Accepted Manuscript

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PII: S0304-405X(18)30234-4
DOI: https://doi.org/10.1016/j.jfineco.2017.09.008
Reference: FINEC 2954

To appear in: *Journal of Financial Economics*

Received date: 3 December 2016
Revised date: 21 August 2017
Accepted date: 18 September 2017

Who benefits in a crisis? Evidence from hedge fund stock and option holdings☆

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Abstract

We use a unique data set of hedge fund long equity and equity option positions to investigate a significant lockup-related premium earned during the tech bubble (1999–2001) and financial crisis (2007–2009). Net fund flows are significantly greater among lockup funds during crisis and noncrisis periods. Managers of hedge funds with locked-up capital trade opportunistically against flow-motivated trades of non-lockup managers, consistent with a hypothesis of rent extraction in providing crisis era liquidity. The success of this opportunistic trading is concentrated during periods of high borrowing costs, in less liquid stock markets, and is enhanced by hedging in the equity option market.

JEL classification: G11, G12

Keywords: Hedge funds, opportunistic trading, lockups, options, derivatives, financial crises

1. Introduction

In a recent study, Ben-David, Franzoni, and Moussawi (2012) find that hedge fund stock trading around the 2007–2009 global financial crisis is characterized overall by significant sell-offs explainable by investor redemptions, despite availability of expected returns from liquidity provision (Nagel, 2012). We propose that these crisis-induced sell-offs contribute significantly to explaining the cross section of hedge fund returns. The linkage potentially arises from variations in usage of contractual lockup provisions that impede cash withdrawals.

☆Thanks to Bill Schwert, an anonymous referee, Nicole Boyson, Rick Sias, and seminar participants at the University of New South Wales, University of Melbourne, Queen's University, University of Virginia, Rutgers University, 2014 Society of Financial Studies Cavalcade, and Hong Kong Polytechnic University.

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Lockup provisions are already associated with higher overall hedge fund returns (Aragon, 2007; Agarwal, Daniel, and Naik, 2009). Managers using lockups make the strategic choice to pursue more costly, less liquid investments overall, and locked-up investors expect higher returns.[1] Because the effects of lockup provisions are potentially most binding during a crisis, managers with lower flow-to-performance elasticity due to lockups should be able to exploit valuable opportunities during a crisis and reap large rewards from doing so.

Separating the available sample into crisis and noncrisis periods reveals significant concentration of the lockup return premium. Fig. 1 shows the 12-month moving average return spread between lockup and non-lockup managers. The estimated monthly lockup outperformance is positive and significant during the 1999–2001 tech bubble (1.08%), financial crisis (0.53%), and periods of above-median Volatility Index (VIX) (0.42%). It is insignificant outside of these periods. This paper seeks to analyze the channel or channels responsible for the observed return differences. Changes in borrowing costs, changes in flow of funds, and changes in trading characteristics all should have a role to play.

High borrowing costs would tend to exacerbate sales of stock to meet investor redemptions. Conditional on a high VIX, the lockup premium is 0.49% per month (t-statistic = 2.05) if borrowing costs are also high, but an insignificant 0.37% (t-statistic = 1.44) under low borrowing costs. These findings show that borrowing costs, as measured by availability of borrowing from prime brokers, are a key ingredient for managers to take advantage of crisis-induced trading opportunities.

To devise a direct test of crisis-related opportunistic trading behavior by lockup funds, we must still first closely examine the relative amounts of fund flows in crisis and non-crisis periods. We find that lockup managers have the more favorable flow of funds in both environments (see Table 4). Furthermore, the group of managers without lockups experiences average net outflows during crisis periods, but for lockup managers the average flow remains positive.

We then use quarterly filings of Securities and Exchange Commission (SEC) Form 13F to compare the trading activities of lockup and non-lockup hedge fund managers. In general, both groups tend to trade in the same direction. For the funds in most distress (outflows), a much different picture emerges. The stocks they trade experience opposing trade by lockup managers, especially

[1] Several prior studies indicate that lockups, other share restrictions, and a lack of marketability can lead to significant illiquidity discounts. See, e.g., Kahl, Liu, and Longstaff (2003), Longstaff (1995, 2001), Derman (2007), and Ang and Bollen (2010).

during crisis periods. This is our primary evidence that lockup managers trade opportunistically against the pressured trades of non-lockup managers during crisis periods.

We extend this baseline analysis of stock trading by conducting several additional tests. We begin by examining the interaction between borrowing costs and crisis periods and find evidence that lockup buying of stocks sold in distress by non-lockup managers is more pronounced with both high VIX and high borrowing costs. This evidence reinforces the idea that high borrowing costs are a key ingredient of the success of lockup managers during a crisis.

Next, we reconcile the potentially conflicting effects of stock liquidity. Presumably, distressed managers would have a preference for selling the most liquid stocks first because the price impact of sales is lower (Scholes, 2000). This could make detecting opportunistic trading difficult if lockup managers have an opposing preference to deploy their capital in the low liquidity sector of the market. If an opportunism story is right, then we should discover that lockup managers deviate more from their usual trading patterns while trading against non-lockup and flow-induced pressure. We do find that the distressed stocks bought by the lockup group tend to be more liquid compared with their usual stock holdings. Nevertheless, the negative relation between the antagonistic trading of lockup managers and non-lockup managers is most pronounced among ex ante illiquid stocks.

A final piece of corroborating evidence comes from hedge fund option trading. We find an economically important association between the opportunistic stock trading of lockup funds and their holdings of exchange traded fund (ETF) index put options. On average, lockup buying of distressed stocks contributes $105 million to $114 million of delta exposure to the Standard & Poor's (S&P) 500, and ETF puts contribute $75 million to $92 million of offsetting delta. This evidence suggests that lockup managers can hedge market risk when trading against pressure sells of non-lockup managers.

Finally, given the strong relation between hedge funds' usage of lockups and option hedging strategies and the return premium shown in the literature for hedge funds that use these devices, we decompose hedge fund returns into these two pieces to measure the lockup and option return premiums separately. Our analysis reveals a positive and significant interaction between lockup and option usage in explaining hedge fund returns. The lockup premium is 25.2 basis points per month higher for managers that use ETF put options compared with managers that do not. This return-based evidence complements the findings of our analysis of stock and option holdings in showing that lockups and option usage are complementary devices when deployed together by hedge fund managers.

Our paper contributes to a growing literature on the flow-motivated trading decisions of institutional investors. Coval and Stafford (2007; Table 4) find that severe flow-induced selling by mutual funds creates temporary price effects of about 4% during the event quarter. In our sample, purchases of stocks sold in distress by non-lockup funds represent 11% of lockup funds portfolio. This works out to 0.15% ($= 0.11 \times 0.04 \div 3$) per month, or 28% of the estimated 0.53% lockup premium. Our analysis of stock trading is unlikely to explain the entire 0.53% because hedge funds also trade significantly in other less liquid markets, where opportunities for locked capital can be considerably larger than those in stock markets.

Shive and Yun (2013) argue that the disclosure requirements of mutual funds allow more patient investors to profit from front-running mutual funds' flow-induced stock trades. We find evidence that lockup hedge funds trade opportunistically in purchasing stocks sold in distress by non-lockup managers.[2] Other studies find that, while hedge funds can trade against mispricing during most periods, they are net sellers of equities during crisis periods.[3] Within the hedge fund universe, we distinguish managers on the basis of redemption restrictions. Lockup managers can afford more patience and thus trade against flow-motivated trades of other hedge funds.

Overall, our evidence shows that the lockup premium is not merely explained by known investment strategies that entail a greater liquidity or risk premium. Our analysis of portfolio returns and stock and option trading indicates that the lockup premium can be explained, in part, by greater returns from opportunistic trading during crisis periods and that option hedging enhances the ability of locked capital to capture these returns.

The remainder of the paper is organized as follows. Sections 2 describes the data and summary statistics. Section 3 examines how the investor flows and the lockup premium in hedge funds' portfolio returns vary across market conditions. Section 4 analyzes stock and option market trading behavior using quarterly holdings data. Section 5 concludes.

[2] The Brunnermeier and Pedersen (2005) model predicts that predatory traders will initially withdraw their liquidity from the stock market by front-running the selling of distressed traders and then purchase the stocks at prices below fundamental value. Because we analyze stock holdings at a quarterly frequency, it is not possible to rule out that lockup managers engage in intra-quarter front-running before purchasing the distressed stocks at the quarter-end.

[3] See Ben-David, Franzoni, and Moussawi (2012). Also, Jylha, Rinne, and Suominen (2014) conclude that while hedge funds typically supply liquidity to equity markets, they become liquidity demanders during crisis periods.

2. Data and sample construction

In this section, we describe the two main databases used in our analysis and then explain and summarize the sample constructed.

2.1. Filings data

Since 1978, all institutional investment managers (including hedge fund investment advisers) who exercise investment discretion over accounts holding at least $100 million are required by Section 13(f) of the Exchange Act of 1934 to make quarterly disclosures of portfolio holdings to the SEC on Form 13F within 45 days of the quarter-end.

The types of securities that are required to be reported on Form 13F include exchange-traded and Nasdaq-quoted stocks, equity options and warrants, convertible bonds, and shares of closed-end investment companies. Short positions, shares of open-end funds, and private securities are not required to be disclosed. All long positions in such securities with more than ten thousand shares or with market values exceeding $200,000 are required to be reported. Form 13F reporting items include the issuers of the securities, the security type, the Committee on Uniform Securities Identification Procedures (CUSIP) number, the number of shares, and the market value of each security owned. In case of options positions, advisers must give the entries about CUSIP, fair value, and amount in terms of the securities underlying the options, not the options themselves. Advisers are also required to report whether the options are calls or puts, but they are not required to report an options striking price or maturity date.[4] Advisers can report aggregated holdings across different funds managed by the same management company.

All filings of Form 13F are available electronically from the SEC Electronic Data Gathering, Analysis, and Retrieval system (EDGAR) since 1999, but these require considerable further processing due to manual formatting. While most standard commercial databases (e.g., Thomson Reuters) only provide stock holdings, the commercially available Whale Wisdom database offers a complete set of reported 13F positions, including stock, option, and other types of securities. To maximize available data, we combine the 2001–2011 coverage of Whale Wisdom with 13F filings from EDGAR for the years 1999 and 2000 for an overall sample running from 1999 to 2011.

