explore how the change in holdings of hedge funds varies around episodes of fire sales depending on the redemption risk faced by the hedge fund. High Restrictions is a dummy variable that is equal to 1 if the fund has share restrictions above sample median; share restrictions is the sum of the number of days in the lock up, redemption notice and payout periods, divided by 100. Quarter t is the quarter of the fire sale identified as in Coval and Stafford (2007). The dependent variable is a fund's change in quarterly holdings ($\Delta shares(t-k)_{f,i,s}$) in the quarters preceding, during or following the fire sale, as indicated on top of each column, divided by the firm's number of share outstanding at the beginning of the quarter. We divide $\Delta shares(t-k)_{f,i,s}$ by the standard deviation of all $\Delta shares(t-k)_{f,i,s}$ of hedge funds during the sample period. All remaining variables are defined in the Appendix. All equations include time fixed effects and a constant whose coefficients are not reported. We present ordinary least squares estimates with errors clustered at the fund level and corrected for heteroskedasticity. ***, **, * denote significance at 1%, 5%, and 10% levels, respectively.

	(1) Δ Shares (t)	(2) Δ Shares (t)	(3) Δ Shares (t)
High Restrictions	0.2777**	0.2852**	0.2744***
	(0.131)	(0.114)	(0.096)
Size	-0.2597***	-0.2558***	-0.2537***
	(0.021)	(0.021)	(0.021)
VOL	0.0250***	0.0256***	0.0258***
	(0.004)	(0.004)	(0.004)
ILLIQ	-0.0253***	-0.0257***	-0.0259***
	(0.006)	(0.007)	(0.007)
BM	-0.0008	-0.0004	-0.0002
	(0.006)	(0.006)	(0.006)
MOM	0.0294	0.0285	0.0337
	(0.053)	(0.053)	(0.053)
Log TNA	0.0441***	0.0395***	0.0382***
	(0.015)	(0.013)	(0.013)
Annual Fees	15.4425		
	(11.130)		
Incentive Fees	-0.2412		
	(1.560)		
High-water Mark	0.2262		
	(0.204)		
Min Inv		-0.0000	
		(0.000)	
Leveraged			0.0808
			(0.133)
Constant	1.1911**	1.5394***	1.4739***
	(0.497)	(0.435)	(0.443)
Observations	58,502	58,297	58,681
R-squared	0.058	0.057	0.057

Table A.8.
Controlling for Additional Factor Exposures

This table reproduces the results in column 4 of Table 11 in the paper, considering other portfolio of sentiment prone stocks. For comparison, we reproduce column 3 of Table 7 in column 1 of the present table. The dependent variable is the monthly return of hedge fund *f*. On top of each column we indicate the portfolio of potentially undervalued stocks we consider in that specification. Portfolios are formed once per year using market equity, age, and volatility at the end of June of year *t*, and accounting data at the fiscal year-end of calendar year *t – 1*. Portfolios are constructed based on NYSE decile breakpoints. Portfolio is the equally weighted monthly return of a given portfolio of stocks. Market is the value-weighted excess market return of all NYSE, AMEX, and NASDAQ stocks, which we obtain from Ken French's website. Neg Sent is a dummy variable that takes value equal to 1 during periods of negative sentiment, defined as in Baker and Wurgler (2007). Momentum is the return of the momentum portfolio from Ken French's website. Fung and Hsieh Factors are the 7 hedge fund factors in Fung and Hsieh (2004). High Share Restrictions is a dummy variable that is equal to 1 for hedge funds with Share Restrictions above sample median. All remaining variables are defined in the Appendix. We present ordinary least squares estimates with errors clustered at the fund and time levels and corrected for heteroskedasticity. ***, **, * denote significance at 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Portfolios	High Vol	Young	Low BM	High RD	High Ext	Low Sales	Nonpayer	Nonprofitable
Port x Neg Sent x High Rest	0.0389**	0.0432**	0.0505**	0.0434**	0.0394**	0.0349*	0.0454**	0.0387**
	(0.016)	(0.018)	(0.025)	(0.017)	(0.016)	(0.019)	(0.020)	(0.016)
Port x High Rest	-0.0195	-0.0150	-0.0391*	-0.0302*	-0.0201	-0.0124	-0.0106	-0.0171
	(0.016)	(0.020)	(0.023)	(0.016)	(0.016)	(0.020)	(0.022)	(0.016)
Port x Neg Sent	-0.0130	0.0390	0.0617	-0.0065	0.0084	-0.0316	0.0153	0.0117
	(0.029)	(0.038)	(0.046)	(0.028)	(0.029)	(0.035)	(0.043)	(0.032)
Port	0.1156***	0.1381***	0.1559***	0.1214***	0.1121***	0.1523***	0.1678***	0.1199***
	(0.023)	(0.029)	(0.031)	(0.020)	(0.022)	(0.026)	(0.030)	(0.023)
Neg Sent	0.0024*	0.0029**	0.0031**	0.0023*	0.0030**	0.0016	0.0019	0.0028**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
High Rest	0.0000	0.0001	-0.0002	0.0002	0.0001	0.0001	0.0002	0.0002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Constant	0.0064***	0.0065***	0.0069***	0.0061***	0.0063***	0.0063***	0.0060***	0.0063***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Market	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Market x closed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PS LIQ	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PS LIQ x closed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MOM	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MOM x closed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sent x closed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Portfolios	(1) High Vol	(2) Young	(3) Low BM	(4) High RD	(5) High Ext	(6) Low Sales	(7) Nonpayer	(8) Nonprofitable
Market x sent	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Market x sent x closed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fung and Hsieh Factors	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	220,122	220,122	220,122	220,122	220,122	220,122	220,122	220,122
R-squared	0.162	0.161	0.161	0.161	0.162	0.163	0.164	0.162