Skin or Skim? Inside Investment and Hedge Fund Performance*

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Abstract

Hedge fund managers contribute substantial personal capital, or "skin in the game," into their funds. While these allocations may better align incentives, managers may also strategically allocate their private capital in ways that negatively affect investors. We find that funds with more inside investment outperform other funds within the same family. However, this relationship is driven by managerial decisions to invest capital in their least-scalable strategies and restrict the entry of new outsider capital into these funds. Our results suggest that skin in the game may work as a rent-extraction mechanism at the expense of fund participation of outside investors.

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Of the $3 trillion in assets under management by hedge funds, $400 billion can be attributed to investments from *insiders*: i.e., general firm partners (GPs) and related parties. While this large allocation of insider capital can better align incentives between investors and hedge fund managers, regulators have also raised concerns that this element of insider "skin in the game" may have potentially adverse consequences.[1] Because insiders have superior private information, have discretion over which of their funds to invest in, and may subsequently alter the fund operations, managers with large personal stakes may choose actions which negatively affect their investors.

Using a Berk and Green (2004)-style model, we show that the strategic allocation of private capital can help hedge fund managers to raise earnings at the cost of capital participation by outside investors. Managers in our model face a tradeoff between the choice of earning returns on private capital against fee revenue levied on outside investors. This assumption is realistic, as we find empirically that returns on privately-invested capital are roughly as large for hedge fund managers as either management or performance fees (Figure I). When choosing where to allocate personal capital, managers internalize the fact that raising additional capital dilutes the fund's return due to decreasing returns to scale. (Previous papers assessing decreasing returns to scale include: Yin (2016), Ramadorai (2013), Getmansky (2012), and Teo (2009)). As a result, our model predicts that managers will invest their capital in their least-scalable strategies, and that they will operate these funds with greater insider capital at a smaller scale by restricting the entry of outside investors. In equilibrium, returns are higher for funds with more insider capital, but this increase comes at the cost of limited entry by outside investors.

We test three hypotheses predicted by our model: (1) hedge fund managers allocate their insider capital to their less-scalable strategies; (2) insiders will restrict access to outside investors in these funds; and (3) insider funds, as a consequence, outperform on a risk-adjusted basis.

[1] See Mary Jo White, SEC Chair, on Oct. 16, 2015: "Examiners observed that some hedge fund advisers may not be adequately disclosing conflicts related to advisers' proprietary funds and the personal accounts of their portfolio managers. Examiners saw, for example, advisers allocating profitable trades and investment opportunities to proprietary funds rather than client accounts in contravention of existing policies and procedures."

Firstly, we find evidence that insider capital is deployed to less-scalable funds. Funds with more insider capital are smaller: one additional percent of inside investment is associated with a fund that is smaller by $7–10 million. This result holds both unconditionally and *within*-firm. We also test the relationship between inside investment and fund scalability. Following the methodology employed by Yin (2016), which measures the decreasing return to scale by regressing style-adjusted returns against lagged assets, we find that funds with greater insider investment are also less scalable.

Secondly, we find that funds with greater insider capital are more likely to restrict outsider capital entry on both intensive and extensive margins. On the intensive margin, managers limit outsider inflows to the high-performing insider funds. On the extensive margin, insiders can strategically close capital access to outsiders entirely. The presence of funds closed to outside investors is a challenge for conventional models of delegated asset management, as managers are thus leaving money on the table by forgoing the management fees earned on additional capital. Instead, we find that such funds strongly outperform, delivering 2–4% additional excess returns yearly. Such strong performance suggests that outside investors are in fact rationed from fund participation. Notably, such funds closed to outside investors are disproportionately funded by inside capital.

Thirdly, we find that inside investment is an important predictor of excess returns when comparing different funds within firms. Our panel regression controls for the Fama and French (1992) and Carhart (1997) factors, as well as the seven factors set out in Fung and Hsieh (2004), at the fund level. An increase in inside investment by a standard deviation, within the same firm, is associated with an annualized excess returns of 1.26%. We confirm this finding in an event study that focuses on firms that create a second fund. In these cases, we find that the original fund outperforms when inside capital stays in this fund relative to when insiders move their capital to the newly-formed fund. These results suggest the possibility of "skimming" motives on the part of fund managers.

We rule out natural alternate explanations for our results. A chief concern of this paper is represented by the signaling issues associated with insider capital. We find that

funds with greater insider capital accept less, not more, outside capital—including in other funds that are part of their families—which is inconsistent with a story that emphasizes the role of inside investment as a signaling tool or marketing strategy. We also find that more intensive inside investment funds take on less leverage and do not have assets with worse liquidity properties nor exhibit greater tail risk—suggesting that these higher returns are not compensation for some alternate forms of risk. Although we cannot fully rule out the relationship between inside investment and other fund attributes, understanding inside investment through the lens of fund capacity constraints appears to best explain our results.

Our key contribution is to document how hedge fund managers prioritize personal investments to less-scalable strategies, and subsequently restrict fund scale, in ways that further boost performance. Yin (2016) emphasizes the role of decreasing returns to scale among hedge funds, describing how managers seem not to fully internalize given their stated contract terms including management and performance fees. We document that a non-stated contract term, the presence of insider capital, provides an important additional reason for fund managers to operate their funds at smaller scales. We show that the impact of these personal stakes on outside investors is mixed: some investors are able to co-invest with insiders and earn superior returns due to smaller fund sizes and alignment of interests. However, the smaller scale of insider funds can have detrimental consequences on other outside investors, who are rationed out of fund participation.

We also contribute to research on managerial ownership in the hedge fund industry. Agarwal, Daniel, and Naik (2009) finds a positive relationship between estimated managerial investment, based on the assumption that fee income is reinvested in funds, and subsequent fund performance. We extend this result and provide additional context by finding evidence for strategic allocation of private capital, as opposed to personal stakes which are increasing mechanically, and by establishing one key mechanism for the outperformance of insider funds: the choice of managers to limit outside capital investment on funds with greater private capital.[2]

[2]Other papers analyze managerial investment at the *firm* level. Brown, Goetzmann, Liang, and Schwarz (2008), for instance, finds that hedge fund firms with concentrated ownership are related to lower performance and suggest possible agency conflicts driving these results.

Our results come with several important caveats. Though we establish inside ownership as an important predictor of excess returns and highlight the role for the strategic allocation and capacity constraints in understanding this result, it is possible that other channels operate in addition to the ones we emphasize. It is possible that inside investors are better informed about the skill of various fund managers, in ways that differ from fund scaling, and that they deploy capital accordingly. Alternatively, high-insider-investment funds may be less subject to agency conflicts and engage in superior research analysis, see Berk, van Binsbergen, and Liu (2017). Finally, it is possible that higher returns from high insider-investment funds are a proxy for some risk factors, unrelated to either the Fama and French (1992), Carhart (1997), and Fung and Hsieh (2004) factors. While more research is needed to establish the precise reasons for the outperformance of high inside-investment firms, we emphasize that our work provides novel evidence that managerial investment is an important strategic choice of managers, and that it has implications for subsequent capital flows and cross-sectional performance consistent with a basic framework including capacity constraints.

Our core results advance knowledge of the asset management industry by highlighting the role for inside investment as an incentive to alter managers' decisions to strategically allocate capital in ways that affect the returns and investment opportunities available to institutional investors. More broadly, this paper contributes to the literature on managerial earnings by emphasizing the unique role for returns on personal capital contributions as a component of overall managerial income in the hedge fund industry.[3] We also contribute to the literature on diseconomies of scale by highlighting the novel incentives for more optimal fund scaling generated by non-contract features of managerial behavior in the form of private capital stakes.[4] Finally, we provide a novel perspective to the literature examining fund families by showing that hedge fund managers allocate personal capital strategically across funds at the expense of crowding out outsider capital.[5]

[3]See Agarwal, Daniel, and Naik (2009), Burasachi, Kosowski, and Sritrakul (2014), Chen, Goldstein, and Jiang (2008), Ackermann, McEnally, and Ravenscraft (1999), Qiu, Tang, and Walter (2018), Ibert, Kaniel, Van Nieuwerburgh, and Vestman (2017), and Ozik and Sadka (2015).

[4]See Chen, Hong, Huang, and Kubik (2004), Yin (2016), Ramadorai (2013), Homberta and Thesmar (2014).

[5]See Massa (2003), Sialm and Tham (2015), Berk, van Binsbergen, and Liu (2017).

I Data

Our dataset combines regulatory Form ADV filings with commercial hedge fund return series from HFR, eVestment, BarclayHedge, Eurekahedge, and CISDM. Form ADV is a required regulatory disclosure form used to register with both the Securities and Exchange Commission (SEC) and state securities authorities. Reporting under Form ADV is governed by the US Investment Advisers Act of 1940, as amended by Dodd-Frank. Disclosure requirements under this form have changed over the years. In the period from 1996–2011, funds with assets under management below $25 million, or fewer than 15 clients, were generally exempt from registration. Hedge funds in this period frequently used complex fund structures to evade disclosure even when assets were above this threshold.

Private fund reporting increased in 2005, when the SEC went to court to force funds to count all investors as clients. Though courts ultimately struck down the SEC's interpretation, disclosure through Form ADV increased throughout this period. Our primary sample is formed after 2011, in the aftermath of changes in required disclosure imposed by Dodd-Frank. Under prevailing regulations, all investment advisors—including hedge funds—are now required to file a Form ADV with the SEC if they (1) reach a $100 million threshold for assets under management for a typical fund, (2) reach a $150 million threshold if the firm has only private clients, (3) have over $25 million in assets and are not subject to examination in their home states (states that do not require examination currently include New York and Wyoming). Subsequent to their initial filing, firms must refile once a year (as long as their assets under management exceed $25 million), or if there have been changes in material information since the last filing.

We obtain Form ADV from the SEC over the period 2011–2016. We link Form ADV information together with information on hedge fund returns obtained from a combination of five datasets: HFR, eVestment, BarclayHedge, Eurekahedge, and CISDM. We begin the merge with HFR, eVestment and BarclayHedge, which contain for many firms an SEC identifier common to both the commercial hedge fund datasets and Form ADV. If we do

not have an SEC identifier, we next look for close matches (selecting only perfect matches) among firm and fund names in both datasets, after eliminating extraneous stop words and abbreviations.

In 2012, Form ADV was updated to include questions about the internal investment of their funds. We draw specifically on Section 7.B.(1), question 14 of Form ADV: "What is the approximate percentage of the *private fund* beneficially owned by you and your *related persons*." This question asks funds to disclose the percentage of investment stakes in the fund which can be attributed in ultimate ownership to "related persons."

Summary Table I shows basic summary information about our core Form ADV dataset taken from 2016, while Table II reports information on our merged sample. The broad ADV sample is able to establish key statistics about the overall size and scope of the entire hedge fund industry beyond prior work. Figure II demonstrates our merge rate across the range of firm ownership. We find that funds with complete inside investment (100%) and no inside investment (0%) exhibit worse merge rates into our ADV dataset. These funds also pose additional identification questions—either outsiders cannot invest, or insiders have chosen not to invest in these funds. For these reasons, we focus the remainder of our analysis on funds in the interior of the internal investment distribution: between 1 and 99% inside investment, inclusive (our result are robust to their inclusion).

A breakdown of "related parties" is provided in Table III, which illustrates all possible configurations of which parties constitute related parties. The most common response is "Sponsor of GP,"[6] suggesting that the definition of related party most often corresponds to a vehicle used by the actual managers or general partners of the fund. Alternately, related parties can include other closely-related entities, such as asset investment by a broker/dealer. A separate set of questions asks the legal name of all related parties: these entities are typically closely related to the management company, share a supervised person three-quarters of the time, and share a common physical office over half of the time.

[6]Appendix Table A1 examines our main analysis regressing inside investment against excess returns, focusing on the subset of funds with only GP investments as their related party.

Despite the limitations of this measure in calculating managerial stakes exactly, we document that related parties are typically vehicles for fund investment by the general partners, and that they typically represent asset management on behalf of closely-related entities that can be considered "inside capital."

The inside investment data used in this paper is illustrated in Figure III. Panel A shows the density of responses on inside investment across our full merged dataset. Panel B shows the distribution of assets under management attributable to inside investment, shown on a log-dollar scale.

II Mechanism

In this section, we outline the key possible mechanisms underlying the relationship between inside investment and fund performance, as predicted by our model. A full exposition of our model and implications can be found in Appendix A.

1. *Size Performance Tradeoff:* Our model's explanation for the role of inside investment as a predictor of cross-sectional fund performance relies on the tradeoff between managerial earnings through fee income on delegated asset management and returns on privately-invested capital. With limited commitment, managers cannot credibly commit to not increasing the size of their fund in the future to the point that the excess returns to investment strategies are driven down to zero. Personal capital commitments better align the incentives of managers and outsiders, providing greater incentives for managers to scale their funds less aggressively in a manner which results in greater returns to investors—but at the cost of capital participation by other outside investors.

2. *Preferential Treatment:* Another possibility is that managers allocate additional attention or trade differently for funds which have greater amounts of insider capital. While our main proposed explanation highlights one aspect of this dynamic—the ability for managers to preferentially manage fund size for funds managing insider capital—managers may also potentially change other attributes of these funds. These

include allocating additional attention, allocating superior managers, or executing superior trading strategies. Funds may take different risks on funds managing insider capital than on funds managing the capital of outside investors.

3. *Superior Information:* An alternate and complementary explanation for the relationship between inside investments and fund performance is that inside investors are simply better informed about managerial ability within the fund family, and they allocate their capital to the better fund managers.

4. *Signaling:* Outside of this paper's model, a potentially offsetting role for managerial capital allocation relies on the role of public signaling. Fund managers, particularly for less-established funds, may need to use inside capital commitments in order to convince outside investors of fund quality. When managers are required to hold costly private stakes in order to demonstrate quality and earn management fees on outside capital, inside investment could potentially predict flows but would be a poor predictor of fund performance. As Form ADVs are commonly used by outside investors to assess fund quality, managerial stakes in this context reflect verifiable and costly personal commitments.

These channels need not be mutually exclusive—for instance, the greater the role of moral hazard or risk-shifting effects in driving managers to exert effort or allocate trades based on inside capital investments, the more private information there will be regarding the success of different funds within a family.

III Empirical Strategy

III.A Excess Return Measures

Throughout our empirical tests, we use three different excess return measures. First, we run a return regression, taking as our benchmark the Fung and Hsieh (2004) Seven-Factor

model:

$$\begin{aligned} r^e_{it} \equiv r_{it} - r_{ft} &= \alpha_{it} + \beta_{1,i} S\&P_t + \beta_{2,i}(SC - LC)_t + \beta_{3,i} 10Y_t + \beta_{4,i} CredSpr_t \\ &+ \beta_{5,i} BdOpt_t + \beta_{6,i} FXOpt_t + \beta_{7,i} ComOpt + \varepsilon_{it} \quad i = 1, \ldots, N. \end{aligned} \tag{1}$$

The Fung and Hsieh (2004) factors are widely used in hedge fund research, including Fung, Hsieh, Ramadorai, and Naik (2008) and Patton and Ramdorai (2013).[7]

We also consider the Fama and French (1992) and Carhart (1997) Four-Factor model, which is more commonly used in mutual fund research:

$$r_{it} - r_{ft} = \alpha_{it} + \beta_{1,i} RMRF_t + \beta_{2,i} SMB_t + \beta_{3,i} HML_t + \beta_{4,i} MOM_t + \varepsilon_{it} \quad i = 1, \ldots, N. \tag{2}$$

The factor exposures allow us to compute an average excess return α_{it} for each month and fund, shown here for the Fama-French and Carhart Four-Factor model (comparably, we estimate a Fung and Hsieh (2004) excess return α^{FH}_{it}):

$$\alpha^{FFC}_{it} = r^e_{it} - \hat{\beta}_{1,i} RMRF_t + \hat{\beta}_{2,i} SMB_t + \hat{\beta}_{3,i} HML_t + \hat{\beta}_{4,i} MOM_t \quad i = 1, \ldots, N. \tag{3}$$

The third return measure we consider is the a *Style-Adjusted-Return* measure, following Yin (2016):

$$\text{Style-Adjusted-Return}_{it} = r_{it} - \frac{1}{S_k} \sum_{j=1}^{S_k} r_{jt} \quad i = 1, \ldots, N, S_k \in \text{strategies}. \tag{4}$$

The above specification differences the return earned by a fund for a given period against the average return of all funds of the same style during the same period. This specification is used for ease of calculation from raw returns, and for its ability to adjust for the risk associated with different investment strategies.

[7] These factors are: 1) an equity market factor—the S&P 500 Index monthly return (S&P); 2) A size-spread factor—the Russell 2000 Index monthly return, S&P 500 (SC-LC); 3) a bond market factor—the monthly change on the 10-year Treasury constant maturity yield (10Y); 4) a credit spread factor—the monthly change in the Moody's Baa yield, 10-year Treasury constant maturity yield (CredSpr); 5) a bond trend-following factor (BdOpt); 6) a currency trend-following factor (FXOpt); and 7) a commodity trend-following factor (ComOpt). Additional details on the factors can be found at: http://faculty.fuqua.duke.edu/~dah7/DataLibrary/TF-FAC.xls.

III.B Inside Investment and Fund Scalability

We test the relationship between excess returns and scalability of the hedge fund, following Yin (2016):

$$r^e_{i,t} = \beta \cdot \log(AUM_{i,t-1}) \times \text{High Ownership}_{i,t-1} + \text{controls} + \varepsilon_{it}. \tag{5}$$

In the above specification, we test three different dependent variables: (i) the return in excess of the style average (following Yin (2016)), (ii) Fama-French-Carhart, and (iii) Fung-Hsieh factor models. Our variable of interest is the coefficient β, from the interaction term between $\log(AUM_{i,t-1})$ and $\text{High Ownership}_{i,t-1}$, an indicator variable taking the value of 1 if the funds insider ownership is greater than the sample median. We control for $\log(AUM_{t-1})$ to take into account the general decreasing returns to scale for all funds. We also control for log(total firm AUM_{t-1}), percent AUM $Flow_{t-1\to t}$, performance fee, management fee, an indicator for a high water mark, log(minimum investment), redemption period, fund age, whether the fund is open to new investment, and leverage. We include fixed effects for the firm, year, and strategy, and cluster at the fund level. All flow and return measures are winsorized at the 1% level.

III.C Inside Investment and Size

To test for the relationship between ownership and size, we also perform a comparable analysis regressing the assets under fund management against the fraction of inside investment:

$$AUM_{it} = \psi Ownership_{it-1} + Firm_i + Year_t + \varepsilon_{it}. \tag{6}$$

The ψ coefficient here captures the relationship of size and fractional inside investment within firm and year.