[4]See Aragon and Martin (2012) for additional details on the reporting of equity options in Form 13F.

To identify managers of hedge funds from the universe of 13F filers, we compile a list of hedge fund company names using the company file in the Trading Advisor Selection System (Lipper TASS) Hedge Fund Database downloaded in January 2013. We then match these hedge fund company names with the reporting names in the filings.

2.2. Fund returns and characteristics data

The Lipper TASS database records monthly fund returns and assets under management (AUM), a snapshot of fund characteristics such as lockup period and investment style category, and the names of the management companies or investment advisers.[5] Both live and defunct funds are included in the analysis to mitigate any potential survivorship bias. The sample period is from January 1994 to December 2012. Because data on defunct funds are not available before 1994, return observations before 1994 are omitted from the sample. We exclude funds of funds and funds that report in non-US currency. We include only managers with at least one filing of Form 13F over 1999–2011.

Several variables available at the fund level require aggregation to the manager level. We compute monthly net dollar flows to a hedge fund as the change in assets under management after removing the change in assets caused by fund returns. The monthly net percentage flows to a manager are calculated as the dollar flows to its funds in that month divided by its total assets at the previous month-end. The raw returns of a manager in a month are calculated as the asset-weighted raw returns of its managed hedge funds in that month.

By focusing on Form 13F filings, we limit our analysis to the subsample of managers that hold at least \$100 million in 13(f) securities (mainly equities and equity options). The mean AUM of Form 13F filers is \$355 million, and the AUM of non-filers is significantly lower at \$165 million. Aside from manager size, we find no significant difference in the average monthly performance between filers and non-filers, suggesting that the performance of our sample managers is representative of the broader hedge fund sample of non-filers.

[5] We follow prior research and use the lockup information reported in the most recent snapshot of the TASS database. However, hedge funds rarely change their lockup provisions over our sample period. Using several prior snapshots of the TASS database over 2002–2012, we find that only 6% of our sample funds change their lockup. We also repeat our analysis using the lockup information contained in the earliest available snapshot for each fund. The results are qualitatively similar and available upon request.

2.3. Sample formation

We start with original 13F filings and remove the amendments.[6] The 13F filing rules require market values of the holdings to be reported in thousands. We remove any filings that do not comply with this requirement, as indicated by a variable denoted "mv_multiplier" in the Whale Wisdom data set. As a further check on reporting accuracy, we calculate market values of the reported holdings as the shares held reported multiplied by prices looked up in the Center for Reserach in Security Prices (CRSP). We eliminate any stock holdings in which the market values reported do not match these calculated market values. We drop the 1% of filings that have the largest equity market value in each quarter.

Next, we drop all positions, such as 13F-reportable convertible bonds, that are not classified by Whale Wisdom as either equity or equity options. We also drop positions that have missing or negative values for reported shares held, as well as those that do not have a matching CUSIP or quarter-end stock price in CRSP. For option positions, a similar filter is applied based on the underlying stocks. We also cross-check several observations of the Whale Wisdom data with the raw 13F filings on EDGAR. This leads to a few more changes to the final sample.

We sort managers into categories based on the lockup provisions of their underlying funds. If all of a manager's funds have lockup periods, the manager is classified as "lockup." If all funds lack lockup periods, the manager is classified as "non-lockup." We drop the remaining "mixed lockup" managers and one additional manager for which the lockup period of its underlying funds is missing from TASS. After applying these filters, our final sample contains 6,547 13F filings corresponding to 365 filing managers over the 1999–2011 period.[7]

2.4. Summary statistics

Panel A of Table 1 presents summary information for the final sample of hedge fund managers. Lockup managers are associated with significantly higher portfolio returns (0.99% versus 0.79% per month), on average, consistent with prior findings of a positive lockup premium. Also, lockup

[6] Amendments to Form 13F either are restatements or disclose additional holdings from a prior quarter that were not disclosed in the original filing as part of a confidential treatment request. We follow prior research and focus on the original filings only. See Aragon, Hertzel, and Shi (2013) and Agarwal, Jiang, Tang, and Yang (2013) for analysis of confidential treatment amendment filings.

[7] The number of managers in our sample is in line with the numbers reported in other papers focusing on 13F-filing hedge fund managers, including 306 from Griffin and Xu (2009), 250 from Aragon and Martin (2012) and Aragon, Hertzel, and Shi (2013), and 414 from Shi (2017).

managers have significantly higher assets under management (\$395.46 versus \$326.80 million). In aggregate (not tabulated), the combined sample held \$28.8 billion in assets under management in 1999, increased to \$88 billion during 2007, and then fell to \$54 billion by 2011. This rise and fall is consistent with the patterns observed in Ben-David, Franzoni, and Moussawi (2012; Table 1, Panel A) over 2004–2009.

Fig. 2 shows that lockups are employed by a minority of 13F filing managers (Panel A). This is consistent with existing findings that the proportion of all hedge funds using a lockup is significantly below 50% (Aragon, 2007). Panel B plots the average market value of disclosed 13F-reportable stock positions. The figure also shows interesting time series dynamics. The equity portfolio value of the non-lockup group falls by 22% from 2007 to 2009. For lockup managers, this variable falls by only 5% over those two years.

Panel B of Table 1 summarizes the characteristics of disclosed stock positions. Despite having larger portfolio AUM, on average, the lockup group reports a smaller position in 13(f) assets, both in terms of market value (\$1.88 versus \$3.17 billion) and number of positions (171 versus 222). Lockup managers could carry a larger footprint in less liquid markets, such as corporate debt markets, which fall outside the scope of 13F reporting. Consistent with this explanation, we find that lockup managers' 13(f) securities are typically less liquid than those held by the non-lockup group. This evidence is consistent with prior findings that hedge fund lockups are associated with greater asset illiquidity in fund portfolios (Aragon, 2007; Aragon, Liang, and Park, 2014).

Finally, in Panel C of Table 1, we summarize the long positions in put options on exchange-traded funds. These positions proxy for hedging market risk because ETFs track market indexes and put option values are negatively related to the underlying assets (i.e., negative delta). Lockup managers are significantly more likely to hold at least one put option as compared with non-lockup managers (12.51% versus 8.65%). Conditional on quarters in which managers hold at least one ETF put option, the aggregate notional value underlying the option hedges of lockup managers is \$239 million and significantly larger than that of the non-lockup group (\$112 million).

3. Fund flows, performance, and crises

In this section, we consider the summary evidence on lockup managers' advantage in both returns and flow of funds.

3.1. Is the lockup return advantage a crisis period phenomenon?

Panel A of Table 2 compares the average returns of lockup and non-lockup managers over various subperiods. Our evidence reveals significant time variation in the return difference (i.e., lockup premium) between these two groups. Managers that use lockups on their underlying funds experience an asset-weighted average return of 0.92% per month over 2007–2009 (financial crisis), as compared with only 0.39% for managers that do not have a lockup provision on any underlying fund. The difference, 0.53% per month, is statistically significant. The divergent return experience of hedge funds during crisis periods is further illustrated in Panel A of Fig. 3, which compares the cumulative monthly performance of lockup and non-lockup managers over the financial crisis. The results are striking. The cumulative price index (normalized to unity at 2007) increases by 35% for lockup managers over 2007–2009, as compared with only 12% for non-lockup managers.[8]

Our analysis also covers the tech bubble (1999–2001). While this period was not a full-blown banking or financial crisis, the rapid rise and fall in technology stock prices exposed many funds to liquidation risks. Brunnermeier and Nagel (2004) note that investor redemptions forced one fund (Jaguar) to liquidate because it was underweighted in tech stocks during the run-up, while another fund that was overweighted in tech stocks (Quantum) experienced extreme outflows as the prices of tech stocks tumbled.[9] The results in Panel A of Table 2 show a significant lockup premium over this period; that is, 1.08% per month and significant. In contrast, for the normal period lying outside the financial crisis and tech bubble periods, the lockup premium is -0.02% and not significant.

Finally, we repeat our performance comparisons of lockup and non-lockup managers based on lagged end-of-month VIX. This is motivated by the Nagel (2012) finding that higher levels of VIX are associated with greater expected returns from liquidity provision and the potential role of lockup managers as liquidity providers. We again find that the lockup premium is concentrated during periods of market stress, as proxied by periods of above median VIX.[10] Panel A of Fig. 1 presents a similar message by plotting the 12-month rolling average return spread between lockup

[8]We also compare the rates at which funds stop reporting to TASS due to fund liquidation and find that the dropout rate of lockup funds is lower than that of non-lockup funds (10.88% versus 15.74%). This evidence helps alleviate concerns that very bad lockups simply drop out of the sample during crises.

[9]Subsection 3.4 shows that lockup managers have a significant flow of funds advantage relative to non-lockup managers during the tech bubble (Table 4, Panel A). See also CNN Money (2000), one implication of which is that, during the period that prices of tech stocks are rapidly increasing, pressure sales can also be prevalent due to redemptions from funds that fail to exploit the technology stocks.

[10] Our results are similar when we identify high and low VIX based on whether the current VIX is above the historical median VIX level over an expanding window (instead of the full sample window).

and non-lockup managers over our sample period (with 90% confidence bands).

3.2. The lockup decision and investment strategy

A manager's decision to impose a lockup is likely to depend on the fund's investment strategy, which can be related to performance during crisis periods. For example, managers of locked capital could passively invest in commercial real estate or emerging markets that deliver higher illiquidity or risk premium and do not necessarily involve opportunistic trading during crisis periods. We therefore use several hedge fund return benchmarks to isolate the component of the lockup premium that is unrelated to risk and illiquidity.

Panels B and C of Table 2 show our estimates of the lockup premium after adjusting for risk using the Fung and Hsieh (2004) seven-factor model and an expanded nine-factor model, respectively.[11] Using either the seven- or nine-factor model, the magnitude of the lockup premium is largely unaffected and remains significant. This suggests that a greater exposure to market liquidity and risk among lockup funds cannot explain our findings.[12]

Hedge funds often report return data prior to their listing dates in the data set, a process known as backfilling. Prior studies note that backfilling could introduce an upward bias in estimates of average returns. This is because a manager could be more inclined to report the performance history of successful funds to the TASS database, while concealing the record of poor performers. Panel D of Table 2 presents the results after removing the backfilled return data, by keeping only the returns after the listing date of each fund in the data set. Although the evidence is statistically weaker in the smaller sample, the point estimates of the difference are similar, suggesting no systematic bias. The evidence for the non-backfilled sample provides further support for the finding that the lockup premium is greater during periods of market crises (compared with the normal period), and

[11] The seven factors are an equity market, size spread, bond market, and credit spread factors, plus three trend-following factors constructed based on Fung and Hsieh (2001). The nine-factor model contains the original seven factors plus the monthly return on the MSCI Emerging Market Index and the Pastor and Stambaugh (2003) market liquidity factor. The seven factors are available for download at http://faculty.fuqua.duke.edu/∼dah7/DataLibrary/TF-FAC.xls.

