Role of managerial incentives and discretion in hedge fund performance

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Abstract

Using a comprehensive database of hedge funds, we examine the role of managerial incentives and discretion in the performance of hedge funds. We find that hedge funds with greater managerial incentives as proxied by delta of option-like incentive fee contract, managerial ownership, and high-water mark provision are associated with superior performance. Incentive fees have no explanatory power for future returns. We also find that funds with higher degree of managerial discretion, proxied by longer lockup, notice, and redemption periods, are associated with superior performance. Our results are robust to various alternate specifications including using alternative performance measures, allowing for nonlinearity for managerial discretion, using different econometric specifications, and controlling for different data-related biases.

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1. Introduction

Do higher managerial incentives and greater managerial discretion lead to better performance? While prior corporate finance literature has examined this question, the results are hard to interpret given significant endogeneity concerns. We believe that the hedge fund industry offers a unique setting to examine these issues. The central contribution of this paper is to demonstrate empirically that, in the case of hedge funds, managerial incentives and discretion are associated with better performance.

Why are hedge funds better suited to study these issues? First, we are able to empirically test theoretical predictions that are difficult to test in corporate finance setting. For example, Lambert and Larcker's (2004) theoretical model shows that the optimal contract for managers is frequently one that involves out-of-the-money options. However, only 6% of the options granted to CEOs are out-of-the-money (Hall and Murphy, 2000). Compensation contracts of hedge fund managers include incentive fees, which are very similar to option compensation awarded to corporate executives. However, in contrast to the compensation contracts of CEOs, those of hedge fund managers' typically include features such as hurdle rate and high-water mark provisions. With a hurdle rate provision, the manager does not get paid any incentive fee if the fund returns are below the specified hurdle rate, which is usually a cash return like LIBOR. Thus, the presence of hurdle rate provision effectively endows the manager with out-of-the-money option at the beginning of each year. With a high-water mark provision, the manager earns incentive fees only on new profits, i.e., after recovering past losses, if any. Thus if the fund has incurred a loss in the previous year, or has earned a return that is positive but not sufficient to recover past losses, the manager's options are effectively out-of-the-money.

Second, we believe that our measures of managerial incentives and managerial discretion have less of endogeneity concern compared to the corporate finance setting. For example, top executives in corporate firms can influence the pay-setting process (Bebchuk, Fried, and Walker, 2002) and can issue stocks and options before release of good news (Yermack, 1997). This compounds the problem of attributing performance to managerial incentives. In addition, if their stock options end up deep-out-of-the-money, the executives can lobby for resetting of the strike price of existing options or issuance of additional at-the-money options (Brenner, Sundaram, and Yermack, 2000). An important difference in the case of hedge funds is that the features of the compensation contract are set at fund's inception and do not change during the life of the fund. The manager decides whether to have hurdle rate and high-water mark provisions, and she also chooses the performance-based incentive fee rate. Then investors decide to allocate money to the fund after observing these provisions knowing fully well that the manager is not going to change these provisions afterwards.[1] Hence, in the case of hedge funds, endogeneity is less of a concern.

Similarly, lockup period, notice period, and redemption period, our proxies for managerial discretion, are chosen at the inception of the fund. Lockup period represents the minimum amount of time the investor has to commit the capital. After the lockup period is over, an investor wishing to withdraw needs to give advance notice (notice period) and then has to wait some more time to receive the money (redemption period). Thus, the longer the lockup, notice, and redemption periods, the greater the freedom the manager has in pursuing different investment strategies without worrying about redemption needs of the investor.[2] For example, managers with higher flexibility may invest in arbitrage opportunities that may take time to

[1] Ackermann et al. (1999, page 862) discuss in detail the issue of incentive fee remaining constant. They also mention that hedge funds do not increase their incentive fee subsequent to good performance.
[2] In this paper, we use the terms discretion, latitude, flexibility, and freedom interchangeably.

become profitable due to noise trader risk (De Long et al., 1990). Also, such managers may not be forced to engage in asset fire sales, which have been shown to be hurtful for both corporations (Pulvino, 1998) and mutual funds (Coval and Stattford, 2005).

For these reasons, we believe hedge funds can serve as a unique laboratory to study the relation of managerial incentives and discretion with performance. A better understanding of these relationships is also important to the hedge fund industry as it could shed light on the efficacy of the financial contracts in the asset management industry. For investors, insights from such an investigation will help improve their contracting and capital allocation process, while for fund managers they will assist in increasing their enterprise value. Given the recent trend of hedge funds becoming more accessible to retail investors, findings of such a study would also be of great interest to regulators.

In investigating these issues, we bring important innovations to the hedge fund literature. Previous studies have used percentage incentive fee as a measure of incentives. We believe that the incentive fee does not fully capture managerial incentives, as two different managers charging the same incentive fee rate could be facing different *dollar* incentives depending on the timing and magnitude of investors' capital flows, the funds' return history, and other contractual features. To overcome these limitations, we recognize, as in Goetzmann, Ingersoll, and Ross (2003), that the incentive-fee contract is a call option written by the investors on the assets under management, where the strike price is determined by the net asset value (NAV) at which different investors enter the fund, and the hurdle rate, and high-water mark provisions. Goetzmann et al. (2003) theoretically model the value of the option granted by performance-linked incentive fee. This paper goes further by being the first to empirically quantify the "delta" of the manager's call-option-like incentive fee contract. We refer to this as manager's option delta.

While the manager earns incentive fee from the investor's assets, she gets to keep the entire return on her co-investment in the fund. Therefore, we estimate the *total* delta, the overall pay-performance sensitivity measure, as the total expected dollar increase in manager's compensation for a one percent increase in fund's NAV. This *total* delta measure combines the delta from investors' assets (manager's option delta) and the delta from manager's co-investment. Unfortunately, data on manager's investment in the fund is not available. Discussions with the industry practitioners suggest that often times the manager reinvests all of the incentive fees earned back into the fund. Following this practice, we compute the dollar amount of incentive fee earned by the manager each year and allow for it to be reinvested into the fund. Thus, at any point in time, the manager's co-investment is the *cumulative* value of the incentive fee reinvested together with the returns earned on it.[3] We scale this co-investment by the total assets under management and use it as our proxy for managerial ownership.

We believe that total delta is a better measure of managerial incentives compared to the incentive fee percentage. For instance, we find that funds charging the same incentive fee exhibit very different values of deltas both in a given a year as well as over time (the correlation between total delta and incentive fees in our sample equals 0.17) because of the differences in their return histories and capital flows. This highlights the limitation of using percentage incentive fee as a proxy for managerial incentives. Also, our delta measure is consistent with executive

[3] We acknowledge that our measure of managerial ownership is a noisy proxy of the true ownership. In the absence of better data on actual investment and her net worth, we believe that this is a good proxy to capture manager's co-investment.

compensation literature, which uses delta from the portfolio of stocks and options held by CEOs of corporations to capture managerial incentives.[4]

We examine these issues using a comprehensive database created by the union of four large hedge fund databases: CISDM, HFR, MSCI, and TASS. Due to data availability constraints, prior studies have used at most two databases, which excludes about one-third to one-half of our sample (see the Venn diagram in Figure 1). Using multiple databases also enables us to resolve occasional discrepancies among different databases. We believe that the comprehensiveness of our sample makes our findings more representative of the hedge fund universe.

Our findings are as follows. First, we find that it is higher delta, and not higher incentive fee rate, that leads to higher future returns. In support, we find that incentive fee has no explanatory power for future returns once we control for delta, while delta continues to be a significant determinant of future returns; further, we find that higher delta leads to higher returns even when we restrict our sample to funds charging same incentive fee rate of 20%, a rate charged by majority of funds. Second, when we use managerial ownership as well as manager's option delta to capture incentives, we find both of them to be positively related to performance. This lends support to industry wisdom of requiring co-investment by the manager. Third, we find that funds with high-water mark provisions have higher returns. Also, funds with hurdle rate provision have higher returns though this relation is not statistically significant. These results provide support to the agency theoretic model in Lambert and Larcker (2004). Fourth, we find that our proxies for managerial discretion are always positively related to performance. This suggests that providing flexibility to the manager may be beneficial provided that right incentives are in place.

[4] See for example, Yermack (1995), Jensen and Murphy (1990), Hall and Liebman (1998), Core and Guay (1999), Guay (1999), Datta, Datta, and Raman (2001), and Coles, Daniel, and Naveen (2006).

Our results are robust to various alternate specifications including using alternative performance measures (such as gross-of-fees returns and risk-adjusted returns), allowing for nonlinearity for managerial discretion, using different econometric specifications, and controlling for different data-related biases. Our findings demonstrate the efficacy of financial contracts in alleviating agency problems, thereby having important implications for contracting not only with asset managers but also with executives managing corporations.

The rest of the paper is organized as follows. Section 2 presents the related literature and testable hypotheses. Section 3 describes the data and construction of variables. Section 4 investigates our hypotheses relating to the cross-sectional variation in fund returns while Section 5 presents several robustness tests. Section 6 offers concluding remarks.

2. Related Literature and Hypotheses Development

The primary focus of the research on hedge funds has been to explain the *time-series* variation in their returns. There has been limited analysis of the *cross-sectional* determinants of hedge fund returns.[5] Our study falls into the latter category.