III.D Fund-Flow Sensitivity and Return Predictability

Following prior literature, such as Chevalier and Ellison (1997), we define fund flows using net flows r_{it} as:

$$Flow_{it} = \frac{AUM_{it} - (1 + r_{it}) \cdot AUM_{i,t-1}}{AUM_{i,t-1}}. \tag{7}$$

Using this definition, we also test standard fund-flow sensitivities:

$$\begin{aligned} Flow_{it} &= \eta \text{High Insider Ownership}_{it-1} + \beta_1 \alpha_{it-1} \times \text{High Insider Ownership}_{it-1} \\ &+ \beta_2 \alpha_{it-2} \times \text{High Insider Ownership}_{it-1} + \beta_3 \alpha_{it-3} \times \text{High Insider Ownership}_{it-1} \\ &+ \delta_1 \alpha_{it-1} + \delta_2 \alpha_{it-2} + \delta_3 \alpha_{it-3} + \mathbf{X}'_{\mathbf{it}} \theta + Firm_i + Year_t + \varepsilon_{it}. \end{aligned} \tag{8}$$

In flow specifications, time is measured quarterly. Other controls in $\mathbf{X}$ include leverage, lagged fund size, management fees, performance fees, redemption period, high watermark, lagged flows, fund formation, and strategy fixed effects.[8] The key coefficient of interest is β_1: whether funds with high inside ownership (defined as inside investment above the median) exhibit less flow-performance. Lower flow-performance would indicate when funds with greater inside investment accept less additional funding in response to better prior performance.

III.E Inside Investment and Performance

We next test whether inside investment results in greater risk-adjusted fund-level returns. Accordingly, we adopt a two-step approach. In the first step, we estimate a time-series regression of excess returns on factor exposures, as discussed in Section III.A. In the second step, we consider both a panel regression (which allows us to control for firm and year fixed effects) as well as a standard Fama and MacBeth (1973) cross-sectional regression which relates excess returns from fund-specific factors to inside ownership and other

[8] Following Getmansky, Liang, Schwarz, and Wermers (2015).

variables. A summary of the main dependent variables used in our analysis can be found in Table IV.

In this specification, we consider excess returns ($r_{it} - r_{ft}$) to be the net returns after fees minus the risk-free rate, as we take the standpoint of an institutional investor interested in allocating across the broad investable universe of fund managers.[9] This monthly time-series analysis is run for each of N funds in order to generate fund-specific factor loadings.

We restrict our sample to funds for which we have at least 24 months of data, excluding the first 24 months of data to avoid incubation bias, and we also require funds to have at least $20 million in gross asset value. We exclude fund-of-funds because their inside investment is relatively limited, and the scope for investment is radically different.[10] We also exclude funds with either 0 or 100% inside ownership. We find that funds with complete inside investment (100%) and no inside investment (0%) exhibit worse merge rates into our ADV dataset. These funds also pose additional identification questions—either outsiders cannot invest, or insiders have chosen not to invest in these funds. For these reasons, we focus the remainder of our analysis on funds in the interior of the inside investment distribution: between 1 and 99% inside investment, inclusive.[11]

With the monthly estimates of risk-adjusted returns, we estimate (following Fama and MacBeth (1973)) cross-sectional regressions against fund characteristics, including our measure of ownership:

$$\alpha_{it} = \phi + \gamma Ownership_{i,t-1} + \mathbf{X'_{i,t-1}}\Theta + \varepsilon_{it}. \tag{9}$$

The key variable of interest is γ, which captures the predictive role of greater inside investment on excess returns. To measure ownership, we use both the percentage of the fund that consists of insider investment (our preferred measure, corresponding to the measure our model suggests is the most relevant) as well as the gross insider exposure. This

[9] Our results also hold when we regress against gross returns, adding fee income back in.

[10] Because fund-of-funds invest in other investment vehicles, rather than underlying securities, we do not expect the same patterns of diminishing returns. We also expect flow-performance and return persistence to work very differently with these investment advisors.

[11] Our analysis is robust to the inclusion of funds with zero or 100% inside ownership, the inclusion of fund-of-funds, and the inclusion of smaller funds.

measure of ownership is drawn from annual ADV forms, and it represents the ownership stake from the prior year. Additional controls in $\mathbf{X}$ include controls for fund age, size, and strategy.

Though standard in the mutual fund literature, a key limitation of the Fama and MacBeth (1973) cross-sectional specification is that it does not allow us to control for time and firm fixed effects. To do so, our baseline specification is a panel regression of fund and firm characteristics against excess returns:

$$\alpha_{it} = \phi + \gamma Ownership_{i,t-1} + \mathbf{X'_{i,t-1}}\Theta + Firm_i + Year_t + \varepsilon_{it}. \tag{10}$$

The key difference is that in this specification, our key coefficient of interest, γ, captures the impact of inside investment, either as percentage of fund as well as gross exposure, on excess return *relative* to another fund in the same family (i.e., within the same firm) and year with less inside investment. This allows us to control for all other invariant firm and time characteristics which might otherwise drive excess returns. Standard errors are clustered at the month level, following Petersen (2009). We also extend our analysis to consider return smoothing motivations, which have been documented for hedge funds, e.g. by Getmansky, Lo, and Makarov (2004).

IV Results

The following subsections tests three hypotheses predicted by our model: first, hedge fund managers allocate their insider capital to their less-scalable strategies; second, insiders restrict access to outside investors in these funds; and third, insider funds, as a consequence, outperform on a risk-adjusted basis.

IV.A Strategic Allocation of Inside Investment

IV.A.1 Fund Scalability and Inside Investment

We first establish that hedge funds face decreasing returns to scale for funds with high GP capital investments, or insider investments. This assertion is hypothesized in our model

and is part of the main mechanism driving our results. We establish this by using a similar approach as Yin (2016): by regressing excess returns against asset flows and fund-level ownership.

The results in Figure IV plot the coefficient of interest for all investment funds and also break these out for specialized arbitrage strategies. This figure estimates equation 5, and shows the interacted terms between lagged log assets and high insider funds are statistically significant and economically large. The sign and significance of the results correspond to strategies that are typically associated with lower scalability due to liquidity, price impact, and limited float. We find that insider funds are associated with even more decreasing returns to scale strategies in strategies such as event-driven and relative value.

The interpretation of these results is that when insider funds experience larger assets under management, the excess returns to investors deteriorate more significantly relative to outsider funds. This result holds whether we examine excess returns using a style-adjusted average, as in Yin (2016), or whether we use the Fama-French or Fung-Hsieh factor models.

IV.A.2 Fund Size and Inside Investment

We next establish the strategic aspect of managerial investments in their own funds through analyzing the role of size and inside investment. As a reminder, our model hypothesizes that a key mechanism driving the superior performance of insider funds is their smaller size, due to decreasing returns to scale in investment technologies.

We confirm that insider funds tend to be smaller, in line with the mechanism of our model. In Table V, we regress the size of the fund against inside investment. In column 2 of Panel A, we focus on our matched dataset and find that an additional percent of inside investment is associated with a fund that is smaller by $4–8 million. This relationship persists when we examine a specification where the dependent variable is the log of assets under management in columns 3–4.

To address concerns about biases in the merged dataset, we retest this specification on the Form ADV dataset only and present the results in Table V, Panel B. These specifications

use the field "Gross Asset Value" derived from fund-level information in Form ADV. Gross asset value differs from assets under management in that it does not subtract out the value of short positions from the portfolio, and so it overestimates true fund size. Despite the limitations of this measure, using this field as a dependent variable enables us to avoid losing observations on the merge between our Form ADV dataset and the commercial hedge fund datasets. Results are very similar when not restricting on funds that merge into commercial hedge fund datasets: we find in column 2 that within a firm, funds with an additional percent of inside investment are around $10 million smaller in gross asset value. These results provide additional support for our main hypothesis: inside investment funds are both smaller , suggesting that managers do not hit the limits of the capacity constraints of their investment strategy when their own private capital is deployed.

We examine other possible determinants of inside investment, reporting the results in Appendix Table A2. In this specification, we run a yearly panel regression of inside investment against a variety of fund and firm characteristics. We begin in column 1 with a regression of the percentage of fund assets attributable to investments by insiders and related parties against a number of fund and firm characteristics without additional fixed effects. Standard errors are clustered at the firm level. We then add fixed effects for fund inception year, firm, and year of observation.

The most robust correlate of inside investment remains fund size: high inside investment funds are smaller. We also find that leverage is negatively associated with inside investment once we control for firm fixed effects. One interpretation to the risk explanation is that skilled managers facing capacity constraints may simply prefer to avoid all outside money (both debt and equity) in select funds, in which they prioritize allocations of their own private capital. For this reason, they may simply prefer to avoid accepting additional assets under management as reflecting debt claims.[12]

There is weak evidence that fees—particularly performance fees—are associated with higher inside investment, though this relationship is generally small in magnitude and not

[12]We thank a referee for making this point.

statistically significant once we add firm fixed effects. Though our basic model assumes that managers and investors take fees as given, one possible reason to consider the endogenous determination of fees might be that insiders use higher fees to further ration out investors in funds with greater levels of inside investment. However, the key predictions of our model—that inside investment will be associated with higher post-fee alpha—remains as long as we assume that managers cannot fully set fees to maximize all of the investor surplus. Fees appear to be sticky, do not exhibit substantial cross-sectional or time-series variation, and are not robustly associated with inside investment once we control for other variables.

IV.B Capital Rationing and Inside Investment

We next test our model's empirical predictions that GP capital is allocated into less-scalable funds and will be most valuable when managers are able to also restrict outside capital entry into these funds. We first consider how lagged excess returns relate to asset flows to funds.

Figure V plots a non-parametric relationship between lagged returns and fund inflows by funds with a greater or lesser degree of insider investment measured at a quarterly frequency. Insider funds are defined as those with a greater-than sample average amount of fraction of fund assets attributable to insiders.[13]

This figure illustrates that outsider funds exhibit a standard fund flow-performance relationship as documented in prior research on hedge funds and mutual funds.[14] However, insider funds demonstrate a different profile: insider funds that experience positive excess returns do not exhibit as subsequently high inflows, consistent with the idea that high-performing funds with greater insider capital manage funds operate closer to their optimal size by restricting inflows by outsiders after positive returns.

[13] For all flow-based analysis, we exclude eVestment from our sample due to unreliable NAV information from this data provider.

[14] See Chevalier and Ellison (1997), Sirri and Tufano (1998), Getmansky, Liang, Schwarz, and Wermers (2015).

The fact that high-inside-investment funds do not attract higher inflows is strong evidence in our setting against signaling-based explanations of the role of inside investment. If personal stakes by managers were necessary to attract additional capital, we would expect that funds with greater inside investment might attract additional funds—particularly when prior returns were high. Instead, we find that high-inside-investment funds do not scale up as much as outsider funds when returns are high. Instead, these results point to a role for moral-hazard explanations for why inside investment is associated with superior performance.

Additionally, we find little evidence that insider funds feature greater capital stability—we do not see strong evidence that poor returns are followed by lower outflows among insider funds relative to funds catering to outside capital. This evidence suggests that insider funds are not characterized by a longer horizon to wait out poor returns, offering funds a more patient source of capital, or the limits of arbitrage (Shleifer and Vishny, 1997).

Table VI presents additional flow performance specifications to test possible signaling explanations, as outlined in equations 8. The dependent variable in these specifications is the percent flow, or an indicator whether inflows are positive. A variety of other controls are included in these specifications.[15] We find in column 1 that greater lagged excess returns predict lower flows among funds with greater inside investment, suggesting that insider funds do not accept as much flow in response to positive returns. Column 2 of this table highlights the extensive margin and suggests that funds with greater inside investment are also much less likely to accept any additional inflows at all in response to past superior performance.

The remaining columns of this table expand our analysis to the *other* funds within the family. We do so to test a broader class of signaling explanations—perhaps funds operate certain "flagship" funds to an optimum scale in order to advertise returns. If this is true, we might expect that returns do not predict flows for some high insider funds (because managers are using these funds to advertise high returns)—but signaling stories would

[15]These include leverage, management fees, number of redemption days, high watermark, lagged flow, and the log of gross asset value (lagged one year).

predict that foregoing additional fee income today (to produce better returns for marketing) should be followed up with higher inflows in the future, perhaps in other funds, generating future fee income.

In columns 3–4, we find little evidence that lagged excess returns drive flows to other funds in the family, measured at either the extensive or the intensive margin (whether inflows are positive). In columns 5–6, we restrict our attention to high ownership funds. For this subset, as well, we find little evidence that high returns drive inflows to other funds in our family. Investors appear to distinguish between different funds in the family when allocating capital, and to preferentially increase flows only to the funds that directly outperform. As a result, we do not find evidence for the idea that managers may want to leave personal capital in some funds in order to signal their quality, thus driving flows (and management fees) to other vehicles they manage. While this finding does not fully rule out a signaling explanation for our results, the bulk of the evidence is more consistent with a moral hazard view.

To further explore the role of active capital rationing, we focus on a sample of funds for which we are able to establish the role of managerial discretion in accepting capital. In Table VII, we examine funds which are explicitly closed to outside investors as reported by commercial databases. In columns 3–6 of this table, we find strong evidence that funds that are closed to outside investors strongly outperform on a factor-adjusted basis. In these specifications, we regress a dummy variable for funds open to investors against excess returns measured using a four- or seven-factor model, finding that funds closed to outside investors outperform by 0.23–0.45% each month, corresponding to 2–4% a year in excess returns.

Funds which do not accept additional inflows are able to generate superior performance. These excess returns suggest that outsiders would like to enter these funds and are being actively rationed out of them. However, the presence of these funds poses a challenge for traditional views of delegated asset managers—why do managers forgo management fees by not accepting outside investors into these funds?

A potential resolution to this puzzle is suggested in columns 1–2 of Table VII. In these specifications, we examine the relationship between inside investment and funds that are open to investors. We find that funds which are closed to investors are substantially more likely to have a greater concentration of inside investment.

These results highlights managerial capital rationing as a mechanism to explain the outperformance of insider funds. Managers restrict the participation of outsider investors both on the intensive margin, but restricting inflows to insider funds that outperform, and on the extensive margin, by prohibiting outsider capital entry entirely on some highly outperforming funds. The superior performance of these insider funds does not drive inflows to other funds within the family, which points to the role of moral hazard as a key driver of the relationship between inside investment and fund returns.

IV.C Inside Investment and Fund Performance

The analysis so far has analyzed how managers allocate private capital to funds with more decreasing returns to scale and optimize the size of such funds. In this section, we explore the implications of this capital scaling on the returns experienced by outside investors.

IV.C.1 Cross-Sectional Relation

Our model predicts that within a firm, funds with a greater proportion of inside capital will outperform, because managers will allocate their least-scalable strategies to funds managing their money, and further will internalize the capacity constraints of the investment strategy when accepting new capital. Funds with greater inside capital retain greater alpha, in equilibrium, because managers maximize profits by not accepting additional outside capital beyond the capacity limit of the investing strategy.

In our main specifications, we use a two-step approach to control more closely for fund factor exposure. We analyze the role of inside investment on risk-adjusted returns. Panel

A of Table VIII presents a panel specification, using as the key regressor the percent of a fund's asset under management that can be attributed to insider investment in the prior year against excess returns. In columns 1–2, we measure excess returns using a seven-factor model in the first stage, and we show the results of a second-stage regression of inside investment against excess returns. We find that inside investment is statistically associated with excess returns. This relationship persists in our preferred specification in column 2, which controls for year and firm effects. Additional fund level controls include a size control (log of gross asset value), the fund's inception year, and the fund's strategy.[16] Our estimates in that column suggest that a fund with a 1% increase in inside investment experiences a 0.48 basis point higher excess return per month, relative to another fund in the same family and year of observation with the same strategy, size, and inception year.

Scaling our result, we find a 1.26% increase in alpha per year for a fund with a standard deviation increase (22%) in the amount of inside investment relative to another fund in the same firm with similar characteristics in the same year. These results are significant and suggest a strong importance for internal investment as a predictor of cross-sectional fund performance. The larger magnitude and significance of results when controlling for firm fixed effects suggests the importance of discretionary fund allocation by insiders: there is high dispersion of fund returns within firms in our sample, and insiders choose which investment strategies to pursue for which funds, as well as which funds to invest in. Our results suggest that inside capital is more likely to be deployed in funds that outperform others within the family. We find similar results in columns 3 and 4 of Panel A, which use the Fama-French and Carhart Four-factor model to adjust for risk exposures.[17]

We also find a strong role for inside investment in Panel B of Table VIII, in which we examine the *gross* amount of inside investment, rather than the fractional amount, while also

[16] Adding management and performance fees leaves the results unchanged, but these are potentially endogenous to inside investment levels, so we exclude them from our main specifications. Controlling for strategy $\times$ year fixed effects to account for capacity constraints at the level of strategy type also leaves our effects unaffected.

[17] To better understand the underlying risk exposure behind these numbers, in Appendix Figures B.2 and B.3 we plot estimated factor exposures for both sets of models; meanwhile, Appendix Figure B.4 shows the correlation between risk factors and inside investment.

controlling for size and other fund-level characteristics. These results are equal-weighted and make a series of sample restrictions outlined in the section above.[18]

In Panel C of Table VIII, we also examine a Fama-MacBeth cross-sectional regression. In this specification, as outlined above, we do not control for firm or year fixed effects. However, we also find comparable results in these specifications across both the seven-factor and four-factor models, illustrating the robustness of our result: that greater inside investment is associated with superior performance.

IV.C.2 Event Study: Skimming

The results from the previous section provide strong evidence of a role for insider investment in driving fund returns. This raises the possibility that insider investment is a critical component of the earnings for managers, alongside management and incentive fees. Further, it is possible that fund managers may seek to further take advantage of this relationship by steering clients into lower-performing funds.

We explore this possibility in Figure VI, which conducts an event study in the aftermath of the creation of a new fund among firms which previously only had one fund. The creation of an additional fund presents two possibilities for fund managers: they can either keep their internal capital invested in the original fund, using the new fund to attract new capital, or they can shift their own capital to the new fund, and market the original fund to investors. If the amount of insider capital is an important determinant of fund performance, we expect different fund performance in the *original* fund under the two cases. If managers are shifting their capital outside of the fund, we expect the performance of the original fund to deteriorate, since managers are no longer as invested in success of the fund. If, on the other hand, managers keep their capital in the original fund, the performance of the original fund should remain strong.

[18] To test for robustness of these restrictions, in Appendix Table A3 we include funds with 0 or 100% inside investment, as well as a specification which value-weights our main specification by Gross Asset Value (measured reliably for all funds from ADV data). We find comparable results in these samples.

To test this possibility, we focus on all cases in which a hedge fund which previously only operated one fund opens a second. We isolate two cases: one in which the new fund has less internal investment than the original, the new fund has "low inside investment," and another in which the new fund has more internal investment than the original. We plot cumulative returns of the original fund for the two-year window both before and after the fund creation date. We track the returns on the original fund to avoid the issue of incubation bias (Evans, 2010) which would be posed by analyzing the returns of the newly-generated fund.

Our results suggest that fund performance is relatively similar before the event date for the original fund, regardless of whether the firm subsequently creates a new fund with high or low internal investment. Differences grow more pronounced in the aftermath of fund creation. We find that when the new fund has "low inside investment"—suggesting that managers keep their internal capital in the original fund—fund performance suffers relative to when the newly formed fund has "high inside investment." We expect to see this difference because managers are more invested in the success of the initial fund if their capital remains deployed in the fund. If their own capital has moved to a different fund, performance tends to suffer in the window after fund creation.[19]

Though these results are not fully conclusive, they are suggestive of the possibility of "skimming" motives on the part of fund managers. If managers are able to shift their internal investments across funds within the same family, they seem to be able to focus their investments on successful funds, while steering outside capital into the lower-performing funds. These results provide additional context to our discussion of mechanisms in Section II and previous empirical results suggesting that active decisions made by fund managers regarding fund creation and capital deployment play a role in determining returns for outside investors.

