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Essays on asset management

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ESSAYS ON ASSET MANAGEMENT

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Essays on Asset Management

By

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Essays on Asset Management

Chapter 1:

The Pitfalls of Going Public: New Evidence from Hedge Funds

Lin Sun and Melvyn Teo

Abstract: Hedge funds managed by listed firms significantly underperform funds managed by unlisted firms. We argue that since the new shareholders of a listed management company typically do not invest alongside the limited partners of the funds managed, the process of going public breaks the incentive alignment between ownership, control, and investment capital, thereby engendering agency problems. In line with the agency explanation, the underperformance is more severe for funds that have low manager total deltas, low governance scores, and no manager personal capital, or that are managed by firms whose stock prices are more sensitive to earnings news. Post IPO, listed firms aggressively raise capital by launching multiple new funds. Consequently, despite the underperformance, listed firms harvest greater fee revenues than do comparable unlisted firms. Investors continue to subscribe to hedge funds managed by listed firms as they appear to offer lower operational risk.

Chapter 2:

Overpriced Stocks and Hedge Fund Performance

Lin Sun

Abstract: Using the mispricing measure constructed by Stambaugh, Yu, and Yuan (2015), I find that propensity to hold mispriced stocks reflect hedge fund managerial ability. Hedge funds hold most overpriced stocks underperform hedge funds hold least overpriced stocks by

3.00% per annual after adjusting for risk. Propensity of hedge funds to hold more overpriced stock is persistent over the next quarter. Hedge funds holding most overpriced stocks are more prone to disposition effect and trade more actively.

Chapter 3:

On the Performance of Hedge Funds Charging Zero Performance Fee

Lin Sun

Abstract: Hedge funds charging zero performance fee significantly underperform hedge funds charging non-zero performance fee by 3.79% per annual. Hedge funds charging zero performance fee take higher systematic risk, invest less distinctively relative to their peers, and implement more scalable strategies. The presence of a performance fee increases the flow-performance sensitivity in both the low performance and high performance terciles.

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Chapter 1:

The Pitfalls of Going Public: New Evidence from Hedge Funds

Lin Sun[#] and Melvyn Teo[^]

Abstract

Hedge funds managed by listed firms significantly underperform funds managed by unlisted firms. We argue that since the new shareholders of a listed management company typically do not invest alongside the limited partners of the funds managed, the process of going public breaks the incentive alignment between ownership, control, and investment capital, thereby engendering agency problems. In line with the agency explanation, the underperformance is more severe for funds that have low manager total deltas, low governance scores, and no manager personal capital, or that are managed by firms whose stock prices are more sensitive to earnings news. Post IPO, listed firms aggressively raise capital by launching multiple new funds. Consequently, despite the underperformance, listed firms harvest greater fee revenues than do comparable unlisted firms. Investors continue to subscribe to hedge funds managed by listed firms as they appear to offer lower operational risk.

Keywords: Hedge funds, Initial Public Offering, Agency, Short-termism

JEL Classification: G11; G12; G14; G23

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1.1. Introduction

"When a fund management company lists on a stock exchange, its clients are not uniformly delighted. They are aware that potential conflicts of interest can arise that some companies fail to manage. "

–The Financial Times, July 2012[1]

"Public listings can lead to a fundamental tension between large investors who select funds for strong returns long term and shareholders who clamor for quarterly earnings increases and constantly monitor the stock price."

–The Wall Street Journal, June 2011[2]

In the recent years, we have witnessed a slew of public listings by large asset management firms including Man Group, Fortress Investment Group, Och-Ziff Capital Management Group, Blackstone Group, and KKR.[3] How does the transition to public equity markets impact investment performance? On one hand, fund management companies argue that going public allows them to boost investment performance by better incentivizing and motivating their employees through employee stock options, and by investing the IPO proceeds in superior technology and business support. Moreover, listed firms may be operationally more robust than their unlisted competitors given the higher level of transparency required of listed companies. On the other hand, fund investors contend that public listings allow firm founders to sell off their stakes in their fund management companies to outsiders, which exacerbates potential conflicts of interests. In this paper, we

[1] "Going public brings benefits and pitfalls," The Financial Times, 22 July 2012.
[2] "For private equity clients, worries over public listing," The Wall Street Journal, 25 June 2011.
[3] By our estimates, at the end of 2013 about 16.68 percent of hedge fund industry assets are managed by funds run by listed firms.

contribute to this debate by investigating the impact on hedge fund performance when asset management firms go public.

The hedge fund industry is an interesting laboratory for studying the impact of initial public offerings on investment performance in asset management. First, hedge funds, both public and private, typically report monthly return data to commercial databases. This allows us to cleanly measure investment performance and compare the performance of funds managed by publicly listed firms with those managed by comparable privately held firms.[4] In contrast, the corporate finance literature traditionally suffers from a dearth of information on private firms. Even when data on private firms are available, e.g., via Sageworks, they are often anonymized, and therefore, do not allow researchers to observe the transition from private to public. Second, it is difficult to run a comparable analysis on private equity funds as traditional performance metrics in private equity such as IRR or investment multiple are measured over a ten-year horizon, effectively precluding researchers from analyzing the performance implications of the transition in a timely fashion. Third, agency problems are more extreme with hedge funds than with mutual funds owing to the complex strategies employed by and the lower level of transparency and disclosure of the former.[5]

Indeed, hedge funds and private equity funds (and to a lesser extent mutual funds) that are managed by publicly listed firms need to contend with a rich set of agency issues: the problems that surface between management and shareholders (Berle and Means, 1932; Jensen and Meckling, 1976), and the conflicts that arise between management and investors (Bollen and Pool, 2008, 2009; Teo, 2011; Aragon and Nanda, 2016). Hedge fund investors have traditionally relied on co-investment by managers to create incentive alignment and

[4] Our results are robust to adjustments for the backfill bias (Bhardwaj, Gorton, and Rouwenhorst, 2014), self-selection bias (Fung and Hsieh, 2009), and illiquidity induced serial correlation of returns (Getmansky, Lo, and Makarov, 2004) that afflict self-reported hedge fund return data.

[5] In line with this view, we find that our baseline results are economically weaker but still statistically significant (at the five percent level for equal-weighted portfolios and at the one percent level for value-weighted portfolios) with actively managed U.S. equity mutual funds.

ameliorate agency problems that stem from conflicts between general partners and limited partners.[6] However, the process of going public breaks the incentive alignment since the new shareholders typically do not invest alongside the limited partners. Fig. 1 illustrates the separation of ownership, control, and investment capital when a hedge fund firm goes public.[7]

[Insert Fig. 1 here]

Our results are striking. We find substantial differences in expected returns, on the portfolios of hedge funds sorted by fund management company listing status, that are unexplained by the Fung and Hsieh (2004) seven factors. Hedge funds managed by listed firms underperform hedge funds managed by unlisted firms by 2.89 percent per year (*t*-statistic = 4.73) after adjusting for co-variation with the Fung and Hsieh (2004) seven factors. The results are not confined to the smallest funds in our sample and cannot be explained by differences in fund age (Aggarwal and Jorion, 2010), fund size (Berk and Green, 2004), return smoothing behavior (Getmansky, Lo, and Makarov, 2004), fees (Agarwal, Daniel, and Naik, 2009), share restrictions and illiquidity (Aragon, 2007; Aragon and Strahan, 2012), and backfill and incubation bias (Liang, 2000; Fung and Hsieh, 2009; Bhardwaj, Gorton, and Rouwenhorst, 2014).

We find using a differences-in-differences analysis that relative to the five-year period before IPO, average fund risk-adjusted performance deteriorates by 13.68 percent per annum while average firm alpha wanes by 8.04 percent per annum during the five-year period following the IPO. Despite the post-event underperformance, listed firms harvest fee

[6] According to Luba Nikulina from Towers Watson, "Capital commitment by fund managers is the single most important way to align the interests of managers and investors." See "Skin in the game is crucial, but how much?" Financial Times, 18 November 2012.

[7] Typically a privately held hedge fund firm is controlled by its founders, i.e., owners, who also invest a substantial percentage of their net worth in the funds managed by the firm. Hence the tight link between ownership, control, and investment capital. Post-IPO, this link is broken as the founders of the firm sell-out to new shareholders who neither invest alongside the limited partners nor manage the hedge funds run by the firm.

revenues that are US$3.48 million greater than comparable private firms. This is because relative to the control group, they are able to grow their assets under management (henceforth AUM) by US$340.95 million or 61.49 percent during the same period. The surge in firm AUM stems less from organic growth in existing fund AUM and more from the launch of new funds post listing. After listing, existing fund AUM ratchets up by US$144 million, but the AUM increase is still lower than that for funds in the control group. At the same time, the number of new funds per firm increases from 3.34 funds to 6.37 funds, which is 2.77 funds per firm greater than that for comparable firms. Indeed, we show that after controlling for a variety of factors, being listed increases the chance that a firm will launch a new fund by 30.65 percent.

What drives the underperformance of hedge funds managed by listed firms? In line with an agency story that centers on conflicts between management and investors, we observe substantial differences in the underperformance of funds managed by listed firms for funds sorted on metrics that are known to ameliorate agency problems. Specifically, the alpha spread between funds managed by listed versus those managed by unlisted firms is larger for funds that are more susceptible to agency: funds with low manager total deltas (Agarwal, Daniel, and Naik, 2009), funds with poor governance scores (Ozik and Sadka, 2016), and funds without co-investment by the manager.

How do the aforementioned agency problems translate into fund underperformance? We argue that post-IPO, the drive to gather assets (Yin, 2016; Lim, Sensoy, and Weisbach, 2016; Fung et al., 2016) may explain the underperformance of listed firms.[8] We find that consistent with the asset gathering view, the underperformance is most severe for funds with

[8] A firm that focuses on gathering assets may underperform as its founding partners may be less motivated to maintain a stellar track record once asset gathering has begun or may by distracted by the demands associated with managing a larger business. Agarwal, Daniel, and Naik (2009) and Aggarwal and Jorion (2010) document the importance of manager motivation to fund performance while Lu, Ray, and Teo (2016) measure the impact of manager inattention on fund alpha.

the greatest capacity to gather assets, i.e., funds that take on little liquidity risk and therefore are less affected by capacity constraints (Berk and Green, 2004). The underperformance of the funds managed by listed firms, relative to those managed by unlisted firms, is 6.66 percent per annum for funds in the lowest Pástor and Stambaugh (2003) liquidity beta quintile but only 2.89 percent per annum for funds in the highest liquidity beta quintile.

Are the agency problems that arise in publicly managed hedge funds also driven by the conflicts between management and shareholders? We hypothesize that the short-termist pressures associated with a stock listing (Poterba and Summers, 1995; Graham, Harvey, and Rajgopal, 2005) may also drive the underperformance and excessive asset gathering of publicly traded asset management firms. As argued by Narayanan (1985), Miller and Rock (1985), Stein (1989), Shleifer and Vishny (1990), Von Thadden (1995) and Holmström (1999), a focus on a firm's short term profits or current stock price will distort firm decisions from the first-best if investors have incomplete information on how the firm should grow to maximize its long term value. Short-termist pressures can induce excessive asset gathering since asset gathering boosts current fee revenues (or current firm earnings) at the expense of future returns (or future earnings). To test the short-termism view, we follow Asker, Farre-Mensa, and Ljungqvist (2015) and measure the sensitivity of stock price to earnings news using "earnings response coefficients" or ERC (Ball and Brown, 1968; Easton and Zmijewski, 1989). If short-termism explains the underperformance and excessive asset gathering of listed firms, we should find that underperformance and asset gathering increase with ERC. This is precisely what we find. High ERC firms whose stock prices are more responsive to earnings underperform more, raise more capital, and launch more funds post listing, than do low ERC firms.

Why do hedge fund investors continue to subscribe to funds managed by listed firms in light of their underperformance? One view is that given the level of transparency that is

required of a publicly listed firm, hedge funds managed by listed firms may score better in terms of operational risk metrics. In line with this view, hedge funds managed by listed firms are less likely to trigger three of the four most common performance flags observed by Bollen and Pool (2012). Specifically, funds managed by listed firms are 3.6 percent less likely to feature return distributions with a discontinuity at zero, 3.2 percent less likely to report a low number of negative returns, and 7.7 percent less likely to report a high number of repeated returns. Moreover, the differences in rejection rates are statistically significant at the one percent level for the aforementioned indicators of fraud risk.

Can the endogeneity of firm listing engender the underperformance of hedge funds managed by public firms? The event study by analyzing the private to public transition allows us to sidestep concerns that time-invariant differences between public and private firms simultaneously explain listing status and fund underperformance. Similarly, the differences-in-differences methodology that we employ help ameliorate concerns that observable time-varying differences in firm characteristics drive our findings. To cater for the possibility that unobserved time-varying differences between public and private firms might concurrently affect the decision to go public or stay private and fund investment performance, we run an instrumental variables analysis with the supply of capital at firm founding as the instrument.[9] The impact of listing on fund performance is even larger after instrumenting for listing status, suggesting that the endogeneity of listing status does not drive our findings.

The results in this paper challenge the view that asset management firms go public so as to better motivate and incentivize their employees. In doing so, we resonate with the three strands of research in the hedge fund literature. The first strand examines agency problems

[9] To proxy for the supply of capital at firm founding, we use firm investment strategy flow during the 24-month period after firm inception. As alternative instruments, we also use firm strategy flow during the 12-month period before inception as well as firm strategy flow during the 12-month period after inception. The instrumental variables regression results are robust to our choice of instrument.

and finds that some hedge funds tend to misreport their returns (Bollen and Pool, 2008; 2009), take on excessive liquidity risk (Teo, 2011), and strategically delay reporting poor returns (Aragon and Nanda, 2016). Our findings indicate that the process of going public heightens the conflicts of interests between managers and investors by disrupting the alignment of incentives. A second strand focuses on capital raising and argues that there are strong direct (Yin, 2016) and indirect (Lim, Sensoy, and Weisbach, 2016) incentives that drive hedge fund managers to raise capital. It also finds that the majority of industry assets are managed by a few successful mega hedge fund firms (Edelman, Fung, and Hsieh, 2013) and that hedge fund firms grow by leveraging on successful first funds to raise follow-on funds at better terms (Fung et al., 2016). Our results suggest that firms that go public are even more motivated to gather assets. They do so principally by aggressively launching new funds. The third strand sheds light on the drivers of alpha in the hedge fund industry. We find that just like motivated (Agarwal, Daniel, and Naik, 2009), emerging (Aggarwal and Jorion, 2010), geographically proximate (Teo, 2009), and attentive (Lu, Ray, and Teo, 2016) funds, those managed by private firms also tend to outperform.

This paper also contributes to the literature on initial public offerings. Researchers have shown that going public hurts the performance of industry competitors (Hsu, Reed, and Rocholl, 2010), impairs an issuer's credit ratings (Kedia, Rajgopal, and Zhou, 2014), lowers the quality of firm internal innovation (Bernstein, 2015), and reduces the sensitivity of corporate investment to investment opportunities (Asker, Farre-Mensa, and Ljungqvist, 2015). Yet little is known about the effect of going public on fund investment performance. Our work addresses this important gap in the literature. We also add to work on short-termism pressures in public firms that started with survey evidence presented by Poterba and Summers (1995) and Graham, Harvey, and Rajgopal (2005), and culminated in empirical work by Asker, Farre-Mensa, and Ljungqvist (2015). We show that the pressure that short-

termist shareholders exert on publicly traded asset management firms can undermine investment performance and give rise to capital raising incentives. Our findings are distinct from those of Jain and Kini (1994) and Loughran and Ritter (1995) who show that IPO firms do worse than matching listed firms when it comes to long-run post-issue operating performance and stock returns, respectively. Indeed, we show that while listed asset managers deliver lower returns for their fund investors than do their unlisted competitors, the former are able to grow fee revenues relative to the latter, which benefits their shareholders.

The remainder of this paper is organized as follows: Section 2 describes the data and methodology. Section 3 reports the results from the empirical analysis while Section 4 presents a myriad of robustness tests. Section 5 concludes.

1.2. Data and methodology

We evaluate the impact of hedge funds using monthly net-of-fee returns and assets under management data of live and dead hedge funds reported in the TASS, HFR, and BarclayHedge datasets from January 1994 to December 2013. Because TASS, HFR, and BarclayHedge started distributing their data in 1994, the data sets do not contain information on funds that died before January 1994. This gives rise to survivorship bias. We mitigate this bias by focusing on data from January 1994 onward.

In our fund universe, we have a total of 30,509 hedge funds, of which 12,380 are live funds and 18,129 are dead funds. However, due to concerns that funds with multiple share classes could cloud the analysis, we exclude duplicate share classes from the sample.[10] This

[10] Inferences do not change when we include multiple share classes of the same fund in the analysis. To merge databases, we follow the procedure outlined in the Appendix of Joenväärä, Kosowski, and Tolonen (2016).

leaves a total of 16,592 hedge funds, of which 5,947 are live funds and 10,645 are dead funds at the end of our sample period. The funds are roughly evenly split between TASS, HFR, and BarclayHedge. While 5,547 funds appear in multiple databases, many funds belong to only one database. Specifically, there are 3,597, 3,446 and 4,002 funds unique to the TASS, HFR, and BarclayHedge databases, respectively. This highlights the advantage of obtaining data from more than one source. In addition to monthly return and size information, our sample also captures data on fund characteristics such as management fee, performance fee, redemption period, lock-up period, investment style, leverage indicator, high-water mark indicator, and fund age.[11]

Following Agarwal, Daniel, and Naik (2009), we classify funds into four broad investment styles: Security Selection, Multi-process, Directional Trader, and Relative Value. Security Selection funds take long and short positions in undervalued and overvalued securities, respectively, and reduce systematic risks in the process. Usually, they take positions in equity markets. Multi-process funds employ multiple strategies that take advantage of opportunities created by significant transactional events, such as spin-offs, mergers and acquisitions, bankruptcy reorganizations, recapitalizations, and share buybacks. Directional Trader funds bet on the direction of market prices of currencies, commodities, equities, and bonds in the futures and cash market. Relative Value funds take positions on spread relations between prices of financial assets and aim to minimize market exposure.

We hand collect the fund management companies' public listing status from several sources. The primary data sources are S&P Capital IQ and Factiva news search. We supplemented this with other Internet sources including: SEC's Investment Adviser Public

[11] To ameliorate the impact of return outliers on our analysis we trim the hedge fund returns in our sample at the 99.5^{th} and 0.5^{th} percentiles. The baseline results are virtually unchanged when we using the original returns reported in the databases or when we winsorize the returns at the 99.5^{th} and at the 0.5^{th} percentiles.

Disclosure website as well as the fund management company official website.[12] Specifically, for each fund management company, we perform a search in S&P Capital IQ and SEC's Investment Adviser Public Disclosure, which provide information about the company's current and prior parent / corporate parents. Once we identify a subsidiary and parent relationship, we identify the effective public listing date for the fund management company by checking the "M&A/Private Placements" section in S&P Capital IQ, conducting a Factiva news search, and perusing the corporate history from fund management company's website.

Table 1 provides summary statistics on the number of listed firms as well as the number of hedge funds and the size of the hedge fund assets that they manage. While the number of listed fund management companies is small relative to the number of unlisted fund management companies, listed fund management companies manage a growing number of hedge funds and pool of assets. In 1994, there were only 12 listed firms managing 39 hedge funds and US$2.55 billion of assets. In 2013, the number of listed firms has grown to 113. These firms manage 856 hedge funds and US$199.34 billion of assets. At end of our sample period, listed firms manage 16.68 percent of industry assets, a significant increase from 4.02 percent of hedge fund industry assets at the start of the sample period.

[Insert Table 1 here]

Our firm sample covers a broad spectrum of fund management companies including large asset management houses that also manage private equity funds and mutual funds. This allows us to shed light on impact of public listings on the asset management industry in general. One concern is that for some of these firms their hedge fund assets may be a relatively small part of their business. Consequently, the impact of hedge fund performance, fee revenues, and AUM on these firms may be relatively muted. To ameliorate such concerns,

[12] For the SEC's Investment Adviser Public Disclosure website see http://www.adviserinfo.sec.gov/IAPD/Content/Search/iapd_Search.aspx

we follow Brunnemeier and Nagel (2004) and discard some firms for whom hedge fund assets only make up a small part of their aggregated institutional portfolio. We first check whether a firm is registered as an investment adviser with the SEC. Registration is a prerequisite for conduct of non-hedge fund business. If a firm is not registered, we include it in our pure play sample. If a firm is registered, we obtain its registration documents (Form ADV). For a registered firm to be included in our pure play hedge fund firm sample, we require that (a) that it charges performance-based fees, and (b) at least 50 percent of its clients are "Other pooled investment vehicles (e.g., hedge funds)" or "High net worth individuals". This leaves us with a total of 96 listed and 1,888 unlisted pure play firms at the end of the sample period. In unreported results that are available upon request, our baseline findings also apply when we analyze only pure play hedge fund firms.

Hedge fund data are susceptible to many biases (Liang, 2000; Fung and Hsieh, 2009). These biases stem from the fact that inclusion in hedge fund databases is voluntary. As a result, there is a self-selection bias. For instance, funds often undergo an incubation period during which they rely on internal funding before seeking capital from outside investors. Incubated funds with successful track records then go on to list in various hedge fund databases while the unsuccessful funds do not, resulting in an incubation bias. Separate from this, when a fund is listed on a database, it often includes data prior to the listing date. Again, because successful funds have a strong incentive to list and attract capital inflows, these backfilled returns tend to be higher than the non-backfilled returns. In the analysis that follows, we will repeat the tests after dropping the first 24 months of return data from each fund so as to ensure that the results are robust to backfill and incubation bias. To fully address concerns about backfill bias raised by Bhardwaj, Gorton, and Rouwenhorst (2014) and others, we also redo the tests after removing all return observations that have been backfilled prior to

fund listing date, which necessitates that we confine the fund sample to databases with data on fund listing date, namely TASS and HFR.

Throughout this paper, we model the risks of hedge funds using the Fung and Hsieh (2004) seven-factor model. The Fung and Hsieh factors are the excess return on the Standard and Poor's (S&P) 500 index (SNPMRF); a small minus big factor (SCMLC) constructed as the difference between the Russell 2000 and the Standard and Poor's (S&P) 500 indices; the yield spread of the US ten-year Treasury bond over the three-month Treasury bill, adjusted for duration of the ten-year bond (BD10RET); the change in the credit spread of Moody's BAA bond over the ten-year Treasury bond, also appropriately adjusted for duration (BAAMTSY); and the excess returns on portfolios of look back straddle options on currencies (PTFSFX), commodities (PTFSCOM), and bonds (PTFSBD), which are constructed to replicate the maximum possible return from trend following strategies (see Fung and Hsieh, 2001) on their respective underlying assets. These seven factors have been shown by Fung and Hsieh (2004) to have considerable explanatory power on hedge fund returns.

1.3. Empirical analysis

1.3.1. Tests of fund performance

To begin, we test for differences in risk-adjusted performance between funds managed by listed and unlisted management companies. Every month, starting in January 1994, two hedge fund portfolios are formed based on whether the hedge fund is managed by a listed or unlisted company. The post-formation returns on these two portfolios are linked

across months to form a single return series for each portfolio. We then evaluate the performance of the portfolios relative to the Fung and Hsieh (2004) model.