Agency theory predicts that the higher the pay-performance sensitivity, the higher the managerial incentives to deliver superior performance.[6] Across various industry settings, however, there is no clear link between incentives and performance. In the private equity industry, there appears to be no relation between incentive fee rate and performance (Gompers and Lerner, 1999). In the mutual fund industry, very few funds charge incentive fees and by law

[5] See, for example, Fung and Hsieh (2001, 2002a, 2002b, 2004), Mitchell and Pulvino (2001), Gatev, Goetzmann, and Rouwenhorst (1999), Agarwal and Naik (2004), and Agarwal, Fung, Loon, and Naik (2005) for *time-series* variation in hedge fund returns. Studies that look at *cross-sectional* differences in fund returns include Ackermann, McEnally, and Ravenscraft (1999), Brown, Goetzmann, and Ibbotson (1999), Liang (1999), and Edwards and Caglayan (2001).

[6] See, for example, Jensen and Meckling (1976), Fama (1980), Fama and Jensen (1983a, b), Jensen and Ruback (1983) and Jensen (1986) for agency theoretic literature. For early empirical evidence, see Morck, Shleifer, and Vishny (1990) and Servaes and McConnell (1990). See Murphy (1999) and Core, Guay, and Larcker (2003) for a survey of literature on executive compensation.

they are symmetric in nature (and not option-type contracts). Elton, Gruber, and Blake (2003) find that funds that charge such symmetric incentive fee earn positive alphas.

As in the venture capital industry, hedge fund managers are paid asymmetric performance-linked incentive fee, which forms a large part of their total compensation. Recent theoretical work by Das and Sundaram (2002) suggests that higher incentive fee should result in better performance; however, the empirical evidence on this is mixed at best. For example, Ackermann et al (1999), Liang (1999), and Edwards and Caglayan (2001) find that hedge funds charging higher incentive fees are associated with better performance. In contrast, Brown, Goetzmann, and Ibbotson (1999) find that higher-fee funds perform no better than lower-fee funds. One of the reasons for this mixed evidence could be that manager's expected dollar gains from increasing returns depend not only on percentage incentive fee but also on several other fund and compensation characteristics. We overcome these limitations by using delta, the expected dollar increase in the manager's wealth for an increase of one percent in the fund's NAV, as our proxy for managerial incentives. This measure is consistent with similar measures used in recent corporate finance literature.

As mentioned in the introduction, one innovation we introduce is to empirically estimate the pay-performance sensitivity (delta) of the manager's compensation contract. In brief, the incentive fee contract of the manager resembles a *portfolio* of call options where each option is related to the money flow each year and has its own strike price (dictated by whether the fund has hurdle rate and high-water mark provisions). We compute the delta of these individual options, and sum them up to obtain the delta from the option-like feature of the compensation contract (manager's option delta). Furthermore, we estimate managerial ownership by assuming that she reinvests all the incentive fees earned back into the fund. To control for fund size, we then define managerial ownership as manager's investment as a fraction of fund's total assets under management. We outline the detailed procedure used in estimating manager's option delta and managerial ownership in Appendix A. We combine the delta from co-investment with the delta from investors' assets to estimate the *total* delta for each fund-year observation.

Although delta takes into account hurdle rate and high-water mark provisions, the very presence of these provisions may also have an impact on performance. For example, Lambert and Larcker (2004) show that the optimal contract for managers is frequently one that involves out-of-the-money options.[7] Since hurdle rate and high-water mark provisions effectively make the incentive fee option out-of-the-money, arguably such features should motivate the managers to deliver superior returns. This leads us to our first hypothesis.

Hypothesis 1: All else equal, funds with better managerial incentives (funds with higher total delta, manager's option delta, managerial ownership, and with hurdle rate and high-water mark provisions) should be associated with better performance.

Having hypothesized the relation between managerial incentives and performance, we next hypothesize the relation between managerial discretion and performance. Although agency theory predicts a negative relation between managerial latitude and performance, empirical evidence in the corporate finance literature has been mixed. Berger et al (1997) and Denis et al. (1997) find a negative relation, Demsetz and Lehn (1985) and Agrawal and Knoeber (1996) find no relation, while Kesner (1987) and Donaldson and Davis (1991) find a positive relation between managerial discretion and performance.

[7] See also Johnson and Tian (2000) for a discussion of incentive effects of premium options and other non-traditional options.

In the context of mutual funds, use of load fees discourages capital redemptions, thereby providing the fund manager greater discretion to invest from long-term point of view. Nanda, Narayanan, and Warther (2000) show the positive effect of managerial discretion in mutual funds, where funds with higher loads are likely to deliver better performance. Another way of providing discretion to mutual fund manager is to permit the use of derivatives, short selling, and leverage. Almazan et al. (2004) examine this form of discretion but do not find it to be associated with better performance.

In contrast to mutual funds, hedge funds have some unique features such as lockup period, notice period, and redemption period. Since notice period and redemption period are applied back-to-back, we add these two periods, and for expositional convenience, call it simply as “restriction period”. These features provide the managers greater freedom in pursuing different investment strategies. For example, managers with higher flexibility could afford to invest in arbitrage opportunities that may take time to become profitable due to noise trader risk (De Long et al., 1990) and may not have to engage in value-decreasing asset fire sales. Therefore, we expect that funds with greater managerial flexibility to be associated with better performance. This provides us with our second hypothesis.

Hypothesis 2: All else equal, hedge funds with greater managerial discretion (longer lockup and restriction periods) should be associated with better performance.

3. Data and Variable Construction

3.1. Data Description

In this paper, we construct a comprehensive hedge fund database that is a union of four large databases, namely, CISDM, HFR, MSCI, and TASS. This database has net-of-fee returns, assets under management, and other fund characteristics such as hurdle rate and high-water mark provisions, lockup, notice, and redemption periods, incentive fees, management fees, inception date, and fund strategy.[8] This enables us to resolve occasional discrepancies among different databases as well as create a sample that is more representative of the hedge fund industry. Our sample period extends from January 1994 to December 2002. We focus on post-1994 period to mitigate potential survivorship bias as most of the databases start reporting information on "defunct" funds only after 1994.[9] After merging the four databases, we find that there are 7,535 hedge funds, out of which 3,924 are operational as of December 2002 while 3,611 became defunct during our sample period. In Figure 1, we report the overlap among the four databases with a Venn diagram. It highlights the fact that there are a large number of hedge funds that are unique to each of the four databases and thus, merging them helps in capturing a more representative sample of the hedge fund universe.

One of the challenges in dealing with multiple databases is that they adopt different nomenclature to identify fund strategies. Based on description provided by the database vendors, we classify funds into four broad strategies: Directional, Relative Value, Security Selection, and Multi-Process Traders. This classification is motivated by Fung and Hsieh (1997) and Brown and Goetzmann (2003) studies which show that there are few distinct style factors in hedge fund returns. Appendix B reports the mapping between the data vendors' and our classifications and reports the distribution of hedge funds across the four broad strategies.

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[8] The database provides information on contractual features as of the last available date for which the fund's data is available. Following previous researchers, we assume that these contract features hold throughout the life of the fund. Discussions with industry experts suggest that this is a reasonable assumption as it is easier for a manager to start a new fund with different contract terms instead of going through the legal complications of changing existing contract with numerous investors.

[9] As in Fung and Hsieh (2000), defunct funds include those that are liquidated, merged/restructured, and funds that stopped reporting returns to the database vendors but may have continued operations.

Having described our data, we now explain the key variables used in our analysis.

3.2. Measures of Performance

Our primary measure of performance is *Returns*, the annual return of a fund. These returns are net of all fees paid to the manager. For robustness, we consider several alternate measures of performance. *Returns2yr*, the compounded net return over two years, is our measure of long-term performance. *Gross Returns* is the annual gross-of-fees returns which the fund manager earns before payment of fees (Appendix A provides computational details of gross returns). *Alpha* is the intercept from fund-level time-series regression of excess returns on the seven factors of Fung and Hsieh (2004).[10] We estimate these regressions every year and on a rolling basis using two years of data.

Table 1 reports the summary statistics of performance measures and other variables of interest, which we define later. The mean annual return is 12.2% (median is 9.7%) while the mean gross return, as expected, is higher at 14.5% (median being 10.8%). In terms of long-term performance, the mean annualized 2-year return is 11.6% (median = 10.7%).

3.3. Proxies for Managerial Incentives

As described earlier, one of our proxies for managerial incentives is given by *total* delta, which equals the expected dollar change in the manager's compensation for a one percent change in the fund's NAV. The incentive fee contract endows the manager with a portfolio of call options, whose characteristics depend on the current NAV ("spot" price, *S*), the threshold NAV that has to be reached before the manager can claim incentive fee ("exercise" price, *X*, which in turn depends on hurdle rate and high-water mark provisions), the dollar amount of investor flows

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[10] One can also use the option-based factor model in Agarwal and Naik (2004) for estimating alphas. However, since their model requires prices on exchange-traded option, it is easier to implement only for equity-oriented hedge fund strategies. Since our sample includes hedge fund strategies that invest in fixed income securities, currencies, and commodities, we believe that Fung and Hsieh seven-factor model is more appropriate in this case.

into the fund at different points in time, and fund volatility. As described previously, we divide the total delta into manager's option delta (coming from investors' assets) and delta from manager's co-investment. We describe the detailed procedure of computing these delta measures in Appendix A. From Table 1, we find that the mean (median) total delta (from manager's option delta and co-investment) equals $189,000 ($31,000).[11] A breakdown of this delta measure indicates that the mean (median) manager's option delta equals $100,000 ($17,000) and the delta from manager's co-investment in the fund constitutes the balance. In our sample, the average (median) managerial ownership, which is the ratio of our estimate of manager's own money to the total assets under management, is 0.071 (0.024).