To be clear, this analysis does not identify whether this is due to insiders having better information on which fund managers can outperform relative to outsiders, or because

[19] In a difference-in-difference regression, the interacted term of High Inside×Post has a coefficient of 0.969 and a standard error of 0.214, which is significant at the 1% level.

managers devote more effort when greater amounts of personal capital are on the line. Despite the multiple possible explanations, we emphasize that our result provides novel evidence on the role of inside investment in shaping fund performance as new funds are created.

IV.D Robustness Tests

The previous results are subject to several important caveats. Firstly, while these results suggest that fund-level inside investment predicts superior excess returns, the relationship might not be causal. It may well be that our measure of inside investment is a proxy for other fund-level characteristics. Another important caveat is that we are not able to fully control for whether our results are driven by some element of risk or instead result from agency conflicts within the firm. Despite our attempts to control for risk using the benchmark fund factors, it is also possible that the outperformance of high inside-investment funds occurs due to a novel risk factor. To further analyze the mechanisms driving our main result, we examine fund decisions along other dimensions.

IV.D.1 Alternative Risks Explanation

One possible caveat to our analysis is that superior performance in insider funds may reflect uncontrolled risk exposures. To account for this, we explore two other measures of liquidity and tail risk, as emphasized in the hedge fund industry (see Teo (2011), Agarwal, Arisoy, and Naik (2017a), and Agarwal, Ruenzi, and Weigert (2017b)).

In Panel A of Figure VII, we explore the relationship between our measure of inside investment and the Getmansky, Lo, and Makarov (2004) liquidity measure. This approach uses an indication of autocorrelation in returns to estimate the extent to which return series are smoothed, hence providing a measure of asset liquidity, with higher numbers indicate greater asset liquidity. While we cannot reject equality across the distribution of inside investment, we find that, if anything, funds with lower inside investment have lower values of the smoothed index—indicating that their holdings have a higher autocorrelation,

indicating holdings of less liquid instruments. Despite the imprecision, we can rule out the possibility that high inside investment funds are holding less liquid securities, at least as judged by the autocorrelation of returns using this metric.

In Panel B of Figure VII, we explore an alternate measure of performance—the maximum drawdown. This measures the greatest percentage loss the fund has experienced, relative to the maximum asset value, thus providing an estimate of tail risk. We plot average maximum drawdown for funds by each percentage of inside investment, and we also find no statistically significant relationship between inside investment and tail risk. However, there is a slight positive relationship between the extent of the maximum drawdown and inside investment—which could potentially suggest that hedge fund managers prefer to take risks with their own private capital which yield excess return in exchange for a small probability of extreme losses. Despite the plausibility of this mechanism, we emphasize that we find little statistically robust evidence that high inside investment funds are systematically engaging in strategies characterized by greater tail risk.

In additional robustness tests to explore the role of autocorrelation of returns, in Appendix Table A4, we include three lags of return to account for return smoothing and illiquidity as omitted factors—these tests leaves our main results unchanged.[20]

IV.D.2 Heterogenous Treatment Effects

As suggested by Getmansky, Liang, Schwarz, and Wermers (2015), investment styles face different capacity constraints. If capacity constraints are driving our main effect, we would also expect a heterogenous treatment effect across different investment styles. Specifically, investment styles that face larger capacity constraint frictions would have a stronger relationship between inside investments and excess returns.

Testing the relationship between inside investment and excess returns, we bucket by investment styles and present the results in Figure VIII, as in column 2 of Panel A Table

[20] We have run additional robustness checks controlling instead for the Getmansky, Lo, and Makarov (2004) measure directly for this and other key specifications, which are available upon request.

VIII. Panel A of this figure plots the coefficient of inside investment against excess return by fund categories, as measured in our set of commercial hedge fund datasets. The main effects are driven by funds that engage in specialist absolute return strategies, arbitrage strategies, and equity funds. Within equity funds, in Panel B, the effects are driven by long–short funds. These fund strategies also plausibly feature capacity constraints in their investment strategies. By contrast, effects are insignificant among fund-of-funds and CTAs, which are typically associated with greater capacity.

We additionally test our main result across the distribution of inside investment. As shown by the quantile regression in Figure B.5 in the Appendix, our results are largely being driven by funds with higher levels of inside investment: those funds for which inside capital provides a substantial component of the capital base, for which we expect to see the highest-powered incentives.[21] In Appendix Table A6 we examine our basic regression across different fund size levels, finding significant effects for the top two fund size quantiles, corresponding to fund sizes of at least $126 million.[22]

IV.D.3 Mechanical Capital Contributions

Next, we examine the role of discretion over personal capital contributions. In Appendix Table A5, we first impute a "mechanical" component of personal capital contributions derived from rolling over prior fee income from the observed inside investment, attributing the residual as reflective of managers' discretionary capital contributions. We find that even after subtracting this "synthetic" or mechanical inside investment potentially resulting from rolled over fees, the discretionary component remains a large and statistically significant driver of fund returns.

[21] Our findings are weaker if we exclude high inside-investment funds from our sample. When we impose a $500m cutoff and restrict to funds with inside investment of $< 50\%$, we find similar results as in the analysis in Kruttli, Monin, and Watugala (2017) based on a linkage of Form PF-ADV. However, our focus is on the larger universe of hedge funds, including those smaller funds not required to file Form PFs and those funds with substantial inside investment stakes.

[22] We also examine our results separately for funds with inception years prior to 2011 and funds started afterwards, examining the hypothesis that funds originated more recently might be more subject to signaling effects. We do not find evidence for a statistically significant difference between these two groups.

IV.D.4 Firm-Level Ownership

We also investigate the implications of dispersion in firm-level ownership and its relation with fund-level inside investments. As shown in the Appendix, Table A7, column 3 suggests that inside investment at the fund level remains a significant predictor of excess returns, even when controlling for measures of firm-level ownership. In addition to fund-level inside investment, we find that the number of equity owners, as a measure of the dispersion in a hedge fund family's ownership structure, negatively predicts excess returns. While this result would be consistent with the idea that dispersion in a firm's equity structure is a sign of agency frictions and internal firm conflict, other explanations might also explain the relationship between the dispersion in firm-level equity ownership and fund performance. Despite the limitations of our measures of firm-level equity, we emphasize that our paper is the first to our knowledge to examine measures of insider capital allocations for a comprehensive sample of hedge funds at the level of fund allocation, as well as firm-level equity contributions.

IV.D.5 Market Timing of Fund Managers

An alternate and complementary mechanism in explaining our main result that greater insider investment predicts higher excess returns is that managers have superior private information about the abilities of fund managers than do outside investors, and so deploy personal capital to the superior managers. To test this hypothesis, we estimate the following specification in Table IX:

$$\alpha_{it} = \beta InsiderInflow_{i,t-1\to t} + \gamma OutsiderInflow_{i,t-1\to t} + \varepsilon_{it}. \tag{11}$$

This specification tests whether *changes* in insider investment predict excess returns. We find that changes do not predict excess returns in either inside or outside flows. While this test is not fully conclusive regarding the channel of superior inside information, this result suggests that insiders do not appear to be able to time their capital allocation decisions

in ways that predicts future excess returns. Put differently: levels of inside investment, rather than changes in investment, predict future returns. In conjunction with the results on fund flows and performance, this result is perhaps unsurprising: fund insiders appear to frequently extract assets from their best-performing funds, rather than further investing, in order to continue to operate funds further from their capacity constraint and gain excess returns.

V Conclusions

A hedge fund manager's ability to access and allocate capital to profitable—but highly limited—investment opportunities within the funds they oversee is a substantial element of fund manager earnings. However, the managers' discretion to choose which of their funds to invest in, and the effects of their decisions on access to limited arbitrage opportunities, have rarely been empirically explored.

Our paper explores the tension produced by the incentives resulting from inside investment. Firstly, we document the strategic nature of GP capital investments into their own funds and find that managers invest in their least-scalable strategies. Secondly, we find that managers also limit outsider capital access into their insider funds, sometimes closing access to outside investors completely. The consequence of these managerial capital decisions (on both outside and inside capital) is that insider funds substantially outperform—but are offered on a limited basis to outside investors.

From an outside investor's perspective, a positive feature of managers' having "skin in the game" is the usual alignment of incentives that improves their returns. Funds with higher internal investment have greater excess returns, even when we control for firm fixed effects. They do so by taking on less leverage and less exposure to asset illiquidity, suggesting that hidden risks are not driving this result. Our results are large in magnitude, and they suggest that a fund with a one-standard-deviation increase in inside investment relative to the mean will provide an additional 1.26% of excess returns, annually.

This improvement in return performance comes at the cost of reduced fund participation by outsiders. We find evidence consistent with the idea that greater inside investment incentivizes managers to better manage the size-performance tradeoff in ways that displace outside capital. High-insider investment funds are less likely to accept inflows in response to positive returns and are more likely to be closed to outside investors entirely. Additionally, we find evidence for strategic capital allocation at the time of new fund creation. When internal assets are shifted to newly-created funds, the original fund tends to underperform relative to the case when managerial commitments remain with the original fund. However, high returns on insider funds do not drive inflows to other funds in the family, suggesting that signaling motives cannot entirely explain our results. The joint relationship between internal investment, fund flows, and performance suggests that funds better manage capacity constraints when managers have personal capital at stake, leading to superior returns at the expense of fewer managed investments.

These results, taken as a whole, provide powerful support for our equilibrium model, along the lines of Berk and Green (2004), that hedge funds face capacity constraints in their operations, and differentially allocate capital across their funds to maximize profits, depending on the mix of inside and outside capital. When funds rely on outside capital, managers are compensated primarily from managerial fees and leave little value to outside investors. Greater reliance on internal financing better aligns the incentives of managers and outside investors, leading them to leave substantial "slack" in fund size and operate strategies on at a smaller size, thereby receiving greater excess returns, even in a competitive market—but at the cost of outsider investor participation.

Our results contribute to the ongoing debates regarding the presence of managerial alpha and financial rents. Many observers are puzzled at the apparently outsize rents earned by financial intermediaries such as hedge funds, even in the wake of apparently strong competition and the role of fund inflows on diminishing returns. In turn, these managerial rents have driven top-end wealth and income inequality (see Kaplan and Rauh (2013)). We suggest that a possible reconciliation of these facts can be found in examining

the option that fund managers have of not only earning management and performance fees, but also deploying their own capital in funds they manage.

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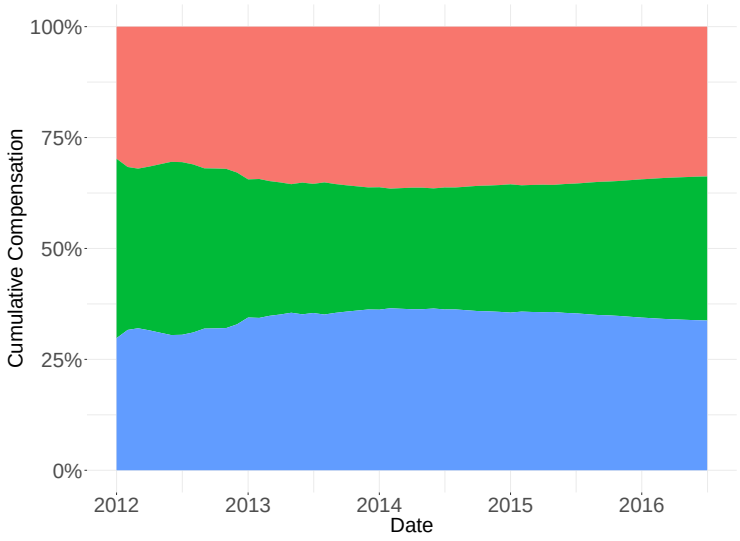
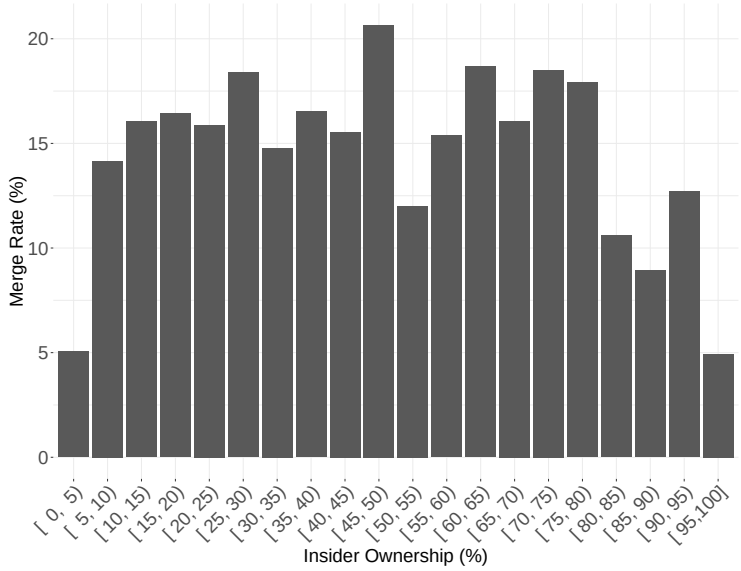
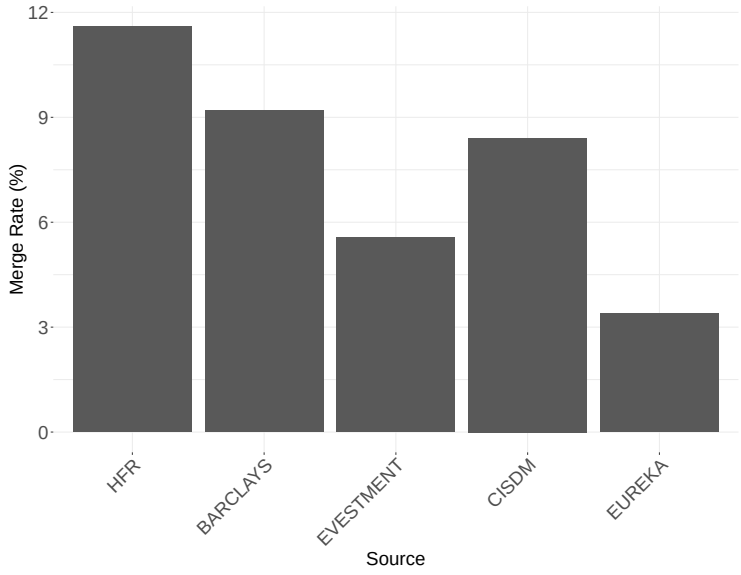


FIGURE I **Decomposition of Earnings for Hedge Fund Managers**

This figure distinguishes between three possible sources of hedge fund earnings—managerial fees (blue), performance fees (green), and excess returns on privately invested capital (red). The sample is restricted to funds for which all fee data are available, and the sample excludes eVestment (for which we do not have accurate assets under management data). To compute management fees, we multiply listed management fees for each fund against monthly assets under management invested by outside investors (assuming that insiders do not pay fees). Performance fees are computed assuming that all funds operate under a high-water mark which begins the first month for which we observe each fund's performance. Stated performance fees are multiplied by the total raw return (assuming no hurdle rate) on outsider fund investment. Insider returns are calculated based on each fund's excess return from a Fung-Hsieh Seven-Factor model multiplied by the quantity of inside investment in place within each fund. Panel A breaks out each source of hedge fund earnings. Panel B shows the running cumulative total of each source, outlining the fraction of aggregate managerial earnings attributable to each source.



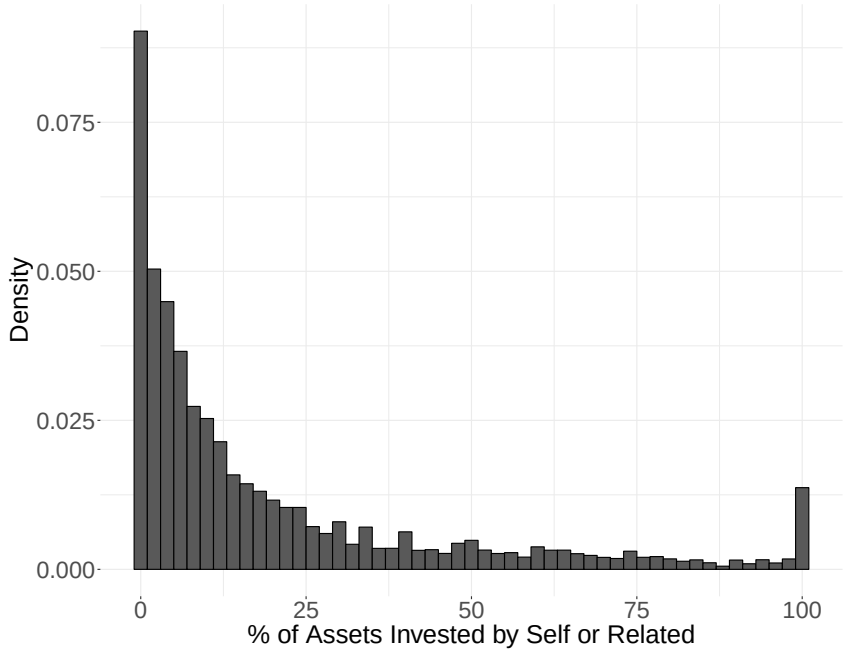
Panel A: Among ADV Hedge Funds, merge rate into Commercial Datasets



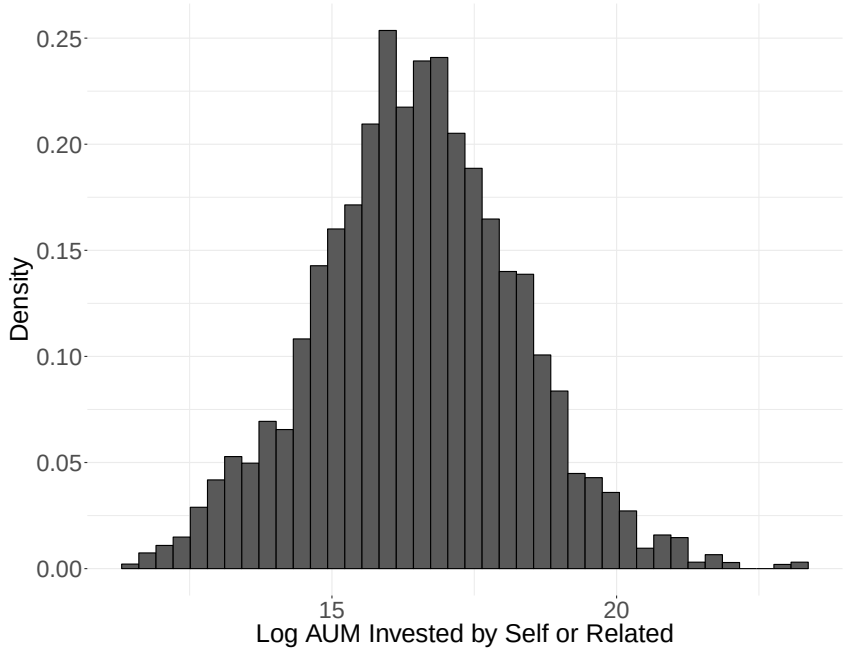
Panel B: Merge Rate by Commercial Data Provider

FIGURE II **Merge Details**

This figure plots the merge rate between observations in Form ADV and those in hedge fund commercial return datasets (outlined in the data section). All data are taken as of 2015. In Panel A, we report the fraction of observations in the ADV dataset for which we find a merged counterpart in the commercial return datasets, with the fraction reported for each 5-point interval of inside investment. In Panel B, we report the merge rate as a fraction of the total funds listed in each of the commercial hedge fund data providers. The order of the datasets reflects the sequential match process—we first search for matches in HFR, then BarclayHedge, then eVestment, then CISDM, then Eureka. For this reason, the match rate for each dataset reflects a conditional match rate, given that the fund did not merge in the previous dataset, and so our merge rates generally decrease as we move across providers.



