Who Trades Against Mispricing? [1]

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Abstract

We investigate whether redemption risk hinders managerial incentives to trade against mispricing (e.g., Shleifer and Vishny (1997)). We begin our analysis with comparing the trading behavior of closed-end funds – which are not subject to redemption risk – with that of open-end funds in stocks that are mispriced due to a price pressure. We find that closed-end funds purchase (sell) fire sale (purchase) stocks to a larger extent than open-end funds. Moreover, closed-end funds' portfolios are more exposed to stocks that are likely to be undervalued because of negative demand shocks. Differences in trading behavior are pronounced for stocks with higher arbitrage risk – stocks that are more likely to lead to a short-term poor performance and thus capital outflows. Finally, we extend our analysis to hedge funds and show that hedge funds with share restrictions behave similarly to closed-end funds. Redemption risk seems to be an important impediment for would-be arbitrageurs.

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

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A central tenet of theoretical studies in limits to arbitrage literature is that intermediaries are reluctant to trade against mispricing because they face redemption risk (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.

A largely untested implication of this view is that asset managers with a capital structure that makes them less susceptible to redemption risk should be more likely to trade against mispricing. In this paper, we aim to fill this gap by investigating how financial institutions with different capital structures vary in their incentives to trade against mispricing.

To this end, we begin our analysis by contrasting the trading behavior of open-end and closed-end funds. We expect that closed-end funds are more inclined to undertake long-term arbitrage as they are insulated from redemptions. We then extend our analysis to hedge funds, comparing hedge funds with and without share restrictions. Hedge funds with share restrictions seem to have a lower sensitivity of flows to performance (Ding, Getmansky, Liang, and Wermers, 2009). We follow this line of inquiry, asking whether this leads to stronger incentives to trade against mispricing.

We conduct a variety of tests that provide evidence consistent with the hypothesis that asset managers with a capital structure that makes them less susceptible to redemption risk are more likely to trade against mispricing. In our main analysis, we use holdings data on long positions, thus focus our analysis more investing in undervalued stocks.

First, we compare the trading of open- and closed-end funds in "fire sales" stocks – stocks that are mispriced due to a negative price pressure caused by heavily liquidating distressed mutual funds. Fire sales have been shown to bring about long-lasting mispricing of financial assets, which can persist because of a lack of long-term arbitrage capital (Mitchell, Pulvino, and Stafford, 2002; Duffie, 2010). We identify fire sales following Coval and Stafford (2007). We find that closed-end funds are more inclined to buy fire sales stocks than open-end funds. This tendency is more pronounced for smaller stocks and stocks with highly volatile returns, which are typically considered to involve riskier arbitrage. Finally, closed-end funds appear more likely to sell the stocks that experience fire purchases thus confirming that they are more inclined to trade against mispricing.

Second, we broaden the analysis to another type of mispricing for which the timing of convergence to fundamental value is uncertain, and test whether closed-end funds increase their exposure to stocks that are likely to be undervalued more than then open-end funds. To identify mispriced securities, we follow Baker and Wurgler (2006) who show that companies whose valuations are more subjective have stock prices that may deviate from fundamental values because of investor sentiment. Examples include the stocks of companies that are young, unprofitable, distressed and non-dividend paying. Baker and Wurgler (2006) show that these stocks tend to be underpriced in periods of low investor sentiment.

Consistent with our earlier results, we find that closed-end funds are more exposed to Baker and Wurgler stocks during periods of low sentiment, that is, precisely when they are underpriced. 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 share restrictions in fire sale stocks. We find that hedge funds with share restrictions, which limit redemptions, are more likely to purchase the stocks that are experiencing a fire sale compared to hedge funds without share restrictions, confirming the importance of capital structure for an asset manager's tendency to trade against mispricing.

This 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). Studies that are most relevant for us show that poor returns experienced by the fund could trigger investors' outflows, and so render the fund more constrained, precisely when mispricing worsens (e.g., Shleifer and Vishny, 1997; Vayanos and Woolley, 2013).

In a paper that is closely related to our empirical analysis, Stein (2005) shows that 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. Liu and Mello (2011), Hanson, Shleifer, Stein, and Vishny (2014) and Hombert and Thesmar (2014) also model in different contexts 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; Agarwal, Daniel, and Naik, 2009). These papers mostly find that hedge funds that are less subject to redemptions have higher returns, because they are able to invest in illiquid assets and obtain an illiquidity premium. 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. None of these

papers provide direct evidence on closed-end funds' 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) or management fees and asset liquidity (Cherkes, 2012). 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 and holdings of mispriced securities. Furthermore, instead of focusing on the funds' incentives to invest in illiquid assets, we highlight that they invest in a way that tends to correct mispricing. We show that this effect is independent from the liquidity of the assets stressed in previous literature.

The remainder of this paper is organized as follows. Section I provides background information and describes the data. Evidence from funds' trades and returns are in Section 2 and 3, respectively. Section 4 concludes.