[12] We also find similar results (not tabulated) when we compute the lockup premium using style-adjusted returns in which we subtract from the raw return of each hedge fund the return on a Lipper index of hedge funds in the same investment style category; a lagged market model that includes the current and two monthly lags of the value-weighted stock market index return to control for nonsynchronous trading as motivated by Scholes and Williams (1977); an expanded Carhart (1997) model that includes the market return and size spread, value spread, and momentum factors, as well as the Pastor and Stambaugh (2003) market liquidity factor; and an expanded nine-factor model that also includes benchmarks for stock variance (Londono and Zhou, 2017) and carry premia (Brunnermeier, Nagel, and Pedersen, 2008).

significantly so during the financial crisis.

3.3. Scarce funding liquidity and the lockup return advantage

If having deployable capital is key during a crisis to take advantage of flow-induced trading opportunities, then the availability of alternative funding sources such as borrowing from prime brokers would seem to be an essential ingredient. For example, if borrowing costs are low, then managers could meet investor redemptions through available borrowing. This would narrow the flow of funds advantage of lockup managers (compared with non-lockup managers) and, hence, the lockup premium. We could therefore expect to find an even larger lockup premium when crisis periods coincide with high borrowing costs.[13]

We extend our Table 2 analysis of fund returns to include a further partition of high and low VIX periods based on whether borrowing costs are high or low. Commercially available databases, such as TASS, do not provide information on fund-level borrowing costs. Therefore, we focus on aggregate borrowing costs as proxied by either the Treasury-eurodollar (TED) spread or the (inverse of) the stock return on a value-weighted index of prime brokers stock returns (Boyson, Stahel, and Stulz, 2010; Ang, Gorovvy, and van Inwegen, 2011).

The results are presented in Table 3. Using either of the two measures, we find a larger and more significant return spread between lockup and non-lockup funds when we focus on periods in which both VIX and borrowing costs are high. In high VIX periods, the return spread is 0.49% per month (t-statistic = 2.05) when prime broker index returns are low (i.e., high borrowing costs) versus an insignificant return spread of 0.37% (t-statistic = 1.44) when prime broker returns are high (i.e., low borrowing costs). When we focus on low VIX periods, we do not find a significant return spread in either the high or low borrowing cost subperiods. A similar pattern holds when we sort on high versus low TED spread periods. Overall, the evidence shows that lockup capital is most advantageous when alternative sources of funding liquidity are scarce.

3.4. Does the lockup flow of funds advantage persist?

Table 4 summarizes the net investor flows to hedge fund managers. Among the non-lockup managers, we observe negative net flows (i.e., net outflows) during the tech bubble and financial

[13] Brunnermeier and Pedersen (2009) note that market volatility and funding liquidity tend to be reinforcing as higher volatility prompts prime brokers to increase margins and reduce lending to hedge funds. In turn, as available borrowing falls, some hedge funds can become capital-constrained and unable to provide liquidity to markets.

crisis periods, which is different from the positive average flows realized during normal months (0.26% per month). More important, the flow experience is different for lockup managers, with flows significantly higher than non-lockup managers, and also positive across market conditions. Panel B of Fig. 1 plots (rolling 12-month average) net flows separately for lockup and non-lockup managers over the full sample period. The evidence shows that the pattern of higher net flows among the lockup group is generally stable over time. During the financial crisis, cumulative net flows are -23% and +30% for non-lockup and lockup managers, respectively (Fig. 3, Panel B).

We interpret higher net flows of locked up funds as less outflows stemming from the lockup provisions, instead of other fund characteristics that are related to flows.[14] To further support this interpretation, we examine the interactions of lockups and the sensitivity of fund flows to past performance. If lockups per se drive flows, then net flows for lockups will exceed non-lockups flows when comparing a set of funds with similarly bad performance over a common period. Following exceptionally good performance, we would expect the two groups to have similar net flows.

To test the above hypothesis, we first identify all lockup managers in the top and bottom deciles of returns and pair each lockup manager with a matching set of non-lockup managers with similar returns in the same quarter. To designate a match, we require that the return be within 5 basis points of the return on the lockup manager. Table 5 shows that lockup managers with bottom decile returns experience net flows of -1.13% over the following month and that the net flows of a matched sample of non-lockup managers are lower, at -2.49% per month. The difference, 1.36% per month, is significant (t-statistic = 2.07). We find no significant difference in net flows during the month following top decile returns (t-statistic = 0.41). Overall, net flows for lockups exceed non-lockups following big drawdowns, but they are not very different following exceptionally good performance.

4. Opportunistic trading of lockup managers

Our evidence from hedge fund portfolio returns indicates that the lockup premium is concentrated during periods of market crisis. In this section, we use equity and option positions to examine whether lockup managers trade opportunistically against the distressed sales of non-lockup man-

[14]Ideally, gross flows would allow us to show that outflows are smaller for locked-up funds but that inflows are roughly similar to non-lockup funds. However, hedge funds do not report gross inflows and outflows separately.

agers.

Existing studies find that hedge fund managers significantly reduce their aggregate stock positions during the financial crisis and that this behavior is explained by investor redemptions in the underlying funds (Ben-David, Franzoni, and Moussawi, 2012). In other words, hedge fund managers reduced their stock positions to raise cash and meet investor redemptions. The importance of investor flows as a factor for stock trading behavior motivates a comparison based on differences in share restrictions. We posit that, given the evidence of greater flows among lockup managers, these managers will be better positioned to maintain, or even increase, their stock positions during the financial crisis. In this sense, we hypothesize that lockup managers trade opportunistically against non-lockup managers over this period.

Fig. 4 plots the percentage of total stock market capitalization held in aggregate by each group of managers, over 2007–2009. For example, at the end of 2007Q1, non-lockup managers collectively held stock market positions (as reported in Form 13F) of 1.66%. The group of lockup managers held only 0.63%. This is consistent with the evidence from Table 1 that lockup managers, on average, hold fewer positions in 13(f)-reportable securities as compared with the non-lockup group. The sum held by both groups, about 2.2%, is comparable to the figure reported by Ben-David, Franzoni, and Moussawi (2012) for their full sample of hedge fund managers.

The figure reveals an interesting pattern for the quarters around the Lehman bankruptcy (September 15, 2008). Non-lockup managers significantly decreased the proportion of total stock market capitalization held, from 2.52% to 1.85%, over 2008Q2 to 2008Q3. This is a larger drop than the 0.4% reported by Ben-David, Franzoni, and Moussawi (2012) for the full sample of managers over the same period. The difference can be explained by the lockup managers group, which increases its stock position from 0.63% to 1.04%. Thus, splitting the sample based on share restrictions uncovers important heterogeneity in trading behavior during the financial crisis.

4.1. Detecting distressed trading

Coval and Stafford (2007) show that the flow-induced trading of mutual funds can lead to price pressure and that investors who trade against these transactions can earn significant returns from liquidity provision. Likewise, in our hedge fund setting, we hypothesize that flow-driven trades of non-lockup managers would be accompanied by opposing trades with lockup managers.[15]

To lay the groundwork for such a test, we first examine whether the stock trading behavior of non-lockup hedge fund managers is related to the investor flows of the underlying funds. For each manager and quarter, we calculate the average change in share ownership (i.e., reported shares held divided by shares outstanding) across all stock positions that the manager held in the prior quarter.[16] We then sort manager and quarter observations into quintiles based on the manager's average monthly flows.

Table 6 reports averages of four stock trading variables for each flow quintile: the change in share ownership ($\Delta holdings$) and the percentage of positions that were maintained, expanded, reduced, and eliminated. The first column shows that the average monthly flow ranges from -8.09% to 12.78% across the flow quintiles. The remaining columns are generally consistent with a positive relation between hedge fund flow of funds and changes in hedge fund stock ownership. Moreover, 47% of all stock positions are eliminated, on average, by managers in the lowest flow decile, as compared with just 41% among managers in the highest flow quintile (t-statistic = 2.84). Low flow managers are also associated with significantly lower expansions of positions (22% versus 28%, t-statistic = 5.01).

The variable $\%netsell$ ($= \%Red. + \%Elim. - \%Maint. - \%Exp$) shows an overall negative relation between greater net selling and fund flows. The last column ($Final\ 13F$?) is an indicator variable valued one for the final 13F filing reported by a manager and, therefore, is a plausible proxy for distress. We find that 8.47% of filings in the lowest quintile are final reports, as compared with only 2.25% in the top quintile.

[15] Possible channels for how lockup managers figure out which stocks to trade in opportunistically include: modeling and predicting competitors funds flows based on available data on past returns, holdings, and current conditions (Shive and Yun, 2013), monitoring price movements in stocks with limit buy orders that are likely to be executed in the event of distressed selling, and learning of competitors' liquidity needs through prime broker and counterparty relations (Brunnermeier and Pedersen, 2005, Table 1).

[16] We find evidence that managers that stop filing 13F are more likely to experience financial distress, as indicated by a significantly greater likelihood that the manager stops voluntarily reporting AUM to TASS in the following quarters. Therefore, in such cases in which a manager does not file a 13F in the subsequent quarter, we assume that all stock positions are liquidated. However, our results are both qualitatively and quantitatively similar when we drop these observations from the analysis.