Panel A: Distribution of Insider Investment Across Funds, Percentage of Total Assets



Panel B: Distribution of Insider Investment Across Funds, Gross Inside Investment

FIGURE III **Distribution of Insider Investment from Merged Sample**

This figure plots insider investment into hedge funds from the merged sample of hedge fund returns and ADV forms. Panel A is a histogram of insider investment, with units of percent of total investment. Insider investment displays a "dumbbell" distribution. Panel B is a histogram of log(Gross Asset Value) of insider investment across funds for the merged sample between ADV and the commercial hedge fund datasets.

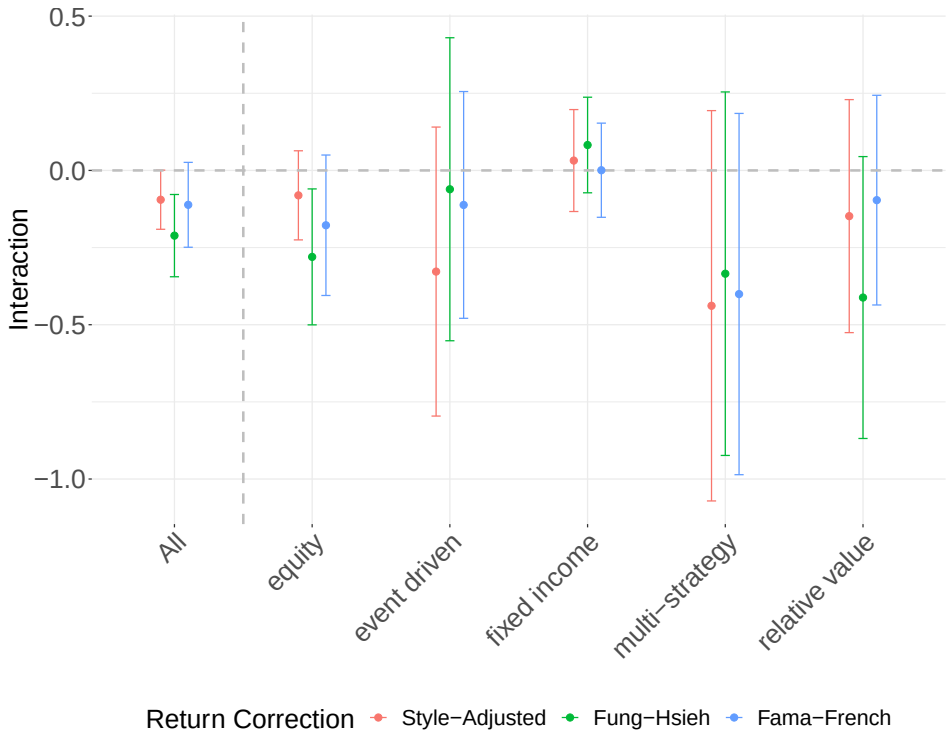


FIGURE IV **Insider Investment Allocation by Fund Scale**

This figure plots the coefficients from a regression estimating a decreasing returns to scale parameter interacted with an indicator for high investment funds. The specification, following Yin (2016), regresses measures of excess return against a number of covariates: Excess Return$_{i,t}$ = βlog($AUM_{i,t-1}$) $\times$ High Ownership$_{i,t-1}$ + controls + $\varepsilon_{i,t}$. Measures of excess return include the return in excess of the style average (following Yin (2016)), as well as the Fama-French and Fung-Hsieh factor models. Controls include log(AUM_{t-1}), log(total firm AUM_{t-1}), percent AUM $Flow_{t-1\to t}$, performance fee, management fee, highwater mark, log(level of minimum investment), redemption period, fund age, whether the fund is open to new investment, and leverage. Further, we include fixed effects for the firm, year, and strategy, clustering at the fund level. All flow and return measures are winsorized at the 1% level. The key parameter plotted is β, which captures the extent to which high insider funds experience greater dilution of returns when more capital is deployed, consistent with returns to scale which are more decreasing.

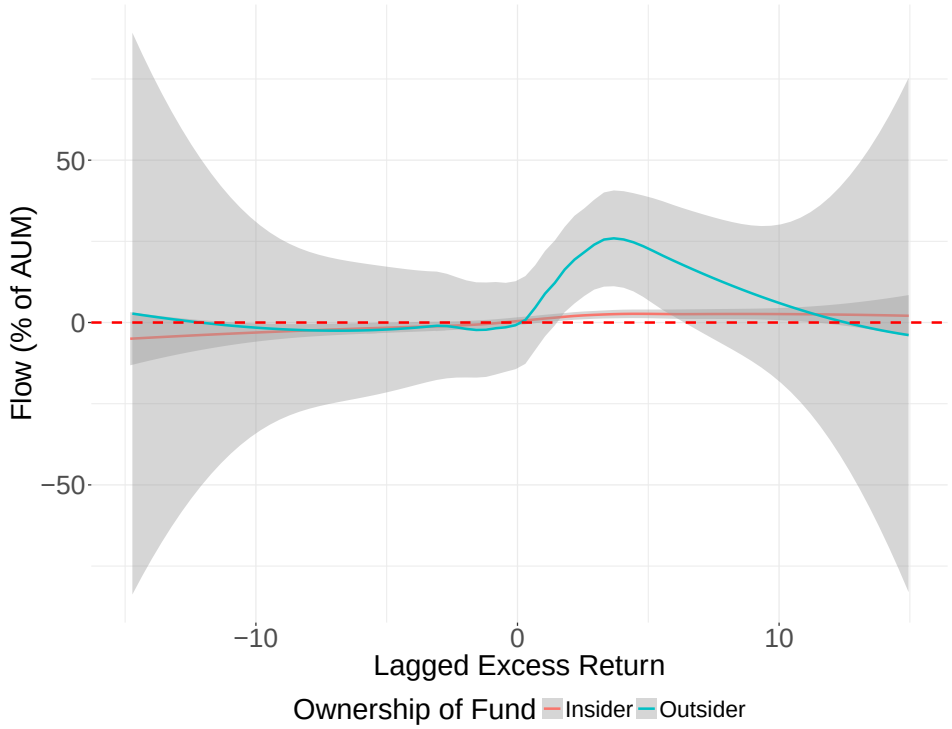


FIGURE V **Flow Performance of Funds by Insider Status**

This figure plots the density of the relationship between lagged excess return and contemporaneous flow. The flow measure is defined as $Flow_{it} = \frac{AUM_{it} - (1+r_{it}) \cdot AUM_{i,t-1}}{AUM_{i,t-1}}$. Excess returns are defined using the Fung-Hsieh Seven-Factor model. Funds are divided by the average level of inside investment into insider funds ($>$ 20.8% Inside Investment) and outsider funds. Grey bars correspond to 95% confidence intervals. Flows are winsorized at a 1% level.

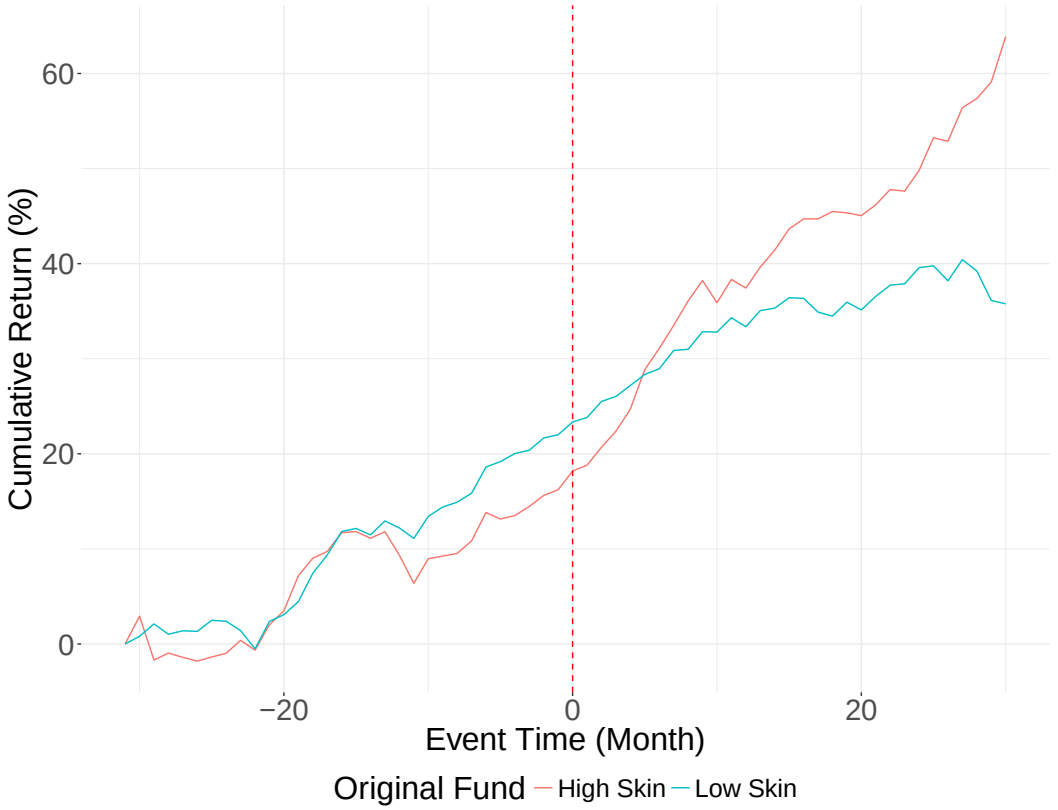
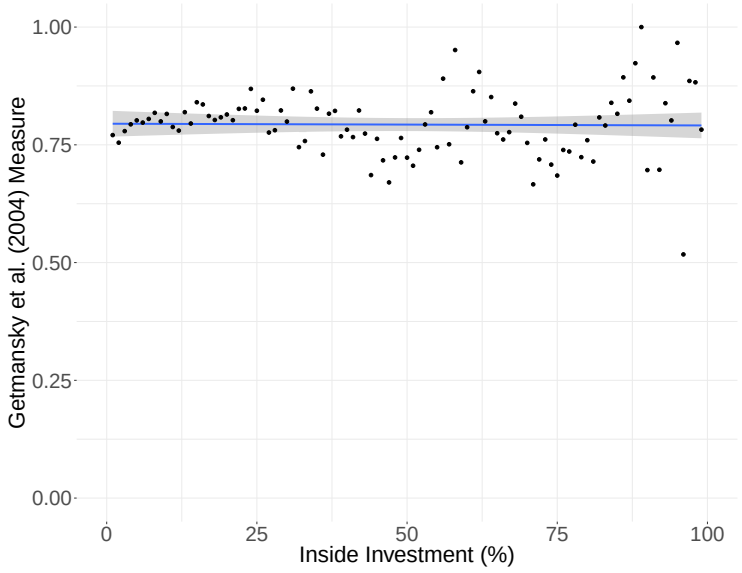
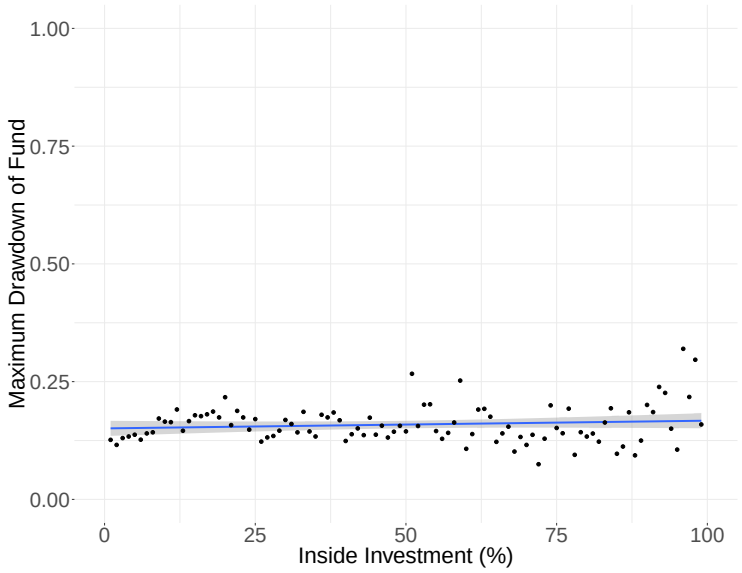


FIGURE VI **Event Study, Transition From One Fund to Multiple Funds**

This figure plots the net cumulative returns of a firm which launches an additional fund after previously only having one. Event times correspond to months from the fund creation date. The lines plot the cumulative performance of the original fund, with the red line tracking a fund in which inside investment increases in the original fund after new fund creation (suggesting that the newly created fund is marketed to outside investors). The blue line tracks the performance of funds in which inside investment the original fund falls after new fund creation (suggesting that the original fund is marketed to outside investors). The red line's post-fund creation rise in returns indicates that fund performance improves when inside investment is strengthened in the fund. In a difference-in-difference regression, the interacted term of High Inside×Post has a coefficient of 0.969 and a standard error of 0.214, which is significant at the 1% level.



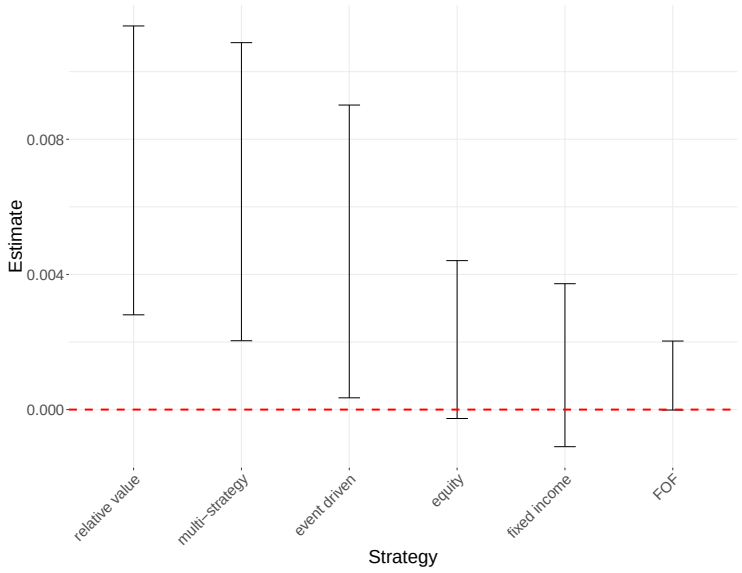
Panel A: Liquidity and Inside Investment



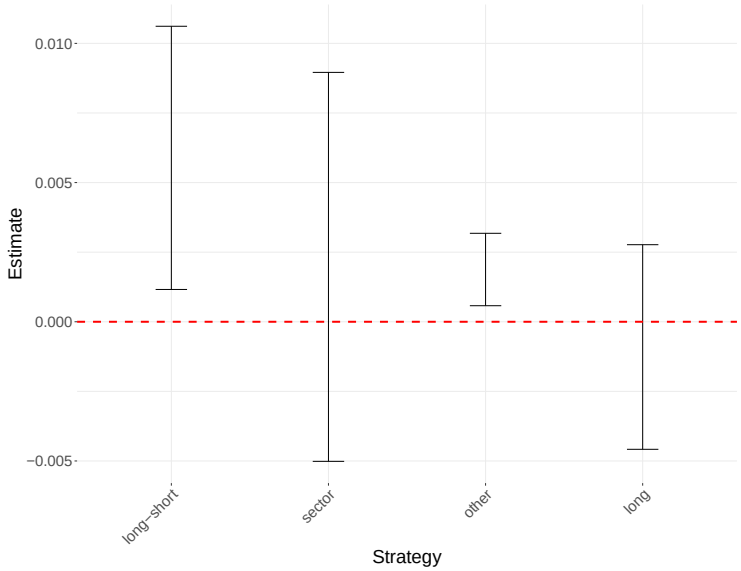
Panel B: Maximum Drawdown and Inside Investment

FIGURE VII **Alternative Risks and Inside Investment**

This figure explores the relationship between alternate possible risks and inside investment. In Panel A, we examine asset liquidity. To measure liquidity, we adopt the return smoothing measure from Getmansky, Lo, and Makarov (2004). For each percent of inside investment, we compute the average normalized measure of liquidity risk, as highlighted in that paper. Lower measures correspond to greater autocorrelation, indicative of less liquidity; higher numbers associate with less autocorrelation, associated with more liquidity (or a worse fit). In Panel B, we plot the distribution of maximum drawdowns (the greatest percentage loss in the fund's history, relative to the maximum attained asset value) across inside investment, so higher numbers indicate a greater average percentage loss. For each percent of inside investment, we plot the average max drawdown for funds in that bucket.



Panel A: Effects by Fund Type



Panel B: Effects by Fund Type among Equity Funds

FIGURE VIII **Inside Investment Return Relationship by Fund Type**

This figure presents a robustness analysis of our main specification, as shown in column 2 of Panel A of Table VIII, which is a panel regression of inside investment against factor-corrected returns. This figure plots the coefficient on inside investment, corresponding to the predictive value of that variable on excess returns, run in a separate regression for each fund category. Funds are categorized based on descriptions found in commercial hedge fund datasets, as listed in the Data section. The error bars indicate a 95% confidence interval for the estimated coefficients.

TABLE I **Summary Statistics: ADV Data**

This summary table describes data on investment advisors taken from Form ADV in 2016. Data is only taken from funds which are registered as hedge funds; firms must have at least one hedge fund and a minimum level of assets of $20 million. Panel A describes firm level information at the level of the management company. Panel B describes information available at the level of individual funds. Note that some assets may be double-counted due to the inclusion of fund of funds. Inside Investment corresponds to ownership by management or related parties, the key variable explored in this paper.