1. Institutional Background

Most investment vehicles, including open-end mutual funds and (most) hedge funds, are structured on an open-end basis. That is, they grant their investors redeemable claims, which —as first highlighted by Shleifer and Vishny (1997)— expose them to withdrawal risk. Closed-end funds and, to 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 issuing a fixed number of common shares that can*not* be directly purchased or redeemed from the fund. Closed-end funds' shares are instead 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-end funds and open-end funds are subject to SEC registration and are regulated primarily under the Investment Company Act of 1940 and the rules adopted under that Act. Closed-end funds and open-end funds are also subject to the Securities Act of 1933 and the Securities Exchange Act of 1934.

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

1.2. Hedge Funds

As an additional and independent test of the role of redemptions risk on asset managers' trading and portfolios, we explore the behavior of hedge funds with share restrictions. Even though they are organized on an open-end basis, upon inception, hedge funds can choose to establish share restrictions that limit investors' ability to redeem by asking for advance notice for redemptions or restricting redemptions to predetermined periods (Aragon, 2007; Agarwal, Daniel and Naik, 2009). Also, some hedge funds have lock up periods that require a minimum investment time to new investors.

All together, these restrictions are far from insulating the funds from redemptions, as investors are generally able to withdraw their capital within a quarter.

However, hedge funds with share restrictions may have somewhat higher flexibility to undertake arbitrage opportunities that might take time to become profitable due to noise trader risk. We then ask whether their trading and portfolios indicate a stronger propensity to trade against mispricing than the trading and portfolios of hedge funds without share restrictions.

2. Closed-End Funds' Data and Sample Construction

We obtain data for 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, including monthly returns, total net assets under management (TNA), annual expense ratio, and allocation schemes, starting from January 1990. Our closed-end fund data ends in June 2012.

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 (formerly known as CDA/Spectrum), respectively. During our sample period, many mutual funds have multiple share classes. Since each share class of a fund has the same portfolio holdings, we aggregate all the observations at the fund level.[2] 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.

[2] 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, alphas, and expenses).

Our tests focus on two alternative samples. The first sample allows us to focus on changes in individual funds' stockholdings across firms in a given quarter and goes from 2005 to June 2012. As we explain below, when we use this first sample, we concentrate on stocks that experience fire sales or purchases. Since our objective is to explore whether financially unconstrained closed-end and open-end funds trade against mispricing to different extents, we exclude mutual funds with extreme inflows and outflows (i.e, funds with 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 our second sample, we focus on funds' monthly returns with the aim of assessing the funds' exposures to different types of stocks. This samples goes from January 1990 to June 2012. We exclude closed-end funds with international specialization or that hold asset classes other than equity. 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 mutual funds in the top TNA quintile from all analyses. Consequently, as shown in Table 1, the average size of the open-end funds in our sample is the same as for the closed-end funds.[3]

Table 1 also compares the main characteristics of the stocks held by closed-end funds and open-end funds. It confirms for the first time using holdings data that the finding of Cherkes, Sagi and Stanton (2008) that closed-end funds tend to hold illiquid stocks to a larger extent. It also indicates that open-end funds' portfolios include more

[3] All results we report hereafter are robust to the use of an alternative control sample in which we include only the open-end fund with assets under management closest to each closed-end fund in our sample.

stocks that experienced high returns in the last six months, suggesting that these funds engage to a larger extent in momentum trading. Consistently, closed-end funds stockholdings have higher book-to-market ratio. In the next section, we device an empirical strategy that allows us to test whether closed-end funds trade against mispricing and allows us to exclude that any different trading behavior depends on the characteristics of the stocks experiencing mispricing.

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

3.1. Methodology

Our objective is to test whether closed-end funds, thanks to their capital structure, which insulates them from redemptions, trade in a way that corrects mispricing. We thus face the challenge of identifying mispriced stocks. To do so, we follow Coval and Stafford (2007), who show that distressed funds experiencing large outflows create selling pressure in the stocks they hold. Similarly, the tendency of funds experiencing large inflows to expand the positions in the stocks they already own creates positive price pressure in these stocks.

Following Coval and Stafford (2007), we identify stocks subject to pressure because of extreme inflows and outflows using the following proxy:

$$Pressure_{i,t} = \frac{\sum_j \max(0, \Delta Holdings_{j,i,t}) | \, flow_{j,t} > P90 - \sum_j \max(0, -\Delta Holdings_{j,i,t}) | \, flow_{j,t} < P10}{Avg\ Volume_{i,t-12:t-6}}$$

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 average stock trading volume of the stock 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*) as follows: $flow_{j,t} = \left[TNA_{j,t} - TNA_{j,t-1} \times (1 + R_{j,t})\right]/TNA_{j,t-1}$ for fund *j* in quarter *t*.

Stocks with *Pressure* below the 10th percentile are considered to experience fire sales, while stocks with pressure above the 90th percentile are considered to experience fire purchases. We identify 8,357 fire sales and 8,092 fire purchases during the period 2005-2012.