From Table 1, we find that 61% of the funds have hurdle rate provision while 80% of the funds have high-water mark provision. As discussed before, presence of these provisions make the incentive-fee option out-of-the-money. We find that these managerial options, on average, are out of the money by 7.2%. For funds with only hurdle rate provision (11% of the funds), the average moneyness [= (S-X)/S] is -4.7%, while for funds with only high-water mark provision (29% of the funds), the average moneyness is –4.2%. Not surprisingly, for funds with both high-water mark and hurdle rate provisions (51% of the funds), the average moneyness is much higher at –10.9%.

3.4. Proxies for Managerial Discretion

Hedge funds impose several impediments (such as lockup, notice, and redemption periods) to capital withdrawals by investors. Since notice period and redemption period are applied back-to-back, we add these two periods, and for expositional convenience, call it simply

[11] Black and Scholes (1973) option delta equals our dollar delta from investors' assets divided by (0.01*incentive fee*investors' assets). Delta from managers own investment is given by his dollar investment times 0.01. Interestingly, our delta measure compares well with the mean (median) delta of executive stock options for the top 1500 firms in S&P during 1992-2002 to be $600,000 ($206,000) reported by Coles, Daniel, and Naveen (2006).

as “restriction period”. We use lockup period and restriction period as our proxy for managerial discretion. We find that 19% of the funds impose a lockup period but all funds specify a restriction period. In Table 1, we report the summary statistics of lockup and restriction periods. For the funds that impose lockup, we find that the mean (median) lockup period is 0.8 (1.0) years. We also find the mean (median) restriction period is 0.3 (0.2) years.

4. Do managerial incentives and discretion matter for fund performance?

In this section, we examine how performance relates to total delta, hurdle rate and high-water mark provisions, and lockup and restriction periods. Towards that end, we estimate the following regression:

$$\begin{aligned} Return_{i,t} = {} & \lambda_0 + \lambda_1 Total\ Delta_{i,t-1} + \lambda_2 Hurdle\ Rate_i + \lambda_3 Highwater\ Mark_i \\ & + \lambda_4 Lockup_i + \lambda_5 Restrict_i + \lambda_6 Size_{i,t-1} + \lambda_7 Flow_{i,t-1} + \lambda_8 \sigma_{i,t-1} \\ & + \lambda_9 Age_{i,t-1} + \lambda_{10} MFee_i + \lambda_{11} Return_{i,t-1} + \sum_{s=1}^{3} \lambda_{12}^{s} I(Strategy_{i,s}) + \xi_{i,t} \end{aligned} \quad \textbf{(1)}$$

where $Return_{i,t}$ is the net return of fund *i* in year *t*, $Total\ Delta_{i,t-1}$ is the total expected dollar change in the manager’s compensation for a 1% change in NAV for fund *i* at end of year *t-1*, $Hurdle\ Rate_i$ is an indicator variable that equals 1 if fund *i* has hurdle rate provision, and equals 0 otherwise, $Highwater\ Mark_i$ is an indicator variable that equals 1 if fund *i* has high-water mark provision, and equals 0 otherwise, $Lockup_i$ and $Restrict_i$ are the lockup and restriction periods for fund *i*, $Size_{i,t-1}$ is the size of the fund measured as the natural logarithm of the assets-under-management for fund *i* at time *t-1*, $Flow_{i,t-1}$ is the money flows in fund *i* in year *t-1*[12], $\sigma_{i,t-1}$ is the

[12] Following Chevalier and Ellison (1997), Sirri and Tufano (1998), and Goetzmann et al. (2003), we compute annual flow as the scaled dollar flow into the fund, $Flow_{i,t} = \frac{AUM_{i,t} - AUM_{i,t-1}\left(1 + Returns_{i,t}\right)}{AUM_{i,t-1}}$ where $AUM_{i,t}$ and

standard deviation of the monthly returns of fund *i* during year *t-1*, $Age_{i,t-1}$ is the age of fund *i* at the end of year *t-1*, $MFee_i$ is the management fees charged by fund *i*, $Return_{i,t-1}$ is the lagged net return of find *i* in year *t-1*, $I\left(Strategy_{i,s}\right)$ are strategy dummies that equals 1 if fund *i* belongs to strategy *s*, and equals 0 otherwise, and $\varepsilon_{i,t}$ is the error term. We winsorize top 1% of all variables in order to minimize the influence of outliers. We report Fama-MacBeth (1973) coefficients and corresponding p-values in Table 2.

The results of our Model 1 show that the coefficient on total delta is positive (coeff. = 0.011) and significant (p = 0.003), implying that higher delta is associated with higher returns in the following year. To gauge the economic significance of this estimate, we compute the effect on returns for one-standard-deviation change in total delta and find that it corresponds to an increase in returns by 0.7% compared to a mean return of 12.2%. This implies a performance improvement of 6%. We also find the coefficient on high-water mark dummy to be positive (coeff. = 0.026) and significant (p = 0.002). The coefficient estimate implies that funds with high-water mark provision earn 2.6% higher returns compared to a mean return of 12.2%. Thus, the presence of high-water provision improves performance by 21%. The coefficient on hurdle rate dummy is positive but not significant. These results on total delta and high-water mark lend support to our *Hypothesis 1* that greater managerial incentives are associated with higher returns.

Better net-of-fees returns of funds having hurdle rate or high-water mark provisions may be arising from two sources. First, it may simply be a mechanical effect where these provisions lower the magnitude of incentive fee paid to the manager, leading to higher net-of-fees returns. In other words, even though there are two funds with the same gross-of-fees returns, the net-of-

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$AUM_{i,t-1}$ are the assets-under-management of fund *i* at the end of year *t* and *t-1* and $Returns_{i,t}$ is the return for fund *i* during year *t*.

fees return of the funds with these provisions will be higher, on average. Second, as we hypothesized earlier following Lambert and Larcker's (2004) theoretical model, the very presence of these provisions provides incentives to the managers to perform better. To distinguish between these two competing explanations, we repeat our analysis with gross-of-fees returns and find the coefficient on high-water mark dummy continues to be positive and significant (reported and discussed in robustness section later). Hence, our results are consistent with the second explanation, providing support to our *Hypothesis 1* of higher incentives being associated with better performance.

With respect to our proxies for managerial discretion, we find that the coefficient on lockup period (coeff. = 0.029) to be significantly positive, while the coefficient on restriction period to be positive, though not significant. A one-standard-deviation increase in lockup period increases returns by 0.9% (a change of 7.4% relative to a mean of 12.2%). These findings highlight beneficial effects of managerial discretion and lend support to *Hypothesis 2,* which predicts that greater managerial discretion should be associated with superior performance. These findings are also consistent with the notion that with greater flexibility, the manager is able to invest in illiquid securities and potentially capture illiquidity risk premia.[13]

In Model 2, we replace hurdle rate and high-water mark dummies with moneyness of the manager's portfolio of options implicit in the compensation contract. Recall that funds with hurdle rate provision get their exercise price reset upward every year. Funds that have high-water mark provision will have underwater options if their returns are negative in the previous year or if their returns are not sufficient to recover past losses. Thus, these provisions serve as the mechanism that makes the incentive-fee option of the manager to be underwater.

[13] Aragon (2004), in a contemporaneous working paper, examines the effect of lockup periods on returns and documents the presence of illiquidity risk premium.

Compared to hurdle rate and high-water mark dummy variables that can only categorize whether the manager has underwater options or not, moneyness has the advantage of precisely measuring the magnitude of moneyness of the manager's option portfolio implicit in his compensation contract. However, one disadvantage of using moneyness is that it is not explicitly observable and easily measurable by investors unlike hurdle rate and high-water mark provisions that are explicitly stated. Considering these pros and cons of different measures, we repeat our analysis using moneyness instead of the hurdle rate and high-water mark dummies and report our results in Table 2. From Model 2, we find that moneyness is significantly negative. This suggests that more out-of-the-money is the incentive-fee option, better is the performance, thereby confirming the prediction of Lambert and Larcker (2004).

In Model 3, we segregate total delta into two components - delta from investors' assets (manager's option delta) and that from managerial ownership. For this purpose, we assume that the manager invests all the incentive fees she earns back into the fund. To control for fund size, we define managerial ownership as manager's investment as a fraction of fund's total assets under management. As argued earlier in the introduction, ownership in corporate finance literature is endogenously related to performance, making it difficult to interpret the results. However, in case of hedge funds, it is determined by the reinvestment of the incentive fees, which depends on the *stochastic* return process. So, there are less endogeneity concerns. From Model 3 results, we find that the delta from investors' assets (manager's option delta) and managerial ownership are both positively related to future returns. This result is also economically significant. A one-standard-deviation increase in managerial ownership increases returns by 1.5% relative to a mean of 12.2% (a performance improvement of 12%). This lends support to the industry practice of requiring co-investment by the manager in the fund for better performance. Since we use all our proxies for managerial incentives – manager's option delta, managerial ownership, hurdle rate, and high-water mark in Model 3 – we refer to it as our *base model* hereafter.