Panel A: **Firm Level Variables**

Names	Total	Median	Mean	Std.Dev
Custodial AUM ($m)	8,525,754.0	775.5	6,458.9	28,332.9
Regulatory AUM ($m)	18,084,715	1,166.7	13,700.5	72,114.3
Discretionary AUM ($m)	17,518,589	1,030.8	13,271.7	71,040.1
Non-Discretionary AUM ($m)	566,126	0	428.9	2,585.1
Number of Employees	139,264	13	57.2	199.0
— Support Staff	81,033	5	33.3	132.9
— Advisors	58,231	7	23.9	75.6
Number of Firms	2,433			

Panel B: **Fund Level Variables**

Names	Total	Median	Mean	Std.Dev
Number of Hedge Funds	9,763			
Gross Asset Value ($m)	6,177,174.0	127.8	632.7	3,060.7
Gross Assets, Inside Investment ($m)	772,663	3.8	79.1	553.2
Gross Assets, Fund of Funds ($m)	1,160,354.0	0	118.9	873
Gross Assets, Non-US Investors ($m)	2,492,344.0	4.7	255.3	1,698.6
Number of Owners		19	66.8	544.3
Minimum Investment ($m)		1	7.5	70.3
Inside Investment (%)		3	16.7	28.6
Investment by Fund of Funds (%)		0	15.9	29.5
Non-US Investors (%)		4	30.7	39.0
Number of Fund of Funds	2,322			

TABLE II **Summary Statistics: Merged Data**

This summary table describes data on the primary dataset based on a merged dataset of Form ADV and commercial hedge fund data providers (Eureka, HFR, BarclaysHedge, eVestment, and CISDM). Data is taken as of 2016. Data is only taken from funds which are registered as hedge funds; firms must have at least one hedge fund and a minimum level of assets of $20 million. Panel A describes firm level information at the level of the management company. Panel B describes information available at the level of individual funds. Note that some assets may be double-counted due to the inclusion of fund of funds. Panel B reports additional variables not included in Table 1. Inside Investment corresponds to ownership by management or related parties, the key variable explored in this paper.

Panel A: **Firm Level Variables**

Names	Total	Median	Mean	Std.Dev
Custodial AUM	1,195,040.0	591	5,218.5	16,444.6
Regulatory AUM	1,759,749.0	1,022	7,684.5	27,716
Discretionary AUM	1,750,849	952.9	7,645.6	27,633.2
Non-Discretionary AUM	8,899.7	0	38.9	195.1
— Number of Employees	16,665	12	38.8	100.4
— Number of Support Staff	9,941	5	23.1	72.4
Advisors	6,724	6	15.6	29.9
Number of Firms	504			

Panel B: **Fund Level Variables**

Names	Total	Median	Mean	Std.Dev
Number of Hedge Funds	720			
Gross Asset Value ($m)	497,625.5	88.3	278.3	708.9
— Equity	219,868.9			
— Relative Value	122,522.7			
— Fund of Funds	53,330.4			
— Multi-Strategy	55,526.5			
— Fixed Income	29,912.7			
— CTA	26,240.1			
— Event Driven	22,403.2			
— Other	20,527.9			
— Options	623.5			
Gross Assets, Inside Investment ($m)	61,380.4	11.9	41.5	108.8
Gross Assets, Fund of Funds ($m)	73,352.2	0	45.8	200.8
Gross Assets, Non-US Investors ($m)	176,673.4	0.2	112.5	400.9
Number of Owners		39	162.3	865.0
Minimum Investment ($m)		1	1.1	3.3
Inside Investment (%)		10	22.8	27.1
Investment by Fund of Funds (%)		0	9.0	16.7
Non-US Investors (%)		1	24.6	36.2
Management Fee		1.5	1.5	0.5
Performance Fee		20	18.2	5.4
Leverage Ratio		1.1	1.5	0.9

TABLE III **Related Party Information**

This table illustrates the identity of related parties, as listed in form ADV in 2016. The rows need not sum to one: firms select as many options as needed to identify all related parties.

Statistic	Mean	SD
Sponsor of GP	0.741	0.438
Other Investment Advisor	0.501	0.500
Commodity Pool	0.401	0.490
Broker/Dealer	0.160	0.367
Insurance	0.065	0.246
Sponsor of LP	0.046	0.210
Bank or Thrift	0.045	0.207
Trust	0.042	0.201
Pension	0.027	0.161
Accountant	0.025	0.156
Real Estate	0.024	0.153
Lawyer	0.019	0.138
Municipal Advisor	0.013	0.113
Futures Merchant	0.009	0.094
Swap Dealer	0.007	0.081
Swap Participant	0.001	0.026
Share Supervised Persons	74%	
Share Office	59%	

TABLE IV **Summary Statistics of Dependent Variables**

This table presents the summary statistics of key dependent variable used throughout the paper. Each panel summarizes the 10th, 25th, 50th, and 90th percentile, as well as the mean and standard deviation. Years include 2011 through 2016, inclusive. Panel A summarizes the excess return imputed by a Fama-French and Carhart model. Panel B summarizes the excess return imputed by the a Fung-Hsieh model. Panel C summarizes the percent asset flow, computed quarterly, and winsorized at the 1% level. Panel D summarizes the percent of inside investment at the fund level.

Panel A: **Alpha from Fama-French and Carhart Model**

Year	10%	25%	50%	75%	90%	Mean	St.Dev
2011	-3.73	-1.68	-0.16	1.00	2.49	-0.46	3.25
2012	-2.28	-0.79	0.31	1.31	2.68	0.24	2.53
2013	-2.28	-0.85	0.18	1.13	2.49	0.14	2.56
2014	-2.55	-0.96	0.14	1.17	2.71	0.14	3.25
2015	-2.77	-1.09	0.13	1.25	2.90	0.16	3.26
2016	-3.36	-1.58	-0.02	1.15	2.77	-0.26	3.13

Panel B: **Alpha from Fung-Hsieh Model**

Year	10%	25%	50%	75%	90%	Mean	St.Dev
2011	-3.49	-1.17	0.27	1.69	3.94	0.18	3.72
2012	-2.59	-0.84	0.37	1.54	3.18	0.32	2.85
2013	-1.51	-0.20	0.84	2.18	3.87	1.04	2.73
2014	-2.81	-0.97	0.40	1.82	3.73	0.45	3.49
2015	-3.48	-1.24	0.28	1.69	3.76	0.23	3.57
2016	-3.79	-1.25	0.31	1.73	3.69	0.07	3.54

Panel C: **Percent Flow, Quarterly**

Year	10%	25%	50%	75%	90%	Mean	St.Dev
2011	-9.66	-4.11	-0.44	1.29	6.49	-1.13	10.83
2012	-10.55	-3.45	-0.07	2.96	11.92	1.04	14.78
2013	-9.26	-2.93	0.24	4.09	17.89	2.86	17.21
2014	-7.66	-2.56	0.02	3.31	12.38	1.59	14.53
2015	-8.49	-3.12	-0.51	1.49	9.62	0.42	12.20
2016	-10.08	-3.82	-0.57	1.59	8.58	-0.32	12.42

Panel D: **Inside Investment, Percentage**

Year	10%	25%	50%	75%	90%	Mean	St.Dev
2011	2	4	9	22	46	17.35	20.87
2012	2	4	10	23	50	17.89	21.04
2013	2	4	10	25	54	19.11	21.59
2014	2	5	11	26	58	20.15	22.48
2015	2	5	11	25	58	20.19	22.72
2016	2	5	11	25	59	20.23	22.74

TABLE V **Inside Investment and Fund Size**

This table shows the panel regression between size and inside investment. Panel A conducts analysis on the matched sample connecting Form ADV with commercial hedge fund datasets (where the key dependent variable is assets under management, taken from the commercial hedge fund datasets, reported as the log of AUM or in millions). Panel B performs analysis on the complete ADV dataset, using Gross Asset Value as the dependent variable. All specifications regress the fraction of the fund which consists on insider investment against a measure of size, measured yearly. Across all specifications, columns 1 and 3 perform this regression with no additional controls; columns 2 and 4 add firm and year fixed effects. Standard errors are in parenthesis.

Panel A: **Results on Matched Dataset**

	AUM (in $m)		Log(AUM)	
	(1)	(2)	(3)	(4)
Inside Investment (Percent)	-3.82^{***}	-7.86^{***}	-0.01^{***}	-0.02^{***}
	(0.24)	(1.20)	(0.001)	(0.003)
Year FE	No	Yes	No	Yes
Firm FE	No	Yes	No	Yes
Fund Controls	No	Yes	No	Yes
Dataset	Matched	Matched	Matched	Matched
Observations	2,633	2,633	2,633	2,633
R^2	0.01	0.88	0.02	0.86

Panel B: **Results on ADV Dataset**

	Gross Asset Value (in $m)		Log(Gross Asset Value)	
	(1)	(2)	(3)	(4)
Inside Investment (Percent)	-6.34^{***}	-10.14^{***}	-0.01^{***}	-0.02^{***}
	(0.89)	(1.12)	(0.001)	(0.001)
Year FE	No	Yes	No	Yes
Firm FE	No	Yes	No	Yes
Fund Controls	No	Yes	No	Yes
Dataset	ADV	ADV	ADV	ADV
Observations	35,960	35,960	35,960	35,960
R^2	0.002	0.57	0.03	0.57

Note: *p<0.1; **p<0.05; ***p<0.01

TABLE VI **Fund Flow Analysis**

This table summarizes the relationship between fund flows and excess returns. Columns 1 and 2 relate excess returns to fund flows of the same funds. Columns 3 through 6 relate excess returns to fund flows of funds within the same family, referred to as complementary funds. Columns 5 and 6 restrict their analysis to funds where the inside investment is greater than the median level. Firm, inception year, calendar year, and strategy fixed effects are included in all regressions.

	Flow Percent	Flow Percent >0	Complementary Flow Percent	Complementary Flow Percent >0	Complementary Flow Percent	Complementary Flow Percent >0
	(1)	(2)	(3)	(4)	(5)	(6)
High Ownership	−0.0073	0.0295	−0.0033	0.0201		
	(0.0079)	(0.0331)	(0.0121)	(0.0403)		
Excess Return$_{t-1}$	0.1880***	0.7927***	−0.1365	−0.3876*	0.0121	−0.3650
	(0.0509)	(0.2714)	(0.1238)	(0.2340)	(0.1206)	(0.2230)
Excess Return$_{t-2}$	0.1780***	0.7715***	−0.2110*	−0.7776**	−0.1350	−0.6218
	(0.0639)	(0.2541)	(0.1216)	(0.3324)	(0.1275)	(0.4062)
Excess Return$_{t-3}$	0.2122***	0.7774***	−0.1875*	−0.7340**	−0.1188	−0.5208*
	(0.0685)	(0.2081)	(0.0967)	(0.2971)	(0.0810)	(0.3019)
Excess Return$_{t-1}$×Insider	−0.0523	−0.1669				
	(0.0713)	(0.2577)				
Excess Return$_{t-2}$×Insider	−0.0960	−0.4574**				
	(0.0900)	(0.1960)				
Excess Return$_{t-3}$×Insider	0.0056	−0.1894				
	(0.0792)	(0.3437)				
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Inception Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Strategy FE	Yes	Yes	Yes	Yes	Yes	Yes
High Ownership	No	No	No	No	Yes	Yes
Observations	4,918	4,918	2,130	2,130	1,133	1,133
R^2	0.2563	0.2612	0.2325	0.2163	0.4750	0.2462

Note: *p<0.1; **p<0.05; ***p<0.01

TABLE VII **Open for New Investments**

This table shows the panel regressions between fund and whether they are open for new investments. The analysis is based on the HFR, Eurekahedge, and BarclayHedge datasets. Columns 1 and 2 relate percent of inside investment to the openness of a fund. Columns 3 and 4 relate the openness of the fund to monthly excess returns, as measured by the Fung-Hsieh Seven-Factors model. Columns 5 and 6 similarly show results with and without controls for the Fama-French and Carhart model.

	Open for Investors		Excess Returns (FH)		Excess Returns (FFC)	
	(1)	(2)	(3)	(4)	(5)	(6)
Inside Investment (%)	-0.0013^{***}	-0.0021^{***}				
	(0.0003)	(0.0003)				
Open for Investors			-0.2291^{**}	-0.2186^{***}	-0.4463^{***}	-0.3141^{***}
			(0.0971)	(0.0746)	(0.0660)	(0.0706)
Fixed Effects	No	Yes	No	Yes	No	Yes
Log(Fund Size)	No	Yes	No	Yes	No	Yes
Sample:	Yearly	Yearly	Monthly	Monthly	Monthly	Monthly
Observations	1,977	1,977	12,065	12,065	12,065	12,065
R^2	0.0069	0.1385	0.0007	0.0168	0.0034	0.0130
Note:						*p<0.1; **p<0.05; ***p<0.01

TABLE VIII **Relationship between Inside Investment and Excess Return**

This table shows the panel regression between the excess monthly return of an investment advisor and the percent investment from an insider or related party. The first two columns always regress against the Fung-Hsieh Seven Factors, and the second two columns always regress against the Fama-French and Carhart Four-Factor model, as outlined in equations 4 and 5 in the text. A size control is always included. Panel A shows a panel regression of percentage inside investment against excess returns. Column 4 includes only a size control, while column 2 also adds additional fund controls (a year fixed effect, a firm fixed effect, and controls for age of fund inception and strategy type). Columns 3 and 4 similarly show results with and without controls for the Fama-French and Carhart model. Panel B shows panel results which change the main dependent variable from percentage inside investment to gross inside investment (log of total insider capital committed). Standard errors are clustered monthly for Panels A and B. Finally, Panel C illustrates a Fama-MacBeth cross-sectional specification. This specification differs in that year and firm fixed effects are not included, and standard errors are computed using the Fama and MacBeth (1973) approach.

Panel A **Baseline Specification**

	FH Excess Returns		FFC Excess Returns	
	(1)	(2)	(3)	(4)
Inside Investment (Percent)	0.0024***	0.0048***	0.0024***	0.0048***
	(0.0009)	(0.0015)	(0.0009)	(0.0013)
Year FE	No	Yes	No	Yes
Firm FE	No	Yes	No	Yes
Fund Controls	No	Yes	No	Yes
Log(Fund Size)	Yes	Yes	Yes	Yes
Observations	41,097	41,097	41,097	41,097
R^2	0.0003	0.0368	0.0009	0.0404

Panel B: **Gross Inside Investment**

	FH Excess Returns		FFC Excess Returns	
	(1)	(2)	(3)	(4)
Inside Investment (Gross)	0.0397**	0.0710**	0.0297**	0.0856***
	(0.0184)	(0.0284)	(0.0150)	(0.0235)
Year FE	No	Yes	No	Yes
Firm FE	No	Yes	No	Yes
Fund Controls	No	Yes	No	Yes
Log(Fund Size)	Yes	Yes	Yes	Yes
Observations	41,097	41,097	41,097	41,097
R^2	0.0002	0.0367	0.0008	0.0404

Panel C: **Fama MacBeth Approach**

	FH Excess Returns		FFC Excess Returns	
	(1)	(2)	(3)	(4)
Inside Investment (Percent)	0.0024***	0.0020**	0.0020**	0.0021**
	(0.0008)	(0.0008)	(0.0008)	(0.0009)
Year FE	No	No	No	No
Firm FE	No	No	No	No
Fund Controls	No	Yes	No	Yes
Log(Fund Size)	Yes	Yes	Yes	Yes
Observations	41,097	41,097	41,097	41,097
R^2	0.1662	0.2034	0.0469	0.0690

Note: *p<0.1; **p<0.05; ***p<0.01

TABLE IX **Fund Flows and Performance**

This table shows the panel regression between size and flows by insiders and outsiders. "Insider Flow" corresponds to changes in capital provided by insiders and related parties, while "Outsider Flow" captures changes in capital provision by all other investors. Changes in both types of flow are measured annually with the release of new ADV forms. Column 2 adds year fixed effects, and column 3 adds firm fixed effects. Standard errors are clustered at the year level.

	(1)	(2)	(3)
Insider Flow (%)	−0.00034	−0.00025	−0.00029
	(0.00023)	(0.00023)	(0.00039)
Outsider Flow (%)	0.00002	0.00003	0.00003*
	(0.00002)	(0.00002)	(0.00002)
Size	Yes	Yes	Yes
Year FE	No	Yes	Yes
Firm FE	No	No	Yes
Observations	228	228	228
R^2	0.00372	0.05192	0.11300
Note:			*p<0.1; **p<0.05; ***p<0.01

A Internet Appendix: Model

To fix ideas, we outline a simple, rational, two-period partial equilibrium model that highlights how the internal capital allocation decisions of hedge fund managers interact with measured performance. We model active portfolio managers who are maximizing their profits by selectively allocating insider capital between a family of funds under their control. Insiders rationally allocate internal capital across strategies to maximize total profits.

Our simple model has several salient features that differ from previous work. First, we disaggregate capital into insiders and outsiders. This step captures the idea that an insider's earnings are tied to both management fees earned on outside capital and returns on insider capital. We also model endogenous fund generation in the form of multiple investment strategies and managerial discretion to differentially allocate insider capital across these strategies. For clarity, in both notation and results, we focus on a two-period model. Finally, costs in our model are convex in *gross returns*, as in Berk and van Binsbergen (2017), as this helps match stylized facts we observe in the data.

A.1 Capital: Insider and Outsider

There are two types of investors in our model: insiders and outsiders.

An *insider* is an investor with highly specialized arbitrage skills.[23] This maps in practice to someone who has access to a positive alpha strategy (i.e., portfolio managers, hedge fund employees, and closely related parties). An investor can invest in their strategy, in the appropriate passive benchmark portfolio, or a combination of both.

An *outsider* refers to anyone who is not an insider. They can be thought of as limited partners who delegate their capital to a manager through a fund. By definition, outsiders

[23] We take a similar view to Shleifer and Vishny (1997) that arbitrage is typically carried out by a few, highly specialized investors.

do not possess specialized skills. As such, outsiders can invest their capital in the appropriate passive benchmark portfolio, delegate their capital to these insiders to access investment strategies, or a combination of both. We assume full competition among outside investors.

Capital is denoted by q and any superscript notation indicates who supplies the capital. Total capital, insider capital, and outsider capital are denoted by q^T, q^I and q^O, respectively. Total capital is defined as:

$$q^T \equiv q^I + q^O \tag{12}$$

We exclude the possibility of leverage and define total capital (q^T) as the sum of inside (q^I) and outside capital (q^O). Further, we exclude the possibility of short-selling, so $q^I, q^O \geq 0$.[24]

A.2 Investment Technology

An active manager specializes in N strategies indexed by n. Each strategy has limited investible capacity. More capital invested in a strategy at time t, either from an insider or an outsider, results in a lower gross excess return. Formally, we define the gross return to strategy n at time $t+1$, for an investment of $q_{n,t}$, by:

$$R_{n,t+1} = \alpha_n - C_n\left(q^T_{n,t}\right) \tag{13}$$

The excess return is above an appropriate passive benchmark to which all investors are assumed to have access. The first term, α_n, captures the maximum alpha to strategy n and is by assumption positive ($\alpha_n > 0$). The second term is a cost function, $C_n\left(q^T_{n,t}\right)$, which depends on the *total* capital invested at period t in strategy n. The cost function is strictly non-negative ($C \geq 0$), increasing, convex ($C' > 0$, and $C'' > 0$). Further, at no investment, $C(0) = 0$, and in the limit, $\lim_{q^T_t \to \infty} C'(q^T_{n,t}) = \infty$.[25] The assumption of decreasing returns to scale is motivated by research suggesting a negative relationship between size and performance, such as Fung, Hsieh, Ramadorai, and Naik (2008).

[24] Including leverage subject to a collateral constraint does not affect our model results.

[25] This results in a decreasing returns to scale in the gross excess return and a departure from Berk and van Binsbergen (2017), where costs are linear in the return equation.