Coval and Stafford (2007) show that a trading strategy selling stocks purchased by mutual funds experiencing large inflows and purchasing stocks sold by mutual funds experiencing large outflows can earn high risk-adjusted returns. Nevertheless, episodes of fire sales and purchases cause persistent mispricing indicating that few investors are willing to take contrarian positions. This is presumably due to the fact that such trades involve significant risk in the short-run.

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-end funds and closed-end funds in stocks experiencing fire sales and purchases before, during and after the fire sales and purchases. For each episode, we exclude all funds that having experienced a shock caused the fire sales and purchases. If the structure of an investor's liabilities affects the investor's willingness to trade against mispricing, we expect any differences to emerge during the fire sale and purchase episodes, but not before or after.

1.1 Fire Sales

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

Table 2 provides more systematic analysis about how the trades of open- and closed-end funds differ in the quarters surrounding a fire sale. In particular, it controls for time effects and firm characteristics that may drive the different trading behavior of closed- and open-end funds. We refer to the quarter in which the variable pressure is in the bottom decile for a firm as quarter 0. As Coval and Stafford show, mutual funds' flows are correlated over time. Thus, while the quarter of the fire sale is typically the quarter in which the cumulative abnormal returns of a firm bottom out, the fire sale stock has been experiencing selling pressure and negative cumulative abnormal returns in the previous quarters.

We find no statistical difference in the purchases of open-end funds and closed-end funds up and including quarter 0. Only during the fire sale quarter, closed-end funds appear to buy the stock to a larger extent than open-end funds. The effect is not only statistically, but also economically significant: The average closed-end fund, which is a quite small investor, buys 0.01 basis point more of the shares outstanding in the quarter following a fire sale. We observe no statistical difference in the behavior of closed-end funds and open-end funds in the two following quarters.

This evidence suggests that indeed closed-end funds trade in a way that corrects mispricing 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.

The previous results also indicate that the different behavior of open- and closed-end funds is driven by the fire sales and the consequent price drops, and not by differences in unobserved firm characteristics, as in this case we should have observed differences in trading also in the quarters preceding the fire sale or when prices are about to converge to their fundamental value at quarters *t+2* and *t+3*.

To better characterize the trading of closed-end funds in stocks experiencing fire sales, we explore to what extent the differences in behavior between closed-end funds and open-end funds vary with stock characteristics. If the structure of closed-end funds is indeed such to overcome the limits to arbitrage, we would expect that following fire sales the differences in behavior between closed- and open-end funds are more pronounced for stocks for which the arbitrage is riskier at least in the short run. For instance, small firms are known to attract more individual investors and, for this reason, may be more subject to noise traders' risk. Theory suggests that investors that are subject to redemptions following short-term underperformance, such as open-end funds, should be particularly reluctant to trade against mispricing in these stocks. Therefore, we expect that closed-end funds' propensity to correct mispricing should be more pronounced for small firms. This is precisely what we find in column 1 of Table 3. Similarly, stocks with higher return volatility involve riskier arbitrage. Consistently with our interpretation of the previous findings, in column 2, closed-end funds appear to purchase to a larger extent the stocks with high return volatility in the quarter following a fire sale.

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 quarter following a fire sale 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 purchase to a larger extent stocks in the quarter following a fire sale

independently from their liquidity, as measured by 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, also do not help explain the trades of closed-end funds in the quarter following a fire sale.

Table 4 explores whether the difference between closed- and open-end funds' propensity to purchase stocks subject to fire sales is related to other characteristics of the funds. In column 1, open-end funds that have experienced large inflows during the last year, relative to their total net assets under management at the beginning of the year, are more likely than other open-end funds to purchase stocks that have been subject to fire sales. This is consistent with our conjecture that redemption risk and more in general financing constraints matter. Similarly, open-end funds with high churn ratios, which Cella, Ellul and Giannetti (2013) show to be particularly concerned about short-term performance, purchase stocks that have been subject to fire sales to a lower extent than other funds.

We find no evidence, however, that a fund's past performance, measured as the fund's average monthly return during the past year, is related to the propensity to purchase stocks that have been subject to fire sales (column3).

Finally, we consider, how the characteristics of closed-end funds may be related to their trading activity. For instance, Tang (2012) argues that closed-end funds could be exposed to rollover risk (rather than to redemption risk) because they borrow in the action rate security market. This could hamper at least some closed-end funds' ability to trade against mispricing. In column 4, we construct a proxy for the closed-end funds' leverage using Capital IQ. We include in our basic specification 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.

Finally, in column 5, we find that the fund's discount, which is always zero for open-end funds, appears unrelated to the trading activity of closed-end funds. Therefore, it appears that increases in the fund's discount, which may lead investor activists to launch campaigns to open the fund, do not hamper close-end fund managers' ability to trade against mispricing (Bradley, Brav, Goldstein and Jian, 2010), possibly due to their ex ante low probability.