In Model 4, we allow for non-linearity in the relation between performance and ownership by including the square of managerial ownership. The common reasoning behind including the square term in corporate finance literature is to test the hypothesis that very high managerial ownership leads to entrenchment (see for example, Morck, Shleifer, and Vishny, 1990 and McConnell and Servaes, 1990). While such logic has appeal in the corporate setting, entrenchment is not possible in the case of hedge funds since investors could pull out their entire money (after meeting lockup and restriction periods) if they are not happy with a fund's performance. Alternately, if a large part of a manager's wealth is invested in the fund, it can lead to excessive risk aversion (see Amihud and Lev, 1981; Smith and Stulz, 1985; Schrand and Unal, 1998; and Guay, 1999 for evidence in corporate finance literature). If so, as in corporate firms, for hedge funds too, we expect to find an inverted U-shaped relation between performance and managerial ownership. We test this in Model 4 of Table 2 and find that the slope coefficient on the square term although negative, is not statistically significant. Thus, it appears that higher ownership is less of a concern in hedge funds.

With respect to the control variables, we observe that the coefficient on size is negative and significant suggesting that there exist diseconomies of scale in the hedge fund industry. This result is consistent with Goetzmann, Ingersoll, and Ross (2003), who find that both large funds and top performers experience outflows of capital. They interpret this as evidence of limits to growth in hedge funds. In a contemporaneous working paper, Getmansky (2004) studies competition in hedge fund industry and also finds decreasing returns to scale. Our results also suggest that funds that experience high flows in the past have poorer returns in the following year. This might suggest that money is not necessarily "smart". We also find weak evidence that older funds have poorer performance. Finally, we find that the coefficient on lagged return, included in the analysis to control for serial correlation induced by funds' investment in relatively illiquid securities (Getmansky, Lo, and Makarov, 2004), is never statistically significant. This finding is not surprising since we use *annual* return, which have less of a problem of serial correlation.

Taken together, the results in Table 2 lend strong support to our hypotheses that higher managerial incentives and greater managerial discretion are associated with better future performance.

4.1. Could alternative stories explain the relation between incentives and performance?

One story may be based on signaling hypothesis where higher-ability managers signal their quality by charging higher incentive fees. Since higher incentive fees implies higher delta, the signaling hypothesis would also predict a positive relation between delta and performance, *ceteris paribus*. To disentangle our incentive hypothesis (*Hypothesis 1*) with the competing signaling hypothesis, we estimate performance regressions for a sub-sample of funds, for which signaling hypothesis is invalid. In our sample, 66% of the funds charge an incentive fee of exactly 20%. Clearly, different funds belonging to this sub-sample are providing *identical* signal about their type or quality. Table 3 reports the regression results for this sub-sample. We continue to find that delta is positively related to performance when we use funds charging the same incentive fee. This result lends further support to our incentive hypothesis.

We also perform an additional test to disentangle the two competing hypotheses above. We include incentive fee as an additional variable in all the regression models reported in Table

3. As per signaling hypothesis, we expect a positive coefficient on incentive fees. Table 4 reports these results. We find that total delta continues to be positive and significant in all the models, while incentive fee does not come out significant in any of the models. The lack of significance on the coefficient of incentive fee is not driven by multicollinearity problems – the correlation between total delta and incentive fees is only 0.17. Our results in Table 4 can also be thought of as a horse-race between incentive fees and total delta. We find that total delta wins clearly in this race. These results suggest that total delta seems to capture the true incentives facing the manager.

Another story may be that persistence in performance is driving the positive relation that we document between delta and performance. The logic is that if the prior performance is good, delta will be higher (since "spot" price will be higher) and next year's performance will also be higher because of persistence in performance. Since we explicitly control for last year's returns in our regressions, we believe that this argument cannot explain our findings.

To sum up, these two alternative stories cannot undermine our findings lending support to our *Hypothesis 1*.

4.2. Is there an endogeneity or reverse-causality problem?

As pointed out in the introduction, one advantage of using hedge funds to test theories developed in corporate finance is that managerial incentives and discretion measures in hedge funds are relatively exogenous compared to those observed in corporate firms. Recall, that compensation contract features such as incentive fees, hurdle rate, and high-water mark provisions are set at the time the fund is incorporated and these do not change over the life of the fund. Thus, it is clear that performance cannot influence the choice of contract provisions as these are pre-determined at inception. Hence, reverse causality is ruled out in our case.

Second, it is reasonable to expect that these provisions are chosen by the manager at inception to maximize the present value of her expected future compensation. This in turn depends on, among other things, her estimate of future gross returns and the capital that investors will provide at various points in time in response to her performance. If contractual features are chosen such that the manager extracts all the rents that she generates, then we should observe no relation between net-of-fees returns and these contractual features. Hence, we do not think that endogeneity, in terms of manager choosing the contractual features, is an issue. The fact that we observe a positive relation between these contractual features and net-of-fees returns suggest that the manager does not consume the entire surplus that she generates.

Even if there were some endogeneity concerns, it is hard to correct for it. Two common ways of tackling these issues have been to use two-stage least squares regressions (2SLS) or use fixed-effects regressions. To implement 2SLS, we need predicted values of our key variables, hurdle rate dummy, high-water mark dummy, lockup period, and restriction period. Since these are supposedly chosen by the manager based on her expected utility maximization problem, we do not observe the parameters so as to empirically obtain a predicted value, rendering implementation of 2SLS not possible.

With respect to fixed-effects regression, all of our variables (that we hypothesize to be related to performance), except delta and managerial ownership are time-invariant. In a fixed-effects regression, these time-invariant variables will be excluded, and the coefficients on the remaining variables (such as delta) will thus not capture the incremental effect, resulting in incorrect inferences. More generally, Zhou (2001) points out that fixed effects is not appropriate when most of the variation arises in the cross-section rather than in the time series.

In summary, we do not think that reverse-causality or endogeneity are concerns in our analysis. In fact, it is for this very reason, we believe our study can shed light on the impact of incentives and discretion on performance.

4.3. Do managerial incentives and discretion affect long-term performance?

Effect of managerial incentives and discretion may not be limited to short-term performance alone. In order to examine the possibility that they may have longer-term effects on performance, we re-estimate our models using two-year return (instead of one-year return) as the dependent variable. For this purpose, we lag all our independent variables by two years and estimate the following regression:

$$\begin{aligned} 2\text{-}\,year\ Return_{i,t} = {} & \theta_0 + \theta_1 Delta_{i,t-2} + \theta_2 Hurdle\ Rate_i + \theta_3 Highwater\ Mark_i \\ & + \theta_4 Lockup_i + \theta_5 Restrict_i + \theta_6 Size_{i,t-2} + \theta_7 Flow_{i,t-2} \\ & + \theta_8 \sigma_{i,t-2} + \theta_9 Age_{i,t-2} + \theta_{10} MFee_i + \sum_{s=1}^{3} \theta_{11}^{s} I(Strategy_{i,s}) + \pi_{i,t} \end{aligned} \qquad \textbf{(2)}$$

Table 5 reports the results. We continue to find positive relation between managerial incentives (total delta, manager’s option delta, managerial ownership, and high-water mark provision) and two-year returns. Further, we find stronger (compared to results in Table 2) positive relation between managerial discretion and performance, with both lockup and restriction period being significant. These findings, once again, lend strong support to our *Hypotheses 1 and 2*.

5. Robustness

In this section, we consider several tests using our base model (Model 3 of Table 2) to demonstrate that our key result of incentives and discretion leading to better performance, are robust on many fronts. Table 6 summarizes our results in a concise manner. For brevity, we report the coefficients and p-values of only the variables of interest. In Row 1, we report the base case results from Model 3 of Table 2 to enable ease of comparison.

(i) We estimate OLS regressions of gross-of-fees returns instead of net-of-fees returns. As stated earlier, this is in response to a concern that a positive relation between net-of-fee returns and hurdle rate or high-water mark provision may simply be a 'mechanical' effect, where these provisions lower the magnitude of incentive fee paid to the manager, thus leading to higher net-of-fees returns. Therefore, to demonstrate that hurdle rate or high-water mark provisions are not spuriously related to net-of-fees returns, we repeat our analysis with gross-of-fees returns. Another reason to consider gross-of-fees returns is to examine the Berk and Green (2004) hypothesis that managers set incentive fees that effectively captures all the rents. If so, one would expect a larger effect of delta on gross-of-fees returns rather than on net-of-fees returns. Row 2 of Table 6 reports the results. Our findings continue to show a positive relation between performance and high-water mark provision suggesting that our earlier results using net-of-fees returns are not driven by 'mechanical' effect. Further, the fact that the slope coefficient on manager's option delta using gross-of-fees returns is one-and-a-half times that when we use net-of-fees returns lends support to Berk and Green (2004).

(ii) We estimate OLS regressions of abnormal returns (alphas), where alphas are the intercept from Fung and Hsieh (2004) model. Hedge fund incentive contracts are set up so that the manager is compensated for actual returns and not abnormal returns. Thus, a priori one would not expect to observe a relation between incentives and alphas. Row 3 of Table 6 reports the results. We find a statistically insignificant relation between incentives (manager's option delta, managerial ownership, and high-water mark) and alpha, and a significantly positive relation between discretion (lockup) and alpha.

We get similar results if we use alphas estimated using 24-month window as the dependent variable with standard errors estimated using GMM to correct for problems due to overlapping estimation windows.[14]

(iii) One may argue that delta is related to the entire performance history of the fund, the fund flows at various points in time, and other contract provisions. Note that in all our models, we do control for prior year's performance and prior year's flows. However, to further ensure that delta is indeed capturing incentives and not the effect of prior performance or investor flows, we estimate the regressions using only the second year of existence for each fund. By doing so, we control for the *entire* history of performance and flows. Row 4 of Table 6 reports the results. We find that the coefficient on manager's option delta continues to be positive and significant confirming that higher managerial incentives are associated with better future performance.