It is important to emphasize that different strategies have different α_n and cost functions C_n. For model simplicity and to make our analysis concrete, we assume a specific functional form for this cost: $C_n\left(q_{n,t}^T\right) = \frac{b_n}{2}\left(q_{n,t}^T\right)^2$ (we relax this assumption in an alternative model assumption). The scale cost is non-negative, $b_n \geq 0$, and captures how well the strategy scales.[26] A smaller scale cost indicates that a strategy scales better. An example of the trade-off between strategies with different excess return and scale is shown in Figure A.1. Our analysis assumes that capacity constraints operate at the level of each fund. Capacity constraints may also operate at larger levels (i.e., convertible bond arbitrage may be a less successful strategy when more funds operate using that strategy); to account for this possibility in our empirical analysis, we control for strategy type. Further, we carry out additional robustness analysis controlling for strategy by year, which also leaves our results unchanged.

To simplify notation, we assume that capital is allocated at time t and accordingly suppress time subscripts on all capital variables q. All returns are assumed to occur at $t+1$, and time subscripts are omitted for returns as well. For exposition and clarity, we abstract from time dynamics beyond the two-period model and risk preferences in this deterministic setup.

A.3 Baseline Model: One Strategy

We focus first on the case in which firms have only one strategy, $N = 1$, and omit the subscript indexing of strategies. We identify the total dollar payoff to managers. The total dollar payoff, V^I, is defined as the profit from investing in their own strategy in addition to fees collected on managed outsider capital.

We assume that the management fee, f, is a fraction of outside capital invested, taking these as given. More realistically, hedge fund fees also incorporate a performance fee on returns above a certain hurdle rate, assuming the fund's value exceeds a high water mark,

[26] Costs are orthogonal to risk factors and collinear with α_n.

as well as exit fees. We incorporate performance fees in the additional analysis below. Outsider dollar payoff is similar to the insider dollar payoff but subtracts the fees:

$$V^I = q^I\left(R\left(q^T\right)\right) + q^O f \tag{14}$$

$$V^O = q^O\left(R\left(q^T\right)\right) - q^O f \tag{15}$$

A.3.1 Case 1: Unconstrained Inside Capital

We first consider the case where insider capital is unconstrained. How much would an insider invest in their own fund? Absent outside investors, the insiders' objective can be written as:

$$\arg\max_{q^I} \quad V^I = q^I\left(\alpha - C\left(q^I\right)\right)$$

With a solution:

$$\bar{q}^{I*} = \sqrt{\frac{2\alpha}{3b}}. \tag{16}$$

Notice that if $\bar{q}^{I*} = q^T$, insiders are sufficiently capitalized and refuse outside capital. Performing a substition back into equation 14, which represents the total dollar payoff to insiders, we obtain $\frac{2\alpha q^I}{3}$, which corresponds to the maximum achievable investor returns from the strategy.

A.3.2 Case 2: Fully Constrained Inside Capital

Next, we consider the case where insider capital is fully constrained, and are unable to pledge any of their capital to a strategy. How much outsider capital would they accept? Outsiders will continue to invest until the benefit from investing in the strategy is equal to zero. The maximum q^O is given by:

$$\bar{q}_t^{O*} = \sqrt{\frac{2\left(\alpha - f\right)}{b}}. \tag{17}$$

Notice that the total dollar payoff to outsiders is driven to zero (as the result of our assumption of full competition among outside investors). Further, the insider only earns management fees.

A.3.3 Case 3: Constrained Inside Capital

We next consider the interior case where an insider has only one investment strategy but it is capital-constrained. That is, $q_t^I \in \left[0, \bar{q}_t^{I*}\right)$. How much outside capital should the insider accept? The insiders choose the amount of outside capital to maximize the objective, subject to the outsider capital providers' participation constraint. These conditions are given by:

$$\arg\max_{q^O} \quad q^I\left(\alpha - C\left(q^T\right)\right) + fq^O \tag{18}$$

$$\text{subject to } V^O \equiv q^O\left(\alpha - C(q^T)\right) - fq^O \geq 0 \tag{19}$$

When $q^O > 0$, and the insider collects a proportional and fixed management fee, f, for their services. The model is solved by:

$$q^{O^*} = \begin{cases} \sqrt{\frac{2(\alpha-f)}{b}} - q^I & if\ \alpha - f < \frac{f^2}{2b(q^I)^2} \\ \frac{f}{bq^I} - q^I & if\ \left(\frac{f}{bq^I} - q^I\right)\left(\alpha - f - \frac{f^2}{2b(q^I)^2}\right) > 0 \\ 0 & else\ \sqrt{\frac{f}{b}} < q^I \end{cases}$$

The first region is the case where both insiders and outsiders allocate to the strategy. Insiders are highly capital constrained, and outsiders can allocate capital up to the point where their participation constraint is binding. As a result, the total dollar payoff to outsiders is equal to zero. In this region, insiders can increase their capital level, which would directly replace the level of outsider capital.

The second region is the case where an insider can maximize their own total dollar payoff by limiting the level of outsider capital. Outsiders would prefer to contribute more capital, but this action would not maximize the total dollar payoff to insiders. As a result, the remaining outside investors earn a positive total dollar payoff from investing in the strategy.

The final region is the case where the outsider's participation constraint is binding. The insider has reduced the gross return of the strategy to the point where the marginal benefit to an additional dollar from an outsider is less than the marginal cost of fees and the capacity constraint. As a result, no outsider would contribute to this strategy. Notice that insiders may continue to contribute to this strategy, as they do not pay fees.

Proposition 1 *For a non-binding management fee and positive level of outside investment, total capital decreases as a portion of insider capital.*

Proof Consider an investment strategy managed by an insider with a non-binding fee, $0 < f < \frac{2}{3}\alpha$, and a positive level of outside investment, $q^O > 0$. Outsider capital q^T decreases in the level of insider investment. This result can be seen directly:

$$\frac{dq^{O^*}}{dq^I} = \begin{cases} -1 & if\ \alpha - f < \frac{f^2}{2b(q^I)^2} \\ -\frac{f}{bq^{I^2}} - 1 & if\ \left(\frac{f}{bq^I} - q^I\right)\left(\alpha - f - \frac{f^2}{2b(q^I)^2}\right) > 0 \end{cases}$$

Proposition 2 *Gross returns increase in inside investment for non-binding management fees and positive levels of outside investment.*

Proof The fact that gross returns decrease in scale follows immediately from our assumption of convex costs. In conjunction with the previous proposition, this finding implies that returns increase in inside capital in the region with non-binding management fees and a positive level of outside investment.

Proposition 3 *Total dollar payoff to insiders increases as a fraction of insider investment*

Proof Plugging the optimal level of outsider capital q^{O^*} into the total dollar payoff to insiders, we have:

$$V^I = \begin{cases} f\sqrt{\frac{2(\alpha-f)}{b}} & if\ \alpha - f < \frac{f^2}{2b(q^I)^2} \\ (\alpha - f)\, q^I - \frac{f^2}{2bq^{I^2}} + f\sqrt{\frac{2(\alpha-f)}{b}} & if\ \left(\frac{f}{bq^I} - q^I\right)\left(\alpha - f - \frac{f^2}{2b(q^I)^2}\right) > 0 \\ q^I\left(\alpha - \frac{b}{2}q^{I^2}\right) & else\ \sqrt{\frac{f}{b}} < \bar{q}_t^{I*} \end{cases}$$

Taking the derivative of the total dollar payoff to insiders with respect to insider capital, we obtain:

$$\frac{dV^I}{dq^I} = \begin{cases} 0 & if\ \alpha - f < \frac{f^2}{2a(q^I)^2} \\ (\alpha - f) + \frac{f^2}{aq^{I^3}} & if\ \left(\frac{f}{aq^I} - q^I\right)\left(\alpha - f - \frac{f^2}{2a(q^I)^2}\right) > 0 \\ \alpha - \frac{3a}{2}q^{I^2} & else\ \sqrt{\frac{f}{a}} < \bar{q}_t^{I*} \end{cases}$$

A.4 Extension: Alternative Fee Specifications

A.4.1 Performance Fees

In this section, we consider the more realistic situation in which managers charge both management and performance fees on excess returns. In this case, funds levy both a proportional management fee f as well as a percentage g of performance fees on additional excess returns. The manager's problem in this case reduces to:

$$\arg\max_{q^O} \qquad \left(q^I + gq^O\right)\left(\alpha - \frac{b}{2}\left(q^T\right)\right) + fq^O \tag{20}$$

$$\text{subject to } V^O \quad \equiv \quad (1-g)\, q^O\left(\alpha - \frac{b}{2}(q^T)\right) - fq^O \geq 0 \tag{21}$$

The key result of our model—that returns increase in inside capital—persists in this alternative specification.

Proposition 4 *For non-binding fees and a positive level of outside investment, gross returns increase in the percent of insider capital*

Proof We focus on the interesting case in which inside capital is scarce but non-zero, so that funds contain a mix of both inside and outside capital. In this case, funds take fees as given and choose the level of outside capital to enter the fund. The solution to the optimal outsider capital is given by:

$$q^O = \frac{2q^I\left(b+2bg\right)+2\sqrt{q^{I2}\left(b+2bg\right)^2+6bg\left(g\alpha+f-q^{I2}\left(\frac{2b+bg}{2}\right)\right)}}{3bg}.$$

The key relation defining how returns change with the proportion of inside capital is determined by:

$$\left(\frac{dq^O}{dq^I}\right) = -\frac{\left(b+2bg\right)q^O+\left(2b+bg\right)q^I}{\left(3bg\right)q^O+\left(b+2bg\right)q^I} < -1.$$

In other words, the introduction of an additional dollar of inside capital displaces more than a dollar of outside capital in equilibrium. The intuition behind this result is that when more of their personal capital is at stake, managers internalize the dilutive effects of fundraising on total strategy profits when their own capital is at stake. Given our assumption of quadratic costs, this displacement of capital ensures that fund returns are higher with additional insider investment. Even though performance fees better align the incentives between managers and investors, and hence result in managers not scaling up the size of the fund as much as when they charge only management fees, these fees are not as effective as personal capital contributions (from which insiders gain all of the additional performance benefits).

A.4.2 Linear Cost

In this section, we revert to only considering management fees, but we consider a cost function which is linear (rather than quadratic) in total capital:

$$\arg\max_{q^O} \quad q^I\left(\alpha - \frac{b}{2}\left(q^O + q^I\right)\right) + fq^O \tag{22}$$

$$\text{subject to } V^O = q^O\left(\alpha - \frac{b}{2}\left(q^O + q^I\right)\right) - fq^O \geq 0. \tag{23}$$

Proposition 5 *For non-binding fees and a positive level of outside investment, gross returns increase in the percent of insider capital with linear costs*

Proof Optimal outsider capital is given by:

$$q^{O^*} = \frac{2\alpha}{b} - 2q^I \tag{24}$$

Which immediately yields $\frac{dq^O}{dq^I} < -1$ and so returns increasing in inside capital.

Finally, an important assumption in our model is that managers and investors take fees (either performance or managerial) as given. To justify this assumption, we document in our empirical results that fees tend to be sticky, exhibiting little cross-sectional or time-series variation, and not strongly varying across inside investment. These facts suggest a strong degree of stickiness in price setting which we approximate through fixed fees. In principle, funds could also adjust fees as well as quantities of outside capital they allow into their funds. If funds are able to do so in a fully flexible manner, they will set fees to equal gross returns, so capturing all value-generation from the fund. As long as managers are not able to fully extract fee income from investors, our key results regarding the relationship between inside investment and returns will hold.

A.5 Extension: Two Strategies

Until now, we have considered the case of one strategy. We extend the analysis to an insider who has access to two strategies, $N = 2$. Consider the insider with access to the following returns:

$$R_1 = \alpha_1 - C_1\left(q_1^T\right)$$
$$R_2 = \alpha_2 - C_2\left(q_2^T\right).$$

Without loss of generality, assume that $\alpha_1 > \alpha_2$. The interesting case arises when $b_1 < b_2$. This configuration means that strategy one has a higher alpha, and also a lower higher scale cost, as compared to strategy two.

Capital between the two strategies and investors is given by $q_n^T = q_n^I + q_n^O$ with $n \in \{1, 2\}$. For insiders $q^I = q_1^I + q_2^I$, for outsiders $q^O = q_1^O + q_2^O$, and in aggregate $q^T = q_1^T + q_2^T$. Shorting an insider's management service is ruled out, so $q_n^I \geq 0$ and $q_n^O \geq 0$.

A.5.1 Case 1: Constrained Inside Capital, One Fund

The insider's total dollar payoff is now the sum from each strategy, $V_1^I + V_2^I$. Given this result, how should an insider allocate their capital between strategies? If so, should the insider capital be allocated across strategies? Would an insider ever invest in the low alpha strategy? If so, what rule would govern this?

We first consider the case in which an insider capital is in the range of $0 < q^I < \sqrt{\frac{2\alpha_1}{3b_1}}$. Intuitively, an insider would invest in the high alpha strategy up to the point where the marginal total dollar add equals the low alpha strategy. Phrased differently, the insider would invest in strategy one for the initial range of q^I where:

$$\frac{dV_1^I}{dq_1^I} \geq \frac{dV_2^I}{dq_2^I}. \tag{25}$$

When the above inequality is satisfied, insiders maximize their dollar payoffs by allocating their capital to the high-alpha strategy—which means $q_1^I = q^I$ and $q_2^I = 0$ for the initial insider capital region. The dollar payoff for this partial regions is equal to V_1^I and is outlined in the previous section.

A.5.2 Case 2: Two Strategies, Sufficient Insider Capital, Two Funds

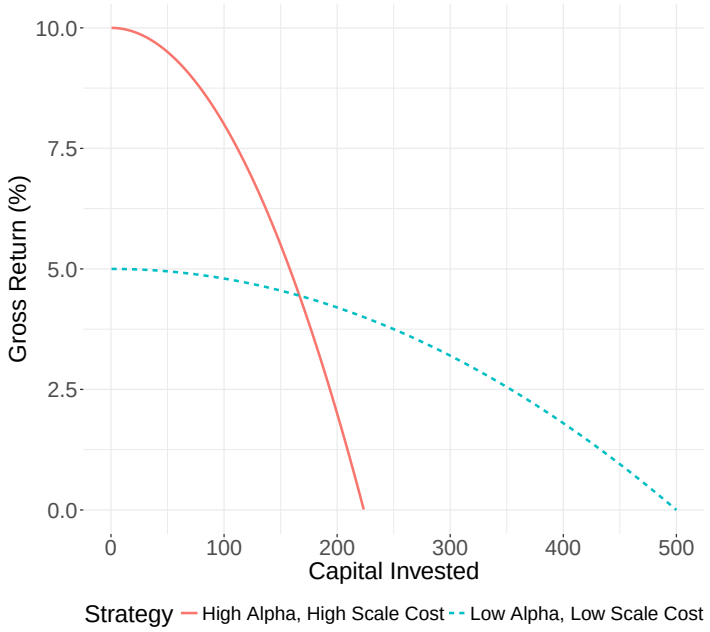
As an insider allocates capital towards strategy one, the marginal payoff of each additional dollar will decrease towards the marginal value of strategy two. That is, at some point, $\frac{dV_1^I}{dq_1^I} = \frac{dV_2^I}{dq_2^I}$ for some $0 < \hat{q}_1^I < \bar{q}_1^{I*}$. Once an insider's capital level reaches the threshold of $\hat{q}_1^I$, they will optimally mix between their two strategies to equate their marginal payoffs to insider capital.

An insider will continue to allocate to *both* strategies, equating the marginal dollar payoff from strategy one to the marginal payoff from strategy two. While we do not explicitly solve the optimal mixing scheme in this paper, we can see a sketch of this strategy in Figure A.2. An insider will continue to strategically allocate insider capital to both strategies for insider capital levels of:

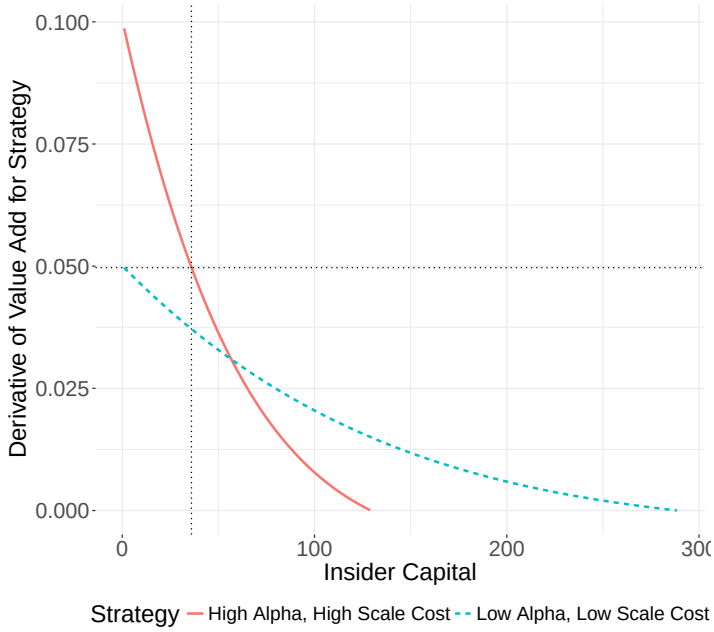
$$q_1^I \in \left[\hat{q}_1^I, \sqrt{\frac{2\alpha_1}{3b_1}} + \sqrt{\frac{2\alpha_2}{3b_2}}\right).$$

If funds raise outside capital, they do so to maximize dollar payoff in each fund subject to the fund-specific participation constraint.[27]

[27] We rule out the possibility that outside investors receive negative payoffs in some funds in order to participate in others.