1.2 Fire Purchases

So far we have shown that thanks to their structure closed-end funds are more likely to purchase undervalued stocks. Therefore, they trade in a way that corrects undervaluation. It is interesting to know if similar differences emerge also when fire purchases occur. Even if open-end funds and closed-end funds are subject to regulatory restrictions that limit their ability to short stocks, we could still observe that they reduce their holdings in stocks that experience positive price pressure because of large inflows in other mutual funds. However, since fund flows are correlated, these stocks are more likely to experience price appreciations in the short-term (Lou, 2012). It is thus interesting to test whether open-end funds that did not experience large inflows provide liquidity to the same extent of closed-end funds or whether their greater focus on short-term performance leads them to hold stocks that are becoming over-valued.

Table 5 shows that during the quarter when stocks subject to fire purchases reach their peak, closed-end funds reduce their positions to a larger extent than open-end funds that hold those stocks and have not been subject to large inflows. This indicates that open-end funds are more inclined to gain from short-term price appreciations than closed-end funds and that the latter are more likely to provide liquidity during these

episodes. 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 likely to depend on the fact that being unable to short, closed-end fund can only sell stocks that they already own and these may not be the stocks that are more difficult to arbitrage during a fire purchase.

2. Evidence from Funds' Returns

2.1 Methodology

The analysis of the funds' trades provides direct evidence on the role of the investors' liability structure and their willingness to trade against mispricing. However, it allows us to focus on a specific cause of mispricing, the open-end funds' flows. To broaden the analysis to other sources of mispricing, we consider that changes in investor sentiment are known to have larger effects on securities whose valuations are highly subjective and difficult to arbitrage (Baker and Wurgler, 2006). We can thus test whether closed-end funds' returns are more exposed to these types of securities during periods of low sentiment, when securities whose valuations are highly subjective and difficult to arbitrage are more prone to be undervalued. These tests also allow us to expand the sample period.

To do so, we construct factor portfolios based on the firm characteristics that Baker and Wurgler (2006) identify to make a firm prone to mispricing. These include small firms, high volatility firms, young firms, low book-to-market firms, high R&D firms, high external finance firms, firms with low sale growth, firms that do not pay dividends, and firms that are unprofitable. Precise definitions of these firms' characteristics cab be found in the Appendix and closely follow Baker and Wurgler (2006).

Similar in spirit to Sharpe (1992), Brown, Goetzmann, and Park (2000), and Brunnermeier and Nagel (2004), we assume that 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 mispricing in turn and the market return. Each fund's return (R_{ft}) can thus be written as:

$$R_{ft} = (b - g)R_{mt} + gR_{mispr\ prone} + \epsilon_{ft},$$

where $R_{mispr\ prone}$ is the return of a portfolio of mispricing prone stocks and R_{mt} is the market return. In what follows, we use equally-weighted returns of the portfolio of mispricing-prone stocks. A larger g implies that a fund's holdings are more tilted towards mispricing prone stocks and that consequently the fund's returns are more exposed to this factor.

We are interested in testing for systematic differences between closed- and open-end funds. We further expect that the sign of these differences will depend on whether a high or low sentiment wave prevails, as this determines the direction of mispricing. In particular, we estimate the following equation:

$$R_{ft} = (b - g_0) * R_{mt} + (b - g_1) * closed * R_{mt}$$
$$+ g_0 * R_{mispr\ prone} + g_1 * closed * low_{sent} * R_{mispr\ prone} + \mathbf{\Gamma X} + \epsilon_{ft},$$

where low_{sent} is a dummy that takes value equal to 1 during periods of negative sentiment, defined as in Baker and Wurgler (2006), closed is a dummy identifying closed-end funds, and **X** is a matrix of controls that includes the lower order interaction terms.

We expect that $g_1 > 0$ if closed-end funds are more inclined to purchase undervalued stocks during periods of low sentiment than open-end funds.

2.2 Results

Table 6 relates funds' monthly returns to the monthly returns of portfolios of stocks that are known to become undervalued during periods of negative sentiment. Since the sign of mispricing is expected to vary conditionally to the prevailing sentiment, we focus on differences between open- and closed-end funds during periods of low sentiment. We allow the exposure of closed- and open-end funds to the market portfolio to vary. [4]

It is evident that during periods of low sentiment closed-end funds' returns are more exposed to portfolios of stocks that Baker and Wurgler (2006) identify as most likely to be undervalued. The parameter estimates imply that, compared to open-end funds, closed-end funds increase their exposure to undervalued stocks in an economically significant way during periods of negative sentiment. For instance, in column 1, closed-end funds always appear to overweigh small stocks in comparison to their weight in the market portfolio, as the coefficient of the interaction of the dummy closed with small portfolio indicates. However, the rate at which closed-end funds overweigh small stocks increases from approximately 7 percent during periods of positive sentiment to 17 percent during periods of negative sentiment when small stocks are undervalued.[5]

The extent to which closed-end funds overweigh other portfolios of possibly undervalued stocks during periods of negative sentiment is similar. For these other portfolios of possibly undervalued stocks, we find no evidence that closed-end funds over-weigh or under-weigh the stocks also during periods of strong market sentiment.