4.2. Testing a price pressure hypothesis

Similar to Coval and Stafford (2007), we define a stock-level measure of aggregate liquidity-motivated trading by non-lockup managers:

$$\begin{aligned} pressure_{i,q} = & \sum_j \left(max\left(0, \Delta holdings_{j,i,q}\right) | flow_{j,t} > percentile(80th)\right) \\ - & \sum_j \left(max\left(0, -\Delta holdings_{j,i,q}\right) | flow_{j,t} < percentile(20th)\right), \end{aligned} \tag{1}$$

where $\Delta holdings_{j,i,q}$ is manager j's change in ownership of stock i between the end of quarters $q-1$ and q and $flow_{j,q}$ represents average monthly flow during quarter q. We require at least one lockup or non-lockup manager to hold the stock in the quarter to calculate the pressure variable.[17] Thus, a stock with positive *pressure* represents flow-induced buying, and negative *pressure* corresponds to flow-induced selling by non-lockup managers.

We fit variations of the pooled regression:

$$\Delta holdings^{L}_{i,q} = \alpha + \beta_1 pressure_{i,q} + \beta_2 non\text{-}pressure_{i,q} + controls + \epsilon_{i,q}, \tag{2}$$

where $\Delta holding^{L}_{i,q}$ is the aggregate change in ownership by lockup managers of stock i during quarter q. A negative coefficient on *pressure* (β_1) would indicate that lockup managers are trading against the flow-motivated trading of non-lockup managers.

Following Shive and Yun (2013), we control for several other variables that are plausibly related to the stock trading of lockup hedge fund managers. We include the aggregate non-pressure trading of non-lockup managers ($non\text{-}pressure_{i,q}$), which is the difference between the aggregate trading of non-lockup managers ($\Delta holding^{NL}_{i,q}$) and $pressure_{i,q}$. This is to control for common factors, other than flow-induced trading, that impact hedge fund managers' trading behavior. This could reflect, for example, commonality in investment styles across lockup and non-lockup managers. We also include calendar quarter dummies and several lagged observations of stock-specific variables, such as market capitalization, market return beta, return variance, average return, turnover, and bid-ask spread. All explanatory variables (except dummies) are standardized to have a zero mean and unit variance.

[17] Coval and Stafford (2007) require at least ten mutual fund owners to calculate *pressure* for a given stock. Given that our sample contains a much smaller number of managers, imposing a similar criterion in our setting would eliminate the majority of our observations.

4.2.1. Baseline analysis

Table 7 presents the baseline regression results in which we estimate Eq. (2) over the full sample period and market crisis subperiods. Model 1 of Panel A shows that the coefficient on total (i.e., pressure plus non-pressure) trading by non-lockup managers ($\Delta holding_{i,q}^{NL}$) is positive and significant. This indicates that, in general, both groups trade in the same direction. Model (2) shows that this pattern is entirely driven by the non-pressure component of non-lockup trading. Model 3 shows the results from a further partitioning of non-lockup trading whereby *pressure* is divided into positive (*pressure buys*) and negative (*pressure sells*) parts. We find a negative relation between change in lockup ownership and pressure sells but the coefficient is not significant. Therefore, whereas lockup and non-lockup managers trade in the same direction of stocks that are not under pressure from the flows of non-lockup hedge funds, no similar commonality exists among trades of stocks under pressure.

Panel A of Table 7 uncovers stronger evidence of opportunistic trading during periods of high VIX. Stock trading by lockup managers during high VIX periods, Model 8, is negatively related to the pressure sells of non-lockup managers. We estimate that flow-motivated drop in non-lockup stock ownership of one standard deviation decrease in *pressure sells* is associated with an increase in lockup ownership of 50 basis points. While the coefficient is only marginally significant (t-statistic = 1.72), it is significantly different from the estimated coefficients on *pressure buys* and *non-pressure*. In contrast, during low VIX periods (Model 7), we find no evidence that *pressure sells* is significantly different either from zero (t-statistic = 0.44) or from the coefficients of *pressure buys* and *non-pressure*.

4.2.2. Low versus high funding liquidity regimes

When high volatility coincides with high borrowing costs, managers find it more costly to borrow as a means to meet investor redemptions. Distressed sales should be higher. In Panels B and C of Table 7, we split the sample of high volatility periods into high and low funding liquidity regimes. Overall, we find evidence that lockup buying of stocks sold in distress by non-lockup managers is more pronounced with both high VIX and low funding liquidity. For example, in Panel B, the coefficient on *pressure sells* is -0.0072 and significant during periods of both high VIX and high TED spread. Thus, a one standard deviation increase in flow-motivated selling by non-lockup managers is associated with an increase in lockup ownership of 72 basis points. The coefficient is smaller in magnitude (-0.0022) and insignificant when VIX is high and TED spread is low.

In Panel C, we report similar findings using prime broker stock returns as a proxy for borrowing costs. The coefficient on *pressure sells* is significant and lower than that of *pressure buys* (p-value $(b) = (c)$).

4.2.3. Do less liquid stocks present greater opportunities?

Prior literature argues that distressed managers try to minimize the costs of fire sales by selling their most liquid assets first (Scholes, 2000; Ben-David, Franzoni, and Moussawi, 2012). By selling liquid stocks, these managers could expect a lower price impact and fire sale discount as compared with selling illiquid stocks. Therefore, we would expect lockup managers to trade opportunistically in illiquid stock markets, where liquidity premiums are largest. To test this hypothesis, we repeat our analysis on stock subsamples based on ex ante stock market liquidity.

Panel A of Table 8 shows the results for three subsamples of illiquid stocks, depending on whether illiquidity is defined as the bottom quintile of stock market capitalization (Model 1), the top quintile of bid-ask spread (Model 3), or the top quintile of the Amihud (2002) illiquidity measure (Model 5). The evidence strongly shows a significant negative relation between lockup manager trading and pressure sells across all three measures of illiquidity. For example, within the subsample of high bid-ask spread stocks, Model 3 shows that a one standard deviation decrease in the pressure sells variable (i.e., an increase in distressed selling) is associated with a 158 basis point increase in ownership by the lockup group. We find no significant relation between lockup and nonpressure trading.

Table 8 also shows the results for the three subsamples of liquid stocks in Models 2, 4, and 6. In contrast to the findings for illiquid stocks, we find no significant negative relation between lockup trading and pressure sells. Overall, the stock-level analysis reveals that lockup managers trade against the distressed sells of the non-lockup managers, especially when opportunities are likely to be greatest, such as during crisis and low funding liquidity periods, and in the most illiquid stock markets.

4.2.4. Can index options aid opportunistic trading?

Prior studies show that predatory trading (Brunnermeier and Pedersen, 2005) and frictions to mobilizing arbitrage capital (Mitchell, Pedersen, and Pulvino, 2007) can allow temporary price pressure to intensify and persist for extended periods. Buyers of a distressed stock can profit when the price reverses. In the meantime, long positions in these stocks also carry exposure to market risk. Identifying an individual distressed stock is basically an idiosyncratic bet, but the risk of the position is not. This market exposure could be too high to bear in crisis periods. We thus could expect significant hedging behavior. We posit that a manager would be more inclined to deploy locked-up capital in distress sale stocks while hedging market risk using, for example, the equity option market.

Table 8 reports the results for the subsample of managers that hold a long position in at least one put option on an ETF at the end of the quarter and, therefore, are a group of plausible hedgers of market risk.[18] We find a negative and significant relation between lockup-hedger manager stock trading demand and non-lockup pressure sells. We do not find a significant relation for the subsample of lockup managers that do not hold a put option on an ETF (non-hedgers).

Next, we gauge the magnitude of market risk hedging via ETF puts. We compute the contribution of distressed stock buying to the overall market risk of the portfolio (delta acquired). This is defined as the market value of the shares purchased times the stock's market beta, summed across all distressed stocks purchased during the quarter. To estimate the offsetting contribution to market risk from the manager's ETF put positions (hedging provided), we take the aggregate (i.e., summed over ETF puts) notional value of the option position, times the underlying ETF's market beta, times the option's delta. We obtain option deltas from OptionMetrics. Because Form 13F does not require the option's exercise price or maturity, we use the average delta across corresponding ETF puts with a time to maturity of two months or less and an exercise price that is less than the current stock price by at most 5% (i.e., 5% out of the money).

Panel B of Table 8 compares our estimates of delta acquired from distressed stock purchases with the hedging provided by ETF put options. For example, assuming that lockup managers hold puts that are within 5% out of the money, the delta acquired is \$105 million and the hedging provided is \$75 million. The difference, \$30 million, is not significant, meaning that we cannot reject a null hypothesis of full delta hedging. The difference is also insignificant when assuming an exercise price is within 1% out of the money.[19]

[18] Like stock positions, the Form 13F reporting rules require managers to report only long positions in options (i.e., written options are not reported).

[19] We lose a few observations because we were unable to find a matching option contract in OptionMetrics under the stricter 1% criteria.

4.3. Opportunistic stock purchases versus usual trading

To the extent lockup and non-lockup managers usually pursue different strategies, our hypotheses imply that lockup managers would have to deviate from their usual trading patterns during crisis periods. A simple test of this implication is to study whether the types of stocks that lockup managers are trading during crisis periods, measured by characteristics or by tracking error relative to past holdings, are different as compared with noncrisis periods.

We classify each of the stocks purchased by lockup managers during crisis periods into quintiles based on three stock characteristics: market capitalization, bid-ask spread, and Amihud illiquidity measure. We then compute a value-weighted average quintile among purchased stocks for each manager and quarter and take an asset-weighted average across managers in the same quarter. We make a similar calculation across stocks held by lockup managers outside crisis periods to measure usual stock trading patterns. By focusing on quintiles, instead of raw values of characteristics, we control for systematic changes in the levels of these variables during crisis and noncrisis periods.

Table 9 shows that lockup managers depart significantly from their usual trading patterns during crisis periods. Stocks purchased by lockup managers during crisis periods are more liquid (i.e., lower bid-ask spread, lower Amihud illiquidity) and have smaller market capitalization. For example, Panel A shows that stocks purchased during the tech bubble and financial crisis have an average Amihud illiquidity quintile of 1.16, which is significantly lower (i.e., more liquid) than that of stocks purchased outside these periods (1.31). We find very similar results for periods of high and low VIX (Panel B).

Overall, this evidence helps solidify the opportunism story. Lockup managers could prefer to hold relatively less liquid stocks (Table 1), yet distressed funds prefer to sell liquid stocks during sell-off quarters (Ben-David, Franzoni, and Moussawi, 2012). Consequently, the distressed stocks bought by the lockup group look more liquid compared with their holdings in normal times.