The results, reported in Panel A of Table 2, reveal substantial differences in expected returns, on the portfolios sorted by management company listing status, that are unexplained by the Fung and Hsieh (2004) seven factors. Hedge funds managed by listed companies underperform those managed by unlisted firms by a statistically significant but modest 1.89 percent per year (*t*-statistic = 3.13). As in the rest of the paper, we base statistical inferences on White (1980) heteroskedasticity-consistent standard errors. After adjusting for co-variation with the factors from the Fung and Hsieh (2004) model, the spread increases to an economically significant 2.89 percent per year (*t*-statistic = 4.73).[13] Since hedge funds with investor capital below US$20 million may not be relevant to large institutional investors, we also conduct the portfolio sort on the sample of hedge funds with at least US$20 million of AUM. The results reported in Panel B of Table 2 indicate that our findings are not driven by the smallest funds in the sample.[14]

[Insert Table 2 and Fig. 2 here]

Fig. 2 complements the results from Panel A of Table 2. It illustrates the monthly cumulative average residuals (henceforth CARs) from the portfolio of funds managed by listed firms (portfolio A) and the portfolio of funds managed by unlisted firms (portfolio B). CAR is the cumulative difference between a portfolio's excess return and its factor loadings (estimated over the entire sample period) multiplied by the Fung and Hsieh (2004) risk factors. The CARs in Fig. 2 indicate that portfolio A consistently underperforms portfolio B

[13] The portfolio sort results are robust to value-weighting the funds within each portfolio. The risk-adjusted spread for the value-weighted sort is 2.75 percent per annum (*t*-statistic = 4.20).

[14] The portfolio sort results are not driven solely by the underperformance of funds launched post IPO by listed firms. We redo our portfolio sort with only funds that were conceived prior to firm listing and find that these funds post firm IPO underperform funds managed by unlisted firms by 2.54 percent per year after adjusting for risk (*t*-statistic = 2.72). We note that in line with the results from Fung et al. (2016), funds launched post IPO underperform funds launched pre IPO, but the performance spread is statistically indistinguishable from zero.

over the entire sample period and suggest that the underperformance of funds managed by listed firms is not peculiar to a particular year.

There may be concerns that the portfolio sort results are driven by shareholder activists as activists that are managed by listed firms may be less willing to exert strong pressure on portfolio companies to make shareholder friendly changes given that they themselves are vulnerable to shareholder activism.[15] To address such concerns, we remove shareholder activist funds from our sample based on their strategy name, substrategy name, fund name, and fund investment strategy description. In total, we have 95 shareholder activist funds in our sample. After removing shareholder activists, we find that funds managed by listed firms still underperform those managed by unlisted firms by 2.85 percent per annum (*t*-statistic = 4.66) after adjusting for risk.

To further test the performance difference between funds managed by listed and unlisted management companies, we estimate the following pooled OLS regression:

$$ALPHA_{im} = a + bLISTED + cMGTFEE_i + dPERFFEE_i + eNOTICE_i + fMININV_i + g\log(SIZE_{im-1}) + hAGE_{im} + \sum_k p^k STYLEDUM_i^k + \sum_l p^l YEARDUM_i^l + \varepsilon_{im} \quad (1)$$

where *ALPHA* is fund monthly abnormal return after stripping away co-variation with the Fung and Hsieh (2004) seven factors, *LISTED* is an indicator variable that takes a value of one when a fund is managed by a listed firm and a value of zero otherwise, *MGTFEE* is fund management fee in percentage, *PERFFEE* is fund performance fee in percentage, *NOTICE* is fund redemption notification period in months, *MININV* is fund minimum investment in millions of US$, *SIZE* is fund monthly AUM in millions of US$, *AGE* is fund age in decades, *STYLEDUM* is fund style dummy, and *YEARDUM* is year dummy. The log(*SIZE*) variable

[15] This is in line with the saying "People in glass houses do not like to throw stones," which has been used to describe the behavior of publicly listed institutional investors. See "It was the hedge fund managers who got off the fence," Financial Times, 12 March 2005.

captures capacity constraints at the fund level (Berk and Green, 2004). *MGTFEE* and *PERFFEE* capture the impact of fund incentives on managerial performance (Agarwal, Daniel, and Naik, 2009) while *NOTICE* caters for the view expounded by Aragon (2007) that funds with longer redemption notification periods take on more liquidity risk and therefore harvest greater returns. We include *AGE* as a response to the Aggarwal and Jorion (2010) finding that younger funds outperform older funds. To facilitate the estimation of fund alpha, we only include results for funds with at least 24 months of return data.[16] We also estimate the analogous regression on raw monthly fund returns to ensure that our findings are not an artifact of the risk adjustment methodology.

[Insert Table 3 here]

The results from the cross-sectional regression analysis are reported in columns one to four of Table 3. They corroborate the findings from the portfolio sorts and indicate that funds run by listed firms underperform those run by unlisted firms. Specifically, the coefficient estimate on *LISTED* in the alpha regression reported in column four of Table 2 indicates that, controlling for other factors that could explain fund performance, funds managed by listed companies underperform funds managed by unlisted companies by 2.44 percent per annum after adjusting for risk. Inferences do not change when we estimate the regression on raw returns suggesting that our prior findings are not driven by our risk adjustment technology. The coefficient estimates on the control variables accord with the extant literature. Higher-powered incentives or performance fees (Agarwal, Daniel and Naik, 2009) and longer redemption notice periods (Aragon, 2007) are associated with superior performance while fund age (Aggarwal and Jorion, 2010) is linked to poorer performance. The impact of fund

[16] Our results prevail when we estimate fund alpha using the past 36 months of returns instead.

size on performance is more ambiguous. While size is associated with lower fund returns (Berk and Green, 2004), it is also linked to higher fund alphas.[17]

To check for robustness, we estimate Fama and MacBeth (1973) regressions in place of the OLS regressions. Specifically, first we run cross-sectional regressions for each month. Then, we report the time-series averages of the coefficient estimates, and use the time-series standard errors of the average slopes to draw inferences. The Fama and MacBeth regressions control for correlation in residuals across different firms within the same month. We compute the standard errors using the method of Newey and West (1987) with a three-month lag to adjust for dependence across time. The Fama and MacBeth (1973) results reported in columns five to eight of Table 3 echo our previous findings and indicate that they are robust to alternative model specifications.

1.3.2. Event study

To complement the baseline portfolio sorts in the previous subsection, we conduct an event study to investigate fund performance and assets under management before and after an asset management firm lists on the stock market. We choose as the event window the period starting 60 months prior to the IPO and ending 60 months after the IPO.[18] To be included in the sample, a fund must have monthly return information during the 48-month period that starts 24 months pre-IPO and ends 24 months post-IPO. This leaves us with 58 funds that belong to 27 firms with sufficient return information. To account for endogeneity concerns driven by observable differences between listed and unlisted firms, we match event hedge funds with non-event hedge funds based on fund performance and fund AUM in the 24-

[17] Diseconomies of scale at the firm level do not explain our findings. In unreported results that are available upon request, we show that the pooled OLS regression findings are robust to including the log of lagged firm AUM as an additional independent variable.

[18] Our differences-in-differences results are robust to using an event window that starts 48 months prior to the IPO and ends 48 months after the IPO.

month pre-IPO period and conduct a differences-in-differences analysis. Panel A of Table 4 reports differences in fund alpha and AUM before and after the IPO relative to the matched sample. We also match event firms with non-event firms based on firm performance, firm AUM, firm revenue, and number of funds per firm, and report the results from a differences-in-differences analysis of these firm attributes in Panel B of Table 4.

[Insert Table 4 here]

The results reported in Table 4 indicate that relative to the five-year period before IPO and to a matched sample of funds, fund risk-adjusted performance deteriorates by 13.68 percent per annum during the five-year period following the IPO.[19] The reduction in fund performance is economically meaningful and statistically significant at the one percent level. At the same time and relative to comparable firms, listed firm risk-adjusted performance wanes by 8.04 percent per annum. These results suggest that the drop in performance may be driven more by the smaller funds than by the larger funds managed by listed firms.

Do the lower alphas of listed firms translate to lower fee revenues for these asset management companies? We find that despite the deterioration in performance, relative to their unlisted competitors, listed firms are able to harvest fee revenues that are US$3.48 million or 16.76 percent greater than those harvested before listing. This is because compared to the control group, they are able to grow their AUM by US$340.95 million or 61.49 percent during the same period. The surge in firm AUM stems less from organic growth in existing fund AUM and more from the launch of new funds post listing. After listing, existing fund AUM ratchets up by US$144 million, but the AUM increase is still lower than that for funds

[19] To reconcile the results from the event study (Table 4) with that of the portfolio sort (Table 2), we rerun the portfolio sort with only funds from the event study sample, i.e., funds with at least 24 months of return information pre- and post-firm IPO. The results indicate that for this group of funds, the spread between the portfolio of funds managed by unlisted firms and that managed by listed firms is 11.03 percent per annum after adjusting for co-variation with the Fung and Hsieh (2004) factors. This is consistent with the magnitude of the alpha spread reported in Table 4.

in the control group. At the same time, the number of new funds per firm increases from 3.34 funds to 6.37 funds, which is 2.77 funds per firm greater than that for comparable firms.

Are listed firms more likely to launch additional hedge funds than are unlisted firms after controlling for other factors that drive fund launch? To investigate, we estimate probit regressions on the probability of launching a new hedge fund or funds in a given year. We include as independent variables an indicator variable for whether a firm listed, as well as controls for past firm performance over the previous year, the number of funds already launched by the firm, standard deviation of monthly firm returns over the previous year, aggregate firm flow over the previous year, firm management fee, firm performance fee, firm notice period, firm minimum investments, firm age, and log of firm size. Firm management fee is simply the value-weighted average management fee of the funds managed by the firm. The other firm attributes are constructed analogously. The results reported in Table 5 suggest that firms raise additional funds post-IPO. The marginal effects from the regression with firm return as a control variable indicate that being listed increases the probability that a firm will launch a new fund by 3.27 percentage points. This result is statistically significant at the one percent level and prevails even when we control for firm alpha. In any given year, about 10.67 percent of firms launch new funds; so being listed increases the chance that a firm will launch a new fund by 30.65 percent. The coefficient estimates on the other independent variables yield interesting insights. They indicate that firms that (i) are larger, (ii) are younger, (iii) set more investor friendly redemption notification terms, and (iv) conceived many funds before are more likely to launch additional funds. The first finding accords with standard intuition since firms with greater resources are better placed to launch new funds, while the last finding is consistent with the results of Fung et al. (2016).

[Insert Table 5 here]

Taken together the findings in Tables 4 and 5 suggest that hedge fund firms derive significant benefits from an IPO. They are able to harvest greater fee revenues principally via the growth of firm AUM post listing. They do so by launching additional funds and, to a lesser extent, by raising the AUM of existing funds. At the same time, investors do not appear to benefit from such capital raising activities. We find that both fund and firm performance decline sharply during the ten-year period surrounding the firm IPO.

1.3.3. Fund agency

The results in the previous subsection are consistent with the view that principal-agent problems drive fund behavior around firm IPO. To investigate further, we stratify the fund sample based on metrics that are known to moderate conflicts between fund management and investors at hedge funds, and redo the portfolio sorts. First, we condition on fund manager total delta. Agarwal, Daniel, and Naik (2009) argue that managers who are operating close to their high watermarks, and hence have higher manager total deltas, have incentives that are more aligned with those of their investors. Second, we condition on the Ozik and Sadka (2016) governance measure from the fund information that we have at the end of the sample. The governance measure is based on whether a fund is an onshore fund, features a high watermark, registered with the SEC, was audited in the past, and employs a top auditor or a top legal counsel.[20] Better fund governance may help temper agency problems at asset management firms and therefore reduce some of the underperformance of hedge funds that they manage. Third, we condition on fund manager personal capital, which has been used by

[20] The top law firms and accounting firms are based on:
http://en.wikipedia.org/wiki/List_of_100_largest_law_firms_by_revenue
http://www.accountingmajors.com/accountingmajors/articles/top100.html

several researchers to understand the impact of agency on fund manager behavior, e.g., Teo (2011).

We report in Panels A to C of Table 6 the results from the baseline portfolio sorts after stratifying the fund sample by the above-mentioned metrics. We find that the alpha spreads between funds managed by listed and by unlisted firms are larger for funds that are more susceptible to agency problems, i.e., funds with low manager total deltas, funds with poor governance scores, and funds without co-investment by the manager, than for funds that are less susceptible to agency issues. These results are supportive of the view that the underperformance of listed firms is driven by agency problems stemming from conflicts between fund management and fund investors.

[Insert Table 6 here]

1.3.4. Fund asset gathering

How do the agency problems that surface post IPO engender fund underperformance? One view is that fund management companies that go public underperform as they are focused on gathering assets and are therefore either less motivated to build on their successful track records (since they are busy exploiting them) or are simply distracted by the demands associated with managing larger businesses. Recent work has argued that in the absence of personal capital there are strong direct (Yin, 2016) and indirect (Lim, Sensoy, and Weisbach, 2016) incentives that drive hedge fund managers to raise capital. Fung et al. (2016) show that hedge fund firms that embark on asset gathering via the launch of multiple funds underperform other hedge fund firms. Indeed, we have found in the previous subsection that relative to their unlisted counterparts, listed firms raise more capital and are more likely launch new funds.

In this subsection, we explore the agency hypothesis further and investigate the link between asset gathering and fund underperformance. We argue that for the asset gathering view to hold it must be that underperformance is concentrated amongst funds that have the greatest scope or potential for gathering assets. Therefore, we sort funds based on their liquidity risk as captured by fund historical Pástor and Stambaugh (2003) liquidity beta. Fund historical liquidity beta is estimated in the presence of the factors from the Fung and Hsieh (2004) model, using the past 24 months of data. Hedge funds with a lower liquidity beta, take on less liquidity risk, are less susceptible to capacity constraints (Berk and Green, 2004), and therefore have greater potential for gathering assets.

Table 7 reports the baseline portfolio sorts on five subgroups of funds stratified by fund historical Pástor and Stambaugh (2003) liquidity beta. We find that consistent with the asset gathering view, the performance differential between funds managed by listed firms and those managed by unlisted firms is greatest for funds that take on lower liquidity risk and therefore, have fewer constraints on growth. Specifically, after adjusting for covariation with the Fung and Hsieh (2004) seven factors, the underperformance of the funds managed by listed firms (relative to those managed by unlisted firms) is 6.66 percent per annum for funds in the lowest liquidity beta quintile but only 2.89 percent per annum for funds in the highest liquidity beta quintile.

[Insert Table 7 here]

1.3.5 Firm short-termism

Is the underperformance of funds managed by listed firms also driven by the conflicts between fund management and shareholders? We hypothesize that the underperformance and excessive asset gathering of publicly traded asset management firms may also be induced by the short-termist pressures associated with a stock listing. As argued by Narayanan (1985),

Miller and Rock (1985), Stein (1989), Shleifer and Vishny (1990), Von Thadden (1995), and Holmström (1999), a focus on a firm's short term profits or current stock price will distort firm decisions from the first-best if investors have incomplete information on how the firm should grow to maximize its long term value. Short-termist pressures may induce excessive asset gathering, since asset gathering boosts current fee revenues (and hence current firm earnings) at the expense of future returns (and hence future earnings).

To test the short-termism view, we follow Asker, Farre-Mensa, and Ljungqvist (2015) and compute earnings response coefficients or ERCs (Ball and Brown, 1968; Easton and Zmijewski, 1989). ERCs measure the sensitivity of stock returns to firm earnings. We compute ERCs using firm level regressions for all listed firms with at least eight quarters of earnings information from I/B/E/S. We argue that if short-termism explains fund underperformance, then we should find that the underperformance is concentrated in funds managed by firms with high ERCs. This is indeed what we find. Table 8 reports the excess returns and alphas of portfolios of hedge funds managed by listed firms with high versus low ERCs. The sample period for the sort extends from January 2000 to December 2013 and corresponds to the period where there are at least ten funds in each of the high ERC and low ERC fund portfolios. We find that the underperformance of funds managed by listed firms relative to those managed by unlisted firms is centered around high ERC firms. Specifically, after adjusting for covariation with the Fung and Hsieh (2004) seven factors, the high ERC portfolio (Portfolio A1) underperforms the unlisted portfolio (Portfolio B) by 2.68 percent per year (*t*-statistic = 3.13) while the low ERC portfolio (Portfolio A2) delivers a risk-adjusted return that is statistically indistinguishable from that of Portfolio B.

[Insert Table 8 here]

In unreported results that are available upon request, we also show using a probit regression on the probability of fund launch post firm listing that in any given year, high ERC firms are 37 percent more likely to launch new funds than are low ERC firms. Moreover, during our sample period, high ERC firms raise more capital than do low ERC firms. Indeed, despite their underperformance, high ERC firms manage on average US$789.47 million more than do low ERC firms. Taken together, these findings indicate that the short-termism pressures associated with public listings partly explain the underperformance and excessive asset gathering of listed fund management companies.

1.3.6. Fund operational risk

Why do hedge fund investors continue to subscribe to hedge funds managed by listed firms in light of their persistent underperformance? One view is that given the level of transparency that is required of a publicly listed firm, hedge funds managed by listed firms score better in terms of operational risk metrics. Therefore, investors in such funds may be trading investment performance for lower operational risk.

To investigate, we leverage on work by Bollen and Pool (2012) who identify performance flags that are associated with the risk that a hedge fund is a fraud. We focus on the four performance flags with the highest rejection rates for reporting violations in the Bollen and Pool (2012) sample.[21] They are (i) Kink, which is triggered when a fund reports a return distribution with a discontinuity at zero, (ii) Maxrsq, which is triggered when a fund has an adjusted R-squared that is not significantly different from zero, (iii) % Negative, which is triggered when a fund reports a low number of negative returns, (iv) % Repeat, which is triggered when a fund reports a high number of repeated returns. We report in Table 9, the percentage of hedge funds managed by listed firms and by unlisted firms that trigger

[21] See Panel B of Table 5 in Bollen and Pool (2012).

any one of the above-mentioned performance flags at the ten percent significance level, as well as the difference in rejection frequencies between the two groups of funds.

[Insert Table 9 here]

Table 9 indicates that hedge funds managed by listed firms are less likely to trigger three of the four performance flags. Specifically, funds managed by listed firms compare favorably to funds managed by unlisted firms based on Kink, % Negative, and % Repeat. They are 3.6 percent less likely to report distributions with a discontinuity at zero, 3.2 percent less likely to report a low number of negative returns, and 7.7 percent less likely to report a high number of repeated returns. Moreover, the differences in rejection rates are statistically significant at the one percent level for these three indicators of fraud risk. These results suggest that hedge funds managed by listed firms may offer lower operational risk relative to their competitors managed by unlisted firms.

1.3.7. Endogeneity of firm listing status

Does the endogeneity of firm listing engender the underperformance of hedge funds managed by public firms? Systematic differences may exist between firms that list and those that do not. These differences could impact both the propensity to list and fund investment performance. The event study in Section 3.2, by analyzing within firm variation in listing status, addresses concerns that the spread in investment performance may be driven by time-invariant differences between private and public firms. Similarly, the differences-in-differences methodology that we employ in the event study allows us to ameliorate concerns that observed time-varying differences between listed and unlisted firms are responsible for the spread in investment performance.

Still, our findings leave open the possibility that unobserved time-varying differences between public and private firms might simultaneously affect the decision to go public and fund investment performance. To address this concern, we complement our event study with an instrumental variables analysis. The instrument that we use, i.e., firm strategy flow at founding, is motivated by Asker, Farre-Mensa, and Ljungqvist's (2015) choice of VC supply at founding to instrument for firm listing status. Firm strategy flow at founding is the strategy flow of the first fund conceived by the firm in the two-year period post firm inception.[22] We argue that the ability to attract capital at inception allows a firm to quickly reach critical mass and sets the stage for a possible public listing several years later. The first-stage results in Column 1 of Table 10 confirm this prediction. The supply of capital around the time of firm founding is a positive and significant predictor of a firm's listing status with an *F*-statistic of 27.30.

The exclusion restriction is that conditional on covariates, firm strategy flow in the two-year period after inception only affects fund investment performance through its impact on firm's listing status. One concern is that early firm strategy flow may drive future strategy returns via strategy-level capacity constraints (Naik, Ramadorai, and Strömqvist, 2007). However the fact that the median firm age at listing in our sample is 8.08 years helps alleviate this concern.[23] Capital accumulation between 6.08 to 8.08 years earlier should have little impact on a fund's investment performance today. Our approach is reminiscent of that used by Acemoglu, Johnson, and Robinson (2001) and Glaeser, Kerr, and Kerr (2015) who rely on the separation of time to motivate the exclusion requirement. Moreover, in unreported results, we find that higher strategy flow over the last two years is not a reliable harbinger of lower

[22] Specifically, Asker, Farre-Mensa, and Ljungqvist (2015) use as their instrument the total number of firms receiving first-round VC funding in a firm's headquarter state two years after a firm was funded. Likewise, we use firm strategy flow in the two-year period after firm inception.

[23] To accommodate our choice of instrument, we remove all firms that list within two years of firm inception for the instrumental variables analysis.

future strategy returns. Therefore, our use of strategy flow as opposed to strategy AUM allows us to sidestep concerns related to strategy-level capacity constraints.

[Insert Table 10 here]

In Columns 2 and 3 of Table 10, we report the second stage results for the fund return and alpha equations, respectively. After instrumenting for firm listing status, hedge funds managed by publicly listed firms continue to underperform those managed by private firms by 21.89 percent per annum before adjusting for risk and by 33.20 percent per annum after adjusting for risk. A comparison to the equivalent naïve OLS estimates in Columns 4 and 5 of Table 10 indicates that these point estimates are larger in absolute terms after instrumenting for listing status. Taken together, these findings suggest that the endogeneity of a firm's listing status is unlikely to drive the observed differences in investment performance between hedge funds managed by public versus private firms.

1.4. Robustness tests

In this section, we present a battery of robustness tests to ascertain the strength of our empirical results.

1.4.1. Backfill bias

Funds managed by unlisted firms may backfill their returns more often than funds managed by listed firms. In response to concerns about backfill bias raised by Bhardwaj, Gorton, and Rouwenhorst (2014) and others, we confine the analysis to TASS and HFR funds for which we have the date that the fund listed on the databases (only TASS and HFR provide this information). Next, we redo the baseline Table 2 portfolio sort for this subset of funds

and for those returns at or after the respective fund listing date. As there are not enough funds with returns post-listing in the cross-section during the earlier years, we perform the analysis for the period after 1996. As shown in Panel A of Table 11, our inferences remain unchanged when we control for backfill bias in this fashion. As an alternative, we also remove the first 24 months of returns for all funds to adjust for backfill and incubation bias. The portfolio alpha spread remains economically meaningful and statistically significant at the one percent level with this adjustment.

[Insert Table 11 here]

1.4.2. Serial correlation

Serial correlation in fund returns could arise from linear interpolation of prices for infrequently traded securities, the use of smoothed broker dealer quotes, or in some cases, deliberate performance-smoothing behavior. This could inflate some of the test statistics that we use to make inferences from the sort results. To allay such concerns, we unsmooth fund returns using the algorithm of Getmansky, Lo, and Makarov (2004) and redo the Table 2 portfolio sort. The results reported in Panel B of Table 11 indicate that our findings are not driven by serial correlation in fund returns.

1.4.3. Pre-fee returns

Hedge fund returns are reported net of fees in the commercial databases. One concern is that funds managed by listed firms may charge higher fees than funds managed by unlisted firms. This may drive the underperformance of the former relative to the latter. To check, we calculate fund performance and management fee using the algorithm outlined in Appendix A of Agarwal, Daniel, and Naik (2009), and back out pre-fee fund returns. As shown in Panel C

of Table 11, the baseline portfolio sort spreads are even greater when we analyze pre-fee fund returns.

1.4.4. Dynamic risk exposures

One concern is that the beta loadings of the fund portfolios might not stay constant over time. As a result, the risk-adjustment for the portfolio sorts may not be accurate. To account for dynamic factor loadings, we calculate the factor loadings using a rolling 24-month window and use those factor loadings to calculate abnormal returns one month forward. The results from the risk exposures calculated using the rolling window approach are presented in Panel D of Table 11. They indicate that our findings are robust to catering for dynamic risk exposures.