[4] In unreported tests, 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.

[5] 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 5 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*closed; g is the coefficient of closed*portfolio during periods of high sentiment and the sum of the latter and the coefficient of closed*portfolio*lowsent 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 $\frac{g}{b}$.

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.

More in general, the evidence that closed-end funds do not under-weigh overvalued portfolios during periods of strong market sentiment is broadly consistent with our previous result that during fire purchases the propensity of closed-end funds to sell stocks is independent from their characteristics. Thus, short-sale constraints may limit closed-end funds' ability to correct stock overvaluation.

The increase in the exposure of closed-end funds' returns to possibly undervalued stocks during periods of low sentiment cannot be explained by these funds' higher exposure to liquidity risk. In column 1 of Table 7, we control for closed- and open-end funds' different exposures to liquidity risk by allowing the exposures of their returns to the Pastor and Stambaugh's (2003) liquidity factor to differ. Our results, if anything, become stronger.

Another possible concern is that the measure of sentiment that we use to identify conditional factor exposure is the first principal component of six variables, including the closed-end discount (Baker and Wurgler, 2007). To show that our results are unrelated to the dynamics of the closed-end fund discount in column 2, we compute a new measure of sentiment as the first principal component of the remaining five variables used by Baker and Wurgler in the original definition of investor sentiment (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). We then define periods in which this variable is negative as having negative investor sentiment. Our results are invariant.

In column 3, we allow the returns of closed-end and open-end funds to have different exposure to the momentum factor. It still appears that closed-end funds' exposure to the portfolio of small stocks is higher during periods of negative sentiment.

It is also interesting that open-end funds' returns are significantly more exposed to the momentum factor than closed-end funds' returns. This also indicates that the different organizational structure of closed- and open-end funds affects their trading strategy and is consistent with the open-end funds' higher propensity to invest in stocks that are most likely to experience short-term price appreciations.

4. Evidence from Hedge Funds

Hedge funds may provide an independent test for the relevance of redemption risk on asset managers' propensity to trade against mispricing. They face much laxer regulation than closed- or open-end funds, but similarly to closed-end funds, upon inception, they may select to have share restrictions, which limit redemption risk.

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. These datasets do not provide information on the hedge funds' stock holdings, which is essential for 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 explore whether around episodes of fire sales the quarterly changes in stockholdings of management companies that we identify as hedge funds differ

depending on the share restrictions of the hedge funds they manage. 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 purchases stocks to trade against mispricing.

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. For the latter, we approximate the number of days considering that an investor in the fund with uniformly distributed liquidity shocks will have to wait 45 days before being able to redeem his capital if the hedge fund has a quarterly (90 days) redemption period.[6] While over 80% of the changes in holdings of fire sales firms in our sample are associated with funds with share restrictions, the intensity of the restrictions vary greatly. The combined number of days associated with share restrictions is less than 30 days for the bottom quartile of the sample and 284 days for the upper quartile.[7]

Table 8 repeats the tests we perform for closed- and open-end funds for hedge funds with different intensity of share restrictions. It shows that hedge funds with share restrictions purchase more fire sales stocks in the quarter preceding the fire sale. No differences in trading between hedge funds related to the intensity of share restrictions emerge in other quarters. While the evidence that hedge funds appear to purchase fire sales stocks in the quarter preceding the actual fire sale contrasts with the evidence from closed-end funds that purchase fire sale stocks in the quarter following the fire sale, it is otherwise consistent with our maintained assumption that redemption risk affects asset managers' willingness to trade against mispricing. As Coval and Stafford (2007) show, fire sales can be anticipated because a fund's net flows are correlated over time. Thus, it

[6] While the tests we present hereafter exploit a fund's share restriction intensity, the specific metric we use does not affect our findings and results are qualitatively invariant if we define a dummy for whether a fund has any share restrictions.

[7] This does not imply that this is the number of days that investors must wait to redeem, but rather an upper bound.

appears that hedge funds with share restrictions have stronger incentives or higher ability than closed-end funds to identify stocks that are undervalued because their investors have experienced outflows.[8] As Vayanos and Woolley (2013) show theoretically, these stocks are expected to continue underperforming in the short run as past outflows predict future outflows for a fund. Since these stocks are already underpriced, however, they guarantee investors an attractive return over a long horizon. Investors could earn an even more attractive return on average by buying these assets after further outflows occur. This, however, exposes them to the risk that further outflows might not occur, in which case the assets would cease to be underpriced. Thus, investors with long horizons –as the hedge funds with share restrictions—and ability to identify undervaluation may want to trade before the stock valuations reach the bottom. Importantly, stronger share restrictions do appear to lengthen the trading horizon of the fund.

The effect we uncover in the quarter preceding the actual fire sale is not only statistically, but also economically significant. A one-standard-deviation increase in our proxy for (low) redemption risk leads hedge funds to purchase 0.02% of the outstanding stocks of the firm. Furthermore, the cross-sectional effects fully support our interpretation of the results as hedge funds with stronger share restrictions buy to a larger extent the stocks of small firms and firms with high volatility, which are precisely the ones that are riskier to arbitrage in the short-term.