4.4. Option hedging and hedge fund returns

Our evidence shows that option hedges are associated with greater opportunistic trading of distressed stocks. At the same time, the existing literature finds a return premium for hedge funds that use options (Aragon and Martin, 2012) and those that use lockups (Liang, 1999; Aragon, 2007; Agarwal, Daniel, and Naik, 2009). Given that option hedging is more common among lockup managers (Table 1), an interesting question is whether lockups and options have separate explanatory power for fund returns and whether their joint usage can further enhance returns.

In Table 10, we present the results from regressions of monthly hedge fund returns on a dummy variable for whether the manager is a lockup manager, a dummy variable for whether the manager ever holds an ETF put option over our sample period, and their interaction. In Model 3, we find a positive and significant coefficient on the interaction variable. The lockup premium is 25.2 basis points per month higher for managers that use ETF put options compared with managers that do not. The lockup and option premiums are insignificant when these devices are not deployed together.

In sum, the evidence points to a positive interaction between lockups and options in hedge fund returns. This finding resonates well with the prediction of Titman and Tiu (2011) that managers with high stock selection abilities choose to have less exposure to market risk. Our analysis of stock trading uncovers a specific example in which informed stock trading is accompanied by factor hedging; that is, lockup managers using ETF puts are more aggressive in trading against the distressed sales of non-lockup managers.

5. Conclusion

Our findings shed light on the mechanics behind two findings from the hedge fund performance literature: the higher excess returns among funds with locked-up capital (Aragon, 2007; Agarwal, Daniel, and Naik, 2009) and among funds that hold equity options positions (Aragon and Martin, 2012). A hedge fund lockup premium not only exists, but it also increases significantly during market crises principally when crisis periods coincide with high borrowing costs. This phenomenon suggests that share restrictions allow managers to capture greater profits from opportunistic trading during these periods, especially when alternative sources of funding liquidity are scarce.

Fund flows and evidence from stock trading support this interpretation. Hedge fund investor flows can explain pressure-related stock trading by non-lockup managers. Lockup managers trade against the extreme flows of their non-lockup counterparts in less liquid stock markets and during periods of market crisis. Evidence of opportunistic trading is stronger among lockup managers with option-implemented stock market hedges, suggesting that they manage market risk from trading against fire sale pressure. Option hedging is more frequent among lockup managers and, when used together, options and lockups significantly enhance hedge fund portfolio returns.

Our findings have implications for financial disclosure regulation. While hedge funds face far fewer disclosure requirements than mutual funds, many are required to publicly disclose their long equity and equity option positions on Form 13F every quarter. This information, together with careful monitoring of price movements, could be used to predict flow-motivated sales and trading opportunities. Based on our evidence, requiring hedge fund managers to disclose even more detailed information about their portfolio holdings and investor flows could facilitate the identification of stocks to trade in opportunistically and the deployment of locked capital during a crisis.

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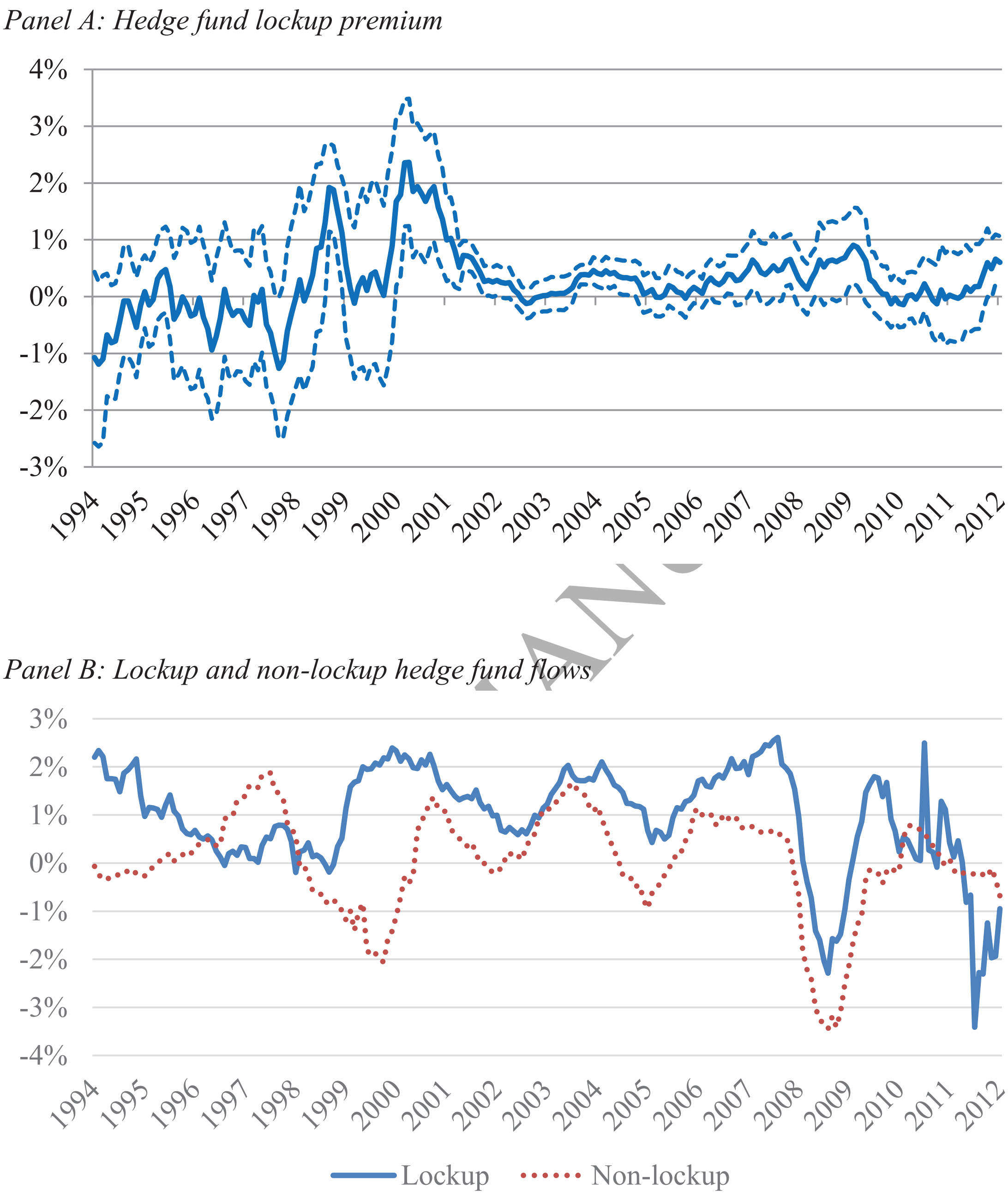
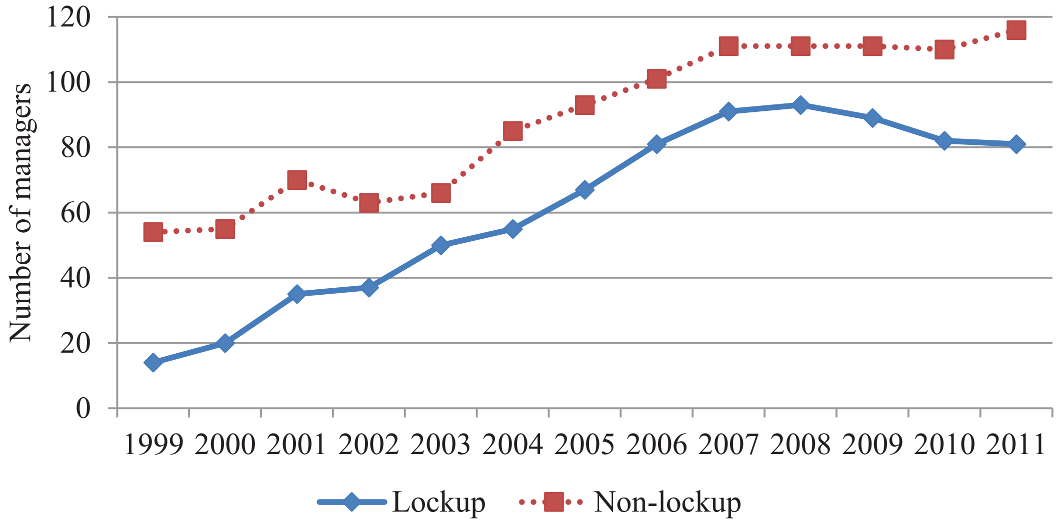


Fig. 1. Hedge fund performance and flows over the full sample period. Panel A plots the 12-month rolling average return spread between lockup and non-lockup managers. Ninety percent confidence bands of sample averages are represented by dashed lines. Panel B shows the 12-month rolling average flows separately for lockup and non-lockup managers. Manager returns and flows are asset-weighted averages of underlying fund returns and flows.

Panel A: Number of managers



Panel B: Mean equity portfolio holdings (millions of dollars)