1.4.5. Omitted risk factors

The presence of additional risk factors could cloud the portfolio sort analysis. Relative to funds managed by listed firms, those managed by unlisted firms could be loading up more on some risk factor (e.g., emerging markets) that did well over the sample period. This could explain why there is a return spread between funds managed by unlisted firms and those managed by listed firms. Hence, we augment the Fung and Hsieh (2004) model with an emerging markets factor derived from the MSCI Emerging Markets Index return and redo the Table 2 sort. To cater for hedge fund exposure to option based strategies (Mitchell and Pulvino, 2001), we also augment the Fung and Hsieh (2004) model with the out-of-the-money S&P 500 call and put option-based factors from the Agarwal and Naik (2004) model.[24] Finally, to account for hedge fund exposure to liquidity risk (Teo, 2011; Aragon and Strahan, 2012; Sadka, 2012), we augment the Fung and Hsieh model with the Pástor and

[24] We are grateful to Vikas Agarwal for supplying these factors.

Stambaugh (2003) liquidity factor. The results presented in Panels E, F, and G of Table 11 indicate that our baseline results are not driven by the presence of omitted risk factors.

1.4.6. Hedge fund termination

There are concerns that because funds that drop out from the database could have terminated their operations, the portfolio alphas are biased upward. To allay such concerns, we assume that, for the month after a fund drops out of the database, its return is -10 percent. Thereafter, money is reallocated to the remaining funds in the portfolio. As shown in Panel H of Table 11, with that adjustment for fund termination, the alphas of the portfolios in the baseline sort fall but the spread remains economically and statistically significant. We also experimented with more extreme termination returns of -20 percent and -30 percent, and obtain qualitatively similar results. These findings suggest that the baseline results are robust to the self-reporting and delisting biases inherent in hedge fund data.

1.4.7. Subsample analysis

To understand how the underperformance of funds managed by listed firms varies over time, we split the sample period into two subperiods: January 1994 to December 2003 and January 2004 to December 2013. Next we redo the Table 2 portfolio sort analysis for each subperiod. The results reported in Panels I and J of Table 11 indicate that funds managed by listed firms underperform those managed by unlisted firms in both subperiods. The risk-adjusted performance spread is largely unchanged when we go from the earlier subperiod (2.97 percent per year) to the later subperiod (3.07 percent per year). Moreover, both spreads are statistically significant at the one percent level.

1.4.8. Manager manipulation of hedge fund returns

Funds managed by listed firms, due to the higher level of transparency required of them, may be less inclined to misreport their returns than funds managed by unlisted firms. If the former are less likely to inflate returns than the latter, this may explain the apparent underperformance of the former when we analyze self-reported returns from commercial hedge fund databases. To address this concern, we construct firm returns from firm stock holdings reported in the Thomson Financial 13-F holdings data. We argue that there is less scope for manipulation in the verifiable 13-F filings data that are reported to the SEC. The baseline portfolio sort results from returns derived from stock holdings data are presented in Panel L of Table 11. Since these results are constructed at the firm level, we also present the baseline portfolio sort results from firm returns in Panel K of Table 11 for completeness. The number of firms at the end of our sample falls by 88 percent when we analyze the sample of firm returns derived from stock holdings data.[25] Nonetheless, the alpha of the spread portfolio reported in Panel L of Table 11 indicate that manager manipulation of hedge fund returns does not drive our results.

1.4.9. Mutual fund performance

Hedge funds are more susceptible to agency problems than are mutual funds given that hedge funds engage in more complex investment strategies and offer less disclosure and lower transparency to their investors. Therefore the agency view predicts that the underperformance of mutual funds managed by public firms (relative to those managed by private firms) will be more modest than that of hedge funds managed by public firms. That is

[25] This is because our sample of hedge funds includes funds invested exclusively in non-US equities such as European focused funds, small equity long/short funds that have less than US$100 million in US equity exposure and are therefore not required to report their quarterly holdings to the SEC, in addition to other funds that do not have single-stock exposure as part of their investment style mandate such as fixed income, distressed debt, and macro funds, as well as commodity trading advisors.

precisely what we find when we analyze the returns of actively managed U.S. equity mutual funds from the CRSP survivorship bias-free mutual fund database. Specifically, we replicate our Table 2 portfolio sort results with mutual funds but instead of the Fung and Hsieh (2004) seven-factor model, we use the Carhart (1997) four-factor model to adjust for risk. [26]The untabulated results, which are available upon request, indicate that on average mutual funds managed by listed firms underperform mutual funds managed by unlisted firms by a modest 43 basis points per year (*t*-statistic = 2.52) after adjusting for covariation with the four factors. When we value-weight the funds within each portfolio using fund total net assets (henceforth TNA), the spread increases to 114 basis points per year (*t*-statistic = 3.82). These results lend credence to the view that the investment underperformance of listed asset management firms is not germane only to the hedge fund industry.

1.5. Conclusion

Our empirical results paint a consistent story. We show that hedge funds managed by listed asset management firms consistently underperform funds managed by their unlisted competitors. The results are driven by agency problems at fund management companies. Hedge funds that are less affected by the conflicts between fund management and fund investors, such as funds with high manager total deltas, with high governance scores, and with manager co-investment, underperform less when their management companies go public. Asset management firms that are especially prone to short-termist pressures from shareholders underperform more than firms that are more insulated from such pressures. The agency problems at hedge funds managed by listed firms translate into a tendency to

[26] At the start of our sample period, i.e., in 1994, there are 199 mutual funds managed by listed firms and 302 mutual funds managed by unlisted firms. At the end of our sample period, i.e., in 2013, there are 574 mutual funds operated by public firms and 697 mutual funds operated by private firms.

aggressively raise capital by growing the AUM of new products. These capital raising activities in turn engender underperformance. We show that funds that have the greatest scope for asset gathering, as a consequence of their low liquidity risk levels, also exhibit the greatest underperformance. Hedge fund investors that continue to subscribe to funds managed by listed firms trade investment performance for the comfort of lower operational risk. These results enrich our understanding of agency forces at work in the asset management industry.

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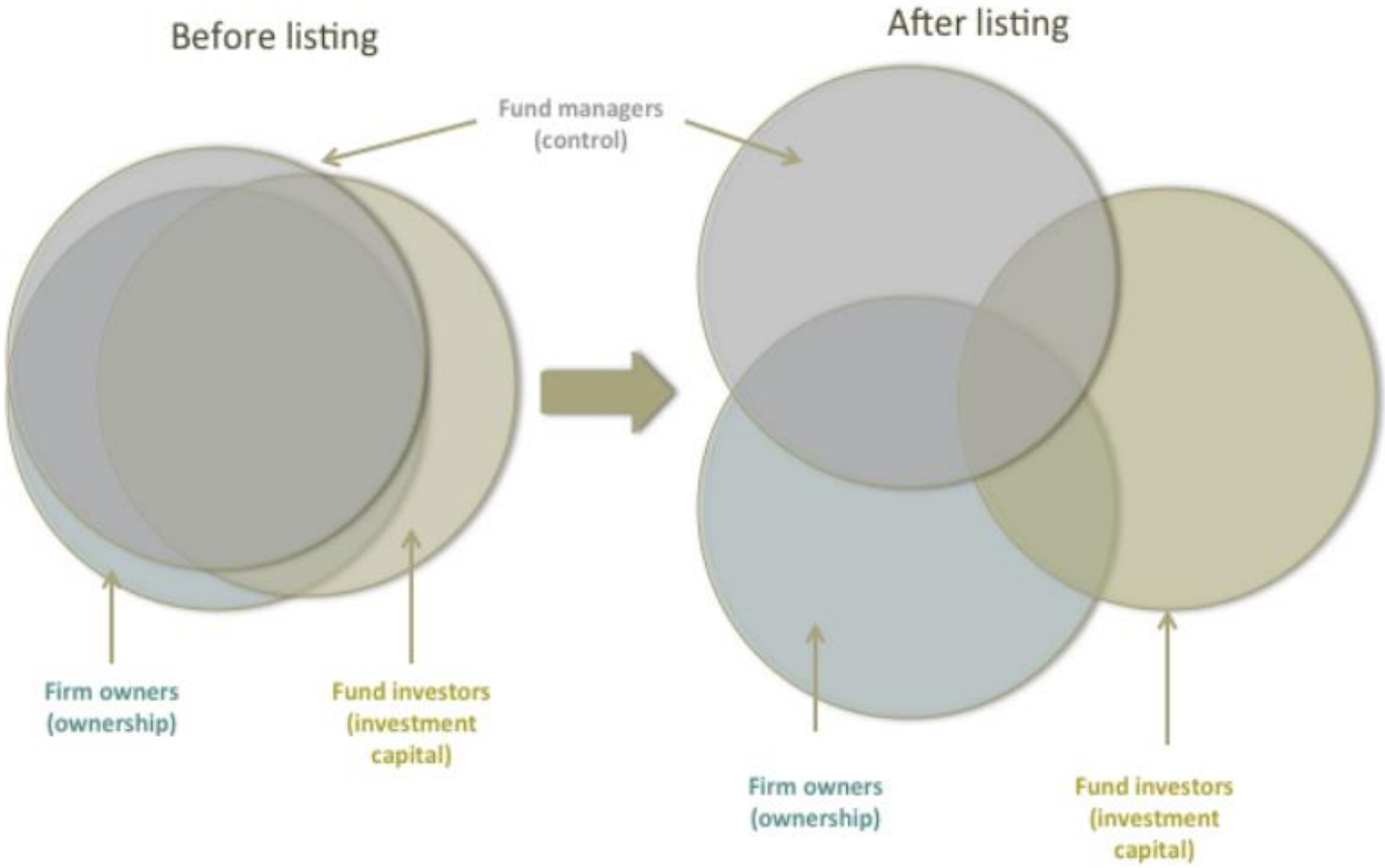

Fig 1. Separation of ownership, control, and investment capital when an asset management firm goes public

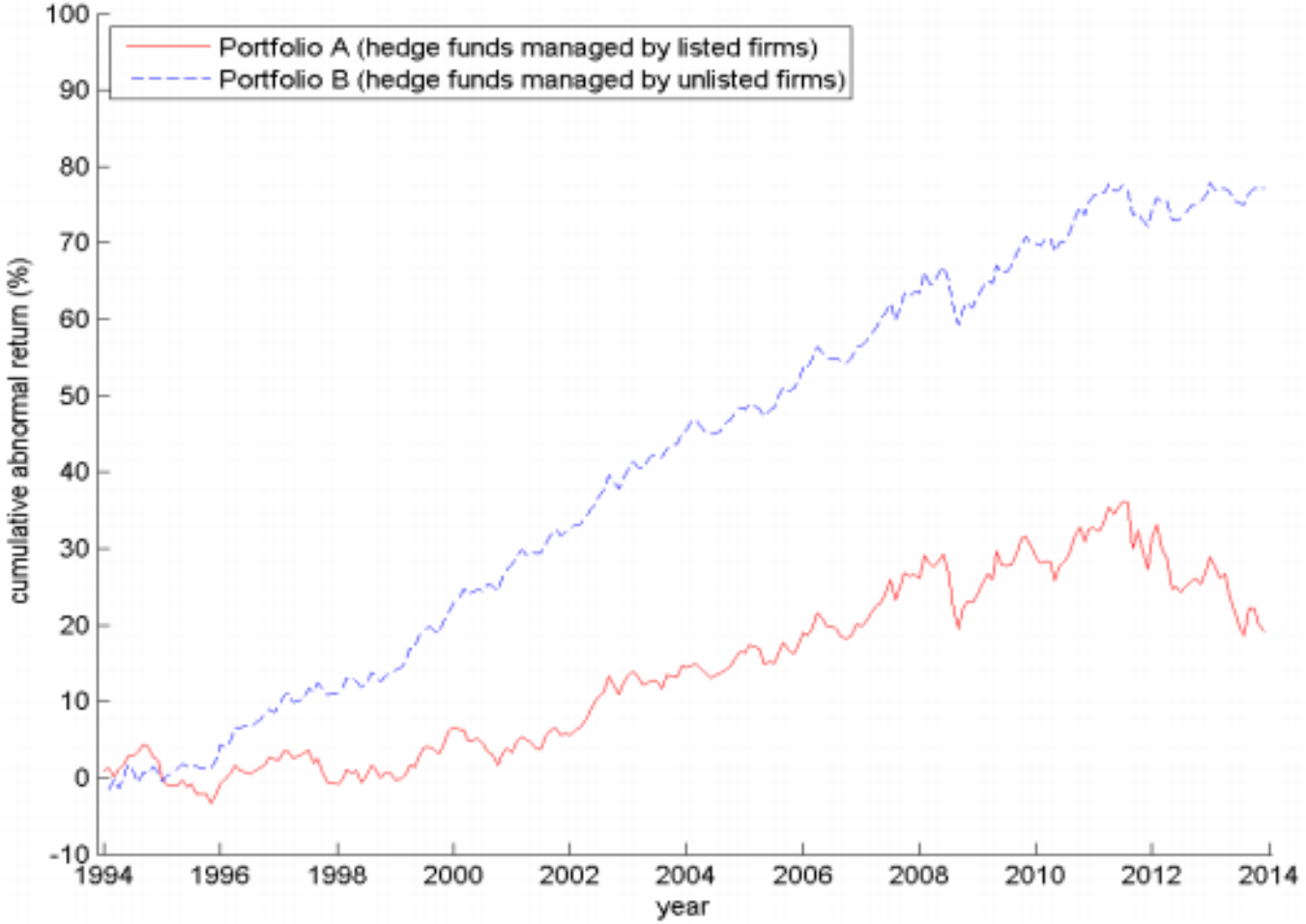

Fig 2. Cumulative abnormal return of hedge funds managed by listed firms versus hedge funds managed by unlisted firms. Equal-weighted portfolios of hedge funds are constructed by sorting funds based on whether they are managed by listed firms. Cumulative abnormal return is the difference between a portfolio's excess return and its factor loadings multiplied by the Fung and Hsieh (2004) risk factors. Factor loadings are estimated over the entire sample period. The sample period is from January 1994 to December 2013.

Table 1

Summary statistics

This table reports the number hedge funds and the size of hedge fund assets managed by listed firms and by unlisted firms. The sample period is from January 1994 to December 2013.

	Listed firms			Unlisted firms		
Year	Number of management companies	Number of hedge funds	Total AUM (US$m)	Number of management companies	Number of hedge funds	Total AUM (US$m)
1994	12	39	$2,548	789	1,187	$60,808
1995	20	68	$4,241	886	1,423	$78,583
1996	27	86	$6,822	1,087	1,758	$97,291
1997	32	109	$10,949	1,253	2,069	$138,441
1998	34	100	$11,115	1,366	2,275	$148,410
1999	42	124	$17,539	1,400	2,267	$183,196
2000	49	144	$22,425	1,553	2,590	$210,932
2001	51	156	$27,770	1,682	2,881	$261,629
2002	57	184	$25,256	1,769	3,034	$289,290
2003	65	245	$35,956	1,999	3,522	$421,120
2004	72	295	$53,008	2,215	4,021	$571,768
2005	83	328	$60,948	2,404	4,466	$633,386
2006	100	427	$86,705	2,517	4,652	$834,923
2007	111	523	$123,558	2,567	4,746	$1,041,548
2008	109	451	$75,800	2,362	4,157	$710,135
2009	115	543	$99,171	2,372	4,109	$721,271
2010	110	584	$104,829	2,252	3,915	$811,890
2011	110	700	$125,195	2,047	3,590	$823,782
2012	118	873	$169,988	2,197	3,915	$916,657
2013	113	856	$199,335	2,083	3,662	$995,804

Table 2

Portfolio sorts on fund management company listing status

Every January, hedge funds are sorted into two groups based on whether they are managed by listed firms. Portfolio A is the portfolio of hedge funds managed by listed firms. Portfolio B is the portfolio of hedge funds managed by unlisted firms. In Panel A, we report the results for the full sample of hedge funds. In Panel B, we report the results for hedge funds with AUM greater than US$20 million. Hedge fund portfolio performance is estimated relative to the Fung and Hsieh (2004) factors. The Fung and Hsieh (2004) factors are S&P 500 return minus risk free rate (SNPMRF), Russell 2000 return minus S&P 500 return (SCMLC), change in the constant maturity yield of the U.S. 10-year Treasury bond appropriately adjusted for the duration (BD10RET), change in the spread of Moody's BAA bond over 10-year Treasury bond appropriately adjusted for duration (BAAMTSY), bond PTFS (PTFSBD), currency PTFS (PTFSFX), and commodities PTFS (PTFSCOM). The sample period is from January 1994 to December 2013. The t-statistics, derived from White (1980) standard errors, are in parentheses. * Significant at the 5% level; ** Significant at the 1% level.

Portfolio	Excess Return (pct / year)	Alpha (pct / year)	SNPMRF	SCMLC	BD10RET	BAAMTSY	PTFSBD	PTFSFX	PTFSCOM	Adj. R2
Panel A: All hedge funds										
Portfolio A (hedge funds managed by listed firms)	4.29*	0.96	0.32**	0.13**	0.11**	0.20**	-0.01	0.01	0.01	0.60
	(2.41)	(0.90)	(14.35)	(4.83)	(2.71)	(3.99)	(-1.18)	(1.89)	(0.80)	
Portfolio B (hedge funds managed by unlisted firms)	6.18**	3.86**	0.24**	0.14**	0.04	0.17**	0.00	0.01**	0.01*	0.64
	(4.32)	(4.95)	(14.91)	(6.86)	(1.21)	(4.59)	(-0.79)	(3.56)	(2.23)	
Spread portfolio (A - B)	-1.89**	-2.89**	0.08**	0.00	0.08**	0.03	0.00	0.00	-0.01	0.22
	(-3.13)	(-4.73)	(6.10)	(-0.28)	(3.20)	(1.13)	(-1.06)	(-1.22)	(-1.43)	
Panel B: Hedge funds with AUM greater than US$20 million										
Portfolio A (hedge funds managed by listed firms)	3.94*	0.63	0.32**	0.11**	0.10*	0.21**	-0.01	0.01	0.01	0.61
	(2.22)	(0.62)	(14.71)	(4.39)	(2.34)	(4.43)	(-1.76)	(1.88)	(1.16)	
Portfolio B (hedge funds managed by unlisted firms)	5.98**	3.59**	0.24**	0.14**	0.04	0.18**	-0.01	0.01**	0.01*	0.63
	(4.03)	(4.54)	(14.37)	(7.05)	(1.30)	(4.77)	(-1.51)	(3.16)	(2.14)	
Spread portfolio (A - B)	-2.04**	-2.95**	0.08**	-0.03	0.05*	0.04	0.00	0.00	0.00	0.26
	(-3.54)	(-5.46)	(7.01)	(-1.96)	(2.56)	(1.46)	(-1.14)	(-1.04)	(-0.91)	

Table 3

Regressions on hedge fund performance

This table reports multivariate regression analysis of hedge fund performance. The dependent variables include hedge fund return and hedge fund alpha. Return is hedge fund monthly net-of-fee return. Alpha is Fung and Hsieh (2004) seven-factor monthly alpha for hedge funds where factor loadings are estimated over the last 24 months. The primary independent variable is the listed dummy (LISTED). It takes value of one if the hedge fund is managed by a listed firm, and zero otherwise. The other independent variables include hedge fund management fee (MGTFEE), performance fee (PERFFEE), redemption notice period in months (NOTICE), minimum investment in USD million (MININV), the natural logarithm of fund size (SIZE), fund age in decades (AGE) as well as dummy variables for year and fund investment strategy. The sample period spans January 1994 to December 2013. The t-statistics for the OLS regressions are derived from White (1980) standard errors, while the t-statistics for the Fama-MacBeth regressions are derived from Newey and West (1987) standard errors. * Significant at the 5% level; ** Significant at the 1% level.

	OLS Regression				Fama-MacBeth (1973) Regression			
Independent variables	Return		Alpha		Return		Alpha	
LISTED	-0.302**	-0.115**	-0.458**	-0.203**	-0.177**	-0.084**	-0.290**	-0.196**
	(-18.86)	(-6.31)	(-21.65)	(-8.87)	(-3.38)	(-2.97)	(-5.53)	(-6.13)
MGTFEE (%)		0.042**		0.014		0.042		0.013
		(4.04)		(1.05)		(1.81)		(0.52)
PERFFEE (%)		0.003**		0.011**		0.006		0.009**
		(2.80)		(10.05)		(1.59)		(3.16)
NOTICE (months)		0.017**		0.013**		0.021*		0.017*
		(7.67)		(5.16)		(2.44)		(2.31)
MININV (US$m)		0.001**		0.000		0.003		0.005
		(2.66)		(0.87)		(1.08)		(1.80)
SIZE		-0.035**		0.013**		-0.043**		0.022*
		(-11.01)		(3.19)		(-3.87)		(2.33)
AGE (decades)		-0.151**		-0.085**		-0.197**		-0.131**
		(-12.14)		(-5.81)		(-3.94)		(-3.29)
year dummies	No	Yes	No	Yes	No	No	No	No
strategy dummies	No	Yes	No	Yes	No	Yes	No	Yes
Adj. R2	0.000	0.026	0.001	0.010	0.004	0.051	0.004	0.032
No. of observations	834,268	693,145	432,028	376,901	240	240	216	216

Table 4
Event study with differences-in-differences analysis
This table reports the event study analysis of hedge fund performance and assets under management around fund management company's public listing date. Return is hedge fund monthly net-of-fee return. Alpha is Fung and Hsieh (2004) seven-factor monthly alpha for hedge funds where factor loadings are estimated over the last 24 months. Event month is the month that fund management company completes its initial public offering (IPO). The period "before" is the 60-month period before the event month and the period "after" is the 60-month period after the event month. To be included in the analysis, a hedge fund or a hedge fund management company must survive at least 24 months before and after the event month. Funds/firms in the control group are matched to funds/firms in the treatment group based on alpha, AUM, fee revenue or number of funds in the pre-event 24-month period. Panel A reports results at hedge fund level, while Panel B reports results at the fund management company level. The sample period is from January 1994 to December 2013. * Significant at the 5% level; ** Significant at the 1% level.

	Before	After	After - Before
Panel A: Hedge fund performance and AUM			
Fund alpha (pct / month) - treatment group	1.08	-0.20	-1.28* (-4.53)
Fund alpha (pct / month) - control group	0.33	0.18	-0.14 (-1.26)
Difference in alpha (pct / month)	0.76	-0.38	-1.14** (-3.78)
Fund AUM (US$m) - treatment group	201.95	346.08	144.12** (10.10)
Fund AUM (US$m) - control group	246.33	460.26	213.93** (14.90)
Difference in AUM (US$m)	-44.38	-114.18	-69.80** (-8.33)
Panel B: Hedge fund firm performance and AUM			
Firm alpha (pct / month) - treatment group	0.68	-0.09	-0.77** (-4.81)
Firm alpha (pct / month) - control group	0.31	0.20	-0.11 (-1.07)
Difference in alpha (pct / month)	0.37	-0.29	-0.67** (-3.72)
Firm AUM (US$m) - treatment group	554.44	1415.42	860.97** (16.40)
Firm AUM (US$m) - control group	587.00	1107.02	520.02** (16.26)
Difference in AUM (US$m)	-32.56	308.40	340.95** (6.48)
Firm fee revenue (US$m / month) - treatment group	1.73	2.95	1.22** (11.93)
Firm fee revenue (US$m / month) - control group	1.66	2.58	0.93** (6.55)
Difference in fee revenue (US$m / month)	0.08	0.37	0.29** (2.70)
Firm number of funds - treatment group	3.34	6.37	3.04** (28.62)
Firm number of funds - control group	3.35	3.62	0.27* (2.09)
Difference in number of funds	-0.01	2.75	2.77** (17.37)

Table 5

Probit model on launching new funds

This table reports results of two probit regressions that model the probability of launching new funds for listed and unlisted hedge fund management companies. The dependent variable (NEWFUNDLAUNCH) takes a value of one if the manager launches at least one new fund in the year, and zero otherwise. All the independent variables are taken from previous year end. The primary independent variable is the listed dummy (LISTED). It takes value of one if the hedge fund management company is a listed firm, and zero otherwise. The other independent variables include hedge fund firm net-of-fee return from the previous year (RET), hedge fund firm rolling alpha (ALPHA), number of hedge funds managed by the management company in the previous year (NUMBEROFFUNDS), fund flow to the fund management company in the previous year (FUNDFLOW), firm management fee (MGTFEE), firm performance fee (PERFFEE), firm redemption notice period in months (NOTICE), firm minimum investment in USD million (MININV), natural logarithm of firm size (SIZE), firm age in decades (AGE), standard deviation of firm returns inthe previous year (RETSTD) as well as year dummies. Firm level metrics such as management fee are constructed by value-weighting the fund level metrics for all funds managed by the firm. The sample period is from January 1994 to December 2013. The robust z-statistics with standard errors clustered by manager are in parentheses. * Significant at the 5% level; ** Significant at the 1% level.