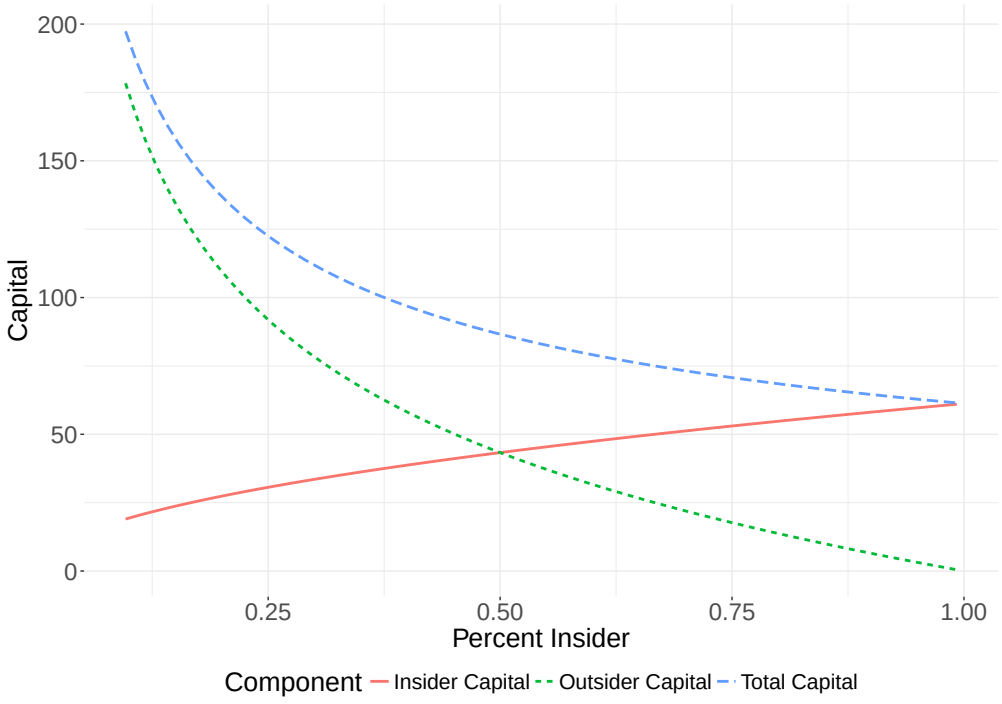
Panel A: Gross Return and Scale



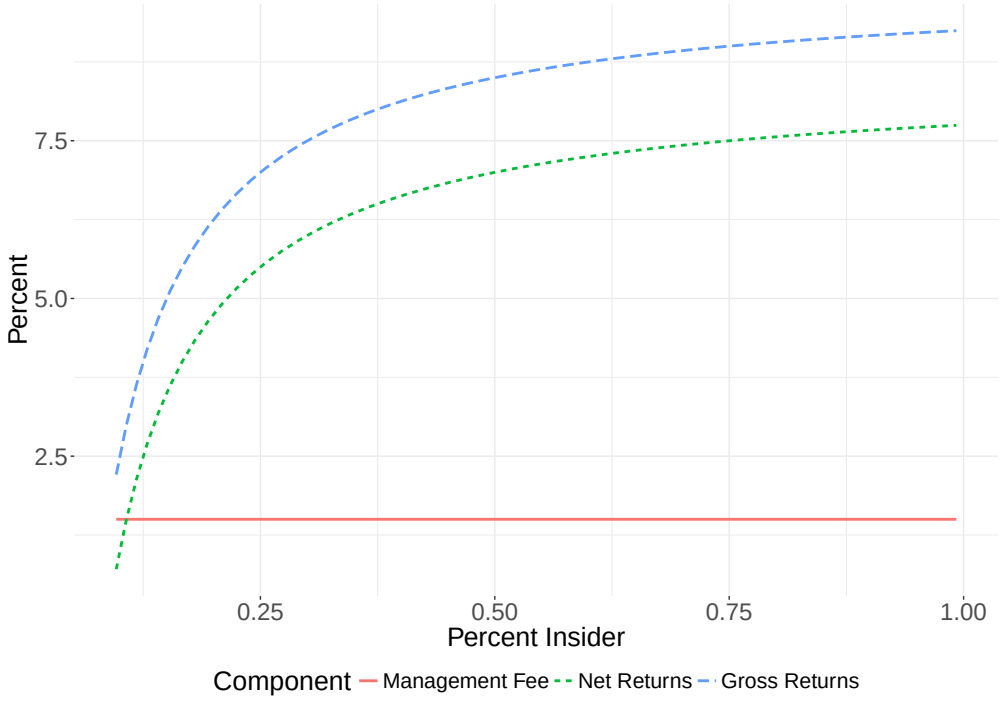
Panel B: Marginal Value-Added by Strategy and Capital

FIGURE A.1 **Return Profiles of Different Strategies**

The above figures shows two strategies. The horizontal axis is the total dollar invested q_t^T in a given strategy, while the vertical axis is $R_{n,t+1}$. The red line refers to a high alpha, high scale costs, while the blue dotted line refers to the low alpha, low scale cost strategy. The first strategy is parameterized by $\alpha = 10\%$, and $b = 4 \times 10^{-6}$, while the second is parameterized by $\alpha = 5\%$ and $b = 4 \times 10^{-7}$. The highest alpha, per strategy, is highest at a zero dollar investment. Panel A shows how gross returns vary across these two strategies as a function of total capital; Panel B shows how the derivative of fund value-added changes as a function of capital across both strategies.



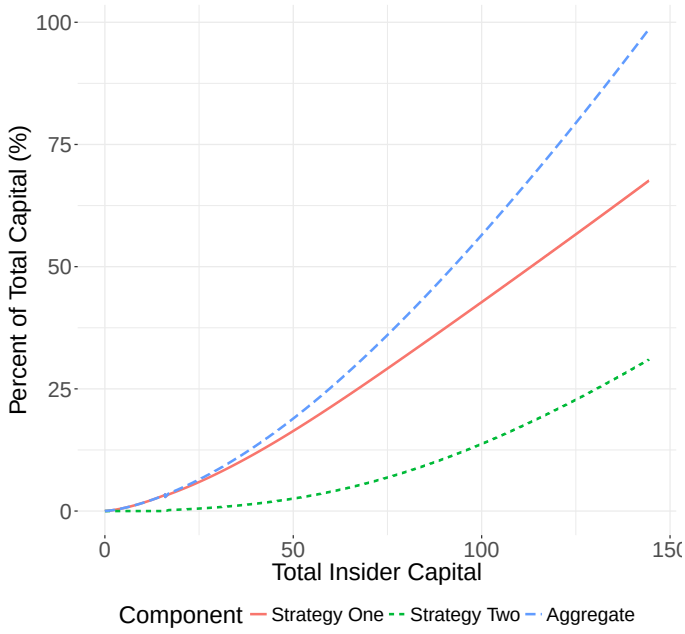
Panel A: Capital Sources



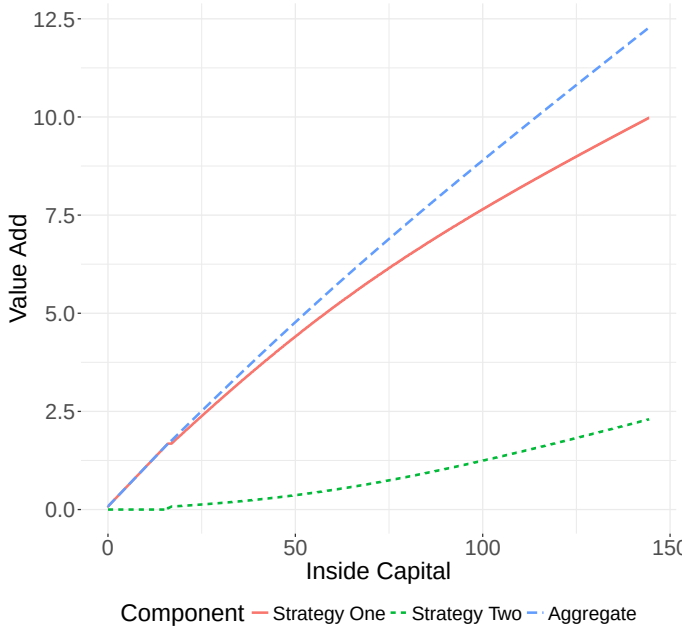
Panel B: Returns by Inside Investment

FIGURE A.2 **Capital and Payoffs**

This figure illustrates the distributions of fund size and returns by fraction of inside investment. Panel A illustrates that the total size of the fund decreases in the fraction of inside capital—the fund operates at a smaller capital capacity the more insiders are invested. Panel B shows that net returns to outsiders are higher with a greater proportion of inside investment. Parameters used in this example are $\alpha = 10\%$ and $b = 4 \times 10^{-6}$.



Panel A: Percent of Inside Capital Allocated Across Funds



Panel B: Payoffs Between Two Strategies

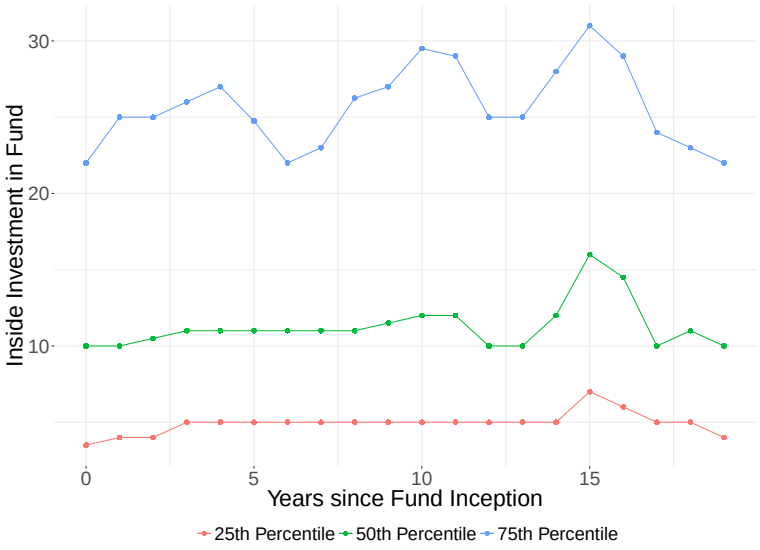
FIGURE A.3 **Percent Inside Allocation and Payoffs of Two Strategies**

This figure shows the optimal percent insider invested in each strategy across the total insider capital. Parameters for the high alpha strategy are $\alpha = 10\%$ and $b = 4 \times 10^{-8}$. Parameters for the low alpha strategy are $\alpha = 5\%$ and $b = 4 \times 10^{-7}$

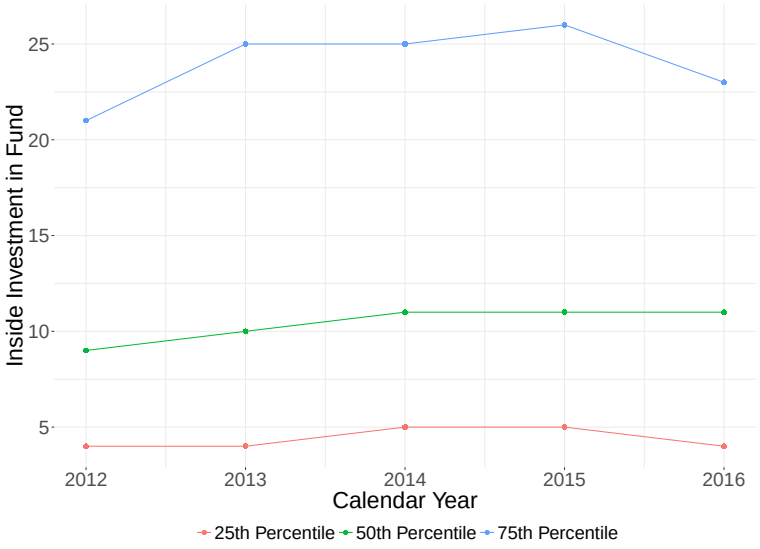
Important Notation

$R_{n,t+1}$	Gross excess return over the relevant benchmark portfolio, after accounting for scale effects of investing in strategy n.
α_n	Gross alpha for the first dollar invested in strategy n. This is the maximum gross excess return over the relevant benchmark, taken to be exogenous.
$r_{n,t+1}$	Net return from strategy n.
q_n^T	Total capital invested in strategy n. By definition, $q_n^T \equiv q_n^I + q_n^O$.
q_n^I	Insider capital invested in strategy n. This is taken to be exogenous.
q_n^O	Outsider capital invested in strategy n. This is taken to be exogenous.
$\bar{q}_n^{I*}$	The maximum amount of capital an insider choses to invest in a strategy if unconstrained.
V_n^I	Dollar payoff to insiders from strategy n. This equals the profit from returns and fees.
V^O	Dollar payoff to outsiders from strategy n. This equals the profit from returns minus fees.
$C_n\left(q^T\right)$	Scale factor of investment strategy. For concreteness, we use $C_n\left(q^T\right) = \frac{b_n}{2}\left(q_n^T\right)^2$ in this paper.
b_n	Scale factor of strategy that is associated with strategy n. This is taken to be exogenous.
f	Management fee as a fraction of the assets delegated by the outsider to the insider.
g	Performance fee as a fraction of the assets delegated by the outsider to the insider.
N	Total number of strategies available to an investor.
n	Refers to an individual strategy n. A strategy has a unique α_n, b_n, and thus $C_n\left(q_n^T\right)$.

B Additional Results



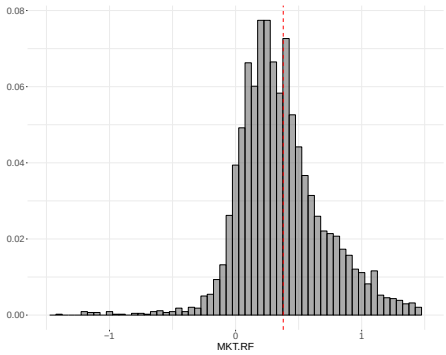
Panel A: Inside Investment against Fund Age



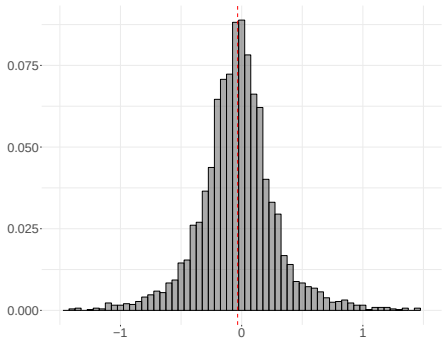
Panel B: Inside Investment against Year

FIGURE B.1 **Evolution of Inside Investment**

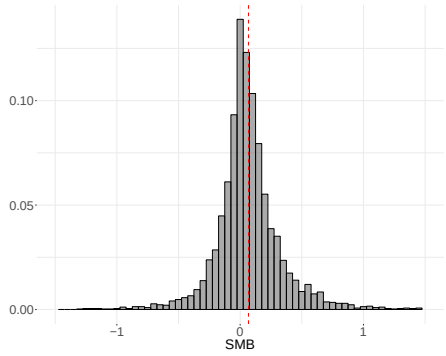
This figure highlights the evolution of inside investment. Panel A highlights the mean level of inside investment of a fund over its lifetime. The red, green, and blue graphs correspond to the 25th, 50th, and 75th percentile of inside investment, respectively. Panel B plots the same statistics over all funds aggregated by calendar year.



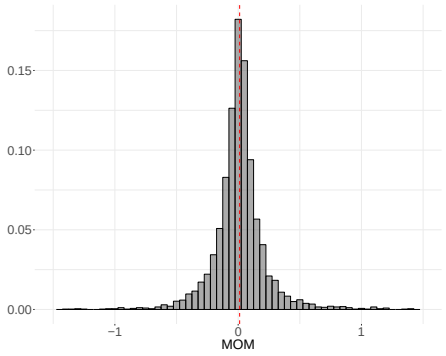
(a) Market Factor



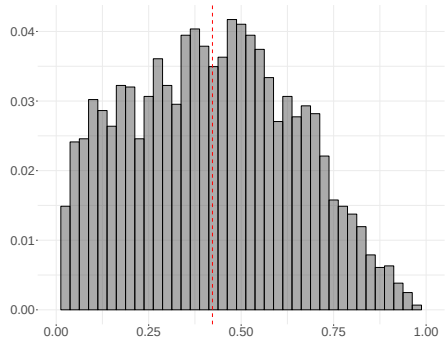
(b) Value Factor



(c) Small Factor



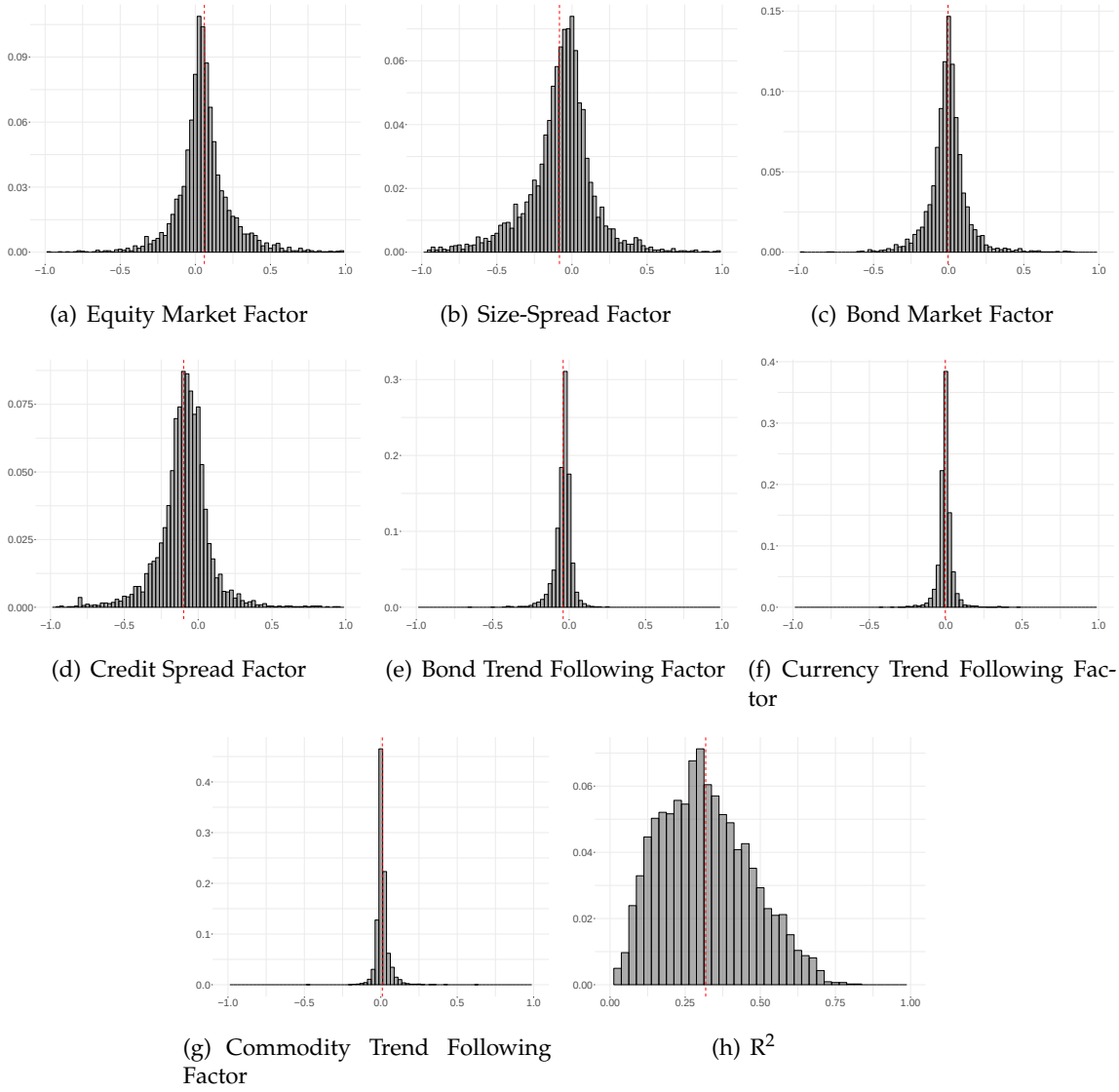
(d) Momentum Factor



(e) R^2

FIGURE B.2 **Factor Distribution in Four-Factor Model**

This figure plots the distribution of factor exposures in the Four-Factor (Fama-French and Carhart) model. The histograms plot the coefficient estimates from a time-series regression of factor exposures against hedge fund returns run for each fund, as well as the R^2 of each model fit.