5. Conclusions

This paper shows that closed-end funds, and more in general asset managers that are less subject to redemption risk, not being subject to redemption risk, are more likely

[8] The evidence that at least some hedge funds are able to predict fire sales is consistent with the findings of Chen, Hanson, Hong and Stein (2008), who show that hedge funds front-run mutual funds experiencing negative shocks by short-selling the stocks they hold. We expect that this behavior aiming at short-term returns is most likely for hedge funds with weaker or without share restrictions.

to trade against mispricing than open-end funds. This provides direct evidence in support of the assumption behind limits-to-arbitrage theories that redemption risk hampers fund managers' ability to trade against mispricing. To this extent, our results can be viewed to indirectly support the conclusions of Stein's (2005) theoretical model that competition between fund managers may lead too many asset managers to choose an open-end structure. While our analysis highlights the benefits of the closed-end fund organizational structure, there are potential costs in terms of governance if bad performing managers are not subject to redemptions. In a recent paper, however, Wu, Wermers and Zechner (2013) suggest that these costs may be small because managerial career concerns and labor market may be able to provide discipline to closed-end fund managers at least in the long-term.

Our findings also suggest a new interpretation for the closed-end fund discount arising from the closed-end funds' propensity to hold undervalued stocks. Solomon, Soltes and Sosyura (2013) argue that the demand for open-end funds that hold popular stocks is high even if the holdings of popular stocks appear to be unrelated to future fund performance. Higher demand translate in inflows for open-end funds, but in closed-end funds it can only affect the share price and generates a premium or discount because shares are not redeemable. Changes in investor demand, driven by the fact that the fund manager holds unpopular stocks during periods of low sentiment, may 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
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
Fund Return	The fund's monthly 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%
Expense Ratio	Annual fund fees
Fund Age	Natural logarithm of fund age measured in years
Churn Ratio	Average of turn ratio in the past 4 quarters where turn ratio 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	Total debt divided by total assets, obtained from Capital IQ, available at annual frequency
Past Flows	Average monthly fund flows in the past 12 months, as a proportion of TNA at the beginning of the period

Stock-level Characteristics

VOL	Standard deviation of monthly returns calculated over a 2-year window
ILLIQ	Computed following 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
BM	Ratio of the latest book value from annual statements to the latest market value in a given quarter
6monthret	Cumulative monthly returns in the past six months
Δ Holding (%)	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, multiplied by 100

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
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 expense (item46) 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 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	Sales growth is 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

This table describes the main characteristics of the closed- and open-end-funds in our sample. The table also compares the characteristics of the stocks they hold. All variables are defined in the Appendix.

A. Holdings: Fund Characteristics

Fund	N	Variable	Mean	Median	Std Dev
Open	16619	Log TNA	5.4244	5.6458	1.3900
		Fund Return	0.0115	0.0111	0.0471
		Flow-Performance Sensitivity	0.0191	0.0102	0.0820
		Churn Ratio	0.8519	0.6850	0.6907
		Fund Age	2.8978	2.8332	0.4845
		Flow	-0.0054	-0.0078	0.0302
		Expense Ratio	0.0132	0.0125	0.0049
Closed	4500	Log TNA	5.6407	5.6657	1.2079
		Return	0.0066	0.0122	0.0775
		Fund Age	2.2153	2.1972	0.8875
		Expense Ratio	0.0136	0.0123	0.0057
		Fund Discount	0.0581	0.0737	0.0923

B. Holdings: Stock Characteristics

Fund	N	Variable	Mean	Median	Std Dev
Open	1978743	6monthret	0.0918	0.0647	0.4072
		Size	22.1780	22.0384	1.8034
		VOL	0.1032	0.0894	0.0625
		ILLIQ	0.0496	0.0004	1.8409
		BM	0.6907	0.4353	4.1693
		Δ Holding	-0.0198	0.0000	15.0798
Closed	220026	6monthret	0.0539	0.0368	0.3358
		Size	22.8855	22.9847	1.7975
		VOL	0.0991	0.0856	0.0583
		ILLIQ	0.1647	0.0001	3.7025
		BM	1.0439	0.5133	5.8344
		Δ Holding (%)	0.0016	0.0000	0.7943