Independent variables	Dependent variable = NEWFUNDLAUNCH	
LISTED	0.210**	0.201*
	(2.94)	(2.43)
RET (%)	0.001	
	(0.36)	
ALPHA (%)		0.003
		(0.80)
NUMBER OF FUNDS	0.089**	0.086**
	(12.77)	(12.54)
FUND FLOW	-0.000	0.002
	(-1.11)	(0.67)
MGTFEE (%)	0.030	0.037
	(1.33)	(1.31)
PERFFEE (%)	0.001	0.002
	(0.40)	(0.61)
NOTICE (months)	-0.039**	-0.032**
	(-5.53)	(-4.10)
MININV (US$m)	-0.000	-0.003
	(-1.31)	(-1.48)
AGE (decades)	-0.319**	-0.295**
	(-8.80)	(-7.25)
SIZE	0.136**	0.144**
	(14.89)	(13.31)
RETSTD (%)	0.001	0.005
	(0.20)	(0.61)
Year dummies	Yes	Yes
Pseudo R2	0.124	0.139
No. of observations	26,697	19,227

Table 6

Portfolio sorts on fund agency and fund management company public listing status

This table reports double sorts on firm listing status and fund agency proxies. Portfolio A is the portfolio of hedge funds managed by listed firms. Portfolio B is the portfolio of hedge funds managed by unlisted firms. In Panel A, hedge funds are first sorted into two groups based on fund manager total delta scaled by fund assets under management (Agarwal, Daniel and Naik, 2009). In Panel B, hedge funds are first sorted into two groups based on their aggregate governance scores (Ozik and Sadka, 2014). In Panel C, hedge funds are first sorted into two groups based on whether the hedge fund manager co-invests in the fund, as measured by the personal capital dummy from the TASS database. Next, funds within each agency metric group are stratified by their fund management company listing status. The sample period spans January 1994 to December 2013. * Significant at the 5% level; ** Significant at the 1% level.

	Hedge fund performance			
Hedge fund firm portfolio	Excess return		Alpha	
Panel A: Sort on managerial total delta	Low	High	Low	High
Portfolio A (hedge funds managed by listed firms)	3.23	7.73**	-0.16	4.59**
	(1.78)	(3.62)	(-0.13)	(2.87)
Portfolio B (hedge funds managed by unlisted firms)	6.09**	7.23**	3.48**	4.33**
	(4.38)	(4.32)	(4.48)	(4.59)
Spread portfolio (A - B)	-2.86**	0.51	-3.64**	0.26
	(-3.30)	(0.39)	(-4.35)	(0.23)
Panel B: Sort on fund's aggregate governance	Low	High	Low	High
Portfolio A (hedge funds managed by listed firms)	1.54	7.35**	-1.33	4.75**
	(0.87)	(4.03)	(-0.89)	(4.39)
Portfolio B (hedge funds managed by unlisted firms)	4.52**	7.97**	2.06	5.37**
	(3.10)	(4.87)	(1.90)	(7.92)
Spread portfolio (A - B)	-2.98**	-0.62	-3.39**	-0.62
	(-2.98)	(-0.57)	(-3.38)	(-0.65)
Panel C: Sort on fund managers' personal capital	No	Yes	No	Yes
Portfolio A (hedge funds managed by listed firms)	3.87	6.56	0.80	4.71
	(1.68)	(1.66)	(0.46)	(1.54)
Portfolio B (hedge funds managed by unlisted firms)	7.34**	8.20**	5.07**	5.88**
	(4.05)	(4.26)	(4.55)	(6.12)
Spread portfolio (A - B)	-3.47**	-1.16	-4.27**	-0.92
	(-2.97)	(-0.35)	(-3.44)	(-0.32)

Table 7

Portfolio sorts on Pastor and Stambaugh (2003) liquidity beta and hedge fund management company public listing status

This table reports double sorts on Pastor and Stambaugh (2003) fund liquidity beta and firm listing status. Every January, hedge funds are first sorted into quintiles based on their beta with respect to the Pastor and Stambaugh (2003) aggregate liquidity measure. Liquidity beta is estimated over the past 24 months in the presence of factors from Fung and Hsieh (2004) model. Next, within each liquidity beta group, hedge funds are sorted based on whether they are managed by listed firms. Hedge fund performance is estimated relative to the Fung and Hsieh (2004) model. The Fung and Hsieh (2004) factors are S&P 500 return minus risk free rate (SNPMRF), Russell 2000 return minus S&P 500 return (SCMLC), change in the constant maturity yield of the U.S. 10-year Treasury bond adjusted for the duration of the 10-year bond (BD10RET), change in the spread of Moody's BAA bond over 10-year Treasury bond appropriately adjusted for duration (BAAMTSY), bond PTFS (PTFSBD), currency PTFS (PTFSFX), and commodities PTFS (PTFSCOM). These variables are omitted for brevity. The sample period is from January 1994 to December 2013. The t-statistics, derived from White (1980) standard errors, are in parentheses. * Significant at the 5% level; ** Significant at the 1% level.

	Sort on Pastor and Stambaugh (2003) liquidity beta									
	Excess return					Alpha				
	1 (low beta)	2	3	4	5 (high beta)	1 (low beta)	2	3	4	5 (high beta)
Portfolio A (hedge funds managed by listed firms)	0.07	3.23	2.24	4.34*	5.20	-3.61	0.25	-0.05	1.88	0.82
	(0.03)	(1.81)	(1.54)	(2.57)	(1.63)	(-1.90)	(0.21)	(-0.06)	(1.59)	(0.38)
Portfolio B (hedge funds managed by unlisted firms)	5.60**	5.04**	4.81**	5.26**	6.33**	3.05**	2.88**	2.87**	2.99**	3.71**
	(3.47)	(3.89)	(4.05)	(3.56)	(3.33)	(2.72)	(3.80)	(5.01)	(4.25)	(3.39)
Spread portfolio (A - B)	-5.53**	-1.82*	-2.57**	-0.92	-1.12	-6.66**	-2.63**	-2.91**	-1.11	-2.89
	(-3.20)	(-2.08)	(-4.24)	(-0.91)	(-0.53)	(-4.81)	(-3.24)	(-5.33)	(-1.04)	(-1.64)

Table 8

Portfolio sorts on fund management company listing status and stock earnings response coefficients (ERCs)

Every January, hedge funds are sorted into two groups based on whether they are managed by listed firms. Portfolio A is the portfolio of hedge funds managed by listed firms. Portfolio B is the portfolio of hedge funds managed by unlisted firms. Portfolio A is further sorted into two portfolios (A1 and A2) based on firm Earnings Response Coefficients (ERCs) as in Easton and Zmijewski (1989). ERCs measure the sensitivity of stock returns to firm earnings. ERCs are computed from individual firm level regressions over the full sample period for firms with at least eight quarters of information. Hedge fund portfolio performance is estimated relative to the Fung and Hsieh (2004) factors. The Fung and Hsieh (2004) factors are S&P 500 return minus risk free rate (SNPMRF), Russell 2000 return minus S&P 500 return (SCMLC), change in the constant maturity yield of the U.S. 10-year Treasury bond appropriately adjusted for the duration (BD10RET), change in the spread of Moody's BAA bond over 10-year Treasury bond appropriately adjusted for duration (BAAMTSY), bond PTFS (PTFSBD), currency PTFS (PTFSFX), and commodities PTFS (PTFSCOM). The sample period is from January 2000 to December 2013 which corresponds to the period where there are at least ten funds in each of the high and low ERC portfolios. The t-statistics, derived from White (1980) standard errors, are in parentheses. * Significant at the 5% level; ** Significant at the 1% level.

Portfolio	Excess Return (pct / year)	Alpha (pct / year)	SNPMRF	SCMLC	BD10RET	BAAMTSY	PTFSBD	PTFSFX	PTFSCOM	Adj. R2
Portfolio A1 (hedge funds managed by listed firms with high ERC	2.70	0.95	0.27**	0.06*	0.05	0.11*	-0.01	0.01	0.01	0.62
	(1.45)	(0.94)	(12.66)	(2.22)	(1.31)	(2.59)	(-1.48)	(1.59)	(0.83)	
Portfolio A2 (hedge funds managed by listed firms with low ERC	4.91**	3.10**	0.16**	0.12**	0.04	0.14**	-0.01	0.00	0.00	0.53
	(3.27)	(3.17)	(8.01)	(4.80)	(1.02)	(3.36)	(-1.02)	(0.27)	(-0.59)	
Portfolio B (hedge funds managed by unlisted firms)	5.87**	3.63**	0.25**	0.13**	0.06	0.16**	-0.01	0.02**	0.01	0.64
	(3.19)	(3.62)	(11.69)	(5.07)	(1.58)	(3.88)	(-1.95)	(2.99)	(1.19)	
Spread portfolio (A1 - B)	-3.17**	-2.68**	0.02	-0.07**	-0.01	-0.05	0.00	-0.01	0.00	0.07
	(-3.39)	(-3.13)	(1.28)	(-3.31)	(-0.30)	(-1.48)	(0.53)	(-1.62)	(-0.41)	
Spread portfolio (A2 - B)	-0.96	-0.53	-0.08**	-0.01	-0.02	-0.03	0.01	-0.01**	-0.01*	0.26
	(-1.10)	(-0.77)	(-5.68)	(-0.58)	(-0.86)	(-0.89)	(1.39)	(-3.97)	(-2.57)	
Spread portfolio (A1 - A2)	-2.21	-2.15*	0.10**	-0.06*	0.01	-0.03	0.00	0.01	0.01	0.12
	(-1.77)	(-2.02)	(4.70)	(-2.29)	(0.31)	(-0.62)	(-0.47)	(1.26)	(1.33)	

Table 9

Bollen and Pool (2012) hedge fund performance flag trigger frequencies

This table reports the percentage of hedge funds that trigger various performance flags at the 10% significance level for hedge funds managed by listed and unlisted firms. The performance flags analyzed include the four performance flags with the highest rejection rates for reporting violations in Bollen and Pool (2012). The four performance flags are Kink, Maxrsq, % Negative, and % Repeat. Kink is triggered when a fund reports a return distribution with a discontinuity at zero. Maxrsq is triggered when a fund delivers an adjusted R-squared that is not significantly different from zero. % Negative is triggered when a fund reports a low number of negative returns. % Repeat is triggered when a fund reports a high number of repeated returns. We test the difference in rejection frequencies for hedge funds managed by listed firms and those managed by unlisted firms. * Significant at the 5% level; ** Significant at the 1% level.

	Performance flag trigger frequency		
Hedge fund performance flag	Hedge fund managed by listed firms	Hedge fund managed by unlisted firms	Difference (listed - unlisted)
Kink	25.2%	28.7%	-3.6%**
Maxrsq	5.0%	3.8%	1.2%
% Negative	19.6%	22.8%	-3.2%**
% Repeat	32.6%	40.3%	-7.7%**

Table 10
Instrumental variable analysis

This table uses an instrumental variable (IV) approach to examine whether the observed differences in hedge fund performance between listed and unlisted hedge fund firms reflect unobserved differences that endogenously determine listing status. Our instrument for listing status exploits the cross sectional differences among hedge fund managers' ability to accumulate capital at the time of founding. We define hedge fund management company founding strategy fund flow (STRATEGYFLOW) as fund manager's strategy fund flow over the 24-month period after inception. The strategy used in STRATEGYFLOW corresponds to the investment strategy of the first fund launched by the firm. We exclude all listed hedge fund firms who go public less than two years after inception. Column 1 shows the first stage probit model of hedge fund listing status on hedge fund management company founding strategy fund flow (STRATEGYFLOW) and a group of control variables used in Table 3. The dependent variable is the listed dummy (LISTED). It takes value of one if the hedge fund management company is a listed firm, and zero otherwise. The independent variables include hedge fund management fee (MGTFEE), performance fee (PERFFEE), redemption notice period in months (NOTICE), minimum investment in USD million (MININV), the natural logarithm of fund size (SIZE), fund age in decades (AGE) as well as dummy variables for year and fund investment strategy. Following Wooldridge (2002), the second stage is estimated by GMM using as instruments the first-stage predicted probability. Column 2 and 3 show the second stage results, where the dependent variables are return and alpha. Return is hedge fund monthly net-of-fee return. Alpha is Fung and Hsieh (2004) seven-factor monthly alpha for hedge funds where factor loadings are estimated over the last 24 months. For comparison, column 4 and 5 report results in column 2 and 3 without instrumenting hedge fund listing status. The sample period is from January 1994 to December 2013. In columns 1, 2, and 3, robust z-statistics are in parentheses. In columns 4 and 5, t-statistics are derived from White (1980) standard errors are in parentheses. * Significant at the 5% level; ** Significant at the 1% level.

Dependent variables	LISTED	RET	ALPHA	RET	ALPHA
	IV first stage (probit)	IV second stage		OLS	
	(1)	(2)	(3)	(4)	(5)
LISTED		-1.824**	-2.767**	-0.144**	-0.191**
		(-4.45)	(-6.66)	(-2.79)	(-3.35)
MGTFEE (%)	-0.021*	0.033*	0.022	0.036*	0.026
	(-2.01)	(2.35)	(1.43)	(2.56)	(1.73)
PERFFEE (%)	0.023**	0.001	0.012**	0.000	0.010**
	(19.96)	(1.15)	(9.45)	(0.26)	(8.24)
NOTICE (months)	-0.130**	0.007*	0.005	0.011**	0.012**
	(-23.04)	(2.30)	(1.67)	(4.06)	(4.20)
MININV (US$m)	-0.040**	-0.001	0.001	0.001	0.004*
	(-3.15)	(-0.59)	(0.54)	(0.63)	(2.33)
SIZE	-0.339**	-0.092**	-0.116**	-0.072**	-0.085**
	(-24.01)	(-5.58)	(-6.88)	(-4.56)	(-5.31)
AGE (decades)	0.167**	0.018**	0.029**	0.006	0.011**
	(40.31)	(3.69)	(5.73)	(1.50)	(2.58)
STRATEGYFLOW	0.035**				
	(5.22)				
F-test: STRATEGYFLOW = 0	27.30**				
year dummies	Yes	Yes	Yes	Yes	Yes
strategy dummies	Yes	Yes	Yes	Yes	Yes
Pseudo R2	0.111				
R2		0.031	0.002		
Adj. R2				0.034	0.009
No. of observations	321,597	321,597	321,597	321,597	321,597

Table 11
Robustness tests

This table reports portfolio sort analysis of fund performance measured by hedge fund excess return and hedge fund alpha with different adjustments. Every January, hedge funds are sorted into two groups based on whether their management companies are listed firms. Portfolio A is the portfolio of hedge funds managed by listed firms. Portfolio B is the portfolio of hedge funds managed by unlisted firms. Panel A reports results adjusted for backfill bias by removing the return observations before fund listing date. Panel B reports results after unsmoothing returns using the Getmansky, Lo, and Makarov (2004) algorithm. Panel C reports results after adding back fees to form pre-fee returns. Panel D reports results adjusted for dynamic risk exposures by using rolling 24-month prior return to calculate portfolio betas. Panel E uses the Fung and Hsieh (2004) model augmented with the MSCI Emerging Market Index excess return. Panel F uses the Fung and Hsieh (2004) model augmented with the Agarwal and Naik (2004) out-of-the money call and put option factors. Panel G uses the Fung and Hsieh (2004) model augmented with the Pastor and Stambaugh (2003) liquidity factor. Panel H adjusts for fund termination by assuming that a fund delivers a minus ten percent return during the month that it drops out of the database. Panels I and J report results for two sub-sample periods: January 1994 to December 2003 and January 2004 to December 2013, respectively. Panel K reports results from the portfolio sort analysis at the firm level with firm returns. Panel L reports results with firm returns computed from Thomson Financial 13F stock holdings. The sample period is from January 1994 to December 2013. The t-statistics, derived from White (1980) standard errors, are in parentheses. * Significant at the 5% level; ** Significant at the 1% level.

Portfolio	Excess Return (pct / year)	Alpha (pct / year)	Adj. R2	Portfolio	Excess Return (pct / year)	Alpha (pct / year)	Adj. R2
Panel A: Adjusted for backfill bias				*Panel G: Fung and Hsieh (2004) model augmented with the Pastor and Stambaugh (2003) liquidity factor*			
Portfolio A (hedge funds managed by listed firms)	2.47	-0.62	0.55	Portfolio A (hedge funds managed by listed firms)	4.29*	0.93	0.60
	(1.31)	(-0.53)			(2.41)	(0.80)	
Portfolio B (hedge funds managed by unlisted firms)	4.79**	2.18**	0.70	Portfolio B (hedge funds managed by unlisted firms)	6.18**	4.28**	0.64
	(2.87)	(2.68)			(4.32)	(5.10)	
Spread portfolio (A - B)	-2.32**	-2.80**	0.05	Spread portfolio (A - B)	-1.89**	-3.35**	0.23
	(-3.00)	(-3.71)			(-3.13)	(-5.10)	
Panel B: Adjusted for serial correlation				*Panel H: Adjusted for fund termination*			
Portfolio A (hedge funds managed by listed firms)	4.29*	0.96	0.60	Portfolio A (hedge funds managed by listed firms)	2.84	-0.40	0.59
	(2.41)	(0.87)			(1.61)	(-0.38)	
Portfolio B (hedge funds managed by unlisted firms)	6.18**	3.86**	0.64	Portfolio B (hedge funds managed by unlisted firms)	4.61**	2.31**	0.64
	(4.32)	(4.93)			(3.23)	(3.00)	
Spread portfolio (A - B)	-1.89**	-2.89**	0.22	Spread portfolio (A - B)	-1.77**	-2.72**	0.21
	(-3.13)	(-5.18)			(-2.95)	(-4.45)	
Panel C: Pre-fee returns				*Panel I: Sub-sample analysis (January 1994 - December 2003)*			
Portfolio A (hedge funds managed by listed firms)	5.31**	2.81**	0.67	Portfolio A (hedge funds managed by listed firms)	4.46*	1.58	0.72
	(3.69)	(3.81)			(2.44)	(1.59)	
Portfolio B (hedge funds managed by unlisted firms)	7.76**	5.81**	0.64	Portfolio B (hedge funds managed by unlisted firms)	6.59**	4.55**	0.69
	(5.99)	(8.41)			(4.15)	(5.25)	
Spread portfolio (A - B)	-2.46**	-3.00**	0.19	Spread portfolio (A - B)	-2.12**	-2.97**	0.21
	(-5.74)	(-7.26)			(-2.94)	(-3.63)	
Panel D: Adjusted for dynamic risk exposures using 24-month rolling betas				*Panel J: Sub-sample analysis (January 2004 - December 2013)*			
Portfolio A (hedge funds managed by listed firms)	4.49*	0.02	n.a.	Portfolio A (hedge funds managed by listed firms)	4.11	-0.25	0.57
	(2.32)	(0.02)			(1.35)	(-0.13)	
Portfolio B (hedge funds managed by unlisted firms)	6.53**	3.44**	n.a.	Portfolio B (hedge funds managed by unlisted firms)	5.77*	2.82*	0.66
	(4.20)	(3.69)			(2.43)	(2.22)	
Spread portfolio (A - B)	-2.05**	-3.42**	n.a.	Spread portfolio (A - B)	-1.66	-3.07**	0.21
	(-3.31)	(-4.92)			(-1.71)	(-3.17)	
Panel E: Fung and Hsieh (2004) model augmented with an emerging markets equity factor				*Panel K: Management company level returns*			
Portfolio A (hedge funds managed by listed firms)	4.29*	1.68	0.74	Portfolio A (hedge funds managed by listed firms)	4.78**	1.74	0.62
	(2.41)	(1.93)			(2.86)	(1.83)	
Portfolio B (hedge funds managed by unlisted firms)	6.18**	4.32**	0.73	Portfolio B (hedge funds managed by unlisted firms)	6.78**	4.47**	0.68
	(4.32)	(6.45)			(4.75)	(6.16)	
Spread portfolio (A - B)	-1.89**	-2.64**	0.32	Spread portfolio (A - B)	-2.01**	-2.73**	0.21
	(-3.13)	(-4.61)			(-3.59)	(-5.49)	
Panel F: Fung and Hsieh (2004) model augmented with the Agarwal and Naik (2004) out-of-the money call and put option factors				*Panel L: Management company returns constructed from 13F stock holdings*			
Portfolio A (hedge funds managed by listed firms)	4.29*	2.46*	0.66	Portfolio A (hedge funds managed by listed firms)	9.19*	1.56	0.88
	(2.41)	(2.41)			(2.28)	(1.83)	
Portfolio B (hedge funds managed by unlisted firms)	6.18**	4.56**	0.63	Portfolio B (hedge funds managed by unlisted firms)	12.01**	3.73**	0.95
	(4.32)	(5.16)			(2.61)	(3.85)	
Spread portfolio (A - B)	-1.89**	-2.10**	0.25	Spread portfolio (A - B)	-4.67*	-2.17*	0.38
	(-3.13)	(-3.51)			(-1.94)	(-2.36)	

Chapter 2:

Overpriced Stocks and Hedge Fund Performance

Lin Sun

Abstract:

Using the mispricing measure constructed by Stambaugh, Yu, and Yuan (2015), I find that propensity to hold mispriced stocks reflect hedge fund managerial ability. Hedge funds hold most overpriced stocks underperform hedge funds hold least overpriced stocks by 3.00% per annual after adjusting for risk. Propensity of hedge funds to hold more overpriced stock is persistent over the next quarter. Hedge funds holding most overpriced stocks are more prone to disposition effect and trade more actively.

2.1. Introduction

Hedge fund asset has grown rapidly in recent twenty years; the asset under management (AUM) is close US$ 3 trillion mark[27]. Unlike the evidence in mutual fund industry, numerous hedge fund researches have shown that hedge fund managers are able to deliver positive risk adjusted return[28]. In asset management industry, hedge fund industry always attracts the best talents. Does talent hedge funds managers better at picking stocks? In this paper, I will investigate hedge fund managers stock picking skills through analyzing their holding of overpriced stocks.

Miller (1977) argues that there is no room for undervalued securities in a market with large number of well informed investors. However there may have a few overvalued investments when those investors are unwilling to sell short the stocks. Miller's argument suggests that there is a possibility that stock prices deviate from their fundamental value.

To investigate hedge funds holding of mispriced stocks, I analyze the hedge fund holding by using Thomas Reuter's Institutional (13f) Holdings database. Recently, there are a few papers studying the hedge fund managerial skill and investment styles through their mandatory 13F filing with SEC. Empirical evidence suggests that hedge funds are riding on the overpricing instead of correcting it (Brunnermeier and Nagel (2004)). Later work by Griffin and Xu (2009) finds that hedge funds are not better than mutual funds at long equity investment. Most recent researches find skill hedge fund managers when they delay their 13F fillings (Agarwal, Jiang, Tang, and Yang (2012),) and when they implement contrarian strategies (Grinblatt, Jostova, Petrasek, and Philipov (2016)).