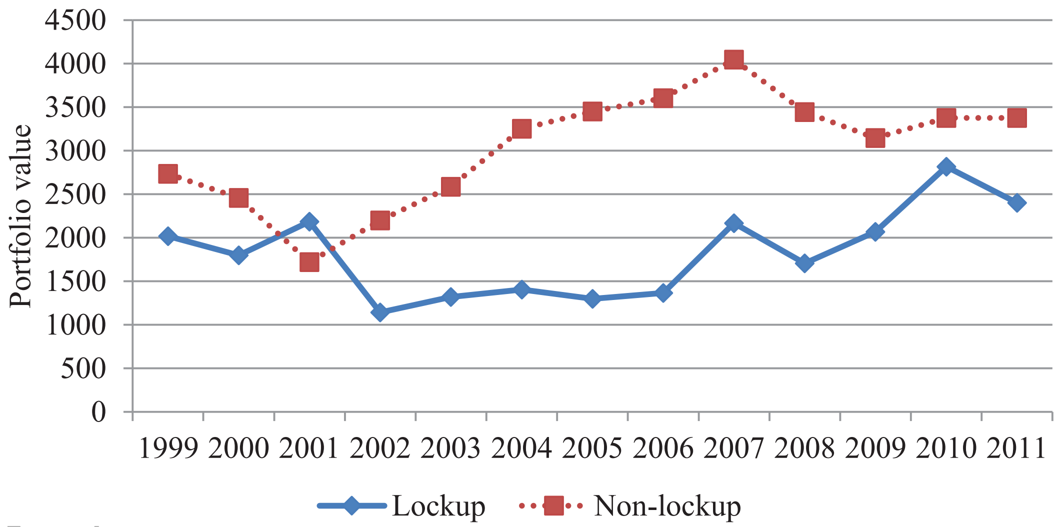
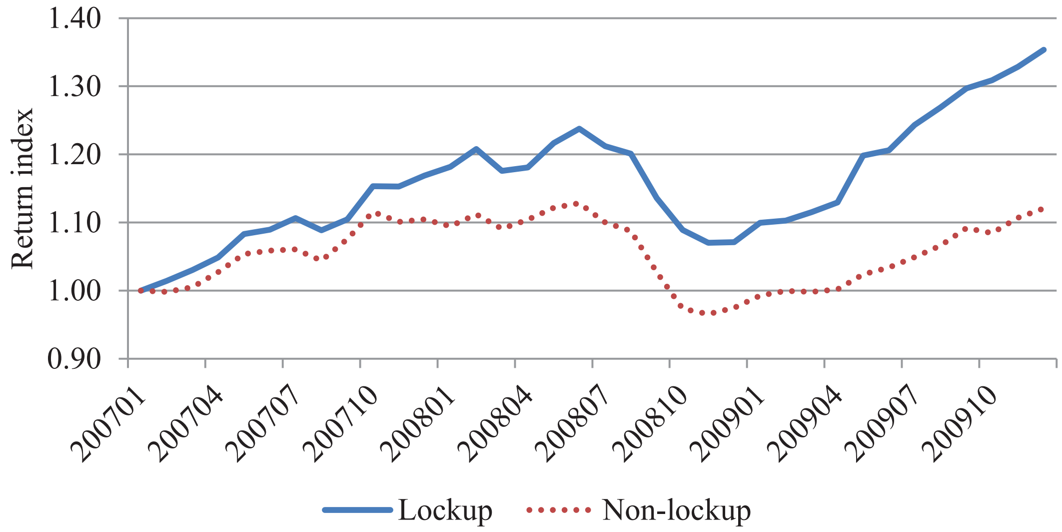


Fig. 2. Number of managers and mean equity portfolio value, by year. The graphs show the number of hedge fund managers in our sample each year (Panel A) and the cross-sectional mean market value (millions of dollars) of stock positions held at each quarter-end within the year (Panel B). Numbers are reported separately for the subsample of lockup (solid line) and non-lockup (dashed line) managers.

Panel A: Total return index



Panel B: Total flow index

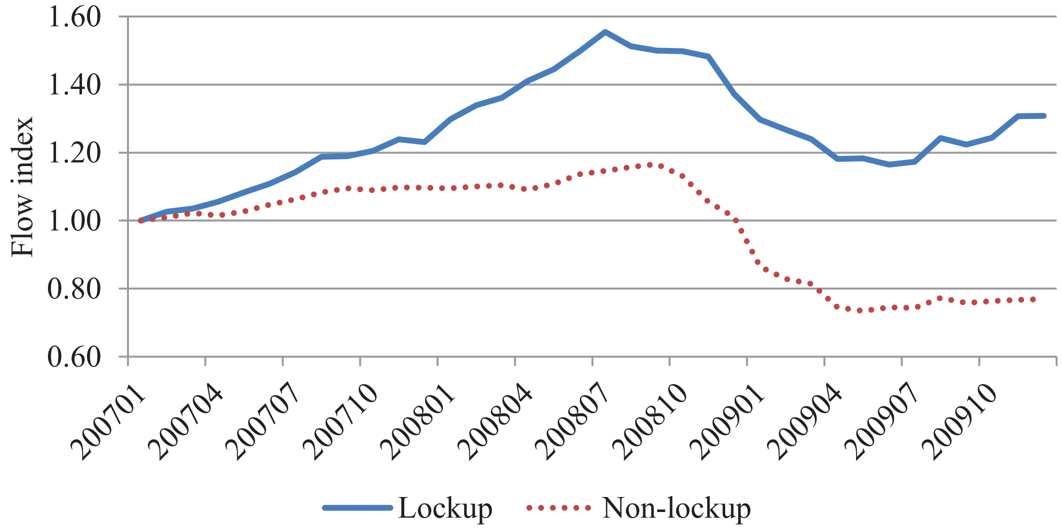


Fig. 3. Hedge fund performance and flows over the financial crisis and post-crisis period. The graphs plot the total return index (Panel A) and total flow index (Panel B) for lockup and non-lockup hedge fund managers over 2007–2009.

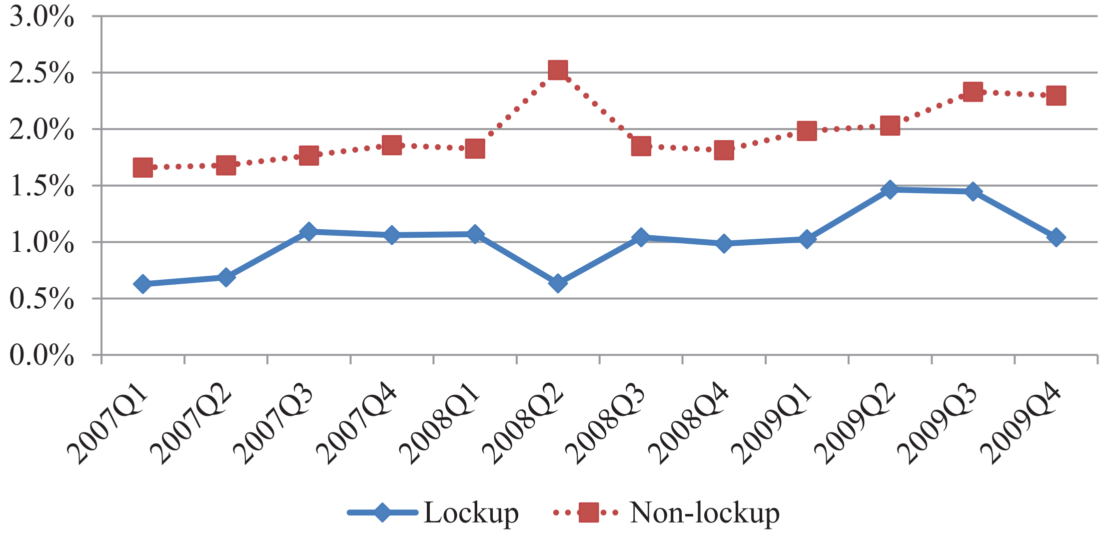


Fig. 4. Aggregate stock market capitalization held by lockup and non-lockup managers. The figure plots the aggregate stock market capitalization held by lockup and non-lockup managers over 2007–2009.

Table 1
Sample characteristics

The table compares portfolio characteristics of lockup and non-lockup managers. Lockup managers use a lockup provision on all underlying funds and non-lockup managers do not use a lockup provision on any underlying funds. Panel A summarizes variables from Tremont Advisor Selection System (Lipper TASS). Assets under management (AUM) are aggregated across all of the manager funds. Monthly returns and net flows are asset-weighted averages across the manager funds. Panel B describes the characteristics of stock positions reported in quarterly filings of Form 13F. Value (number) of positions is the total market value (number) of stock positions reported by the manager at each quarter-end. The remaining characteristics are averages across stocks disclosed in quarterly filings. Bid-ask spread, Amihud illiquidity, stock return beta, average stock return, and stock return volatility are computed over the prior 36 months. Panel C describes exchange-traded fund (ETF) put option positions disclosed in quarterly filings. Option hedge dummy equals one if the manager holds at least one put option on an ETF during the quarter. The final two rows summarize the number of ETF puts and aggregate notional value (millions of dollars) underlying ETF puts held by each manager that holds at least one ETF put at quarter-end. The final column reports the t-statistic from the difference in means test between lockup and non-lockup managers. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	Median		Mean		
Characteristic	Lockup	Non-lockup	Lockup	Non-lockup	t-statistic
Panel A: Monthly portfolio characteristics from TASS					
AUM (millions of dollars)	92.00	83.40	395.46	326.80	5.41***
Net flows	0.23%	0.06%	2.57%	2.21%	0.57
Return	0.89%	0.72%	0.99%	0.79%	3.29***
Panel B: Characteristics of stock positions					
Value of positions (millions of dollars)	246.79	380.80	1881.67	3173.96	-6.66***
Number of positions	46.00	101.00	170.96	222.21	-6.31***
log(market capitalization)	21.57	21.95	21.57	21.92	-11.27***
Bid-ask spread	0.24%	0.20%	0.47%	0.45%	1.61
Amihud illiquidity measure	0.02	0.01	0.50	0.26	3.72***
Stock return beta	1.29	1.24	1.33	1.29	4.60***
Average stock return	1.44%	1.52%	1.42%	1.58%	-4.86***
Stock return volatility	2.10%	1.88%	2.48%	2.28%	4.79***
Panel C: Characteristics of option hedging positions					
Option hedge dummy	0.00%	0.00%	12.51%	8.65%	5.08***
Number of puts	2.00	1.00	4.98	1.99	5.74***
Size of puts (millions of dollars)	29.20	23.30	239.00	112.00	3.61***

Table 2
Hedge fund performance during market crises

The table reports monthly portfolio returns for lockup and non-lockup hedge fund managers. Monthly returns are asset-weighted averages of the underlying fund returns in the month. Asset weights are based on fund assets at the end of the previous month. Raw returns, Fung and Hsieh (2004) seven-factor alphas, and extended Fung and Hsieh (2004) nine-factor alphas are reported in Panels A, B, and C, respectively. The extended Fung and Hsieh (2004) nine-factor model includes the original seven factors, the MSCI Emerging Market Index, and the Pastor and Stambaugh (2003) market liquidity factor. Panel D reports the nine-factor alphas after removing the backfilled return data, by keeping only the returns after the listing date of each fund in the data set. Lockup managers use a lockup provision on all underlying funds and non-lockup managers do not use a lockup provision on any underlying fund. Fund returns and assets under management are those reported to Tremont Advisor Selection System (Lipper TASS). Averages are reported for various subperiods, including the tech bubble (January 1999–December 2001) and the financial crisis (January 2007–December 2009). “Normal” covers all other months over February 1994–December 2012. VIX subsamples are based on whether the Volatility Index at the prior month-end is below (low) or above (high) its median value. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	Lockup			Non-lockup			Difference	
Subperiod	N	Mean	Standard deviation	N	Mean	Standard deviation	Mean	t-statistic
Panel A: Raw returns								
Normal	156	0.78%	2.59%	156	0.80%	1.93%	-0.02%	-0.19
Tech bubble	36	1.93%	3.06%	36	0.86%	4.56%	1.08%	2.79***
Financial crisis	36	0.92%	2.23%	36	0.39%	2.02%	0.53%	3.06***
Low VIX	114	0.94%	2.27%	114	0.89%	1.73%	0.05%	0.36
High VIX	114	1.02%	2.98%	114	0.60%	3.14%	0.42%	2.38**
Panel B: Fung and Hsieh (2004) alphas								
Normal	156	0.19%	1.77%	156	0.28%	1.49%	-0.10%	-0.79
Tech bubble	36	1.55%	1.77%	36	0.45%	3.42%	1.10%	2.80***
Financial crisis	36	0.74%	2.33%	36	0.23%	1.97%	0.52%	2.94***
Low VIX	114	0.39%	1.70%	114	0.45%	1.26%	-0.05%	-0.39
High VIX	114	0.59%	2.14%	114	0.15%	2.50%	0.43%	2.50**

Table 2 (cont.)