(iv) In all of our results, we find that the coefficient on high-water mark is positive and significant while that on hurdle rate is positive but not significant. It is conceivable that funds having both these provisions might exhibit even superior performance. To test this hypothesis, we include the interaction of hurdle rate and high-water mark dummies. Row 5 of Table 6 reports the results. The coefficient on the interaction term turns out to be insignificant (p-value of 0.460), while that on high-water mark provision continues to be significant (as in our base case).

(v) We include the square term of both lockup period and restriction period to explore nonlinearity in the relation between discretion and performance. We report our results in Row 6 of Table 6 and do not find any support for such nonlinearity. The coefficients on the square terms are negative but not significant.

(vi) We combine lockup and restriction period into one variable. This variable represents the minimum amount of time that the investor has to wait before he could expect to redeem his

[14] We thank Andrea Frazzini for his insights into the GMM estimation in Fama-MacBeth regressions.

money. Row 7 of Table 6 reports the results. We find that the coefficient on the combined variable is positive and significant (coeff = 0.024, p = 0.037), thereby lending further support to our *Hypothesis 2*.

(vii) We replace lagged volatility with contemporaneous volatility to allow for contemporaneous relation between risk and return. Row 8 of Table 6 reports our results. None of our inferences change.

(viii) We test if our results are driven by presence of small funds, those with less than, say $15 million, of assets under management. For robustness, we exclude such small funds and report the results in Row 9 of Table 6. Our results remain unchanged.

(ix) Since we have panel data, as an alternative to Fama-MacBeth (1973) procedure, we also estimate pooled regressions with standard errors corrected for heteroskedasticity and autocorrelation. Row 10 of Table 6 reports our results. None of our inferences change.

(x) The hedge fund literature has documented various biases in hedge fund databases such as survivorship bias and backfilling or instant-history bias. Since we have included performance history of defunct funds (44% of fund-year observations) in our analysis, we believe that survivorship bias is not a major concern. In fact, if we estimate our regressions using only funds that are alive as of the end of sample period (Dec 2002), we find results (see Row 11 of Table 6) similar to our base case. This shows that *survivorship* bias does not seem to affect the relation between incentives, discretion, and performance.

Another bias that could potentially explain our results is *backfilling* or *instant-history* bias. This occurs when a fund chooses to start reporting to the database subsequent to good performance and the data vendor starts reporting past as well as the current performance. The standard way of tackling this bias is to exclude the first two years' data of each fund from the analysis (e.g., Ackermann, McEnally, and Ravenscraft, 1999). Row 12 of Table 6 shows that all our proxies for managerial incentives (total delta, manager's option delta, managerial ownership, and high-water mark) continue to be positively related to performance. However, our result for lockup period weakens marginally (p-value of 0.112).

Taken together, the findings in Table 6 confirm that the strong relation between incentives, discretion, and performance is robust on several fronts.

6. Concluding Remarks

Hedge funds have many unique contractual arrangements compared to mutual funds. They charge performance-based incentive fees, require co-investment by manager, and require a longer term capital commitment by investors. We believe that these arrangements provide incentives and discretion to the manager, which should have implications for fund performance. Using the most comprehensive database of hedge funds, we examine these issues and document several new and interesting findings.

First, we find that funds with better managerial incentives (higher total delta, manager's option delta, managerial ownership, and high-water mark provision) are associated with better performance. Further, our results overwhelmingly demonstrate that delta, and not incentive fee, is the right measure of managerial incentives. They also demonstrate the importance of managerial ownership lending support to industry wisdom of requiring co-investment by the manager. Second, we observe that funds with greater managerial discretion (longer lockups and restriction periods) generate higher returns. Our results are robust to alternative performance measures, nonlinearity of managerial discretion, different econometric procedures, and different data-related biases. Overall, our findings demonstrate the efficacy of financial contracts in alleviating agency problems, thereby having important implications for contracting not only with asset managers but also with executives managing corporations.

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Table 1. Cross-Sectional Fund Characteristics

This table shows the summary statistics of various fund characteristics. *Returns* are the annual net return. *Returns: 2year* is the compounded net return over two years. *Gross Returns* is the estimated gross returns earned by the fund before fees are netted off. *Alpha* is the intercept from fund-level time-series regression of excess net returns on the seven factors of Fung and Hsieh (2004). *Total Delta* is the total expected dollar change in manager's wealth for a 1% change in NAV. *Manager's Option Delta* is the delta from investors' assets. *Managerial Ownership* is the ratio of manager's investment in the fund to the total assets under management. *Hurdle Rate* is an indicator variable that equals 1 if the fund has hurdle rate provision, and equals 0 otherwise. *High-Water Mark* is an indicator variable that equals 1 if the fund has high-water mark provision, and equals 0 otherwise. *Moneyness* is defined as spot price minus the exercise price divided by the spot price. *Lockup period* is the minimum time that an investor has to wait (after making his investment) before he can withdraw his money. *Restriction Period* is given by the sum of the *Notice Period* and the *Redemption Period*, where *Notice period* is the time the investor has to give notice to the fund about his intention to withdraw money from the fund, and *Redemption Period* is the time that the fund takes to return the money after the notice period is over. *Flow* is the investors' dollar flow scaled by assets. *AUM* is the assets under management. *Volatility* is standard deviation of monthly returns estimated over the calendar year. *Age* is the age of the fund in years. *Management Fee* and *Incentive Fee* are terms of the compensation contract. Hurdle rate, high-water mark, lockup period, restriction period, management fee, and incentive fee are time-invariant. The summary statistic for lockup is based on the sub-sample of funds that impose lockups.

Fund Characteristics	**Mean**	**SD**	**25th Percentile**	**Median**	**75th Percentile**
Returns	0.122	0.264	0.009	0.097	0.208
Gross Returns	0.145	0.300	0.001	0.108	0.238
Alpha	0.004	0.013	-0.002	0.004	0.010
Returns: 2 year	0.116	0.174	0.032	0.107	0.191
Total Delta ($M)	0.189	0.581	0.004	0.031	0.120
Manager's Option Delta ($M)	0.100	0.279	0.001	0.017	0.071
Managerial Ownership	0.071	0.135	0.001	0.024	0.075
Hurdle Rate	0.608				
High-Water Mark	0.801				
Moneyness for all funds (%)	-7.2	0.119	-6.1	-5.0	0.0
Moneyness for funds with only hurdle rate provision (%)	-4.7	0.018	-5.8	-5.5	-2.4
Moneyness for funds with only high-water mark provision (%)	-4.2	0.112	-0.8	0.0	0.0
Moneyness for funds with both provisions (%)	-10.9	0.133	-11.4	-5.7	-5.0
Lockup Period (years)	0.8	0.4	0.5	1.0	1.0
Restriction Period (years)	0.3	0.3	0.2	0.2	0.3
Flow	0.606	1.923	-0.143	0.059	0.546
AUM ($M)	120.6	371.1	8.0	25.3	78.0
Volatility (%)	4.4	3.7	1.7	3.4	5.8
Age (years)	5.4	3.6	2.6	4.5	7.2
Management Fee (%)	1.2	0.7	1.0	1.0	1.5
Incentive Fee (%)	16.3	7.8	15.0	20.0	20.0

Table 2. Do managerial incentives and discretion affect returns?

This table reports Fama-MacBeth coefficient estimates using $Returns_t$ as the dependent variable. Sample period is 1994-2002. Total Delta is the total dollar change in manager's wealth for a 1% change in fund NAV. Manager's Option Delta is the delta from investors' assets. Managerial Ownership is the ratio of manager's investment in the fund to the total assets under management. Hurdle Rate (High-Water Mark) is an indicator variable that equals 1 if the fund has hurdle rate (High-Water Mark) provision. Moneyness is defined as spot price minus the exercise price divided by the spot price. Lockup period is the minimum time that an investor has to wait (after making his investment) before he can withdraw his money. Restriction Period is the sum of Notice Period and the Redemption Period, where Notice period is the time the investor has to give notice to the fund about his intention to withdraw money from the fund, and Redemption Period is the time that the fund takes to return the money after the notice period is over. Size is the logarithm of assets under management. Flow is the new money flow scaled by assets. Volatility is the standard deviation of returns. Age is fund age. p-values are reported in parentheses. Figures marked with ***, **, and * are significant at the 1%, 5%, and 10% respectively.