[27] See, "Hedge-Fund Assets Below $3 Trillion for First Time Since 2014" Bloomberg, 26 Feb 2016
[28] See Brown, Goetzmann, and Ibbotson (1999), Ackermann, McEnally, and Ravenscraft (1999), Liang (1999), Agarwal and Naik (2000a, b, c), Fung and Hsieh (2004), Kosowski, Naik, and Teo (2007), and Fung, Hsieh, Naik, and Ramadorai (2008).

Stambaugh, Yu, and Yuan (2012) use 11 asset pricing anomalies that survive adjustments for Fama and French (1993) three factors to construct an aggregated measure of mispricing for each stock. I use the value weighted average of overpricing measure for all stocks held by hedge fund manager as my measure of manager mispricing. Hedge funds have higher level of mispricing measure when they are holding stocks with higher net stock issues (Ritter (1991), Loughran and Ritter (1995)), higher composite equity issues (Daniel and Titman(2006)), higher accruals (Sloan (1996)), higher net operating assets (Hirshleifer, Hou, Teoh, and Zhang (2004)), higher asset growth (Cooper, Gulen, and Schill (2008)), higher investment-to-assets (Titman, Wei, and Xie (2004), Xing (2008)), higher chance of distress (Campbell, Hilscher, and Szilagyi (2008)), higher O-score (Ohlson (1980)), momentum (Jegadeesh and Titman (1993), Carhart (1997)), lower gross profitability premium (Novy-Marx (2013)), lower return on assets (Fama and French (2006), Chen, Novy-Marx, and Zhang (2010), and Wang and Yu (2013)).

Similar work by Avramov, Cheng, and Hameed (2015) use 11 market anomalies to identify overpriced stocks, and argue that propensity of mutual fund holding overpriced stocks reflects managerial skills. Mutual fund managers holding more overpriced stocks deliver poorer performance. The underperformance is more significant during high sentiment period. They also show that mutual funds holding most overpriced stocks attract higher inflow. Moreover managers buy more overpriced stocks when there is a fund inflow and sell less overpriced stocks when there is a fund outflow. Motivated by their work, I investigate the impact of stock holding mispricing on hedge fund performance. Hedge fund industry is an interesting laboratory to explore the relationship between stock mispricing level and hedge fund performance. Comparing to mutual funds, hedge funds invest in smaller, opaque value securities, and have higher turnover and more active share bets (Griffin and Xu (2011)). Empirical evidence suggests that hedge funds managers are more skillful than mutual fund

managers. In this paper, I propose a behavior type explanation on the underperformance of professional investors holding more overpriced stocks.

The main hypothesis is that hedge fund holding of overpriced stocks reflects poorer managerial skills. Specifically, hedge fund holding of overpriced stocks is an indication of poorer stock selection skills, which contributes to a lower expected return in the next period. To investigate the role of behavioral bias and investment styles on performance, I further hypothesis that mispricing level of hedge fund holdings is positively correlated with behavioral bias exhibited by fund managers. As documented in existing literature, disposition effect (e.g. Odean (1998)) and active trading (Barber and Odean (2000, 2001)) hurt investment performance.

My empirical evidence supports my hypotheses. The main finding of this paper is that hedge fund holding of mispriced stocks is negatively correlated with fund performance. In the portfolio sort analysis, hedge funds holding most overpriced stocks underperform hedge funds holding least overpriced stocks. The difference is 3.00% (*t*-statistic = 2.71) after adjusting for co-variation with the Fung and Hsieh (2004) seven factors. The results are not confined to the smallest funds in our sample and cannot be explained by differences in fund age (Aggarwal and Jorion, 2010), fund size (Berk and Green, 2004), fees (Agarwal, Daniel, and Naik, 2009), share restrictions and illiquidity (Aragon, 2007; Aragon and Strahan, 2012), and managerial manipulation of fund returns (Bollen and Pool, 2009).

What drives the underperformance of hedge funds holding mispriced stocks? I further test whether the manager behavioral bias exhibited by hedge fund manager can explain the underperformance. In line with Odean (1998) and Barber and Odean (2000, 2001), I observe that hedge funds holding most overpriced stocks are more prone to disposition effects and

trade more actively than hedge funds holding least overpriced stocks. Disposition effects and active trading lead to lower performance.

Does the hedge fund manager holding of overpriced stocks persist overtime? Does the outperformance persist over longer time? My finding indicates that the last quarter mispricing level predicts a positive current quarter mispricing level. The results suggest that there is persistence in the holding of overpriced stocks. I also observe that the underperformance of hedge funds holding most overpriced stocks is persist up to a 36 months.

This paper contributes to the literature in several ways. First, this paper provides new evidence on hedge fund manager stock picking skills through their holding of mispriced stocks. Hedge funds holding least overpriced stocks outperform. This finding helps investor to identify skilled managers (Griffin and Xu, 2009; Agarwal, Jiang, Tang, and Yang, 2012; Grinblatt, Jostova, Petrasek, and Philipov, 2016). Second, my work finds that hedge funds holding most overpriced stocks are also more prone to disposition effect and trade more actively. The results improve our understanding the role of behavioral bias on hedge fund investment performance (Odean, 1998; Barber and Odean, 2000, 2001). Finally, I find that outperformance persists over a long period of time up to 36 months.

The remainder of this paper is organized as follows: Section 2 describes the data and methodology. Section 3 reports the results from the empirical analysis while Section 4 presents a myriad of robustness tests. Section 5 concludes.

2.2. Data and methodology

I evaluate the impact of hedge funds using monthly net–of–fee returns and assets under management data of live and dead hedge funds reported in the TASS, HFR, and

BarclayHedge datasets from January 1994 to December 2013. Because TASS, HFR, and BarclayHedge started distributing their data in 1994, the data sets do not contain information on funds that died before January 1994. This gives rise to survivorship bias. To mitigate this bias, I only focus on data from January 1994 onward.

I merge the data for hedge funds from three hedge fund databases: TASS, HFR, and BarclayHedge. First, I match hedge funds by their names. Second, I identify multiple share classes whose pairwise monthly return correlations are more than 0.99. Since multiple share classes may cloud our analysis, I exclude multiple share classes by keeping the funds based on the following priority rule: (i) longest return series, (ii) largest AUM, (iii) USD share class, and (iv) onshore share class. The final sample has a total of 16,633 hedge funds, 5,745 of which are live funds and 10,888 of which are dead funds at the end of our sample.

I obtain the hedge fund managers' quarterly holding from Thomas Reuter's Institutional (13f) Holdings database. Since 1978, all institutions with over $100 million under management are required to fill out 13F forms quarterly for all U.S. equity positions worth over $200,000 or consisting of more than 10,000 shares29. To identify the hedge fund manager from the 13F fillings, I merge the 13F manager name with the merged hedge fund database. Following the work by Brunnermeier and Nagel (2004), I require (1) that at least 50% of its clients are "Other pooled investment vehicles (e.g., hedge funds)" or "High net worth individuals," and (2) that it charges performance-based fees, according to Form ADV. I am able to identify 826 hedge funds managers in 13F database.

The mispricing measure is taken from Robert F. Stambaugh data library. At the end of each month, Stambaugh, Yu and Yuan (2015)[30] constructed the mispricing measure by

[29] As discussed in Brunnermeier and Nagel (2004), Griffin and Xu (2009), and Agarwal, Jiang, Tang and Yang (2013).

[30] See http://finance.wharton.upenn.edu/~stambaugh/Mispricing_Measure_Documentation.pdf

combining 11 anomaly variables. They assign a rank of 0 to 100 for each of the 11 anomaly variables. A higher rank indicates a higher degree of overpricing and lower expected return in the next period. The aggregated measure is the arithmetic mean value of these 11 anomalies. These 11 variables are: net stock issues (Ritter (1991), Loughran and Ritter (1995)), composite equity issues (Daniel and Titman(2006)), accruals (Sloan (1996)), net operating assets (Hirshleifer, Hou, Teoh, and Zhang (2004)), asset growth (Cooper, Gulen, and Schill (2008)), investment-to-assets (Titman, Wei, and Xie (2004), Xing (2008)), distress (Campbell, Hilscher, and Szilagyi (2008)), O-score (Ohlson (1980)), momentum (Jegadeesh and Titman (1993), Carhart (1997)), gross profitability premium (Novy-Marx (2013)), return on assets (Fama and French (2006), Chen, Novy-Marx, and Zhang (2010), and Wang and Yu (2013)).

I merge the 13F data with Stambaugh, Yu and Yuan (2015) mispricing measure by PERMNO. Quarterly hedge fund manager level mispricing measure is constructed as the value weighted mean mispricing of all the individual stocks.

Throughout this paper, I model the risks of hedge funds using the Fung and Hsieh (2004) seven–factor model. The Fung and Hsieh factors are the excess return on the Standard and Poor's (S&P) 500 index (SNPMRF); a small minus big factor (SCMLC) constructed as the difference between the Russell 2000 and the Standard and Poor's (S&P) 500 indices; the yield spread of the US ten–year Treasury bond over the three–month Treasury bill, adjusted for duration of the ten–year bond (BD10RET); the change in the credit spread of Moody's BAA bond over the ten–year Treasury bond, also appropriately adjusted for duration (BAAMTSY); and the excess returns on portfolios of look back straddle options on currencies (PTFSFX), commodities (PTFSCOM), and bonds (PTFSBD), which are constructed to replicate the maximum possible return from trend following strategies (see Fung and Hsieh, 2001) on their respective underlying assets. These seven factors have been

shown by Fung and Hsieh (2004) to have considerable explanatory power on hedge fund returns.

To further enhance the results, I also used the Daniel, Grinblatt, Titman, and Wermers (1997, DGTW) method to adjust for risk. DGTW adjusted return for individual stock is the excess return of 125 benchmark portfolios based on market capitalization, book-to-market ratio, and momentum stocks. I calculate the hedge fund firm level DGTW adjusted return by taking the value weighted mean value of all the stocks.

Table 1 provides summary statistics on the mispricing measures at hedge fund manager level and other hedge fund characteristics. On average, hedge funds tend to hold less overprice stocks. The mean and median values of overpricing measure (MISP) are 42.72 and 43.87 respectively, which are less the unconditional expected value of 50.

[Insert Table 1 here]

2.3. Empirical analysis

2.3.1. Tests of fund performance

To begin, I test for differences in risk–adjusted performance of hedge funds with diffident level of overpricing. Every quarter, starting in January 1998, five hedge fund portfolios are formed based on overpricing at the beginning of each quarter. The post–formation returns on these five portfolios are linked across months to form a single return series for each portfolio. I then evaluate the performance of the portfolios relative to the Fung and Hsieh (2004) model. I also report the DGTW adjusted return.

The results, reported in Table 2, reveal substantial differences in expected returns, on the portfolios sorted by different level of overpricing, that are unexplained by the DGTW style portfolio and the Fung and Hsieh (2004) seven factors. Hedge funds hold most overpriced stocks underperform those hold least overpriced stocks by an economically and statistically significant 3.26 percent per year (*t*–statistic = 2.64). As in the rest of the paper, I base statistical inferences on White (1980) heteroskedasticity–consistent standard errors. After adjusting for co–variation with the factors from the Fung and Hsieh (2004) model, the spread increases to 3.00 percent per year (*t*–statistic = 2.71). To confirm the result, I also test the cross sectional difference in performance based on hedge fund 13F holding data. The difference in holding return is economically and statistically significant at 6.02 percent per year (*t*–statistic = 2.61). After adjusting for DGTW benchmark portfolio, the difference gives an economically and statistically significant 4.48 percent per year (*t*–statistic = 2.50).

[Insert Table 2 and Fig 1 here]

Figure 1 complements the results from Panel A of Table 2. It illustrates the monthly cumulative average residuals (henceforth CARs) from the portfolio of hedge funds hold least overpriced stocks (portfolio A) and the portfolio of hedge funds hold most overpriced stocks (portfolio B). CAR is the cumulative difference between a portfolio's excess return and its factor loadings (estimated over the entire sample period) multiplied by the Fung and Hsieh (2004) risk factors (left panel) or DGTW adjusted return (right panel). The CARs in Figure 1 indicate that portfolio B consistently underperforms portfolio A over the entire sample period and suggest that the underperformance of funds holding most overpriced stocks is not peculiar to a particular year.

To further test the relationship between hedge fund performance and propensity to hold mispriced stocks, I estimate the following pooled OLS regression by controlling for fund characteristics that may affect fund performance:

$$ALPHA_{im} = a + bMISP + cMGTFEE_i + dPERFFEE + eNOTICE_i + fMININV_i + g\log(SIZE_{im-1}) + hAGE_{im} + \sum_l i^l YEARDUM_i^l + \varepsilon_{im}, \quad (1)$$

where *ALPHA* is fund monthly abnormal return after stripping away co–variation with the Fung and Hsieh (2004) seven factors, *MISP* is the hedge fund last quarter's mispricing level, *MGTFEE* is fund management fee in percentage, *PERFFEE* is fund performance fee in percentage, *NOTICE* is fund redemption notification period in months, *MININV* is fund minimum investment in millions of US$, *SIZE* is fund monthly AUM in millions of US$, *AGE* is fund age in decades, and *YEARDUM* is year dummy. The log(*SIZE*) variable captures capacity constraints at the fund level (Berk and Green, 2004). *MGTFEE* and *PERFFEE* captures the impact of fund incentives on managerial performance (Agarwal, Daniel, and Naik, 2009) while *NOTICE* caters for the view expounded by Aragon (2007) that funds with longer redemption notification periods take on more liquidity risk and therefore harvest greater returns. I include *AGE* as a response to the Aggarwal and Jorion (2010) finding that younger funds outperform older funds. To facilitate the estimation of fund alpha, I only include results for funds with at least 24 months of return data. I also estimate the analogous regression on raw monthly fund returns to ensure that our findings are not an artifact of the risk adjustment methodology.

[Insert Table 3 here]

The results from the cross–sectional regression analysis are reported in columns one to four of Table 3. They corroborate the findings from the portfolio sorts and indicate that funds charge zero performance fee underperform those charge non-zero performance fee.

Specifically, the coefficient estimate on *MISP* in the alpha regression reported in column four of Table 2 indicates that, controlling for other factors that could explain fund performance, funds holding more overpriced stocks underperform funds holding less overpriced after adjusting for risk. The underperformance is both statistically and economically significant. One standard derivation increase in *MISP* is corresponding to an 8.07% underperformance per annual. The coefficient estimates on the control variables accord with the extant literature. Longer redemption notice periods (Aragon, 2007) is associated with superior performance while fund size (Berk and Green, 2004) and fund age (Aggarwal and Jorion, 2010) are linked to poorer performance. Inferences do not change when I estimate the regression on raw returns suggesting that my findings are not driven by our risk adjustment technology.

To check for robustness, I estimate Fama and MacBeth (1973) regressions in place of the OLS regressions. Specifically, first I run cross–sectional regressions for each month. Then, I report the time–series averages of the coefficient estimates, and use the time–series standard errors of the average slopes to draw inferences. The Fama and MacBeth regressions control for correlation in residuals across different firms within the same month. I compute the standard errors using the method of Newey and West (1987) with a three–month lag to adjust for dependence across time. The Fama and MacBeth (1973) results reported in columns five to eight of Table 3 echo our previous findings and indicate that they are robust to alternative model specifications.

2.3.2. Behavioral bias and investment style

Will hedge fund managers' investment behavior affect their decision to hold more overpriced stocks? I conduct a univariate analysis on behavioral bias and fund to examine the difference investment behavior between hedge funds holding most overpriced stocks and least overpriced stocks.

I use five difference measures of investment styles and factor exposures: disposition effect by Odean (1998), active shares by Cremers and Petajisto (2009), R-squared estimated from Fung and Hsieh (2004) 7 factor model, strategy distinctiveness index based on Sun, Wang, and Zheng (2012), and deviation of Fung and Hsieh 7 factor beta loading from the hedge fund strategy peers used in Lu, Ray, and Teo (2016). Odean (1998) shows that retail investors who demonstrate disposition effect leads to lower investment returns. Later work by Barber and Odean (2000, 2001) suggest that active trading is hazardous to wealth. Some recent works examine the relationship between fund distinctiveness and performance. Titman and Tiu (2011) find that low R-squared funds have better performance than high R-squared funds measuring by Sharpe ratio, information ratio, and manipulation-proof performance. They argue that better-informed managers will choose less exposure to factor risk. In line with their findings, Sun, Wang, and Zheng (2012) examine the hedge fund's return distinctiveness with respective to its strategy peers. They find that those more distinct funds outperform. As a supplementary to the R-squared and strategy distinctiveness index, I calculate the hedge fund's sum of absolute Fung and Hsieh (2004) beta difference from its peers by following the work by Lu, Ray, and Teo (2016).

[Insert Table 4 here]

The results from the univariate analysis are presented in Table 6. The findings suggest that hedge fund holding most overpriced stocks are more prone to disposition effect than hedge funds holding least overpriced stocks by 2.4% (*t*–statistic = 2.72). Moreover, hedge funds holding most overpriced stocks trade more actively than hedge funds holding least overpriced stocks measured by RSQUARED, SDI and BETADEVIATION. Specifically, hedge funds holding most overpriced stocks have 1.3% lower R-squared, distinct 2% more, and deviate 9.3% more than hedge funds holding least overpriced stocks. All these results are statistically significant at 1% level. Taken together, the result suggest that hedge funds

holding most overpriced stocks are more prone to disposition effect and take excess trading, which lead to poorer performance.

2.3.3. Double sort on size and mispricing level

To investigate the role of capacity constraint (Berk and Green, 2004) on mispricing, I conduct a double sort analysis on hedge fund size and mispricing level.

The results are presented in Table 5. I find that the alpha spread between hedge funds holding most overpriced stocks and least overpriced stocks is more significant for larger hedge funds. The alpha spread increases from 3.00% from 3.69%. The results suggest that underperformance of hedge funds holding most overpriced stocks are servicer when they are facing capacity constraint.

[Insert Table 5 here]

2.3.4. Persistence of hedge fund mispricing

To assess the persistence in overpricing, I run OLS regression of current quarter mispricing level on last quarter mispricing level, together with other control variables from previous quarter including: return, alpha, fund flow, management fee, performance fee, redemption notification period, minimum investment in millions of US$, age in decades, AUM in millions of US$, and standard deviation of return.

[Insert Table 6 here]

The results in Table 6 suggest that there is a strong positive correlation of lagged mispricing level with current mispricing level at quarterly frequency. The coefficient is 0.685 (*t*–statistic = 64.31).

2.3.5. Alternative portfolio sorting and holding period

In my baseline results in table 2, my portfolio formation period is the latest quarterly 13F holding and my holding period is 3 months. To test the robustness of my results, I apply alternative portfolio formation and holding periods to my baseline results. Specifically, I use three sets of portfolio formation period including: last quarter, last 4 quarters, and last 8 quarters. I calculate the mean value of the past mispricing level based on hedge fund managers' quarterly 13F filings. The alternative portfolio holding periods include: 3 months, 6 months, 12 months, 24 months, and 36 months.

The results are presented in Table 7. First, the alpha spread between hedge funds holding most overpriced stocks and hedge fund holding least overpriced stock remain statistically and economically significant at 3.00%, 3.19% and 3.43% for portfolio formation period of 1 quarter, 4 quarters and 8 quarters respectively. Second, underperformance shows a decreasing trend and remains significant when I vary the holding period from 3 months to 36 months. Taken together, the findings suggest that the underperformance of hedge funds holding most overpriced stocks is robust for alternative holding periods and the underperformance is persistent up to 36 months.

[Insert Table 7 here]

2.4. Robustness tests

In this section, I present a battery of robustness tests to ascertain the strength of our empirical results.

2.4.1. Backfill bias

Funds managed by unlisted firms may backfill their returns more often than funds managed by listed firms. In response to concerns about backfill bias raised by Bhardwaj, Gorton, and Rouwenhorst (2014) and others, I redo my baseline analysis by removing the first 24 months of return data for each fund. As there are not enough funds with returns post-listing in the cross-section during the earlier years, I perform the analysis for the period after 2000. As shown in Panel A of Table 8, my inferences remain unchanged when I control for backfill bias in this fashion. The portfolio alpha spread remains economically meaningful and statistically significant at the one percent level with this adjustment.

[Insert Table 8 here]

2.4.2. Serial correlation

Serial correlation in fund returns could arise from linear interpolation of prices for infrequently traded securities, the use of smoothed broker dealer quotes, or in some cases, deliberate performance-smoothing behavior. This could inflate some of the test statistics that I use to make inferences from the sort results. To allay such concerns, I unsmooth fund returns using the algorithm of Getmansky, Lo, and Makarov (2004) and redo the Table 2 portfolio sort. The results reported in Panel B of Table 8 indicate that my findings are not driven by serial correlation in fund returns.

2.4.3. Pre-fee returns

Hedge fund returns are reported net of fees in the commercial databases. One concern is that funds holding most overpriced stocks may charge higher fees than funds holding least overpriced stocks. This may drive the underperformance of the former relative to the latter.

To check, I calculate fund performance and management fee using the algorithm outlined in Appendix A of Agarwal, Daniel, and Naik (2009), and back out pre-fee fund returns. As shown in Panel C of Table 8, the baseline portfolio sort spreads are even greater when I analyze pre-fee fund returns.

2.4.4. Omitted risk factors

The presence of additional risk factors could cloud the portfolio sort analysis. Relative to funds holding most overpriced stocks, those holding least overpriced stocks could be loading up more on some risk factor (e.g., emerging markets) that did well over the sample period. This could explain why there is a return spread between funds managed by unlisted firms and those managed by listed firms. Hence, I augment the Fung and Hsieh (2004) model with an emerging markets factor derived from the MSCI Emerging Markets Index return and redo the Table 2 sort. To cater for hedge fund exposure to option based strategies (Mitchell and Pulvino, 2001), I also augment the Fung and Hsieh (2004) model with out-of-the-money S&P 500 call and put option-based factors from the Agarwal and Naik (2004) model.[31] Finally, to account for hedge fund exposure to liquidity risk (Teo, 2011; Aragon and Strahan, 2012; Sadka, 2012), I augment the Fung and Hsieh model with the Pástor and Stambaugh (2003) liquidity factor. The results presented in Panels D, E, and F of Table 8 indicate that our baseline results are not driven by the presence of omitted risk factors.

2.4.5. Fund termination

There are concerns that because funds that drop out from the database could have terminated their operations, the portfolio alphas are biased upward. To allay such concerns, I assume that, for the month after a fund drops out of the database, its return is -10 percent.

[31] I am grateful to Vikas Agarwal for supplying these factors.

Thereafter, money is reallocated to the remaining funds in the portfolio. As shown in Panel G of Table 8, with that adjustment for fund termination, the alphas of the portfolios in the baseline sort fall but the spread remain economically and statistically significant. I also experimented with more extreme termination returns of -20 percent and -30 percent, and obtain qualitatively similar results. These findings suggest that the baseline results are robust to the self-reporting and delisting biases inherent in hedge fund data.

2.4.6. Subsample analysis

It will be interesting to understand how the underperformance of funds managed by listed firms varies over time. In that effort, I split the sample period into two sub periods: January 1998 to December 2005 and January 2006 to December 2013. Next I redo the Table 2 portfolio sort analysis for each sub period. The results reported in Panels H and I of Table 8 indicate that funds holding most overpriced stocks underperform those holding least overpriced stocks in both sub periods. The risk-adjusted performance spread is decreased when we go from the earlier sub period (4.32 percent per year) to the later sub period (2.24 percent per year). Moreover, both spreads are statistically significant.

2.5. Conclusion

This paper investigates the relationship between hedge fund manager holding of mispriced stocks and their investment performance. First, I show that hedge funds holding most overpriced stocks underperform hedge funds holding least overpriced stocks by 3.00% per annual after adjusting for risk. Second, the propensity of hedge funds to hold overpriced stocks persists over next quarter. Third, hedge funds holding most overpriced stocks are more prone to disposition effect and trade more actively than hedge funds holding least overpriced

stocks. Last, the results hold for alternative portfolio formation and holding period. There results contribute our understanding of the impact of hedge fund holding overpriced stock on the investment performance.