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 holding (Δ Holding) during the quarter 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 multiply Δ Holding by 100. All remaining variables are defined in the appendix. All equations include time fixed effects 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-2)	(2) Δ Holding (t-1)	(3) Δ Holding (t)	(4) Δ Holding (t+1)	(5) Δ Holding (t+2)	(6) Δ Holding (t+3)
Closed	-0.0088	-0.0071	0.0147	0.0091**	0.0042	0.0013
	(0.008)	(0.006)	(0.011)	(0.004)	(0.005)	(0.006)
Size	-0.0122***	-0.0105***	0.0084	0.0068***	0.0097***	0.0068***
	(0.002)	(0.001)	(0.008)	(0.001)	(0.002)	(0.001)
VOL	0.2536***	0.1587***	0.1540	-0.1647***	-0.1829***	-0.0876**
	(0.047)	(0.043)	(0.249)	(0.050)	(0.064)	(0.035)
ILLIQ	-0.0017	0.0006	0.0009	0.0031**	-0.0016	0.0030
	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
BM	0.0020*	0.0002	-0.0034**	-0.0002	-0.0020	0.0001
	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)
6monthret	-0.0156	-0.0166**	0.0028	0.0192***	0.0260**	0.0094
	(0.012)	(0.007)	(0.011)	(0.006)	(0.011)	(0.006)
Log TNA	0.0100***	0.0086***	-0.0053	-0.0048***	-0.0051**	-0.0040***
	(0.002)	(0.002)	(0.005)	(0.002)	(0.002)	(0.001)
Constant	0.2391***	0.1721***	-0.1542	-0.1585***	-0.2054***	-0.1291***
	(0.040)	(0.027)	(0.167)	(0.034)	(0.048)	(0.025)
N	60,204	77,268	97,786	73,722	56,227	48,296
R-squared	0.009	0.008	0.000	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. 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 holding (Δ Holding) during the quarter 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 multiply Δ Holding by 100. All remaining variables are defined in the appendix. All equations include time fixed effects 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.

VARIABLES	(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)
Closed	0.1453**	-0.0080	0.0094**	0.0080*	0.0094**
	(0.057)	(0.006)	(0.004)	(0.004)	(0.004)
Closed x Size	-0.0062**				
	(0.002)				
Closed x VOL		0.1681***			
		(0.059)			
Closed x ILLIQ			-0.0024		
			(0.002)		
Closed x BM				0.0012	
				(0.001)	
Closed x 6monthret					-0.0077
					(0.007)
Size	0.0072***	0.0067***	0.0068***	0.0068***	0.0068***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
VOL	-0.1634***	-0.1771***	-0.1647***	-0.1647***	-0.1647***
	(0.049)	(0.052)	(0.050)	(0.050)	(0.050)
ILLIQ	0.0030**	0.0031**	0.0038**	0.0031**	0.0031**
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
BM	-0.0003	-0.0002	-0.0002	-0.0004	-0.0002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
6monthret	0.0192***	0.0192***	0.0193***	0.0192***	0.0199***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Log TNA	-0.0048***	-0.0048***	-0.0048***	-0.0048***	-0.0048***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	-0.1679***	-0.1559***	-0.1586***	-0.1584***	-0.1585***
	(0.036)	(0.033)	(0.034)	(0.034)	(0.034)
N	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 episodes of fire sales. 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 holding (Δ Holding) during quarter t+1, divided by the firm's number of share outstanding at the beginning of the quarter. We multiply Δ Holding by 100. All remaining variables are defined in the appendix. All equations include time fixed effects 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.

VARIABLES	(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)
Open	-0.0077*	0.0017			
	(0.004)	(0.005)			
Closed				0.0078*	0.0119**
				(0.004)	(0.005)
Open × Past Flows	0.0238**				
	(0.010)				
Open × Churn Ratio		-0.0117***			
		(0.004)			
Open × Past Return			0.0960		
			(0.171)		
Closed × Leverage				0.0394	
				(0.043)	
Closed × Discount					-0.0003
					(0.021)
Size	0.0069***	0.0069***	0.0094***	0.0068***	0.0069***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
VOL	-0.1659***	-0.1563***	-0.1219*	-0.1647***	-0.1624*
	(0.050)	(0.049)	(0.065)	(0.050)	(0.083)
ILLIQ	0.0031**	0.0030**	0.0026***	0.0031**	0.0031**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
BM	-0.0002	-0.0004	-0.0005	-0.0002	-0.0003
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
6monthret	0.0196***	0.0212***	0.0112	0.0192***	0.0194
	(0.006)	(0.006)	(0.007)	(0.006)	(0.013)
Log TNA	-0.0050***	-0.0056***	-0.0062***	-0.0048***	-0.0047***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
Constant	-0.1529***	-0.1473***	-0.1727***	-0.1584***	-0.1610***
	(0.033)	(0.032)	(0.047)	(0.034)	(0.024)
N	72,864	73,242	30,523	73,722	73,141
R-squared	0.004	0.005	0.007	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 holding (Δ Holding) during the quarter preceding, during or following the fire purchase, as indicated on top of each column, divided by the firm's number of share outstanding at the beginning of the quarter. We multiply Δ Holding by 100. All remaining variables are defined in the appendix. All equations include time fixed effects 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-2)	(2) Δ Holding (t-1)	(3) Δ Holding (t)	(4) Δ Holding (t+1)	(5) Δ Holding (t+2)	(6) Δ Holding (t+3)
Closed	-0.0378	-0.0066	-0.0204***	0.0039	0.0047	0.0059
	(0.023)	(0.004)	(0.006)	(0.004)	(0.004)	(0.004)
Size	-0.0218**	-0.0081***	-0.0104***	0.0044***	0.0064***	0.0076***
	(0.009)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
VOL	0.5012**	0.2086**	0.1783***	-0.1695*	-0.0418	-0.0518*
	(0.217)	(0.104)	(0.042)	(0.099)	(0.027)	(0.029)
ILLIQ	-0.0020***	-0.0003	-0.0001	-0.0004	-0.0016	-0.0012
	(0.001)	(0.000)	(0.000)	(0.001)	(0.002)	(0.002)
BM	0.0053	0.0023	0.0037***	-0.0013*	-0.0015**	-0.0008
	(0.004)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
6monthret	-0.2131	-0.0110	-0.0688***	0.0185**	0.0042	0.0113**
	(0.150)	(0.008)	(0.021)	(0.008)	(0.006)	(0.006)
Log TNA	0.0068	0.0066***	0.0082***	-0.0037***	-0.0048***	-0.0033***
	(0.007)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Constant	0.4422**	0.1347***	0.1933***	-0.0742*	-0.1244***	-0.1563***
	(0.181)	(0.041)	(0.040)	(0.041)	(0.023)	(0.027)
N	62,910	80,457	105,895	83,824	65,796	56,867
R-squared	0.001	0.008	0.003	0.003	0.005	0.004