Independent Variables	Expected Sign	Model 1	Model 2	Model 3	Model 4
MANAGERIAL INCENTIVES					
Total $Delta_{t-1}$	+	0.011***	0.013***		
		(0.003)	(0.001)		
Manager's Option $Delta_{t-1}$	+			0.015**	0.015**
				(0.017)	(0.022)
Managerial $Ownership_{t-1}$	+			0.126***	0.275*
				(0.009)	(0.073)
Managerial $Ownership^2_{t-1}$	-				-0.508
					(0.178)
Hurdle Rate	+	0.004		0.008	0.009
		(0.362)		(0.156)	(0.148)
High-Water Mark	+	0.026***		0.026***	0.027***
		(0.002)		(0.002)	(0.001)
$Moneyness_{t-1}$	-		-0.136**		
			(0.037)		
MANAGERIAL DISCRETION					
Lockup Period	+	0.029*	0.032*	0.029*	0.028*
		(0.096)	(0.083)	(0.095)	(0.095)
Restriction Period	+	0.018	0.018	0.019	0.019
		(0.157)	(0.153)	(0.147)	(0.141)
CONTROLS					
$Size_{t-1}$		-0.012***	-0.012***	-0.011***	-0.011***
		(0.003)	(0.004)	(0.005)	(0.005)
$Flow_{t-1}$		-0.007**	-0.007**	-0.006*	-0.006*
		(0.038)	(0.042)	(0.062)	(0.084)
$Volatility_{t-1}$		0.328	0.232	0.303	0.295
		(0.596)	(0.694)	(0.623)	(0.629)
Age_{t-1}		-0.003	-0.003	-0.004*	-0.004*
		(0.154)	(0.135)	(0.063)	(0.074)
Management Fee		-0.431	-0.480	-0.640	-0.722
		(0.428)	(0.384)	(0.258)	(0.253)
$Returns_{t-1}$		0.070	0.097	0.060	0.056
		(0.433)	(0.270)	(0.505)	(0.546)
Intercept		0.117***	0.131***	0.113***	0.111***
		(0.000)	(0.000)	(0.000)	(0.000)
Strategy Dummies		Yes	Yes	Yes	Yes
Adjusted R^2		13.6%	13.9%	13.8%	14.0%
Observations		16,901	16,901	16,901	16,901

Table 3. Does delta matter? Evidence from sample of funds with incentive fee = 20%

This table reports Fama-MacBeth coefficient estimates using $Returns_t$ as the dependent variable. Sample period is 1994-2002 and the sample of funds all have incentive fee equal to 20%. Total Delta is the total dollar change in manager's wealth for a 1% change in fund NAV. Manager's Option Delta is the delta from investors' assets. Managerial Ownership is the ratio of manager's investment in the fund to the total assets under management. Hurdle Rate (High-Water Mark) is an indicator variable that equals 1 if the fund has hurdle rate (High-Water Mark) provision. Moneyness is defined as spot price minus the exercise price divided by the spot price. Lockup period is the minimum time that an investor has to wait (after making his investment) before he can withdraw his money. Restriction Period is the sum of Notice Period and the Redemption Period, where Notice period is the time the investor has to give notice to the fund about his intention to withdraw money from the fund, and Redemption Period is the time that the fund takes to return the money after the notice period is over. Size is the logarithm of assets under management. Flow is the new money flow scaled by assets. Volatility is the standard deviation of returns. Age is fund age. p-values are reported in parentheses. Figures marked with ***, **, and * are significant at the 1%, 5%, and 10% respectively.

Independent Variables	Expected Sign	Model 1	Model 2	Model 3	Model 4
MANAGERIAL INCENTIVES					
Total Delta$_{t-1}$	+	0.009***	0.010***		
		(0.008)	(0.003)		
Manager's Option Delta$_{t-1}$	+			0.018***	0.017**
				(0.009)	(0.007)
Managerial Ownership$_{t-1}$	+			0.090	0.267
				(0.158)	(0.109)
Managerial Ownership$^2_{t-1}$	-				-0.585
					(0.131)
Hurdle Rate	+	0.011		0.014	0.015
		(0.201)		(0.172)	(0.164)
High-Water Mark	+	0.025***		0.025***	0.026***
		(0.002)		(0.002)	(0.002)
Moneyness$_{t-1}$	-		-0.141*		
			(0.069)		
MANAGERIAL DISCRETION					
Lockup Period	+	0.027	0.031*	0.027	0.027
		(0.125)	(0.099)	(0.119)	(0.125)
Restriction Period	+	0.017	0.018*	0.017	0.018
		(0.135)	(0.097)	(0.134)	(0.109)
CONTROLS					
Size$_{t-1}$		-0.014***	-0.013***	-0.013***	-0.013***
		(0.001)	(0.001)	(0.002)	(0.001)
Flow$_{t-1}$		-0.007*	-0.006*	-0.006	-0.005
		(0.085)	(0.091)	(0.160)	(0.245)
Volatility$_{t-1}$		0.230	0.121	0.214	0.194
		(0.705)	(0.836)	(0.729)	(0.750)
Age$_{t-1}$		-0.002	-0.002	-0.003**	-0.004*
		(0.290)	(0.224)	(0.050)	(0.077)
Management Fee		-0.649	-0.517	-0.710	-0.724
		(0.515)	(0.601)	(0.481)	(0.476)
Returns$_{t-1}$		0.055	0.084	0.047	0.039
		(0.555)	(0.350)	(0.632)	(0.692)
Intercept		0.125***	0.139***	0.123***	0.118***
		(0.000)	(0.000)	(0.000)	(0.001)
Strategy Dummies		Yes	Yes	Yes	Yes
Adjusted R^2		13.1%	13.3%	13.3%	13.6%
Observations		11,149	11,149	11,149	11,149

Table 4. Do incentive fees have additional explanatory power over delta?

This table reports Fama-MacBeth coefficient estimates using $Returns_t$ as the dependent variable. Sample period is 1994-2002. Total Delta is the dollar change in manager's wealth for a 1% change in fund NAV. Manager's Option Delta is the delta from investors' assets. Managerial Ownership is the ratio of manager's investment in the fund to the total assets under management (AUM). Hurdle Rate (High-Water Mark) is an indicator variable that equals 1 if the fund has Hurdle Rate (High-Water Mark) provision. Moneyness is defined as spot price minus the exercise price divided by the spot price. Lockup period is the minimum time that an investor has to wait before he can withdraw his money. Restriction Period is the sum of Notice Period and Redemption Period, where Notice period is the time the investor has to give notice to the fund to withdraw money from the fund, and Redemption Period is the time that the fund takes to return the money after the notice period is over. Size is the logarithm of AUM. Flow is the new money flow scaled by assets. Volatility is the standard deviation of returns. Age is fund age. p-values are reported in parentheses. Figures marked with ***, **, and * are significant at the 1%, 5%, and 10% respectively.

Independent Variables	Expected Sign	Model 1	Model 2	Model 3	Model 4
MANAGERIAL INCENTIVES					
Total $Delta_{t-1}$	+	0.010***	0.011***		
		(0.004)	(0.001)		
Manager's Option $Delta_{t-1}$	+			0.015**	0.014**
				(0.020)	(0.021)
Managerial $Ownership_{t-1}$	+			0.103***	0.239*
				(0.005)	(0.069)
Managerial $Ownership^2_{t-1}$	-				-0.409
					(0.185)
Incentive Fee	+	0.070	0.074	0.037	0.020
		(0.169)	(0.142)	(0.442)	(0.671)
Hurdle Rate	+	0.006		0.008	0.009
		(0.233)		(0.139)	(0.141)
High-Water Mark	+	0.026***		0.026***	0.026***
		(0.002)		(0.002)	(0.001)
$Moneyness_{t-1}$	-		-0.142**		
			(0.031)		
MANAGERIAL DISCRETION					
Lockup Period	+	0.026	0.029*	0.028*	0.027*
		(0.107)	(0.094)	(0.095)	(0.096)
Restriction Period	+	0.018	0.019	0.018	0.019
		(0.165)	(0.149)	(0.156)	(0.144)
CONTROLS					
$Size_{t-1}$		-0.012***	-0.012***	-0.011***	-0.011***
		(0.001)	(0.004)	(0.005)	(0.005)
$Flow_{t-1}$		-0.007**	-0.007**	-0.006*	-0.006*
		(0.039)	(0.042)	(0.058)	(0.079)
$Volatility_{t-1}$		0.322	0.223	0.306	0.297
		(0.602)	(0.705)	(0.621)	(0.627)
Age_{t-1}		-0.003	-0.003	-0.004*	-0.004*
		(0.185)	(0.162)	(0.085)	(0.096)
Management Fee		-0.688	-0.765	-0.730	-0.757
		(0.308)	(0.262)	(0.279)	(0.267)
$Returns_{t-1}$		0.068	0.097	0.061	0.057
		(0.446)	(0.275)	(0.499)	(0.536)
Intercept		0.107***	0.121***	0.108***	0.109***
		(0.000)	(0.000)	(0.000)	(0.000)
Strategy Dummies		Yes	Yes	Yes	Yes
Adjusted R^2		13.8%	14.1%	13.9%	14.1%
Observations		16,901	16,901	16,901	16,901

Table 5. Do managerial incentives and discretion affect long-term returns?

This table reports Fama-MacBeth coefficient estimates using Returns: $2year_t$ as the dependent variable. Sample period is 1994-2002. Total Delta is the total dollar change in manager's wealth for a 1% change in fund NAV. Manager's Option Delta is the delta from investors' assets. Managerial Ownership is the ratio of manager's investment in the fund to the total assets under management. Hurdle Rate (High-Water Mark) is an indicator variable that equals 1 if the fund has hurdle rate (High-Water Mark) provision. Moneyness is defined as spot price minus the exercise price divided by the spot price. Lockup period is the minimum time that an investor has to wait (after making his investment) before he can withdraw his money. Restriction Period is the sum of Notice Period and the Redemption Period, where Notice period is the time the investor has to give notice to the fund about his intention to withdraw money from the fund, and Redemption Period is the time that the fund takes to return the money after the notice period is over. Size is the logarithm of assets under management. Flow is the new money flow scaled by assets. Volatility is the standard deviation of returns. Age is fund age. p-values are reported in parentheses. Figures marked with ***, **, and * are significant at the 1%, 5%, and 10% respectively.