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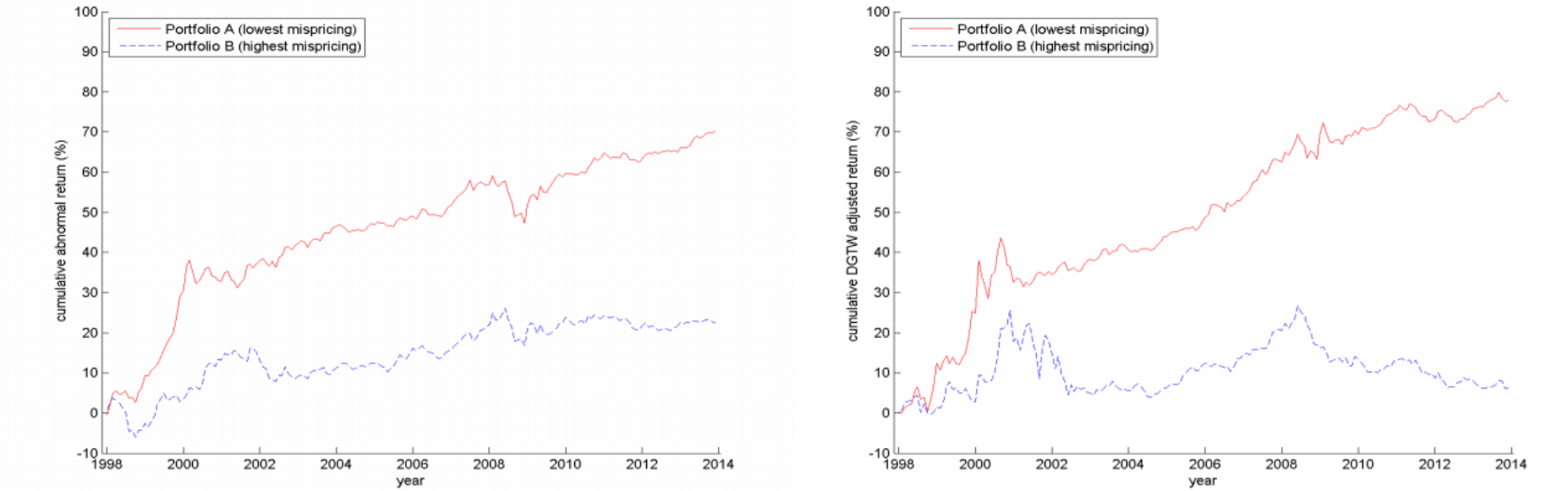

Fig 1. Cumulative abnormal return and DGTW (1997) adjusted return of hedge funds holding most overpriced stocks versus hedge funds holding least overpriced stocks. Equal weighted portfolios of hedge funds are constructed by sorting funds based on level of overpriced stocks held. Cumulative abnormal return is the difference between a portfolio's excess return and its factor loadings multiplied by the Fung and Hsieh (2004) risk factors. Factor loadings are estimated over the entire sample period. DGTW (1997) adjusted return are constructed based on hedge funds quarterly 13F filings.The sample period is from January 1994 to December 2013.

Table 1

Summary statistics

This table reports the descriptive statistics for the main variables used in this paper. The sample period is from January 1998 to December 2013.

Variables	MEAN	STD	P25	P50	P75
MISP	42.72	9.61	38.56	43.87	48.38
AGE (decades)	0.75	0.56	0.32	0.63	1.06
SIZE	5.00	1.85	3.77	4.98	6.26
MGTFEE (%)	1.43	0.59	1.00	1.50	1.75
PERFFEE (%)	18.96	4.27	20.00	20.00	20.00
MININV (US$m)	3.88	59.99	0.50	1.00	1.00
NOTICE (months)	3.14	2.82	1.00	3.00	3.00
RET (%)	0.85	4.28	-0.78	0.81	2.49
ALPHA (%)	0.29	3.90	-1.18	0.23	1.76

Table 2

Portfolio sorts on hedge fund manager mispricing level

At the beginning of each quarter, hedge funds are sorted into quintiles based on their overpricing level in previous quarter. Portfolio "Least overpriced" is the portfolio of hedge funds holding least overpriced stocks in previous quarter. Portfolio "Most ovepriced" is the portfolio of hedge funds holding most overpriced stocks in previous quarter. I report results for both 13F holding based measure and hedge fund self reported return based measure. Holding based performance is estimated relative to DGTW (1997) characteristics based benchmark. Hedge fund portfolio performance is estimated relative to the Fung and Hsieh (2004) factors. The Fung and Hsieh (2004) factors are S&P 500 return minus risk free rate (SNPMRF), Russell 2000 return minus S&P 500 return (SCMLC), change in the constant maturity yield of the U.S. 10-year Treasury bond appropriately adjusted for the duration (BD10RET), change in the spread of Moody's BAA bond over 10-year Treasury bond appropriately adjusted for duration (BAAMTSY), bond PTFS (PTFSBD), currency PTFS (PTFSFX), and commodities PTFS (PTFSCOM). The sample period is from January 1998 to December 2013. The t-statistics, derived from White (1980) standard errors, are in parentheses. * Significant at the 5% level; ** Significant at the 1% level.

Portfolio	13F Holding Return	DGTW Adjusted 13F Holding Return	Excess Return (pct / year)	Alpha (pct / year)	SNPMRF	SCMLC	BD10RET	BAAMTSY	PTFSBD	PTFSFX	PTFSCOM	Adj. R2
Sort on level of mispricing												
Least overpriced	15.16*	4.86**	9.94**	4.40**	0.31**	0.29**	-0.03	0.22**	-0.02**	0.01	0.00	0.72
	(2.37)	(3.05)	(3.48)	(3.52)	(10.66)	(4.58)	(-0.60)	(3.03)	(-3.06)	(0.80)	(-0.10)	
2	14.14*	3.76*	9.85**	4.62**	0.38**	0.23**	0.00	0.10	-0.01	0.00	0.00	0.78
	(2.32)	(2.50)	(4.02)	(4.31)	(14.83)	(7.74)	(-0.08)	(1.86)	(-1.90)	(0.75)	(-0.60)	
3	12.97*	2.79*	8.03**	2.93*	0.35**	0.19**	0.02	0.14**	-0.01	0.01	-0.01	0.73
	(2.11)	(1.99)	(3.39)	(2.57)	(11.64)	(6.02)	(0.35)	(2.83)	(-1.19)	(1.51)	(-1.38)	
4	12.25*	2.60	7.63**	2.57*	0.35**	0.24**	0.01	0.13	-0.01	0.01	0.00	0.73
	(1.98)	(1.65)	(3.18)	(2.24)	(14.14)	(6.67)	(0.18)	(1.91)	(-1.09)	(0.85)	(-0.17)	
Most overpriced	9.14	0.39	6.68*	1.40	0.37**	0.21**	-0.04	0.21**	-0.01	0.00	0.00	0.78
	(1.41)	(0.25)	(2.50)	(1.19)	(11.50)	(6.88)	(-0.93)	(3.56)	(-0.71)	(0.66)	(-0.57)	
Most - least	-6.02**	-4.48*	-3.26**	-3.00**	0.06**	-0.07	-0.01	-0.01	0.01	0.00	0.00	0.06
	(-2.61)	(-2.50)	(-2.64)	(-2.71)	(3.04)	(-1.37)	(-0.25)	(-0.31)	(1.71)	(-0.31)	(-0.40)	

Table 3

Regressions on hedge fund performance

This table reports multivariate regression analysis of hedge fund performance. The dependent variables include hedge fund return and hedge fund alpha. Return is hedge fund monthly net-of-fee return. Alpha is Fung and Hsieh (2004) seven-factor monthly alpha for hedge funds where factor loadings are estimated over the last 24 months. The primary independent variable is the hedge funds mispricing level at the end of previous quarter (MISP). It takes value of 0 to 100. The higher value suggests a higher level mispricing. The other independent variables include hedge fund management fee (MGTFEE), hedge fund performacne fee (PERFFEE), redemption notice period in months (NOTICE), minimum investment in USD million (MININV), the natural logarithm of fund size (SIZE), fund age in decades (AGE) as well as dummy variables for year and fund investment strategy. The sample period spans January 1998 to December 2013. The t-statistics for the OLS regressions are derived from White (1980) standard errors. Fama-MacBeth regression coefficients are the time series average of cross-sectional regression coefficients, with t-statistics derived from Newey and West (1987) standard errors. The adjusted R-squared is the average across all cross-sectional regressions. * Significant at the 5% level; ** Significant at the 1% level.

	OLS Regression				Fama-MacBeth (1973) Regression			
Independent variables	Return		Alpha		Return		Alpha	
MISP	-0.008**	-0.011**	-0.007**	-0.007**	-0.012**	-0.011**	-0.011*	-0.010*
	(-3.64)	(-4.74)	(-3.29)	(-3.19)	(-2.96)	(-2.65)	(-2.49)	(-2.22)
MGTFEE (%)		0.004		0.045		0.020		0.065
		(0.11)		(0.92)		(0.37)		(1.06)
PERFFEE (%)		0.009*		0.007		0.007		0.005
		(2.08)		(1.54)		(1.41)		(1.08)
NOTICE (months)		0.002		0.004		0.000		0.003
		(0.19)		(0.52)		(0.01)		(0.30)
MININV (US$m)		0.000		0.000		0.010		0.017
		(-1.66)		(-1.16)		(0.67)		(1.68)
SIZE		-0.033*		-0.001		-0.054		-0.026
		(-2.53)		(-0.09)		(-1.82)		(-1.08)
AGE (decades)		-0.073		-0.062		-0.099		-0.045
		(-1.86)		(-1.68)		(-1.26)		(-0.84)
year dummies	No	Yes	No	Yes	No	No	No	No
Adj. R2	0.000	0.057	0.000	0.007	0.005	0.031	0.004	0.007
No. of observations	38,313	37,905	34,127	33,875	192	192	192	192

Table 4

Univariate analysis of behavior bias and hedge fund investment styles

This table reports univariate regression analysis of hedge fund investment styles on hedge fund mispricing level. At the beginning of each quarter, hedge funds are sorted into quintiles based on their overpricing level in previous quarter. Portfolio "Least overpriced" is the portfolio of hedge funds holding least overpriced stocks in previous quarter. Portfolio "Most ovepriced" is the portfolio of hedge funds holding most overpriced stocks in previous quarter. DISP measures the disposition effect among hedge fund managers, which is proportion of gains realized minus proportion of losses realized in Odean (1998). ACTIVESHARE measures deviation of hedge fund holding from benchmarks (Cremers and Petajisto (2009)). RSQUARED measures systematic factor exposure and is the R-squared from the regression of fund excess returns on the Fung and Hsieh (2004) 7 factors esimated using prior 24 months return. SDI is Sun, Wang, and Zheng (2012) "Strategy Distinctiveness Index", which measures distinctiveness of hedge fund's return relative to its peers. BETADEVIATION measures the hedge fund's deviation from its investment styles, which is the sum of the absolute deviations of Fund and Hsieh (2004) 7 factors beta loadings from the hedge funds of same investment style. * Significant at the 5% level; ** Significant at the 1% level.

Variable	Least overpriced	Most ovepriced	High - Low
DISP (PGR - PLR)	-0.005	0.020	0.024** (2.72)
ACTIVESHARE	0.811	0.834	0.023 (1.54)
RSQUARED	0.555	0.542	-0.013** (-3.79)
SDI	0.422	0.442	0.020** (4.14)
BETADEVIATION	1.291	1.384	0.093** (5.30)

Table 5

Portfolio sorts on hedge fund manager size and mispricing level

This table reports double sorts on firm mispricing level and firm size. Portfolio "Least overpriced" is the portfolio of hedge funds holding least overpriced stocks in previous quarter. Portfolio "Most ovepriced" is the portfolio of hedge funds holding most overpriced stocks in previous quarter. Hedge funds are first sorted into two groups based on last quarter end AUM. Next, hedge funds are sorted into quintiles based on their mispricing level. The sample period spans January 1998 to December 2013. * Significant at the 5% level; ** Significant at the 1% level.

Hedge fund firm portfolio	Hedge fund performance			
	Excess return		Alpha	
	Firm size		Firm size	
	Small	Large	Small	Large
Sort on level of mispricing				
Least overpriced	10.13**	10.33**	4.16*	5.01**
	(2.98)	(3.73)	(2.57)	(3.73)
2	10.99**	7.86**	5.66**	2.47
	(4.18)	(3.12)	(4.41)	(1.93)
3	11.45**	6.59**	6.36**	1.59
	(4.15)	(2.79)	(4.69)	(1.19)
4	8.38**	7.16**	2.98*	2.39*
	(3.22)	(3.16)	(2.31)	(2.08)
Most overpriced	7.63**	6.45*	2.22	1.31
	(2.61)	(2.41)	(1.64)	(0.99)
Most - least	-2.50	-3.88**	-1.94	-3.69**
	(-1.34)	(-2.77)	(-1.16)	(-2.78)

Table 6

Determinant of hedge fund manager mispricing level

This table reports multivariate regression to test the determinant of hedge fund mispricing level. The dependent variable (MISP) is hedge fund manager current quarter mispricing level. All the independent variables are taken from previous quarter end. The independent variables include lagged mispricing leverl (LAGMISP), hedge fund firm net-of-fee return from the previous year (RET), hedge fund firm rolling alpha (ALPHA), fund flow to the fund management company in the previous quarter (FUNDFLOW), firm management fee (MGTFEE), firm performance fee (PERFFEE), firm redemption notice period in months (NOTICE), firm minimum investment in USD million (MININV), natural logarithm of firm size (SIZE), firm age in decades (AGE), standard deviation of firm returns in the previous quarter (RETSTD) as well as year dummies. Firm level metrics such as management fee are constructed by value-weighting the fund level metrics for all funds managed by the firm. The sample period is from January 1998 to December 2013. The t-statistics for the OLS regressions are derived from White (1980) standard errors. * Significant at the 5% level; ** Significant at the 1% level.

Variables	Dependent variable = MISP	
LAGMISP	0.685**	0.685**
	(64.31)	(61.68)
RET (%)	0.053	
	(1.89)	
ALPHA (%)		0.010
		(0.29)
FUNDFLOW	0.000	0.184
	(0.03)	(0.79)
MGTFEE (%)	-0.003	-0.085
	(-0.05)	(-0.66)
PERFFEE (%)	-0.002	0.001
	(-0.18)	(0.10)
NOTICE (months)	-0.055*	-0.057*
	(-2.25)	(-2.15)
MININV (US$m)	0.001**	0.001**
	(3.59)	(3.13)
AGE (decades)	0.090	0.130
	(0.73)	(0.99)
SIZE	-0.082*	-0.071
	(-2.09)	(-1.64)
RETSTD (%)	-0.013	-0.019
	(-0.42)	(-0.57)
Year dummies	Yes	Yes

Table 7

Alternative portfolio formation and holding period

This table reports portfolio sort analysis of fund performance measured by hedge fund excess return and hedge fund alpha with alternative portfolio sorting and holding period. Portfolio "Least overpriced" is the portfolio of hedge funds holding least overpriced stocks in previous quarter. Portfolio "Most ovepriced" is the portfolio of hedge funds holding most overpriced stocks in previous quarter. Panel A uses last quarter end holding to form the portfolio, while Panel B and Panel C use last 4 quarters and 8 quarters respectively. The holding period spans from 3 months to 36 months after portfolio formation. The sample period is from January 1998 to December 2013. The t-statistics, derived from White (1980) standard errors, are in parentheses. * Significant at the 5% level; ** Significant at the 1% level.

Portfolio	Excess Return (pct / year)	Alpha (pct / year)	Portfolio	Excess Return (pct / year)	Alpha (pct / year)	Portfolio	Excess Return (pct / year)	Alpha (pct / year)
Panel A: portfolio sort on last quarter holding			Panel B: portfolio sort on last 4 quarters holding			Panel C: portfolio sort on last 8 quarter holding		
Hold for 3 months			Hold for 3 months			Hold for 3 months		
Least overpriced	9.94**	4.40**	Least overpriced	9.97**	4.43**	Least overpriced	9.67**	4.19**
	(3.48)	(3.52)		(3.55)	(3.56)		(3.48)	(3.46)
Most overpriced	6.68*	1.40	Most overpriced	6.49*	1.24	Most overpriced	5.99*	0.76
	(2.50)	(1.19)		(2.42)	(1.04)		(2.23)	(0.62)
Most - least	-3.26**	-3.00**	Most - least	-3.48**	-3.19**	Most - least	-3.68**	-3.43**
	(-2.64)	(-2.71)		(-3.00)	(-2.76)		(-3.01)	(-2.86)
Hold for 6 months			Hold for 6 months			Hold for 6 months		
Least overpriced	10.10**	4.51**	Least overpriced	10.08**	4.52**	Least overpriced	9.82**	4.30**
	(3.62)	(3.75)		(3.65)	(3.77)		(3.57)	(3.65)
Most overpriced	6.85**	1.64	Most overpriced	6.68*	1.52	Most overpriced	6.23*	1.10
	(2.64)	(1.48)		(2.55)	(1.34)		(2.38)	(0.99)
Most - least	-3.24**	-2.87**	Most - least	-3.40**	-3.00**	Most - least	-3.59**	-3.20**
	(-2.87)	(-2.83)		(-3.20)	(-2.84)		(-3.19)	(-2.89)
Hold for 12 months			Hold for 12 months			Hold for 12 months		
Least overpriced	9.57**	3.94**	Least overpriced	9.46**	3.83**	Least overpriced	9.12**	3.49**
	(3.47)	(3.38)		(3.45)	(3.32)		(3.33)	(3.06)
Most overpriced	6.90*	1.66	Most overpriced	6.72*	1.50	Most overpriced	6.45*	1.26
	(2.58)	(1.47)		(2.49)	(1.30)		(2.37)	(1.11)
Most - least	-2.67*	-2.28*	Most - least	-2.73*	-2.33*	Most - least	-2.67*	-2.23*
	(-2.50)	(-2.47)		(-2.60)	(-2.44)		(-2.50)	(-2.30)
Hold for 24 months			Hold for 24 months			Hold for 24 months		
Least overpriced	9.27**	3.81**	Least overpriced	9.11**	3.66**	Least overpriced	8.84**	3.37**
	(3.47)	(3.48)		(3.44)	(3.39)		(3.33)	(3.12)
Most overpriced	7.42**	2.05	Most overpriced	7.22**	1.85	Most overpriced	6.97*	1.58
	(2.73)	(1.86)		(2.63)	(1.67)		(2.50)	(1.38)
Most - least	-1.84*	-1.76*	Most - least	-1.90*	-1.80*	Most - least	-1.86	-1.79*
	(-2.01)	(-2.23)		(-2.02)	(-2.21)		(-1.95)	(-2.10)
Hold for 36 months			Hold for 36 months			Hold for 36 months		
Least overpriced	9.35**	3.86**	Least overpriced	9.18**	3.71**	Least overpriced	9.21**	3.71**
	(3.52)	(3.62)		(3.48)	(3.50)		(3.49)	(3.49)
Most overpriced	7.45**	2.08	Most overpriced	7.33**	1.95	Most overpriced	7.15*	1.76
	(2.78)	(1.96)		(2.70)	(1.80)		(2.58)	(1.58)
Most - least	-1.90*	-1.78**	Most - least	-1.85*	-1.76**	Most - least	-2.06**	-1.95**
	(-2.59)	(-2.78)		(-2.52)	(-2.66)		(-2.71)	(-2.73)

Table 8
Robustness tests

This table reports portfolio sort analysis of fund performance measured by hedge fund excess return and hedge fund alpha with different adjustments. t the beginning of each quarter, hedge funds are sorted into quintiles based on their overpricing level in previous quarter. Portfolio "Least overpriced" is the portfolio of hedge funds holding least overpriced stocks in previous quarter. Portfolio "Most ovepriced" is the portfolio of hedge funds holding most overpriced stocks in previous quarter. Panel A reports results adjusted for backfill bias by removing the return observations before fund listing date. Panel B reports results after unsmoothing returns using the Getmansky, Lo, and Makarov (2004) algorithm. Panel C reports results after adding back fees to form pre-fee returns. Panel D uses the Fung and Hsieh (2004) model augmented with the MSCI Emerging Market Index excess return. Panel E uses the Fung and Hsieh (2004) model augmented with the Agarwal and Naik (2004) out-of-the money call and put option factors. Panel F uses the Fung and Hsieh (2004) model augmented with the Pastor and Stambaugh (2003) liquidity factor. Panel G adjusts for fund termination by assuming that a fund delivers a minus ten percent return during the month that it drops out of the database. Panels H and I report results for two sub-sample periods: January 1998 to December 2005 and January 2006 to December 2013, respectively. * Significant at the 5% level; ** Significant at the 1% level.

Portfolio	Excess Return (pct / year)	Alpha (pct / year)
Panel A: Adjusted for backfill bias		
Least overpriced	9.85**	4.24**
	(3.44)	(3.30)
Most overpriced	5.94*	0.63
	(2.17)	(0.52)
Most - least	-3.91**	-3.61**
	(-2.92)	(-2.88)
Panel B: Adjusted for serial correlation		
Least overpriced	7.65**	4.40**
	(2.67)	(3.06)
Most overpriced	4.38	1.40
	(1.64)	(1.11)
Most - least	-3.26**	-3.00*
	(-2.64)	(-2.29)
Panel C: Pre-fee returns		
Least overpriced	10.96**	5.22**
	(3.64)	(3.67)
Most overpriced	7.90**	2.49
	(2.93)	(1.84)
Most - least	-3.06*	-2.73*
	(-2.09)	(-2.14)
Panel D: Fung and Hsieh (2004) model augmented with an emerging markets equity factor		
Least overpriced	9.94**	4.09**
	(3.48)	(3.49)
Most overpriced	6.68*	1.12
	(2.50)	(1.02)
Most - least	-3.26**	-2.98**
	(-2.64)	(-2.68)
Panel E: Fung and Hsieh (2004) model augmented with the Agarwal and Naik (2004) out-of-the money call and put option factors		
Least overpriced	9.94**	5.17**
	(3.48)	(2.78)
Most overpriced	6.68*	1.33
	(2.50)	(0.69)
Most - least	-3.26**	-3.85*
	(-2.64)	(-2.26)
Panel F: Fung and Hsieh (2004) model augmented with the Pastor and Stambaugh (2003) liquidity factor		
Least overpriced	9.94**	5.45**
	(3.48)	(4.33)
Most overpriced	6.68*	2.77*
	(2.50)	(2.40)
Most - least	-3.26**	-2.68*
	(-2.64)	(-2.28)
Panel G: Adjusted for fund termination		
Least overpriced	9.88**	4.34**
	(3.48)	(3.45)
Most overpriced	6.44*	1.19
	(2.43)	(1.02)
Most - least	-3.44**	-3.15**
	(-2.78)	(-2.86)
Panel H: Sub-sample analysis (January 1994 - December 2003)		
Least overpriced	11.80**	5.90**
	(3.10)	(3.29)
Most overpriced	7.29*	1.58
	(2.06)	(0.97)
Most - least	-4.51	-4.32*
	(-1.94)	(-2.10)
Panel I: Sub-sample analysis (January 2004 - December 2013)		
Least overpriced	8.09	3.98**
	(1.91)	(3.00)
Most overpriced	6.07	1.75
	(1.52)	(1.30)
Most - least	-2.01**	-2.24**
	(-2.68)	(-3.21)

Chapter 3:

On the Performance of Hedge Funds Charging Zero Performance Fee

Lin Sun

Abstract:

Hedge funds charging zero performance fee significantly underperform hedge funds charging non-zero performance fee by 3.79% per annual. Hedge funds charging zero performance fee take higher systematic risk, invest less distinctively relative to their peers, and implement more scalable strategies. The presence of a performance fee increases the flow-performance sensitivity in both the low performance and high performance terciles.