Table 6
Return 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. 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 Finance	(7) Low Sales	(8) Nonpayer	(9) Nonprofitable
Portfolio x 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 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)
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. Sent is a dummy variable that takes value equal to 1 during periods of negative sentiment, defined as in Baker and Wurgler (2007). Alternative 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)
Small x Sent x Closed	0.0767***	0.0525***	
	(0.017)	(0.013)	
Small x Alternative Sent x Closed			0.0610***
			(0.020)
Small x Closed	0.0426***	0.0394***	0.0446*
	(0.009)	(0.015)	(0.027)
Small x Sent	0.0320	0.0435***	
	(0.037)	(0.005)	
Sent	0.0026*	0.0026***	
	(0.002)	(0.000)	
Small	0.0548	0.0565***	0.0848***
	(0.034)	(0.006)	(0.021)
Closed	-0.0080***	-0.0074***	-0.0069***
	(0.001)	(0.000)	(0.001)
Momentum		0.0273***	
		(0.005)	
Closed x Momentum		-0.0578***	
		(0.012)	
Market	0.9722***	0.9802***	0.9542***
	(0.017)	(0.007)	(0.019)
Closed x Market	-0.2949***	-0.3120***	-0.3452***
	(0.026)	(0.026)	(0.031)
PS LIQ	-0.0024	-0.0016	
	(0.017)	(0.002)	
PS LIQ x Closed	0.0513***	0.0524***	
	(0.018)	(0.010)	
Small x Alternative Sent			-0.0408
			(0.039)
Alternative Sent			0.0001**
			(0.000)
Constant	0.0019***	0.0015***	0.0009
	(0.001)	(0.000)	(0.001)
N	272,373	272,373	260,335
R-squared	0.568	0.569	0.532

Table 8
Hedge Funds and Fire Sales

We explore how the change in holdings of hedge funds vary around episodes of fire sales depending on the redemption risk faced by the hedge fund. The variable low redemption risk is defined as the 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 the number of days is set to zero. 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 holding (Δ Holding) during the quarter 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. All remaining variables are defined in the appendix. All equations include time fixed effects 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 Holding (t-2)	Δ Holding (t-1)	Δ Holding (t)	Δ Holding (t+1)	Δ Holding (t+2)	Δ Holding (t-1)	Δ Holding (t-1)
Low Risk	0.000	0.001**	0.000	0.000	-0.000	0.005**	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)
Low Risk x Size						-0.019**	
						(0.007)	
Low Risk x VOL							0.003***
							(0.001)
Size	-0.092*	-0.050***	-0.113**	0.039	0.081**	-0.020*	-0.049***
	(0.053)	(0.011)	(0.044)	(0.041)	(0.035)	(0.010)	(0.011)
VOL	0.002	0.003*	-0.000	-0.002	-0.001	0.003*	-0.002
	(0.003)	(0.001)	(0.004)	(0.003)	(0.003)	(0.002)	(0.003)
ILLIQ	-0.000	-0.000	-0.000**	0.000	0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
BM	0.000*	-0.000	0.000	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
6monthret	-0.003	-0.000	-0.003*	0.001	0.003**	-0.000	-0.000
	(0.002)	(0.000)	(0.002)	(0.002)	(0.001)	(0.000)	(0.000)
Log TNA	0.000	0.000**	0.000*	-0.000	-0.000	0.000**	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.017*	0.009***	0.018**	-0.009	-0.015**	0.003	0.010***
	(0.010)	(0.002)	(0.008)	(0.007)	(0.006)	(0.003)	(0.002)
N	45928	53105	71575	69406	52521	53105	53105
R2	.00133	.00699	.00205	.000245	.00321	.00725	.00711