Independent Variables	Expected Sign	Model 1	Model 2	Model 3	Model 4
MANAGERIAL INCENTIVES					
Total Delta$_{t-2}$	+	0.007***	0.008***		
		(0.004)	(0.001)		
Manager's Option Delta$_{t-2}$	+			0.008***	0.008***
				(0.005)	(0.002)
Managerial Ownership$_{t-2}$	+			0.059*	0.089
				(0.056)	(0.250)
Managerial Ownership$^2_{t-2}$	-				-0.119
					(0.351)
Hurdle Rate	+	-0.001		0.001	0.001
		(0.717)		(0.915)	(0.927)
High-Water Mark	+	0.019***		0.019***	0.019***
		(0.000)		(0.000)	(0.000)
Moneyness$_{t-2}$	-		-0.071		
			(0.129)		
MANAGERIAL DISCRETION					
Lockup Period	+	0.029**	0.030**	0.029**	0.028**
		(0.021)	(0.017)	(0.021)	(0.019)
Restriction Period	+	0.026**	0.025***	0.026**	0.026**
		(0.011)	(0.009)	(0.011)	(0.010)
CONTROLS					
Size$_{t-2}$		-0.009***	-0.008***	-0.008***	-0.008***
		(0.001)	(0.001)	(0.001)	(0.001)
Flow$_{t-2}$		-0.005***	-0.004***	-0.005**	-0.005**
		(0.010)	(0.009)	(0.012)	(0.011)
Volatility$_{t-2}$		-0.040	-0.082	-0.052	-0.057
		(0.852)	(0.696)	(0.805)	(0.783)
Age$_{t-2}$		-0.003*	-0.003*	-0.003**	-0.003**
		(0.075)	(0.061)	(0.040)	(0.045)
Management Fee		-0.351	-0.376	-0.462	-0.475
		(0.355)	(0.319)	(0.226)	(0.252)
Intercept		0.137***	0.146***	0.134***	0.134***
		(0.000)	(0.000)	(<0.0001)	(<0.0001)
Strategy Dummies		Yes	Yes	Yes	Yes
Adjusted R^2		7.3%	7.5%	7.4%	7.5%
Observations		12,988	12,988	12,988	12,988

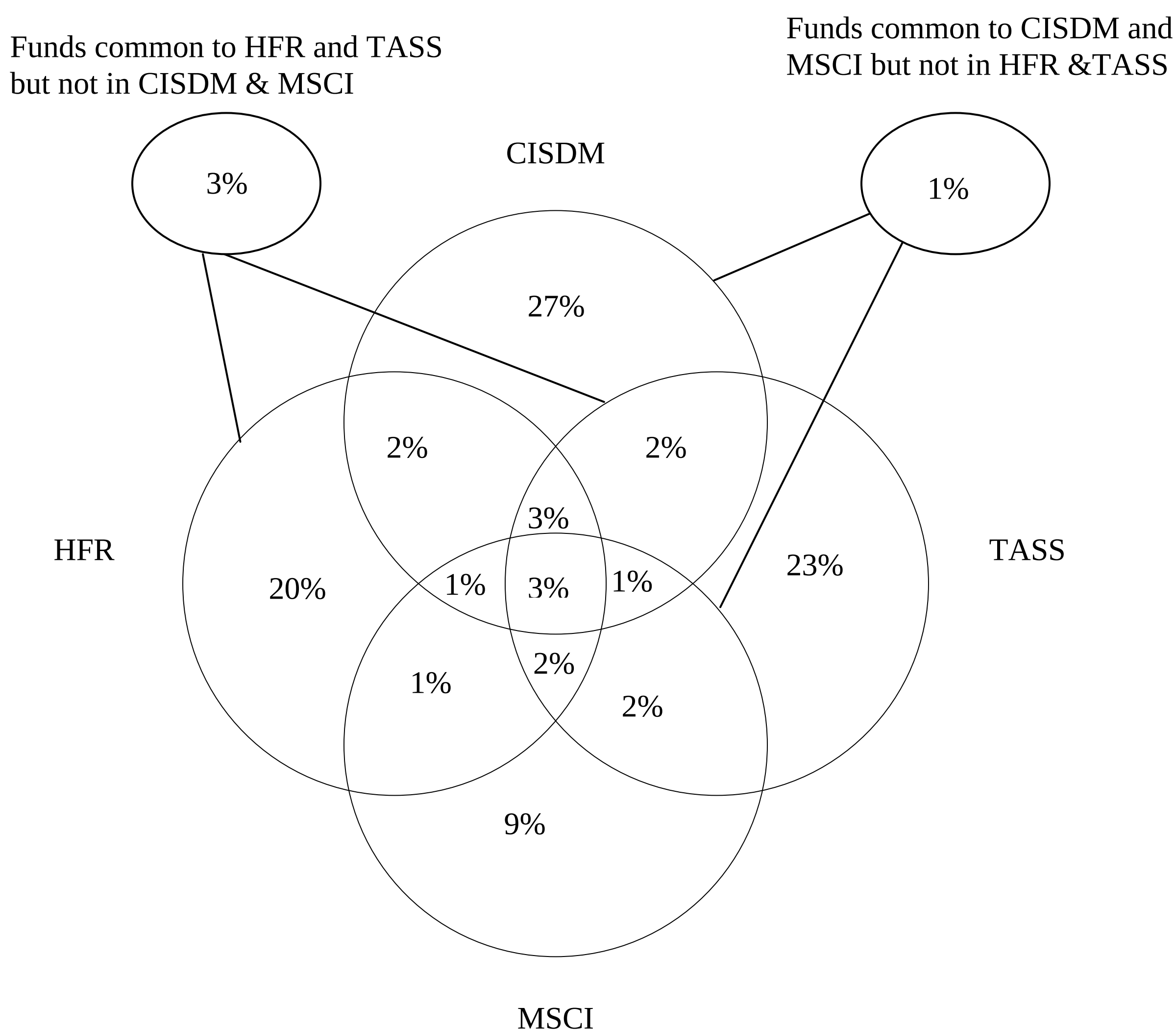
Table 6. Robustness

This table reports the robustness of our results to various measures of performance and tests of alternative hypotheses. For expositional convenience, we report the coefficients and p-values for only the managerial incentive (manager's option delta, managerial ownership, hurdle rate, and high-water mark) and discretion (lockup and restriction periods) measures and suppress the reporting of other control variables. Figures marked with ***, **, and * are significant at the 1%, 5%, and 10% respectively.

	Type of robustness	Manager's Option Delta	Managerial Ownership	Hurdle Rate	High-Water Mark	Lockup Period	Restriction Period	Adj. R^2	Obs
1.	**Net Returns (BASE CASE)**	0.015**	0.126***	0.008	0.026***	0.029*	0.019		
		(0.017)	(0.009)	(0.156)	(0.002)	(0.095)	(0.147)	13.8%	16,901
2.	**Gross Returns: 1-year**	0.023**	0.125*	-0.0002	0.027***	0.046**	0.018		
		(0.011)	(0.057)	(0.977)	(0.003)	(0.049)	(0.235)	14.1%	16,341
3.	**Alphas: 1-year**	0.041	0.373	0.052	0.072	0.483***	0.081		
		(0.401)	(0.176)	(0.261)	(0.133)	(0.003)	(0.462)	7.2%	15,652
4.	**Including only second year of funds' existence**	0.069*	0.251	0.019*	0.027**	0.028*	0.021		
		(0.060)	(0.349)	(0.073)	(0.045)	(0.089)	(0.159)	14.6%	4,313
5.	**Including hurdle rate and high-water mark interaction**	0.015**	0.127***	0.014	0.031**	0.029*	0.019		
		(0.016)	(0.009)	(0.248)	(0.021)	(0.096)	(0.145)	13.8%	16,901
6.	**Including square of lockup and square of restriction period**	0.015**	0.129***	0.007	0.025***	0.059	0.061	13.9%	16,901
		(0.022)	(0.009)	(0.170)	(0.001)	(0.416)	(0.156)		
7.	**Combining lockup and restriction period into one variable**	0.016**	0.127***	0.007	0.027***	0.024**		13.7%	16,901
		(0.018)	(0.009)	(0.172)	(0.002)	(0.037)			
8.	**Replacing lag volatility by contemporaneous volatility**	0.012**	0.119**	0.007	0.021***	0.026	0.024**		
		(0.022)	(0.018)	(0.245)	(0.003)	(0.120)	(0.049)	16.5%	16,901
9.	**Excluding small funds (AUM less than $15 million)**	0.009*	0.103**	0.007	0.020***	0.021*	0.016		
		(0.092)	(0.028)	(0.240)	(0.007)	(0.076)	(0.186)	15.3%	11,596
10.	**Pooled OLS**	0.017**	0.044**	0.002	0.027***	0.017***	0.020***		
		(0.017)	(0.012)	(0.619)	(<0.0001)	(0.006)	(0.005)	15.0%	16,901
11.	**Sample with survivorship bias**	0.014**	0.110***	0.005	0.022***	0.029*	0.018		
		(0.026)	(0.009)	(0.268)	(0.001)	(0.090)	(0.152)	14.1%	14,697
12.	**Control for backfilling bias**	0.009*	0.117**	0.006	0.023***	0.028	0.018		
		(0.083)	(0.013)	(0.257)	(0.006)	(0.112)	(0.140)	13.0%	14,221

Figure 1: Distribution of Hedge Funds by Data Sources

This figure shows the percentage of hedge funds from the four databases namely CISDM, HFR, MSCI, and TASS at the end of our sample period (2002).