3.1. Introduction

Hedge fund asset has grown rapidly in recent twenty years; the asset under management (AUM) is close US$ 3 trillion mark[32]. Unlike the evidence in mutual fund industry, numerous hedge fund researches have shown that hedge fund managers are able to deliver positive risk adjusted return[33]. In asset management industry, hedge fund industry always attracts the best talents. They are also more expensive than mutual fund managers. A typical hedge fund charges: 1. a 2% management fee on fund AUM; 2. a 20% performance fee on the profit earned if the fund return hit the hurdle rate and high water mark. Numerous evidences show that this convex compensation scheme is more complex than I was expected. It not only incentivizes managers to deliver better performance, but also motivates them to take higher risk and engage in more frauds. However none of the previous research has looked at an important group of the hedge funds – hedge funds charging zero performance fee. In this paper, I will investigate the performance, risk taking, investment styles, and investor's reaction of this group of hedge funds. This unique setting enables me to separate performance fee and management fee from the convex compensation scheme. The performance and investment behavior will give us better understanding the role of performance fee in the industry.

Zero performance fee hedge funds are an interesting group of hedge funds for investigating the role of performance fee in this industry. As a boundary condition, zero performance fee contracts separate the performance fee and management fee. Under the zero performance fee contracts, hedge fund managers can only live on the management fee. Their incentive is similar to that of mutual fund industry. Fund managers try to deliver good

[32] See, "Hedge-Fund Assets Below $3 Trillion for First Time Since 2014" Bloomberg, 26 Feb 2016
[33] See Brown, Goetzmann, and Ibbotson (1999), Ackermann, McEnally, and Ravenscraft (1999), Liang (1999), Agarwal and Naik (2000a, b, c), Fung and Hsieh (2004), Kosowski, Naik, and Teo (2007), and Fung, Hsieh, Naik, and Ramadorai (2008).

performance to attract more capital inflows. I conduct a portfolio sort analysis on whether hedge funds charging performance fee. Consist to the previous literature, I find that less incentivized zero performance fee hedge funds underperform better incentivized non-zero performance fee funds by 3.87% per annual on risk adjusted basis. The results are not confined to the smallest funds in my sample and cannot be explained by differences in fund age (Aggarwal and Jorion, 2010), fund size (Berk and Green, 2004), and return smoothing behavior (Getmansky et al. 2004).

Why do zero performance fee hedge funds underperform their peers so much? How does the investment behavior of zero performance fee hedge funds different from non-zero performance fee hedge funds? To answer these questions, I investigate their systematic risk taking (Titman and Tiu (2011)), and strategy distinctiveness of the fund (Sun et al. (2012)). Consistent with my conjecture, zero performance fee hedge funds are taking higher systematic risk and investing less distinctive from their peers.

How do investors react upon the recent fund performance in absence of performance fee? Sirri and Tuffano (1998) and Chevalier and Ellison (1997) find a convex flow performance relationship in mutual fund industry. As discussed in Getmansky et al. (2015) survey paper, A lot of studies show that investor fund flow has a positive relationship with past fund performance and managerial incentives. Similar with mutual fund investors, hedge fund investors are chasing positive returns and flee from negative returns (Goetzmann, et al. (2003), Baquero and Verbeek (2009), and Getmansky, et al. (2015)). However the flow performance relationship is more complex than in the mutual fund industry. In their discussion, common hedge funds characteristics (share restriction, minimum investment, lock-up period, capacity constraints, asset illiquidity and etc.) may have important impact on hedge funds flows. In this study, I am able to investigate the role of performance fee on hedge fund flow. My finding suggests that zero performance fee hedge fund investors are

generally less sensitive to recent performance than non-zero performance fee fund investors. They are stickier with recent poor performers, and less likely to chase after the recent star performers.

The most related paper of this study is the work by Agarwal et al. (2009). They study a special group of mutual funds implementing hedge fund strategy, which they call "hedged mutual fund". They compare this group of hedge funds with traditional mutual funds and hedge funds. The performance of hedged mutual funds falls between the traditional mutual funds and hedge funds. They attribute the outperformance of hedged mutual funds to traditional mutual funds to the flexible investment strategies, and the outperformance of hedge funds to hedged mutual funds to the lighter regulation and better incentives. My setting is different from their works in three ways: 1. My sample consists of funds offered by hedge fund management companies other than mutual fund companies. 2. By looking at the performance fee hedge funds, I am able to role of performance fee in motivating hedge funds managers. 3. My samples of hedge funds enable me to study the fund flow and return relationship among professional hedge fund investors.

Results in this paper contribute to the literature in three ways. First, this paper shows that zero performance fee hedge funds underperform, which zero management fee hedge funds outperform. This result suggests that performance fee plays a more important role than management fee to motivate the hedge fund manager to perform well. Second, zero performance fee hedge funds bet on higher systematic risk and invest less distinct from their peers. This suggests that hedge fund managers invest in a passive manner in absence of performance fee. Finally, zero performance fee fund investors are less sensitive to recent poor and superior performance. In the absence of performance fee, fund investors are more likely to flee away from recent poor performance, and more likely to chase after the recent superior performance.

The remainder of this paper is organized as follows: Section 2 describes the data and methodology. Section 3 reports the results from the empirical analysis while Section 4 presents a myriad of robustness tests. Section 5 concludes.

3.2. Data and methodology

I evaluate the impact of hedge funds using monthly net–of–fee returns and assets under management data of live and dead hedge funds reported in the TASS, HFR, and BarclayHedge datasets from January 1994 to December 2013. Because TASS, HFR, and BarclayHedge started distributing their data in 1994, the data sets do not contain information on funds that died before January 1994. This gives rise to survivorship bias. To mitigate this bias, I only focus on data from January 1994 onward.

I merge the data for hedge funds from three hedge fund databases: TASS, HFR, and BarclayHedge. First, I match hedge funds by their names. Second, I identify multiple share classes whose pairwise monthly return correlations are more than 0.99. Since multiple share classes may cloud my analysis, I exclude multiple share classes by keeping the funds based on the following priority rule: (i) longest return series, (ii) largest AUM, (iii) USD share class, and (iv) onshore share class. My sample has a total of 16,633 hedge funds, 5,745 of which are live funds and 10,888 of which are dead funds at the end of my sample.

Following Agarwal, Daniel, and Naik (2009), I classify funds into four broad investment styles: Security Selection, Multi–process, Directional Trader, and Relative Value. Security Selection funds take long and short positions in undervalued and overvalued securities, respectively, and reduce systematic risks in the process. Usually, they take positions in equity markets. Multi–process funds employ multiple strategies that take

advantage of opportunities created by significant transactional events, such as spin–offs, mergers and acquisitions, bankruptcy reorganizations, recapitalizations, and share buybacks. Directional Trader funds bet on the direction of market prices of currencies, commodities, equities, and bonds in the futures and cash market. Relative Value funds take positions on spread relations between prices of financial assets and aim to minimize market exposure.

Table 1 provides summary statistics on the number of management companies as well as the number of funds and the size of the assets that they manage for zero performance fee hedge funds and non-zero performance fee hedge funds. While there is a decreasing market share of zero performance fee hedge funds, it remains a significant market share of 14% of total asset under management in my sample.

[Insert Table 1 here]

Throughout this paper, I model the risks of hedge funds using the Fung and Hsieh (2004) seven–factor model. The Fung and Hsieh factors are the excess return on the Standard and Poor's (S&P) 500 index (SNPMRF); a small minus big factor (SCMLC) constructed as the difference between the Russell 2000 and the Standard and Poor's (S&P) 500 indices; the yield spread of the US ten–year Treasury bond over the three–month Treasury bill, adjusted for duration of the ten–year bond (BD10RET); the change in the credit spread of Moody's BAA bond over the ten–year Treasury bond, also appropriately adjusted for duration (BAAMTSY); and the excess returns on portfolios of look back straddle options on currencies (PTFSFX), commodities (PTFSCOM), and bonds (PTFSBD), which are constructed to replicate the maximum possible return from trend following strategies (see Fung and Hsieh, 2001) on their respective underlying assets. These seven factors have been shown by Fung and Hsieh (2004) to have considerable explanatory power on hedge fund returns

3.3. Empirical analysis

3.3.1. Tests of fund performance

To begin, I test for differences in risk–adjusted performance between hedge funds charging zero performance fee and hedge funds change non-zero performance fee. Every month, starting in January 1994, two hedge fund portfolios are formed based on whether they are charging performance fee. The post–formation returns on these two portfolios are linked across months to form a single return series for each portfolio. I then evaluate the performance of the portfolios relative to the Fung and Hsieh (2004) model.

The results, reported in Panel A of Table 2, reveal substantial differences in expected returns, on the portfolios sorted by whether hedge funds charging performance fee, that are unexplained by the Fung and Hsieh (2004) seven factors. Hedge funds not charging performance fee underperform those charging performance fee by an economically and statistically significant 2.36 percent per year (*t*–statistic = 3.04). As in the rest of the paper, I base statistical inferences on White (1980) heteroskedasticity–consistent standard errors. After adjusting for co–variation with the factors from the Fung and Hsieh (2004) model, the spread increases to 3.79 percent per year (*t*–statistic = 7.10). Since hedge funds with investor capital below US$20m may not be relevant to large institutional investors, I also conduct the portfolio sort on the sample of hedge funds with at least US$20m of AUM. The results reported in Panel B of Table 2 indicate that my findings are not driven by the smallest funds in the sample. To address the concern that different manager's ability, I conduct another portfolio sort analysis for hedge funds charging performance fee and not charging performance fee under same management company. The risk adjusted spread remains significant at -2.43% per year (*t*-statistic = 2.72).

[Insert Table 2 and Fig 1 here]

Figure 1 complements the results from Panel A of Table 2. It illustrates the monthly cumulative average residuals (henceforth CARs) from the portfolio of funds charge zero performance fee (portfolio A) and the portfolio of funds charge non-zero performance fee (portfolio B). CAR is the cumulative difference between a portfolio's excess return and its factor loadings (estimated over the entire sample period) multiplied by the Fung and Hsieh (2004) risk factors. The CARs in Figure 1 indicate that portfolio A consistently underperforms portfolio B over the entire sample period and suggest that the underperformance of funds not charging performance fee is not peculiar to a particular year.

To further test the performance difference between funds managed by zero performance fee hedge funds and non-zero performance fee hedge funds, I estimate the following pooled OLS regression:

$$ALPHA_{im} = a + bZEROPERFFEE + cMGTFEE_i + dNOTICE_i + eMININV_i + f\log(SIZE_{im-1}) + gAGE_{im} + \sum_k p^k STYLEDUM_i^k + \sum_l p^l YEARDUM_i^l + \varepsilon_{im}, \quad (1)$$

where *ALPHA* is fund monthly abnormal return after stripping away co–variation with the Fung and Hsieh (2004) seven factors, *ZEROPERFFEE* is an indicator variable that takes a value of one if the hedge fund is charging performance fee and a value of zero otherwise, *MGTFEE* is fund management fee in percentage, *NOTICE* is fund redemption notification period in months, *MININV* is fund minimum investment in millions of US$, *SIZE* is fund monthly AUM in millions of US$, *AGE* is fund age in decades, *STYLEDUM* is fund style dummy, and *YEARDUM* is year dummy. The log(*SIZE*) variable captures capacity constraints at the fund level (Berk and Green, 2004). *MGTFEE* captures the impact of fund incentives on managerial performance (Agarwal, Daniel, and Naik, 2009) while *NOTICE* caters for the

view expounded by Aragon (2007) that funds with longer redemption notification periods take on more liquidity risk and therefore harvest greater returns. I include *AGE* as a response to the Aggarwal and Jorion (2010) finding that younger funds outperform older funds. To facilitate the estimation of fund alpha, I only include results for funds with at least 24 months of return data. I also estimate the analogous regression on raw monthly fund returns to ensure that my findings are not an artifact of the risk adjustment methodology.

[Insert Table 3 here]

The results from the cross–sectional regression analysis are reported in columns one to four of Table 3. They corroborate the findings from the portfolio sorts and indicate that funds charge zero performance fee underperform those charge non-zero performance fee. Specifically, the coefficient estimate on *ZEROPERFFEE* in the alpha regression reported in column four of Table 2 indicates that, controlling for other factors that could explain fund performance, funds managed charge zero performance fee underperform funds charge non-zero performance fee by 2.10 percent per annum after adjusting for risk. The coefficient estimates on the control variables accord with the extant literature. Longer redemption notice periods (Aragon, 2007) is associated with superior performance while fund size (Berk and Green, 2004) and fund age (Aggarwal and Jorion, 2010) are linked to poorer performance. Inferences do not change when I estimate the regression on raw returns suggesting that my findings are not driven by my risk adjustment technology.

To check for robustness, I estimate Fama and MacBeth (1973) regressions in place of the OLS regressions. Specifically, first I run cross–sectional regressions for each month. Then, I report the time–series averages of the coefficient estimates, and use the time–series standard errors of the average slopes to draw inferences. The Fama and MacBeth regressions control for correlation in residuals across different firms within the same month. I compute

the standard errors using the method of Newey and West (1987) with a three–month lag to adjust for dependence across time. The Fama and MacBeth (1973) results reported in columns five to eight of Table 3 echo my previous findings and indicate that they are robust to alternative model specifications.

3.3.2. Investment styles and factor exposure

Given the convex compensation scheme in hedge funds industry, hedge fund manager may choose different investment styles given the existence of performance fee. The convex payoff structure may induce the hedge fund managers to increase their risk taking. Will hedge fund manager behavior differently in absence of incentive fee? I conduct a univariate analysis on fund investment styles and factor exposure to examine the difference investment behavior between hedge funds on whether they are charging performance fee.

I use three difference measures of investment styles and factor exposures: R-squared estimated from Fung and Hsieh (2004) 7 factor model, strategy distinctiveness index based on Sun, Wang, and Zheng (2012), and deviation of Fung and Hsieh 7 factor beta loading from the hedge fund strategy peers used in Lu, Ray, and Teo (2016). Some recent works examine the relationship between fund distinctiveness and performance. Titman and Tiu (2011) find that low R-squared funds have better performance than high R-squared funds measuring by Sharpe ratio, information ratio, and manipulation-proof performance. They argue that better-informed managers will choose less exposure to factor risk. In line with their findings, Sun, Wang, and Zheng (2012) examine the hedge fund's return distinctiveness with respective to its strategy peers. They find that those more distinct funds outperform. As a supplementary to the R-squared and strategy distinctiveness index, I calculate the hedge fund's sum of absolute Fung and Hsieh (2004) beta difference from its peers by following the work by Lu, Ray, and Teo (2016).

[Insert Table 4 here]

The results from the univariate analysis are presented in Table 4. The findings suggest that hedge fund charging zero performance fee have higher factor loadings, less distinctive from its peers. Specifically, hedge funds charging zero performance fee have 9% high R-squared, distinct 10% less, and deviate 3.7% less than hedge funds charging non-zero performance fee. All these results are statistically significant at 1% level.

3.3.3. Capacity constraint

Given the similar compensation scheme of mutual funds and hedge funds charging zero performance fees, I would expect that zero performance fee hedge fund would be less capacity constraint.

In this subsection, I explore the capacity constraint for zero performance fee hedge funds versus non-zero performance fee hedge funds. Following the intuition of Teo (2009) and Yin (2016), I test the relationship between hedge fund performance and hedge fund size. I divide the sample into two groups: hedge funds with zero performance fee and hedge funds with non-zero performance fee. For each group of hedge funds, I conduct the following regression hedge fund *ALPHA* on lagged *SIZE*, *SQUARESIZE,* and control variables used in Table 3:

$$ALPHA_{im} = a + bSIZE_{it-1} + cSQUARESIZE_{it-1} + dMGTFEE_i + eNOTICE_i + fMININV_i + gAGE_{im} + \sum_k p^k STYLEDUM_i^k + \sum_l p^l YEARDUM_i^l + \varepsilon_{im},$$

where *ALPHA* is fund monthly abnormal return after stripping away co–variation with the Fung and Hsieh (2004) seven factors, *SIZE* is the natural log of fund monthly AUM in millions of US$, *SQUARESIZE* is the square of *SIZE*, *MGTFEE* is fund management fee in percentage, *NOTICE* is fund redemption notification period in months, *MININV* is fund

minimum investment in millions of US$, *AGE* is fund age in decades, *STYLEDUM* is fund style dummy, and *YEARDUM* is year dummy.

[Insert Table 5 here]

The results are presented in Table 5. Consistent with my prediction, the zero performance fee hedge funds are not capacity constrained. The coefficient of *SIZE* for zero performance fee hedge funds is -0.5%, which is statistically insignificant. The result suggests that there is no diseconomy of scales of fund size and fund performance. However for non-zero performance fee hedge funds, the coefficient for *SIZE* is -1.6%, which is statistically significant at 1% level. Consistent with Teo (2009) and Yin (2016), the result suggests that there is a diseconomy of scale for hedge fund size on performance. In an unreported test, I also found that zero performance fee hedge funds charge lower management fee, require smaller initial investment and shorter redemption notice period. All these results are suggesting that non-zero performance fee hedge funds are offering more scalable strategies and more favorable terms to attract capital.

3.3.4. Investor flow and past performance

Earlier results show that hedge fund managers behavior differently in terms of investment style in absence of performance fee. Does investor behavior differently in absence of performance fee? To answer this question, I conduct fund flow analysis at quarterly frequency.

As discussed in earlier section, hedge fund flow often exhibits a non-linear relationship with past performance. The quarterly fund net flow is defined as follow:

$$FUNDFLOW_{it} = \frac{ASSET_{it} - ASSET_{it-1}(1 + r_{it})}{ASSET_{it-1}}.$$

Following the work by Sirri and Tufano (1998), Getmansky, Liang, Schwarz, and Wermers (2015), I first sort the hedge fund past quarter return into a fractional rank $FRANK_{it}$ from 0 to 1, and then I created three tercile ranks as follows:

$$LOWPERFORMANCE_{it} = MIN\left(\frac{1}{3}, FRANK_{it}\right)$$

$$MIDPERFORMANCE_{it} = MIN\left(\frac{1}{3}, FRANK_{it} - LOWPERFORMANCE_{it}\right)$$

$$HIGHPERFORMANCE_{it} = MIN(\frac{1}{3}\ ,$$
$$FRANK_{it}\ -\ LOWPERFORMANCE_{it}\ -MIDPERFORMANCE_{it}).$$

To test the marginal effect of performance fee on fund flow and return sensitivity, I interact each of the three variables with the ZEROPERFFEE dummy defined in the earlier section. To avoid the outliers, I winsorize the top one percent of the fund flow. The following regression is the then conducted:

$$FUNFLOW_{it} = a + b_1 LOWPERFORMANCE_{it} + b_2 MIDPERFORMANCE_{it} +$$
$$b_3 HIGHPERFORMANCE_{it} + c_1 LOWPERFORMANCE_{it} *$$
$$ZEROPERFFEE + c_2 MIDPERFORMANCE_{it} * ZEROPERFFEE +$$
$$c_3 HIGHPERFORMANCE_{it} * ZEROPERFFEE + dZEROPERFFEE +$$
$$eMGTFEE_i + fFUNFLOW_{it-1} + gFUNFLOWSTRAT_{it} + hAGE_{im} +$$
$$i\log(SIZE_{im-1})d + jTOTALREDEMPTION_i + kMININV_i + lONSHORE +$$
$$mHWM + nSTDRET + \sum_k p^k STYLEDUM_i^k + \sum_l p^l YEARDUM_i^l + \varepsilon_{im}. \quad (3)$$

All of the variables are already defined in the section 3.1 and section 3.2.

[Insert Table 6 here]

Results are presented in Table 6. The findings suggest that the fund flow performance relationship is convex with the presence of performance fee. All the coefficients are highly significant at 1% level. When the performance fee is removed (ZEROPERFFEE = 1), then flow performance relationship becomes an S shape. The negative and significant on $LOWPERFORMANCE_{it} * ZEROPERFFEE$ indicates that the zero performance fee hedge fund investors are less sensitive to recent poor performance, which suggests that they are less likely to flee away from recent poor performance. Similarly, the negative and significant on $HIGHPERFORMANCE_{it} * ZEROPERFFEE$ indicates that the zero performance fee hedge fund investors are less sensitive to recent good performance, which suggests that they are less likely to chase recent good performance.

3.4. Robustness tests

In this section, I present a battery of robustness tests to ascertain the strength of my empirical results.

3.4.1. Backfill bias

Funds charge non-zero performance fee may backfill their returns more often than funds charge zero performance fee. In response to concerns about backfill bias raised by Bhardwaj, Gorton, and Rouwenhorst (2014) and others, I confine the analysis to TASS and HFR funds for which I have the date that the fund listed on the databases (only TASS and HFR provide this information). Next, I redo the baseline Table 2 portfolio sort for this subset of funds and for those returns at or after the respective fund listing date. As there are not enough funds with returns post-listing in the cross-section during the earlier years, I perform the analysis for the period after 1996. As shown in Panel A of Table 7, my inferences remain

unchanged when I control for backfill bias in this fashion. The portfolio alpha spread remains economically meaningful and statistically significant at the one percent level with this adjustment.

[Insert Table 7 here]

3.4.2. Serial correlation

Serial correlation in fund returns could arise from linear interpolation of prices for infrequently traded securities, the use of smoothed broker dealer quotes, or in some cases, deliberate performance-smoothing behavior. This could inflate some of the test statistics that I use to make inferences from the sort results. To allay such concerns, I unsmooth fund returns using the algorithm of Getmansky, Lo, and Makarov (2004) and redo the Table 2 portfolio sort. The results reported in Panel B of Table 7 indicate that my findings are not driven by serial correlation in fund returns.

3.4.3. Pre-fee returns

Hedge fund returns are reported net of fees in the commercial databases. One concern is that the fee structure may affect hedge fund performance. To allay this concern, I calculate fund performance and management fee using the algorithm outlined in Appendix A of Agarwal, Daniel, and Naik (2009), and back out pre-fee fund returns. As shown in Panel C of Table 7, the baseline portfolio sort spreads are even greater when I analyze pre-fee fund returns.

3.4.4. Dynamic risk exposures

One concern is that the beta loadings of the fund portfolios might not stay constant over time. As a result, the risk-adjustment for the portfolio sorts may not be accurate. To

account for dynamic factor loadings, I calculate the factor loadings using a rolling 24-month window and use those factor loadings to calculate abnormal returns one month forward. The results from the risk exposures calculated using the rolling window approach are presented in Panel D of Table 7. They indicate that my findings are robust to catering for dynamic risk exposures.

3.4.5. Omitted risk factors

The presence of additional risk factors could cloud the portfolio sort analysis. Relative to funds managed by listed firms, those managed by unlisted firms could be loading up more on some risk factor (e.g., emerging markets) that did well over the sample period. This could explain why there is a return spread between funds managed by unlisted firms and those managed by listed firms. Hence, I augment the Fung and Hsieh (2004) model with an emerging markets factor derived from the MSCI Emerging Markets Index return and redo the Table 2 sort. To cater for hedge fund exposure to option based strategies (Mitchell and Pulvino, 2001), I also augment the Fung and Hsieh (2004) model with the out-of-the-money S&P 500 call and put option-based factors from the Agarwal and Naik (2004) model.[34] Finally, to account for hedge fund exposure to liquidity risk (Teo, 2011; Aragon and Strahan, 2012; Sadka, 2012), I augment the Fung and Hsieh model with the Pástor and Stambaugh (2003) liquidity factor. The results presented in Panels E, F, and G of Table 7 indicate that my baseline results are not driven by the presence of omitted risk factors.