Panel C: Extended Fung and Hsieh (2004) alphas								
Normal	156	0.18%	1.76%	156	0.28%	1.52%	-0.09%	-0.77
Tech bubble	36	1.45%	1.75%	36	0.36%	3.33%	1.09%	2.71***
Financial crisis	36	0.58%	2.09%	36	0.10%	1.75%	0.49%	2.79***
Low VIX	114	0.31%	1.64%	114	0.38%	1.23%	-0.07%	-0.49
High VIX	114	0.58%	2.06%	114	0.14%	2.46%	0.44%	2.52**
Panel D: Extended Fung and Hsieh (2004) alphas, no backfilled returns								
Normal	150	0.27%	2.35%	150	0.14%	1.97%	0.13%	0.67
Tech bubble	36	1.68%	2.71%	36	0.35%	6.21%	1.32%	1.55
Financial crisis	36	0.55%	2.06%	36	0.09%	2.08%	0.46%	2.30**
Low VIX	109	0.41%	1.26%	109	0.19%	1.97%	0.22%	1.09
High VIX	113	0.67%	3.15%	113	0.14%	3.85%	0.53%	1.61

Table 3
Hedge fund performance during market crises: high versus low borrowing costs

The table reports monthly alphas for lockup and non-lockup hedge fund managers. Alphas are computed from portfolio returns using the extended Fung and Hsieh (2004) nine-factor model. Monthly returns are asset-weighted averages of the underlying fund returns in the month. Asset weights are based on fund assets at the end of the previous month. Averages are reported for various subsamples based on whether the Volatility Index (VIX) and borrowing costs are above or below their medians at the prior month-end. Borrowing costs are measured using the TED spread and prime broker returns. The TED spread is the Treasury-eurodollar spread reported in the Federal Reserve website (https://fred.stlouisfed.org/). Following Teo (2011), prime broker stock returns are computed as the value-weighted stock returns of Goldman Sachs, Morgan Stanley, Bear Stearns, UBS AG, Bank of America, Citigroup, Merrill Lynch, Lehman Brothers, Credit Suisse, Deutsche Bank, and Bank of New York Mellon. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	Lockup			Non-lockup			Difference	
VIX, borrow costs	N	Mean	Standard deviation	N	Mean	Standard deviation	Mean	t-statistic
Panel A: Borrowing costs indicated by high TED spread								
Low, low	65	0.16%	1.47%	65	0.06%	0.98%	0.11%	0.73
Low, high	48	0.48%	1.86%	48	0.82%	1.40%	-0.33%	-1.35
High, low	45	0.13%	1.07%	45	-0.14%	1.21%	0.27%	1.72*
High, high	69	0.87%	2.46%	69	0.32%	3.00%	0.54%	2.03**
Panel B: Borrowing costs indicated by low prime broker stock returns								
Low, low	66	0.38%	1.55%	66	0.41%	1.34%	-0.03%	-0.20
Low, high	48	0.23%	1.78%	48	0.34%	1.07%	-0.11%	-0.50
High, low	48	0.62%	1.93%	48	0.25%	1.78%	0.37%	1.44
High, high	66	0.55%	2.16%	66	0.06%	2.86%	0.49%	2.05**

Table 4
Hedge fund flows during market crises

The table reports monthly fund flows for lockup and non-lockup hedge fund managers. Monthly flows are asset-weighted averages of the underlying monthly fund flows. Asset weights are based on fund assets at the end of the previous month. Fund flows are calculated as the monthly percentage change in assets under management minus the monthly return. Averages are reported for various subperiods, including the tech Bubble (January 1999–December 2001) and the financial crisis (January 2007–December 2009). "Normal" covers all other months over February 1994–December 2012. VIX subsamples are based on whether the Volatility Index at the prior month-end is below (low) or above (high) its median value. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	Lockup			Non-lockup			Difference	
Subperiod	N	Mean	Standard deviation	N	Mean	Standard deviation	Mean	t-statistic
Panel A: All observations								
Normal	156	0.79%	4.35%	156	0.26%	1.59%	0.52%	1.50
Tech bubble	36	1.70%	1.63%	36	-0.41%	2.67%	2.12%	4.19***
Financial crisis	36	0.82%	3.03%	36	-0.69%	3.42%	1.51%	3.60***
Low VIX	114	1.31%	4.58%	114	0.31%	1.31%	0.99%	2.44**
High VIX	114	0.57%	2.92%	114	-0.30%	2.77%	0.87%	2.59**
Panel B: Excluding backfilled observations								
Normal	150	0.45%	4.76%	150	0.88%	3.06%	-0.43%	-0.93
Tech bubble	36	1.07%	2.19%	36	-0.12%	2.91%	1.20%	2.04**
Financial crisis	36	0.79%	2.87%	36	-0.75%	3.67%	1.54%	3.49***
Low VIX	109	0.89%	5.11%	109	0.85%	3.22%	0.04%	0.07
High VIX	113	0.32%	2.99%	113	0.06%	3.13%	0.26%	0.69

Table 5
Comparison of net flows following large fund returns

This table compares the monthly net flows of lockup managers with a matched sample of non-lockup managers based on their portfolio returns over the prior three months. Lockup managers are sorted into deciles each month based on their average portfolio return over the prior three months. Large positive and negative fund returns are identified as the top and bottom deciles, respectively. Each lockup manager-month observation is then matched with non-lockup managers in the same month with similar average returns over the prior three months. To qualify as a match, the difference in monthly performance between lockup and non-lockup managers is required to be less than 0.1% (Panel A), 0.05% (Panel B), or 0.01% (Panel C). Monthly flows are asset-weighted averages of the underlying fund flows in the month. Asset weights are based on fund assets at the end of the prior quarter. Fund flows are calculated as the monthly percentage change in assets under management minus the monthly return. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Decile	N	Lockup	Non-lockup	Difference	t-statistic
Panel A: Matching fund return within 10 basis points					
Top decile (best performer)	438	3.65%	2.72%	0.94%	1.45
Bottom decile (worst performer)	508	-1.41%	-2.43%	1.02%	1.98**
Panel B: Matching fund return within 5 basis points					
Top decile (best performer)	240	3.56%	3.16%	0.40%	0.41
Bottom decile (worst performer)	313	-1.13%	-2.49%	1.36%	2.07**
Panel C: Matching fund return within 1 basis point					
Top decile (best performer)	68	3.76%	3.32%	0.45%	0.22
Bottom decile (worst performer)	68	-0.87%	-4.28%	3.41%	2.20**

Table 6
Stock trading behavior of non-lockup managers associated with fund flows (1999-2011)

This table summarizes how hedge fund manager stock positions change conditional on actual fund flows. Flows are calculated each month as the percentage change in assets under management minus the fund return. Monthly flows are then aggregated to obtain quarterly flows. The full sample of manager and quarter observations with available flow data are sorted according to quarterly flows. Within each flow quintile, the table reports the average percentage change in position ownership ($\Delta holdings$) and the fraction of positions that were maintained (%*Maint.*), expanded (%*Exp.*), reduced (%*Red.*), or eliminated (%*Elim.*). %*net sell* equals $\%Red. + \%Elim. - \%Maint. - \%Exp.$ "$Final$ 13F?" indicates whether the current quarter corresponds to the final 13F filing reported by the manager (except for the final quarter in our sample period). Stock positions that were not held in the prior quarter are excluded. Results are reported for non-lockup managers. The table reports numbers from equal-weighting of manager and quarter observations of stock trading. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Quintile	Flow	$\Delta holdings$	%*Maint.*	%*Exp.*	%*Red.*	%*Elim.*	%*Net sell*	*Final 13F?*
1	-8.09%	-0.14%	1.69%	22.14%	29.16%	47.00%	52.33%	8.47%
2	-1.15%	-0.15%	2.37%	25.66%	34.47%	37.50%	43.94%	4.51%
3	0.01%	-0.15%	2.57%	26.75%	35.28%	35.41%	41.37%	6.76%
4	1.14%	-0.14%	2.14%	26.62%	30.79%	40.45%	42.48%	4.51%
5	12.78%	-0.11%	1.78%	28.38%	28.85%	40.99%	39.68%	2.25%
diff(5–1)	20.86%	0.03%	0.09%	6.24%	-0.31%	-6.01%	-12.65%	-6.22%
t-statistic	9.60***	1.43	0.32	5.01***	-0.24	-2.84***	-4.83***	-3.71***

Table 7
Regressions of lockup manager stock trading on non-lockup manager trading

The table reports the results from regressing the change in equity holdings of lockup managers on non-lockup manager change in equity holding ($\Delta holdings^{NL}$) and its non-pressure and pressure components. *pressure* is the difference between the change in holdings (if positive; otherwise, zero) of non-lockup managers with top quintile quarterly fund flows minus the change in holdings (if negative; otherwise, zero) of non-lockup managers with bottom quintile quarterly fund flows. *pressure buys* equals max{*pressure*,0}; and *pressure sells* equals min{*pressure*,0}. *non-pressure* is defined as $\Delta holdings^{NL}$ minus *pressure*. We use, as other stock control variables (not tabulated), quarterly lagged stock-specific variables, including market capitalization, turnover, and historical market beta, return variance, mean return, bid-ask spread, and turnover. Year-quarter dummies are included in all models. Panel A shows the results for the full sample (1999–2011) and various subperiods, including the tech bubble (January 1999–December 2001) and financial crisis (January 2007–December 2009). "Normal" covers all other quarters over 1999–2011. Panels B and C show the results for subsamples based on whether the Volatility Index (VIX) and borrowing costs at the prior quarter-end are above or below their medians. Borrowing costs are measured in Panels B and C using periods of high Treasury-eurodollar (TED) spreads and low prime broker returns, respectively. All explanatory variables are standardized to have a zero mean and unit variance. Standard errors account for heteroskedasticity and are clustered at the quarter levels. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Panel A: Full sample and subperiod analysis