Appendix A: Computation of Delta

Incentive fee contacts provide managers with options on the investors' assets under management (AUM). We calculate the option delta based on Black-Scholes (1973) formula for valuing European call options.

Manager's Option Delta = sensitivity of the option value to a 1% change in asset value
= N(Z) * S * 0.01 * I **(1)**

where Z $= \frac{ln\left(\frac{S}{X}\right) + T\left(r + \frac{\sigma^2}{2}\right)}{\sigma T^{0.5}}$

S = spot price (= market value of investor's assets as of end of current year)
X = exercise price (= the market value of the investor's assets that has to be reached next year before incentive fees can be paid next year)
T = time to maturity of the option (= 1 year)
r = natural log of 1+ risk-free interest rate (= log of (1+LIBOR) rate for next year)
σ = volatility of monthly net returns (estimated over the year)
I = incentive fee rate (expressed as a fraction)
N( ) = cdf of standard normal distribution

Manager's option delta of the fund is the sum of delta from different sets of investors', each of whom will have their own exercise price depending on when they enter the fund. To compute the spot price (S) and exercise price (X) used in the computation of delta above, we make the following assumptions.

1) Assets at inception are assumed to be that of the investor.
2) Investors' money flows occur at the end of each year
3) The dollar inflows from investors are tracked separately for each year. Hence, each investor has his own exercise price depending on when he enters the fund and the hurdle rate and high-water mark provisions.
4) When dollar outflows from investors occur, we adopt first-in-first-out rule to decide which of the investor's money leaves the fund.
5) Hurdle rate is LIBOR for funds with hurdle rate provision.
6) In case, no incentive fee is paid for a year due to insufficient returns, the hurdle for next year is based on geometrically compounded hurdle rate over that time.
7) Management fees cover fixed costs.
8) Incentive fees are paid annually at the end of the year. The manager reinvests all of the incentive fees into the fund after paying personal taxes. Offshore managers pay no personal taxes on incentive fees whereas onshore managers pay taxes @35%.

We adopt the following steps:

1) Estimate fund's annual gross returns given data on net returns.

The 1st investor enters the fund at the end of year 0, the 2nd investor enters the fund at the end of year 1, the 3rd investor enters the fund at the end of year 2, and so on….

For the fund's first full year of existence, since there is only one investor (assumption 1), gross returns can be computed as follows:

$$gross_t = \left\{ \begin{array}{l} \dfrac{net_t - hurdle_t * I}{1 - I} \text{ if } net_t > hurdle_t \\ net_t \text{ otherwise} \end{array} \right\} \quad \textbf{(2)}$$

where $hurdle_t = libor_t$ if the fund has hurdle rate provision, and = 0 otherwise.

From the second year onwards, the computation of gross returns becomes more involved. Since investor money flow is assumed to occur at the end of the year, the reported net return is the year-end market value of year-beginning AUM after incentive fees has been paid to the AUM divided by the year-beginning AUM. For example, for a given investor '*i*', the year-end market value of his assets net of incentive fees, *MVafterINC*, is given by

$$MVafterINC_i = S_{i,t-1}(1+gross_t) - Max[(S_{i.t-1}(1+gross_t) - X_{i.t-1}), 0]\ I$$

where S_i denotes market value of assets of investor '*i*' ("spot price" as of year-end '*t-1*'), X_i denotes the market value of assets of investor '*i*' that has to be reached ("exercise price" as of year-end '*t-1*') before incentive fees could be paid out in year '*t*', and *I* is the incentive fee rate. The numerator in the net return formula is then the summation of the above over all investors ($\sum MVafterInc_i$) plus the year-end market value of manager's year-beginning investment in the fund. Since this is a non-linear function of gross returns, a closed-form solution for gross returns is not possible. Therefore, we solve this recursive problem iteratively to back out gross returns from the data.

2) Estimate the market value of manager's investment in the fund (*MVmgr*). This equals the year-end market value of her year-beginning investment plus the post-tax incentive fees earned in that year.

3) Estimate new money flow into or out of the fund as the difference between the reported year-end AUM less ($\sum MVafterInc_i$ + *MVmgr*).

4) If there is net outflow, then the *MVafterINC* of the earliest investor is reduced by the outflow computed in step 3. If the outflow is greater than *MVafterINC* of the earliest investor, then the remaining balance is assumed to be withdrawn from the second earliest investor and so on.

5) Compute the year-end market value of assets for each investor (spot price S) and the fund manager.

6) Compute the exercise price for each investor (exercise price X) depending on whether the fund has a hurdle rate and/or high-water mark provision

   a) If the gross return of the fund is high-enough such that an investor has to pay incentive fee, then the exercise price is higher than the current market value by the hurdle rate (=LIBOR if the fund has hurdle rate provision, and = 0 if the fund does not have the hurdle rate provision)

   b) If the gross fund return is not sufficient enough that an investor has to pay incentive fee and if the fund has high-water mark provision, the new exercise price is higher than the last year's exercise price by the hurdle rate

   c) If the gross fund return is not sufficient enough that an investor has to pay incentive fee and if the fund does not have the high-water mark provision, then the exercise price is higher than the current market value by the hurdle rate

7) Using the S and X of various investors' capital in the fund, compute the delta of each and sum them up along with the delta from manager's investment in the fund to estimate the total delta of the fund.

8) The *total delta* of the fund equals delta from investors' assets (manager's option delta) plus the delta from manager's stake. Since manager retains all the return on his own investment, delta from manager's stake equals market value of manager's investment in the fund * 0.01 (i.e., when fund earns one percent return, value of the manager's stake goes up by one percent). *Managerial ownership* as we use in our analysis is the market value of manager's investment in the fund expressed as a fraction of fund's total assets under management.

Appendix B: Classification of Hedge Fund Strategies

This table provides the mapping of the strategies provided by different data vendors with the four broad strategies that we use in our study. It also provides a brief definition of each of the four broad strategies and distribution of funds across the four strategies.

Broad Strategy	Vendor's Strategy	Vendor
Directional Traders	Dedicated Short Bias	TASS
Directional Traders	Discretionary Trading	MSCI
Directional Traders	Emerging Markets	TASS
Directional Traders	Emerging Markets: Asia	HFR
Directional Traders	Emerging Markets: E. Europe/CIS	HFR
Directional Traders	Emerging Markets: Global	CISDM and HFR
Directional Traders	Emerging Markets: Latin America	HFR
Directional Traders	Foreign Exchange	HFR
Directional Traders	Global Macro	CISDM, HFR, and TASS
Directional Traders	Macro	HFR
Directional Traders	Market Timing	HFR
Directional Traders	Sector	CISDM and HFR
Directional Traders	Short Bias	MSCI
Directional Traders	Short Sales	CISDM and TASS
Directional Traders	Short Selling	HFR
Directional Traders	Systematic Trading	MSCI
Directional Traders	Tactical Allocation	MSCI
Relative Value	Arbitrage	MSCI
Relative Value	Convertible Arbitrage	HFR and TASS
Relative Value	Equity Market Neutral	HFR and TASS
Relative Value	Fixed Income: Arbitrage	HFR and TASS
Relative Value	Fixed Income: Convertible Bonds	HFR
Relative Value	Fixed Income: High Yield	HFR
Relative Value	Fixed Income: Mortgage-Backed	HFR
Relative Value	Long-Short Credit	MSCI
Relative Value	Market Neutral	CISDM
Relative Value	Merger Arbitrage	HFR and MSCI
Relative Value	Relative Value Arbitrage	HFR and TASS
Relative Value	Statistical Arbitrage	MSCI

Security Selection	Equity Hedge	HFR
Security Selection	Equity Non-Hedge	CISDM and HFR
Security Selection	Global	CISDM
Security Selection	Global Established	CISDM
Security Selection	Global International	CISDM
Security Selection	Long/Short Equity Hedge	HFR and TASS
Security Selection	Long Bias	HFR and MSCI
Security Selection	No Bias	MSCI
Security Selection	Private Placements	MSCI
Security Selection	US Opportunistic	CISDM
Security Selection	Variable Bias	MSCI
Multi-Process	Event Driven	CISDM, HFR, MSCI, and TASS
Multi-Process	Fixed Income: Diversified	HFR
Multi-Process	Distressed Securities	CISDM, HFR, and MSCI
Multi-Process	Multi-Process	MSCI and TASS
Multi-Process	Multi-Strategy	HFR

Directional Traders usually bet on the direction of market prices of currencies, commodities, equities, and bonds in the futures and cash markets. 24% of the funds in our sample fall in this category.

Relative Value strategies take positions on spread relationships between prices of financial assets or commodities and aim to minimize market exposure. 23% of the funds in our sample fall in this category.

Security Selection managers take long and short positions in undervalued and overvalued securities respectively and reduce the systematic market risks in the process. Usually, they take positions in equity markets. 42% of the funds in our sample fall in this category.

Multi-Process strategy involves multiple strategies employed by the funds usually involving investments in opportunities created by significant transactional events, such as spin-offs, mergers and acquisitions, bankruptcy reorganizations, recapitalizations and share buybacks. For example, the portfolio of some Event-Driven managers may shift in majority weighting between Merger Arbitrage and Distressed Securities, while others may take a broader scope. 11% of the funds in our sample fall in this category.

Note: We exclude managed futures, natural resources, mutual funds, and ‘other’ hedge funds since these categories are not usually considered as “typical” hedge funds. We also exclude long-only funds, Regulation D funds, and funds with missing strategy information.