3.4.6. Fund termination

There are concerns that because funds that drop out from the database could have terminated their operations, the portfolio alphas are biased upward. To allay such concerns, I

[34] I am grateful to Vikas Agarwal for supplying these factors.

assume that, for the month after a fund drops out of the database, its return is -10 percent. Thereafter, money is reallocated to the remaining funds in the portfolio. As shown in Panel H of Table 7, with that adjustment for fund termination, the alphas of the portfolios in the baseline sort fall but the spread remains economically and statistically significant. I also experimented with more extreme termination returns of -20 percent and -30 percent, and obtain qualitatively similar results. These findings suggest that the baseline results are robust to the self-reporting and delisting biases inherent in hedge fund data.

3.4.7. Subsample analysis

To understand how the underperformance of funds charging zero performance fee varies over time, I split the sample period into two subperiods: January 1994 to December 2003 and January 2004 to December 2013. Next I redo the Table 2 portfolio sort analysis for each subperiod. The results reported in Panels I and J of Table 7 indicate that funds managed by listed firms underperform those managed by unlisted firms in both subperiods. The risk-adjusted performance spread is largely unchanged when I go from the earlier subperiod to the later subperiod. Moreover, both spreads are statistically significant at the one percent level.

3.5. Conclusion

This paper studies a unique group of hedge funds – hedge funds that charging zero performance fees. First, I show that hedge funds charging zero performance significantly underperform the hedge funds charging non-zero performance fee. Second, hedge funds charging zero performance fee have higher systematic risk and less distinct from industry peers. Third, hedge funds charging zero performance are implementing more scalable strategies and offering more favorable terms. Last, zero performance fee hedge fund investors

are less sensitive to recent poor and superior performance, which exhibit a convex then concave fund flow and return relationship. There results contribute our understanding of the role of hedge fund performance fee on the investment performance, styles and investor reactions.

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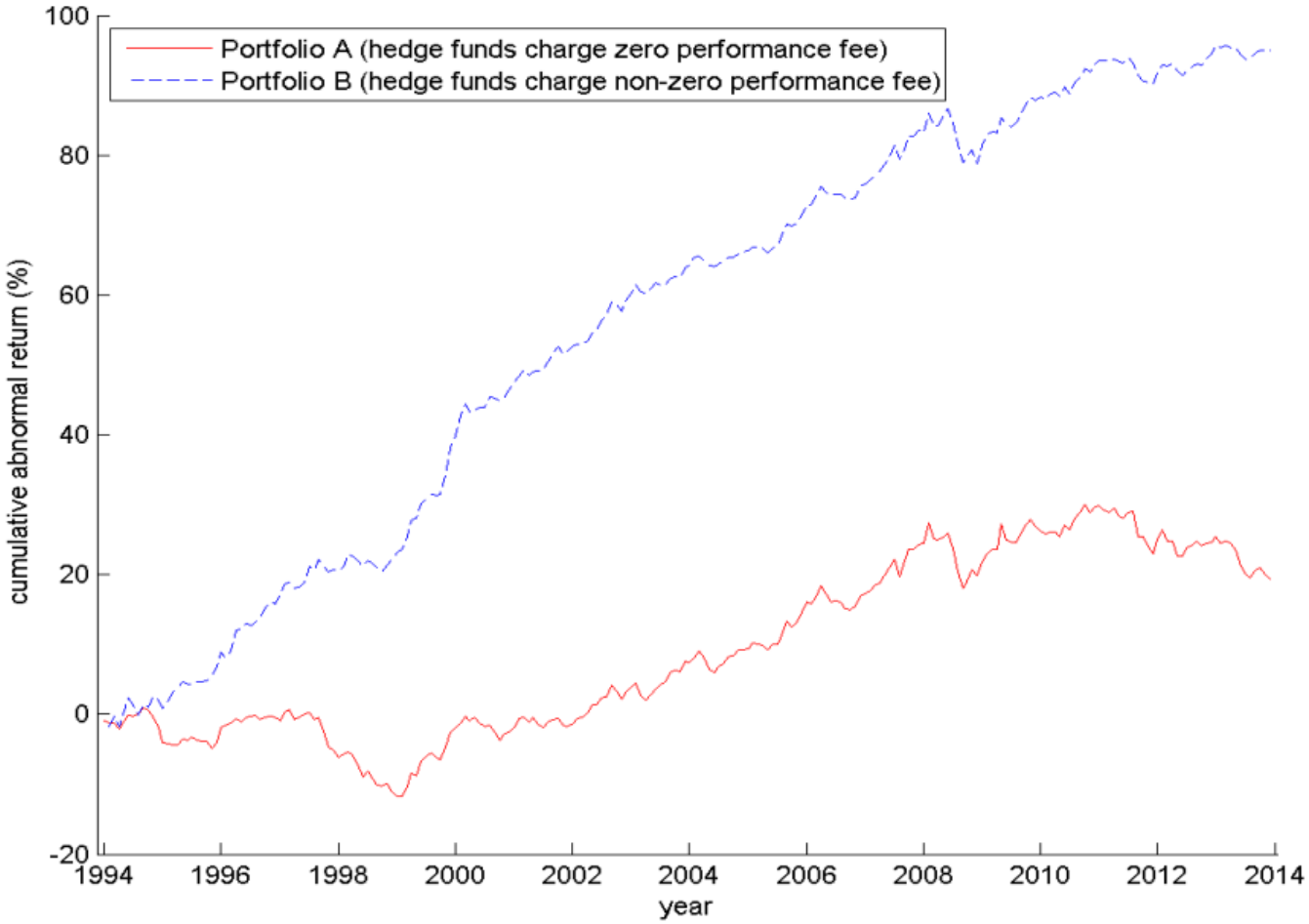

Fig 1. Cumulative abnormal return of hedge funds charge zero performance fee versus hedge funds charge non-zero performance fee. Equal-weighted portfolios of hedge funds are constructed by sorting funds based on whether they are charging performance fee. Cumulative abnormal return is the difference between a portfolio's excess return and its factor loadings multiplied by the Fung and Hsieh (2004) risk factors. Factor loadings are estimated over the entire sample period. The sample period is from January 1994 to December 2013.

Table 1

Summary statistics

This table reports the number hedge funds and the size of hedge fund assets for hedge funds having zero and non-zero performance fee. The sample period is from January 1994 to December 2013.

	Zero performance fee			Non-zero performance fee		
Year	Number of management companies	Number of hedge funds	Total AUM (US$m)	Number of management companies	Number of hedge funds	Total AUM (US$m)
1994	84	115	$12,281	723	1,062	$48,078
1995	99	143	$13,702	825	1,290	$60,890
1996	113	163	$15,707	1,010	1,609	$77,762
1997	124	175	$22,001	1,178	1,932	$120,680
1998	124	180	$22,651	1,313	2,176	$128,415
1999	124	181	$23,983	1,475	2,407	$176,595
2000	117	177	$18,737	1,512	2,521	$194,712
2001	111	171	$22,480	1,603	2,748	$233,860
2002	95	141	$21,299	1,705	2,933	$266,258
2003	112	165	$29,872	1,887	3,330	$388,615
2004	131	193	$39,070	2,086	3,778	$559,136
2005	138	204	$43,855	2,264	4,149	$598,424
2006	158	240	$46,969	2,350	4,278	$816,698
2007	173	256	$51,709	2,370	4,334	$1,015,016
2008	168	229	$34,498	2,182	3,791	$711,809
2009	160	233	$47,017	2,100	3,508	$686,229
2010	155	232	$69,374	1,969	3,247	$745,850
2011	154	250	$80,926	1,777	2,857	$759,884
2012	182	306	$112,181	1,900	3,121	$835,355
2013	172	290	$141,209	1,805	2,945	$892,940

Table 2

Portfolio sorts on hedge fund performance fee level

On every January, hedge funds are sorted into two groups based on whether they are charging performance fee. Portfolio A is the portfolio of hedge funds charge zero performance fee. Portfolio B is the portfolio of hedge funds charge posititve performance fee. In Panel A, I report the results for the full sample of hedge funds. In Panel B, I report the results for hedge funds with AUM greater than US$20 million. Hedge fund portfolio performance is estimated relative to the Fung and Hsieh (2004) factors. In Panel C, I compare the performance of zero and non-zero performance fee hedge funds managed by same management company. Hedge fund portfolio performance is estimated relative to the Fung and Hsieh (2004) factors. The Fung and Hsieh (2004) factors are S&P 500 return minus risk free rate (SNPMRF), Russell 2000 return minus S&P 500 return (SCMLC), change in the constant maturity yield of the U.S. 10-year Treasury bond appropriately adjusted for the duration (BD10RET), change in the spread of Moody's BAA bond over 10-year Treasury bond appropriately adjusted for duration (BAAMTSY), bond PTFS (PTFSBD), currency PTFS (PTFSFX), and commodities PTFS (PTFSCOM). The sample period is from January 1994 to December 2013. The t-statistics, derived from White (1980) standard errors, are in parentheses. * Significant at the 5% level; ** Significant at the 1% level.

Portfolio	Excess Return (pct / year)	Alpha (pct / year)	SNPMRF	SCMLC	BD10RET	BAAMTSY	PTFSBD	PTFSFX	PTFSCOM	Adj. R2
Panel A: All hedge funds										
Portfolio A: (hedge funds charge zero performance fee)	4.87*	0.97	0.39**	0.18**	0.07*	0.25**	-0.01	0.01	0.00	0.78
	(2.32)	(1.12)	(21.40)	(8.12)	(2.13)	(6.19)	(-1.49)	(1.94)	(0.51)	
Portfolio B: (hedge funds charge non-zero performance fee)	7.23**	4.75**	0.25**	0.16**	0.03	0.20**	0.00	0.01**	0.01	0.66
	(4.47)	(5.85)	(15.05)	(7.86)	(0.99)	(5.19)	(-0.34)	(3.60)	(1.86)	
Spread portfolio (A - B)	-2.36**	-3.79**	0.13**	0.02	0.04	0.05*	-0.01	-0.01*	-0.01*	0.53
	(-3.04)	(-7.10)	(11.84)	(1.22)	(1.95)	(2.15)	(-1.91)	(-2.33)	(-1.99)	
Panel B: Hedge funds with AUM greater than US$20 million										
Portfolio A: (hedge funds charge zero performance fee)	4.01*	0.24	0.35**	0.15**	0.09**	0.26**	-0.01*	0.01	0.00	0.76
	(2.04)	(0.28)	(19.81)	(7.00)	(2.61)	(6.54)	(-2.22)	(1.32)	(0.77)	
Portfolio B: (hedge funds charge non-zero performance fee)	5.95**	3.42**	0.24**	0.17**	0.04	0.22**	-0.01	0.01**	0.01	0.65
	(3.61)	(4.17)	(14.05)	(8.04)	(1.15)	(5.63)	(-1.18)	(3.07)	(1.80)	
Spread portfolio (A - B)	-1.94**	-3.19**	0.11**	-0.02	0.05*	0.05	-0.01	-0.01*	-0.01	0.42
	(-2.99)	(-5.65)	(9.52)	(-1.11)	(2.27)	(1.71)	(-1.64)	(-2.47)	(-1.45)	
Panel C: Zero and non-zero performance fee hedge funds under same management company										
Portfolio A: (hedge funds charge zero performance fee)	4.92*	0.99	0.37**	0.18**	0.08*	0.29**	-0.01	0.01*	0.00	0.75
	(2.30)	(1.05)	(18.65)	(7.65)	(2.11)	(6.60)	(-1.76)	(2.15)	(0.06)	
Portfolio B: (hedge funds charge non-zero performance fee)	6.17**	3.42**	0.26**	0.15**	0.07	0.29**	0.00	0.03**	0.01	0.52
	(3.17)	(2.91)	(10.79)	(5.22)	(1.57)	(5.33)	(0.16)	(4.88)	(1.48)	
Spread portfolio (A - B)	-1.25	-2.43**	0.10**	0.03	0.01	0.00	-0.01*	-0.02**	-0.01	0.30
	(-1.16)	(-2.72)	(5.52)	(1.23)	(0.16)	(-0.02)	(-2.06)	(-4.12)	(-1.88)	

Table 3

Regressions on hedge fund performance

This table reports multivariate regression analysis of hedge fund performance. The dependent variables include hedge fund return and hedge fund alpha. Return is hedge fund monthly net-of-fee return. Alpha is Fung and Hsieh (2004) seven-factor monthly alpha for hedge funds where factor loadings are estimated over the last 24 months. The primary independent variable is the performance fee dummy (ZEROPERFFEE). It takes value of one if the hedge fund is charging zero performance fee, and zero otherwise. The other independent variables include hedge fund management fee (MGTFEE), redemption notice period in months (NOTICE), minimum investment in USD million (MININV), the natural logarithm of fund size (SIZE), fund age in decades (AGE) as well as dummy variables for year and fund investment strategy. The sample period spans January 1994 to December 2013. The t-statistics for the OLS regressions are derived from White (1980) standard errors. Fama-MacBeth regression coefficients are the time series average of cross-sectional regression coefficients, with t-statistics derived from Newey and West (1987) standard errors. The adjusted R-squared is the average across all cross-sectional regressions. * Significant at the 5% level; ** Significant at the 1% level.

	OLS Regression				Fama-MacBeth (1973) Regression			
Independent variables	Return		Alpha		Return		Alpha	
ZEROPERFFEE	-0.158**	-0.104**	-0.182**	-0.175**	-0.196**	-0.129*	-0.155**	-0.178**
	(-6.29)	(-3.82)	(-5.97)	(-5.33)	(-3.04)	(-2.06)	(-2.64)	(-2.97)
MGTFEE (%)		0.051**		0.020		0.049		0.027
		(3.81)		(1.15)		(1.88)		(0.82)
NOTICE (months)		0.027**		0.008*		0.029**		0.012
		(9.88)		(2.29)		(3.32)		(1.68)
MININV (US$m)		0.000		0.001		0.006		0.006*
		(1.64)		(1.56)		(1.81)		(2.01)
SIZE		-0.069**		-0.011*		-0.085**		-0.008
		(-16.24)		(-2.04)		(-5.66)		(-0.55)
AGE (decades)		-0.153**		-0.090**		-0.188**		-0.147**
		(-10.02)		(-4.63)		(-3.33)		(-2.67)
year dummies	No	Yes	No	Yes	No	No	No	No
strategy dummies	No	Yes	No	Yes	No	Yes	No	Yes
Adj. R2	0.000	0.027	0.000	0.006	0.002	0.041	0.001	0.022
No. of observations	732,335	621,659	441,618	387,394	240	240	216	216

Table 4

Univariate analysis of hedge fund investment styles and factor exposure

This table reports univariate regression analysis of hedge fund investment styles on whether hedge funds charging performance fee. RSQUARED measures systematic factor exposure and is the R-squared from the regression of fund excess returns on the Fung and Hsieh (2004) 7 factors esimated using prior 24 months return. SDI is Sun, Wang, and Zheng (2012) "Strategy Distinctiveness Index", which measures distinctiveness of hedge fund's return relative to its peers. DEVIAEESTYLE measures the hedge fund's deviation from its investment styles, which is the sum of the absolute deviations of Fund and Hsieh (2004) 7 factors beta loadings from the hedge funds of same investment style. * Significant at the 5% level; ** Significant at the 1% level.

Variable	hedge funds charge zero performance fee	hedge funds charge non-zero performance fee	difference
RSQUARED	0.599	0.508	0.091** (64.38)
SDI	0.479	0.578	-0.099** (-49.51)
DEVIATESTYLE	1.709	1.775	-0.066** (-6.50)

Table 5

Fund performance and size relationship

This table reports OLS regression of hedge fund performance and size relationship. The dependent variable hedge fund monthly alpha. Alpha is Fung and Hsieh (2004) seven-factor monthly alpha for hedge funds where factor loadings are estimated over the last 24 months. SIZE is the natural logarithm of hedge fund AUM in USD million. SQUARESIZE is the square of SIZE. I also include other control variables, which are the same as in Table 3. All the independent variables are omitted for brevity. The sample period is from January 1994 to December 2013. * Significant at the 5% level; ** Significant at the 1% level.

	Intercept	SIZE	SQUARESIZE
hedge funds charge zero performance fee	-0.245	-0.005	
	(-0.54)	(-0.27)	
	-0.055	-0.108	0.012
	(-0.12)	(-1.68)	(1.90)
hedge funds charge non-zero performance fee	0.003	-0.016**	
	(0.03)	(-2.79)	
	-0.051	0.016	-0.004
	(-0.45)	(0.66)	(-1.50)

Table 6

Fund flow and performance relationship

This table reports results of Fama-MacBeth regression of hedge fund quarterly net flow on performance. The dependent variable (FUNDFLOW) is the hedge funds' quraterly fund flow. All the independent variables are taken from previous quarter end except for the current quarter strategy average fund flow (FUNDFLOWSTAT). The dependent variables are three terciles of performance (LOWPERFORMANCE, MIDPERFORMANCE and HIGHPERFORMANCE) at previous quarter. I also include their interaction terms with performance fee dummy (ZEROPERFFEE), which takes value of one if the hedge fund is charging zero performance fee, and zero otherwise. The other independent variables include hedge fund management fee (MGTFEE), previous quarter hedge fund flow (FUNDFLOWLAG), average fund flow for each strategy (FUNDFLOWSTRAT), fund age in decades (AGE), natural logarithm of fund size (SIZE), total redemption period (redemption plus advance notice priods, TOTALREDEMPTION), fund minimum investment in USD million (MININV), onshore dummy (ONSHORE), high water mark dummy (HWM), standard deviation of return of previous quarter (STDRET). The sample period is from January 1994 to December 2013. The coefficients are the time series average of cross-sectional regression coefficients, with t-statistics derived from Newey and West (1987) standard errors. * Significant at the 5% level; ** Significant at the 1% level.

Variables	Dependent variable = FUNDFLOW
LOWPERFORMANCE	0.150**
	(6.69)
MIDPERFORMANCE	0.229**
	(12.77)
HIGHPERFORMANCE	0.253**
	(10.49)
LOWPERFORMANCE * ZEROPERFFEE	-0.147**
	(-3.53)
MIDPERFORMANCE * ZEROPERFFEE	-0.025
	(-0.77)
HIGHPERFORMANCE * ZEROPERFFEE	-0.175**
	(-2.98)
ZEROPERFFEE	0.067**
	(6.33)
MGTFEE (%)	0.000
	(-0.12)
FUNDFLOWLAG	0.031**
	(6.23)
FUNDFLOWSTRAT	0.081**
	(3.92)
AGE (decades)	-0.070**
	(-14.47)
SIZE	-0.016**
	(-13.28)
TOTALREDEMPTION	0.000
	(1.37)
MININV (US$m)	0.002**
	(5.37)
ONSHORE	-0.009*
	(-2.17)
HWM	0.013**
	(4.80)
STDRET	-0.790**
	(-10.85)

Table 7
Robustness tests

This table reports portfolio sort analysis of fund performance measured by hedge fund excess return and hedge fund alpha with different adjustments. On every January, hedge funds are sorted into two groups based on whether they are charging performance fee. Portfolio A is the portfolio of hedge funds charge zero performance fee. Portfolio B is the portfolio of hedge funds charge posititve performance fee. Panel A reports results adjusted for backfill bias by removing the return observations before fund listing date. Panel B reports results after unsmoothing returns using the Getmansky, Lo, and Makarov (2004) algorithm. Panel C reports results after adding back fees to form pre-fee returns. Panel D reports results adjusted for dynamic risk exposures by using rolling 24-month prior return to calculate portfolio betas. Panel E uses the Fung and Hsieh (2004) model augmented with the MSCI Emerging Market Index excess return. Panel F uses the Fung and Hsieh (2004) model augmented with the Agarwal and Naik (2004) out-of-the money call and put option factors. Panel G uses the Fung and Hsieh (2004) model augmented with the Pastor and Stambaugh (2003) liquidity factor. Panel H adjusts for fund termination by assuming that a fund delivers a minus ten percent return during the month that it drops out of the database. Panels I and J report results for two sub-sample periods: January 1994 to December 2003 and January 2004 to December 2013, respectively. * Significant at the 5% level; ** Significant at the 1% level.

Portfolio	Excess Return (pct / year)	Alpha (pct / year)	Adj. R2
Panel A: Adjusted for backfill bias			
Portfolio A: (hedge funds charge zero performance fee)	3.02 (1.34)	-0.76 (-0.83)	0.79
Portfolio B: (hedge funds charge non-zero performance fee)	4.63* (2.34)	2.26 (1.91)	0.54
Spread portfolio (A - B)	-2.70** (-2.79)	-2.90** (-3.32)	0.06
Panel B: Adjusted for serial correlation			
Portfolio A: (hedge funds charge zero performance fee)	4.74* (2.39)	1.03 (1.14)	0.78
Portfolio B: (hedge funds charge non-zero performance fee)	6.90** (4.66)	4.63** (5.87)	0.66
Spread portfolio (A - B)	-2.16** (-2.90)	-3.60** (-6.80)	0.56
Panel C: Pre-fee returns			
Portfolio A: (hedge funds charge zero performance fee)	6.15** (3.01)	2.31** (2.68)	0.77
Portfolio B: (hedge funds charge non-zero performance fee)	9.07** (5.62)	6.58** (8.07)	0.66
Spread portfolio (A - B)	-2.92** (-3.89)	-4.27** (-7.76)	0.46
Panel D: Adjusted for dynamic risk exposures using 24-month rolling betas			
Portfolio A: (hedge funds charge zero performance fee)	5.02* (2.33)	0.88 (0.78)	n.a.
Portfolio B: (hedge funds charge non-zero performance fee)	7.15** (4.44)	4.37** (4.94)	n.a.
Spread portfolio (A - B)	-2.12** (-2.72)	-3.50** (-5.30)	n.a.
Panel E: Fung and Hsieh (2004) model augmented with an emerging markets equity factor			
Portfolio A: (hedge funds charge zero performance fee)	4.74* (2.39)	1.73** (3.01)	0.90
Portfolio B: (hedge funds charge non-zero performance fee)	6.90** (4.66)	5.06** (7.67)	0.74
Spread portfolio (A - B)	-2.16** (-2.90)	-3.32** (-7.44)	0.65
Panel F: Fung and Hsieh (2004) model augmented with the Agarwal and Naik (2004) out-of-the money call and put option factors			
Portfolio A: (hedge funds charge zero performance fee)	4.74* (2.39)	1.62 (1.67)	0.78
Portfolio B: (hedge funds charge non-zero performance fee)	6.90** (4.66)	5.20** (5.53)	0.64
Spread portfolio (A - B)	-2.16** (-2.90)	-3.58** (-5.85)	0.52
Panel G: Fung and Hsieh (2004) model augmented with the Pastor and Stambaugh (2003) liquidity factor			
Portfolio A: (hedge funds charge zero performance fee)	4.74* (2.39)	1.68 (1.86)	0.78
Portfolio B: (hedge funds charge non-zero performance fee)	6.90** (4.66)	5.34** (6.61)	0.66
Spread portfolio (A - B)	-2.16** (-2.90)	-3.66** (-6.71)	0.56
Panel H: Adjusted for fund termination			
Portfolio A: (hedge funds charge zero performance fee)	4.35* (2.18)	0.67 (0.80)	0.77
Portfolio B: (hedge funds charge non-zero performance fee)	6.42** (4.34)	4.17** (5.52)	0.66
Spread portfolio (A - B)	-2.07** (-2.73)	-3.50** (-6.94)	0.56
Panel I: Sub-sample analysis (January 1994 - December 2003)			
Portfolio A: (hedge funds charge zero performance fee)	4.07 (1.70)	0.81 (0.84)	0.81
Portfolio B: (hedge funds charge non-zero performance fee)	8.01** (4.29)	5.81** (5.68)	0.68
Spread portfolio (A - B)	-3.94** (-3.86)	-4.99** (-6.54)	0.51
Panel J: Sub-sample analysis (January 2004 - December 2013)			
Portfolio A: (hedge funds charge zero performance fee)	5.41 (1.71)	1.01 (0.71)	0.75
Portfolio B: (hedge funds charge non-zero performance fee)	5.79* (2.55)	3.35** (3.09)	0.69
Spread portfolio (A - B)	-0.39 (-0.39)	-2.34** (-4.01)	0.71