	Full sample			Normal	Tech bubble	Financial crisis	Low VIX	High VIX
Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
(a) *pressure*		-0.0014						
		(0.37)						
(b) *pressure buys*			0.0027	-0.0014	0.0041	0.0079	-0.0014	0.0070
			(0.63)	(0.18)	(1.63)	(2.28)**	(0.17)	(2.70)**
(c) *pressure sells*			-0.0033	0.0011	-0.0063	-0.0057	0.0049	-0.0050
			(1.02)	(0.13)	(1.38)	(1.33)	(0.44)	(1.72)*
(d) *non-pressure*		0.0108	0.0107	0.0152	-0.0067	0.0309	0.0134	0.0083
		(2.43)**	(2.42)**	(2.20)**	(1.57)	(4.52)***	(1.79)*	(1.60)
$\Delta holdings^{NL}$	0.0093							
	(2.05)**							
Number of observations	80,411	80,411	80,411	43,310	14,609	22,492	37,047	43,364
Other controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
p-value: (a) = (d)		0.03						
p-value: (b) = (c)			0.27	0.82	0.11	0.05	0.65	0.01
p-value: (b) = (d)			0.15	0.08	0.08	0.00	0.18	0.75
p-value: (c) = (d)			0.01	0.24	0.92	0.00	0.54	0.03

Table 7 (cont.)

Panel B: Borrowing costs indicated by high TED spread				
Variable	Model 1	Model 2	Model 3	Model 4
(b) *pressure buys*	-0.0044	0.0144	0.0101	0.0036
	(0.47)	(2.04)*	(2.00)*	(2.02)*
(c) *pressure sells*	0.0051	0.0043	-0.0022	-0.0072
	(0.23)	(0.52)	(0.38)	(2.13)*
(d) *non-pressure*	0.013	0.0147	0.0161	0.004
	(1.26)	(1.43)	(1.69)	(0.68)
Number of observations	23,664	13,383	19,768	23,596
Other controls?	Yes	Yes	Yes	Yes
VIX	Low	Low	High	High
Borrow costs	Low	High	Low	High
p-value: (b) = (c)	0.69	0.48	0.12	0.02
p-value: (b) = (d)	0.21	0.98	0.40	0.95
p-value: (c) = (d)	0.75	0.48	0.13	0.11

Panel C: Borrowing costs indicated by low prime broker stock returns				
Variable	Model 1	Model 2	Model 3	Model 4
(b) *pressure buys*	-0.0050	0.0005	0.0037	0.0106
	(1.19)	(0.03)	(1.03)	(2.28)**
(c) *pressure sells*	-0.0095	0.0209	-0.0008	-0.0074
	(0.97)	(0.99)	(0.22)	(1.82)*
(d) *non-pressure*	0.0032	0.0233	-0.0000	0.0189
	(0.32)	(2.67)**	(0.00)	(1.88)*
Number of observations	14,283	22,764	22,438	20,926
Other controls?	Yes	Yes	Yes	Yes
VIX	Low	Low	High	High
Borrow costs	Low	High	Low	High
p-value: (b) = (c)	0.70	0.43	0.42	0.00
p-value: (b) = (d)	0.33	0.21	0.43	0.28
p-value: (c) = (d)	0.30	0.93	0.92	0.01

Table 8
Lockup manager stock trading of pressure stocks: stock market liquidity and option hedging

Panel A shows the results from repeating Model 3 in Panel A of Table 7 for various stock subsamples, including stocks in the bottom quintile of market capitalization ("Small stock?"), stocks in the top quintile of bid-ask spread ("High bid-ask?"), stocks in the top quintile of Amihud illiquidity ("High Illiq?"), and stocks held by managers that also hold a put option on an exchange-traded fund (ETF) at the end of the quarter ("Hedging?"). The table also reports analogous results for stocks in the top quintile of market capitalization, stocks in the bottom quintile of bid-ask spread, stocks in the bottom quintile of Amihud illiquidity, and stocks held by managers that do not hold a put option on an ETF (no hedging). All explanatory variables are standardized to have a zero mean and unit variance. Panel B compares the delta acquired from distressed stock purchases with the hedging provided by ETF put options. *Delta acquired* is defined as the market value of the shares purchased times the stock's market beta, summed across all distressed stocks purchased during the quarter. Distressed stocks are those with *pressure* less than zero. *Hedging provided* is calculated as the aggregate (i.e., summed over ETF puts) product of the notional value of the option position, the underlying ETF's market beta, and the option's delta. Option deltas are obtained from current quarter-end market quotes of matched put options in OptionMetrics. Each ETF put option position is matched with out of the money put options on the same underlying ETF with a time to maturity less than two months. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Panel A: Stock characteristics and option hedging

	Small stock?		High bid-ask?		High Illiq?		Hedging?	
	Yes	No	Yes	No	Yes	No	Yes	No
Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
(b) *pressure buys*	-0.0371	0.0085	-0.0203	0.0035	0.0076	0.0050	-0.0150	0.0067
	(1.49)	(2.14)**	(0.88)	(0.98)	(0.83)	(1.21)	(0.84)	(2.49)**
(c) *pressure sells*	-0.0156	0.0080	-0.0158	0.0096	-0.0116	0.0227	-0.0034	-0.0029
	(2.33)**	(2.06)**	(2.12)**	(1.42)	(1.75)*	(1.67)	(2.01)**	(0.90)
(d) *non-pressure*	-0.0026	0.0399	-0.0034	0.0211	-0.0035	0.0391	0.0034	0.0095
	(0.28)	(4.23)***	(0.38)	(2.84)***	(0.52)	(4.27)***	(0.53)	(2.24)**
Number of observations	6,365	25,548	7,581	27,681	7,544	28,009	73,197	79,353
Other controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
p-value: (b) = (c)	0.41	0.94	0.86	0.40	0.10	0.22	0.52	0.02
p-value: (b) = (d)	0.22	0.00	0.53	0.02	0.31	0.00	0.36	0.50
p-value: (c) = (d)	0.25	0.00	0.29	0.16	0.35	0.30	0.30	0.02

Table 8 (cont.)

Panel B: Magnitude of delta-hedging in pressure trades

	Delta acquired ($100 million)			*Hedging provided* ($100 million)			Difference		
Option moneyness	N	Mean	Standard deviation	N	Mean	Standard deviation	Mean	t-statistic	p-value
5% out of the money	206	1.05	2.62	206	0.75	1.62	0.30	1.54	0.13
1% out of the money	182	1.14	2.76	182	0.92	2.20	0.23	0.97	0.34

Table 9
Trading patterns of lockup managers: crisis versus noncrisis periods

This table compares the characteristics of distressed stocks that are purchased by lockup managers during crisis periods and the characteristics of stocks that are held by lockup managers during noncrisis periods. Stock characteristics include the stock's market capitalization at the previous quarter-end and the average daily bid-ask spread or Amihud illiquidity measured over the previous quarter. During each crisis quarter, distressed stocks purchased by lockup managers are assigned quintiles based on the stock's market capitalization ("Mkt cap"), bid-ask spread ("Bid-ask"), or Amihud illiquidity ("Illiq"). Value-weighted averages of quintiles are then computed for each manager during each crisis quarter. Value-weighted average of average quintiles are then computed across managers in the same crisis quarter. The table reports the equal-weighted average across crisis quarters. A similar calculation is made across all stocks held by lockup managers outside crisis periods. In Panel A, crisis quarters include the tech bubble (January 1999–December 2001) and financial crisis (January 2007–December 2009. Non-crisis quarters cover all other months over February 1994–December 2012. In Panel B, crisis quarters are those in which the Volatility Index (VIX) at the prior month-end is above its median value (high VIX), and noncrisis quarters are all remaining quarters (low VIX). *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	N	Mkt cap	Bid-ask	Illiq
Panel A: Crisis versus noncrisis				
Crisis purchases	24	4.04	1.38	1.16
Noncrisis holdings	28	4.26	1.48	1.31
Difference		-0.22	-0.10	-0.15
t-statistic (difference)		2.34***	2.74***	7.53***
Panel B: High versus low VIX				
High VIX purchases	28	3.81	1.39	1.17
Low VIX holdings	24	4.29	1.46	1.31
Difference		-0.48	-0.07	-0.14
t-statistic (difference)		3.66***	2.71***	6.33***

Table 10
Lockup and option-use premiums in hedge fund returns

The table reports the results of regressing hedge fund manager monthly returns on a lockup dummy, option dummy, and the interaction of the two variables. *Lockup dummy* equals one if the manager uses a lockup provision on all underlying funds and zero otherwise. *Option dummy* equals one if the manager holds an exchange-traded fund (ETF) put option during the sample period. *Dummy interaction* is the product of the lockup and option dummies. Models 4-6 also include as explanatory variables the seven factors of Fung and Hsieh (2004), the monthly return on the MSCI Emerging Market index, and the monthly Pastor and Stambaugh (2003) market liquidity factor. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Lockup dummy	0.00213***	0.00186***	0.000984	0.00191***	0.00163***	0.000756
	(3.62)	(3.18)	(1.31)	(3.55)	(3.07)	(1.11)
Option dummy		0.00178***	0.000695		0.00158***	0.000489
		(3.07)	(0.96)		(2.99)	(0.73)
Dummy interaction			0.00252**			0.00252**
			(2.12)			(2.33)
Constant	0.00555***	0.00514***	0.00549***	0.00353***	0.00312***	0.00348***
	(15.03)	(10.88)	(10.55)	(9.24)	(6.64)	(6.78)
Number of observations	28,023	26,524	26,524	28,023	26,524	26,524
Other controls?	No	No	No	Yes	Yes	Yes