(a) Equity Market Factor

(b) Size-Spread Factor

(c) Bond Market Factor

(d) Credit Spread Factor

(e) Bond Trend Following Factor

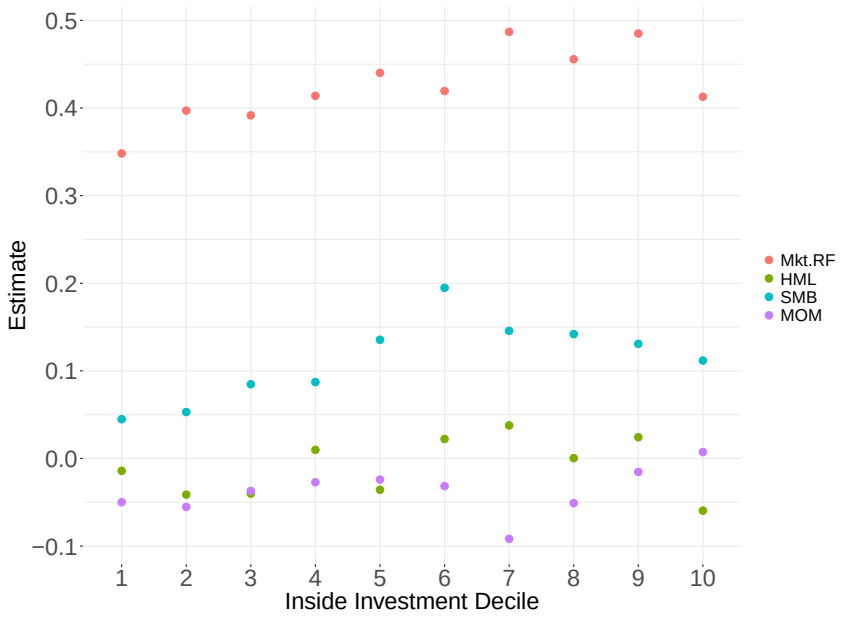
(f) Currency Trend Following Factor

(g) Commodity Trend Following Factor

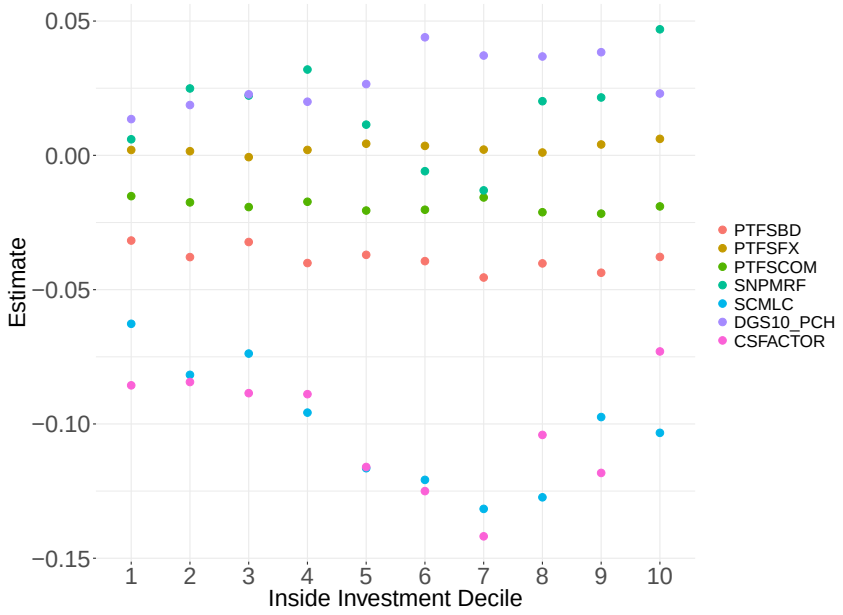
(h) R^2

FIGURE B.3 **Factor Distribution in 4-Factor Model**

This figure plots the distribution of factor exposures in the 7-Factor Fung-Hsieh model. The histograms plot the coefficient estimates from a time-series regression of factor exposures against hedge fund returns run for each fund, as well as the R^2 of each model fit.



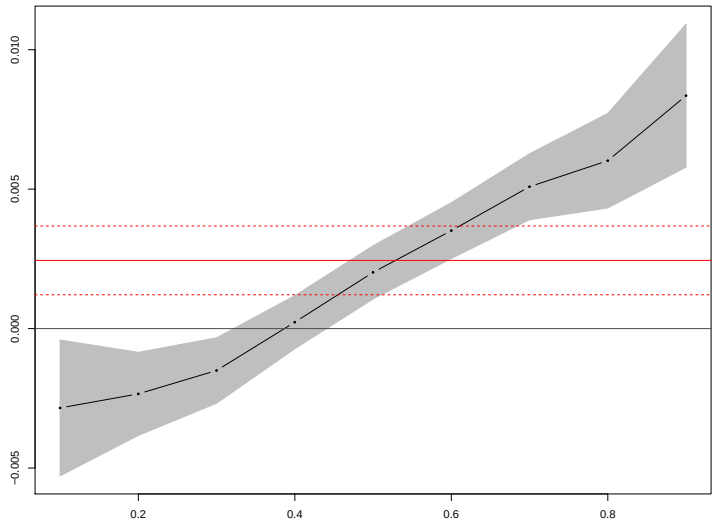
Panel A: Inside Investment Decile against FFC Factor Exposure



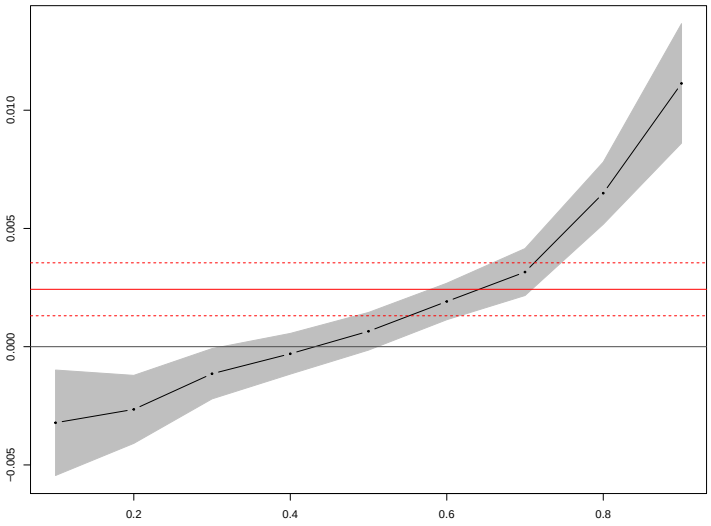
Panel B: Inside Investment Decile against FH Factor Exposure

FIGURE B.4 **Factor Exposure and Inside Investment**

This figure illustrates the relationship between factor exposure and insider investment. For each decile of inside investment, the figures plot the average factor exposures across the two sets of models explored in the paper. Panel A shows the beta exposures from the Fama-French and Carhart model. Panel B shows the factor exposures for the Fung-Hsieh Seven-factor model. In each decile, each average factor exposure is plotted equal-weighting all funds.



Panel A: Quantile Regression, Seven-Factor



Panel B: Quantile Regression, Four-Factor

FIGURE B.5 **Quantile Regression of Inside Investment on Excess Returns**

This figure plots results from a quantile regression of percentage inside investment against fund-level excess returns, also controlling for fund size. Panel A shows the returns corrected for the Fung-Hsieh Seven-factor model, while Panel B shows returns corrected for the Fama-French and Carhart Four-factor model. Across each of the ten deciles of percentage inside investment, we examine the slope of the relationship between inside investment and excess returns. The shaded grey area illustrates the 95% confidence interval. We find that our results are driven by funds at high levels of inside investment.

TABLE A1 **Inside Investment and Excess Returns—Restricting to Funds with Only GP Investment-Related Parties**

This table repeats the analysis of Table VIII, but restricts its analysis to funds with *only* GP investments as their related parties. The first two columns regress against the Fung-Hsieh Seven-Factors, and the second two columns regress against the Fama-French and Carhart Four-Factor model as outlined in equations 4 and 5 in the text, respectively.

	FH Excess Returns		FFC Excess Returns	
	All	Controls	All	Controls
	(1)	(2)	(3)	(4)
Inside Investment (Percent)	0.0035***	0.0055***	0.0030***	0.0056***
	(0.0011)	(0.0017)	(0.0010)	(0.0014)
Log(Fund Size)	No	Yes	No	Yes
Fixed Effects	No	Yes	No	Yes
Observations	29,691	29,691	29,691	29,691
R^2	0.0006	0.0387	0.0015	0.0492

TABLE A2 **Determinants of Inside Investment**

This table shows a yearly panel regression of inside investment against fund and firm characteristics. Column 1 includes no additional fixed effects, while column 2 adds fund inception year fixed effects, column 3 adds firm fixed effects, and column 4 also adds year of observation fixed effects. Standard errors are clustered at the firm level. The omitted strategy is Equity funds.

	Inside Investment (Percent)			
	(1)	(2)	(3)	(4)
log(Fund Size)	−3.1461***	−3.2257***	−6.4338***	−6.9775***
	(0.4519)	(0.4382)	(0.8473)	(0.8656)
Management Fee	−0.5006	−0.4119	3.7062	4.1315
	(1.6504)	(1.6810)	(3.0880)	(3.0326)
Performance Fee	0.3901***	0.3955***	0.1775	0.1769
	(0.1229)	(0.1230)	(0.2211)	(0.2100)
High Watermark	−0.7488	−0.8052	−1.1501	−0.3707
	(1.5650)	(1.6582)	(2.8761)	(2.8641)
Redemption Days	0.0043	0.0032	0.0079	0.0072
	(0.0082)	(0.0079)	(0.0200)	(0.0193)
Leverage	0.5363	0.3984	−5.0499***	−5.1682***
	(0.9839)	(1.0431)	(1.7544)	(1.7464)
Number of Advisors	0.0405***	0.0371***	−0.0410	−0.0326
	(0.0087)	(0.0097)	(0.0574)	(0.0519)
Strategy:				
− CTA	2.2385	2.4984	5.3826	4.8524
	(2.8050)	(2.9209)	(7.6972)	(7.5276)
−Event Driven	−4.3384*	−4.4216*	13.6770**	13.5364**
	(2.2823)	(2.4024)	(6.9444)	(6.7910)
−Fixed Income	−2.4840	−1.8786	17.8290**	17.8366**
	(2.4639)	(2.4680)	(7.4266)	(7.1818)
−Multi-Strategy	−1.8645	−1.6295	1.6652	2.3089
	(2.6426)	(2.5617)	(6.8248)	(6.9296)
−Other Strategy	−5.6653*	−6.3861*	11.4604**	11.8979**
	(3.3476)	(3.5624)	(5.6058)	(5.7574)
−Relative Value	0.2941	0.1653	8.9426	8.8212
	(3.1162)	(3.1154)	(8.8751)	(8.8400)
Inception Year FE	No	Yes	Yes	Yes
Firm FE	No	No	Yes	Yes
Year FE	No	No	No	Yes
Observations	4,484	4,484	4,484	4,484
R^2	0.0541	0.0890	0.7105	0.7176
Note:				*p<0.1; **p<0.05; ***p<0.01

TABLE A3 **Alternate Specifications for Inside Investment and Return**

This table illustrates some alternate specifications of our main result. In Panel A, we modify the benchmark specification to include funds with zero or 100% inside investment. These funds are excluded from our benchmark results because of difficulty in matching. Panel B illustrates a value-weighted specification using the Gross Asset Value field from form ADV (our primary specification is equal-weighted).

Panel A **Including Full Inside Investment Distribution**

	FH Excess Returns		FFC Excess Returns	
	(1)	(2)	(3)	(4)
Inside Investment (Percent)	0.0017**	0.0035***	0.0026***	0.0044***
	(0.0007)	(0.0012)	(0.0007)	(0.0011)
Log(Fund Size)	Yes	Yes	Yes	Yes
Fixed Effects	No	Yes	No	Yes
Observations	47,589	47,589	47,589	47,589
R^2	0.0002	0.0348	0.0010	0.0393

Panel B: **Value-Weighted**

	FH Excess Returns		FFC Excess Returns	
	(1)	(2)	(3)	(4)
Inside Investment (Percent)	0.0060***	0.0048**	0.0047***	0.0073***
	(0.0014)	(0.0022)	(0.0013)	(0.0024)
Log(Fund Size)	Yes	Yes	Yes	Yes
Fixed Effects	No	Yes	No	Yes
Observations	41,097	41,097	41,097	41,097
R^2	0.0015	0.0389	0.0006	0.0352
Adjusted R^2	0.0015	0.0216	0.0006	0.0178
Note:				*p<0.1; **p<0.05; ***p<0.01

TABLE A4 **Relationship between Inside Investment and Excess Return—with Lagged Returns**

This table repeats the analysis of Table VIII, but restricts its analysis to funds with *only* GP investments as their related parties. The first two columns always regress against the Fung-Hsieh Seven Factors, and the second two columns always regress against the Fama-French and Carhart Four-Factor model as outlined in equations 4 and 5 in the text, respectively.

Panel A **Baseline Specification**

	FH Excess Returns		FFC Excess Returns	
Inside Investment (Percent)	0.0025**	0.0055***	0.0021**	0.0045***
	(0.0010)	(0.0014)	(0.0009)	(0.0013)
$Return_{i,t-1}$	0.0066	−0.0249	0.1027***	0.0837***
	(0.0384)	(0.0363)	(0.0206)	(0.0218)
$Return_{i,t-2}$	−0.0014	−0.0273	0.0334	0.0143
	(0.0331)	(0.0315)	(0.0238)	(0.0219)
$Return_{i,t-3}$	0.0341	0.0117	0.0138	−0.0081
	(0.0369)	(0.0370)	(0.0202)	(0.0199)
Log(Fund Size)	No	Yes	No	Yes
Fixed Effects	No	Yes	No	Yes
Observations	37,958	37,958	37,958	37,958
R^2	0.0020	0.0425	0.0212	0.0535

Panel B: **Gross Inside Investment**

	FH Excess Returns		FFC Excess Returns	
Inside Investment (Gross)	0.0406**	0.0812***	0.0246*	0.0829***
	(0.0195)	(0.0290)	(0.0144)	(0.0240)
$Return_{i,t-1}$	0.0067	−0.0248	0.1028***	0.0837***
	(0.0384)	(0.0363)	(0.0206)	(0.0217)
$Return_{i,t-2}$	−0.0013	−0.0272	0.0335	0.0143
	(0.0331)	(0.0315)	(0.0238)	(0.0219)
$Return_{i,t-3}$	0.0342	0.0118	0.0139	−0.0081
	(0.0369)	(0.0371)	(0.0202)	(0.0199)
Log(Fund Size)	Yes	Yes	Yes	Yes
Fixed Effects	No	Yes	No	Yes
Observations	37,958	37,958	37,958	37,958
R^2	0.0019	0.0424	0.0211	0.0535

Panel C: **Fama MacBeth Approach**

	FH Excess Returns		FFC Excess Returns	
Inside Investment (Percent)	0.0022***	0.0021***	0.0015*	0.0019**
	(0.0008)	(0.0008)	(0.0008)	(0.0008)
$Return_{i,t-1}$	0.0469**	0.0504**	0.0893***	0.0886***
	(0.0225)	(0.0216)	(0.0191)	(0.0192)
$Return_{i,t-2}$	0.0404*	0.0403*	0.0522***	0.0487**
	(0.0245)	(0.0244)	(0.0194)	(0.0202)
$Return_{i,t-3}$	0.0130	0.0134	0.0002	0.0050
	(0.0242)	(0.0232)	(0.0170)	(0.0171)
Log(Fund Size)	No	Yes	No	Yes
Fixed Effects	No	Yes	No	Yes
Observations	37,958	37,958	37,958	37,958
R^2	0.2585	0.2836	0.1285	0.1492

Note: *p<0.1; **p<0.05; ***p<0.01

TABLE A5 **Inside Investment, Adjusted for Mechanically Reinvested Earnings**

This table examines the role of discretion over personal capital contributions. The emphadjusted inside investment measure subtracts the "mechanical" component of personal capital contributions derived from rolling over prior fee income from the observed inside investment. This residual results in the discretionary capital contributions of the managers. Panel A regresses the adjusted measure of invest investment against all funds, while Panel B restricts this analysis to funds less than eight years old.

Panel A: All Funds

	All	Controls	All	Controls
	(1)	(2)	(3)	(4)
Adjusted Inside Investment (Percent)	0.0039***	0.0085***	0.0028***	0.0069***
	(0.0013)	(0.0017)	(0.0009)	(0.0014)
Log(Fund Size)	No	Yes	No	Yes
Fixed Effects	No	Yes	No	Yes
Observations	41,097	41,097	41,097	41,097
R^2	0.0008	0.0377	0.0011	0.0410
Note:				*p<0.1; **p<0.05; ***p<0.01

Panel B: Young Funds

	All	Controls	All	Controls
	(1)	(2)	(3)	(4)
Adjusted Inside Investment (Percent)	0.0034**	0.0085***	0.0026**	0.0078***
	(0.0015)	(0.0015)	(0.0012)	(0.0017)
Log(Fund Size)	No	Yes	No	Yes
Fixed Effects	No	Yes	No	Yes
Observations	25,938	25,938	25,938	25,938
R^2	0.0005	0.0415	0.0007	0.0424
Note:				*p<0.1; **p<0.05; ***p<0.01

TABLE A6 **Cuts by Fund Size**

This table illustrates our main specification (column 2 of Panel A in Table VIII) across the fund size distribution. We cut by the quantiles of fund size, which correspond to the buckets: [$20m-$57m), [$57m, $126m), [$126m, $378m), [$379m+). Standard errors are clustered at the date level. Excess returns are computed using the Fung-Hsieh model.

	Quartile 1	Quartile 2	Quartile 3	Quartile 4
	(1)	(2)	(3)	(4)
Inside Investment (Percent)	0.0009	0.0021	0.0037***	0.0054***
	(0.0015)	(0.0013)	(0.0014)	(0.0017)
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Fund Controls	Yes	Yes	Yes	Yes
Log(Fund Size)	Yes	Yes	Yes	Yes
Observations	10,280	10,281	10,267	10,269
R^2	0.0133	0.0127	0.0141	0.0189
Note:				*p<0.1; **p<0.05; ***p<0.01

TABLE A7 **Firm-Level Equity Ownership and Returns**

This table shows a panel regression with alternate measures of firm ownership. # of Equity Holders captures the total number of beneficial owners listed in Form ADV for the firm's equity. HHI of Firm Equity captures a Herfindahl-Hirschman index measure of concentration of equity ownership. Standard errors are clustered at the fund level and are shown in parenthesis. Excess return is computed using the Fung-Hsieh model.

	Monthly Excess Return (FH)			
	(1)	(2)	(3)	(4)
Inside Investment (Percent)	0.0029^{***}	0.0024^{***}	0.0029^{***}	0.0028^{***}
	(0.0009)	(0.0008)	(0.0009)	(0.0008)
# of Equity Holders	-0.0174^{**}		-0.0197^{***}	-0.0191^{***}
	(0.0071)		(0.0070)	(0.0068)
HHI of Firm Equity		0.0444	−0.0645	−0.0578
		(0.0826)	(0.0794)	(0.0796)
log(Gross Assets)	0.0312	0.0163	0.0317	0.0350
	(0.0243)	(0.0249)	(0.0241)	(0.0218)
Year	Yes	Yes	Yes	Yes
Log(Size)	Yes	Yes	Yes	Yes
Fund Controls	No	No	No	Yes
Observations	41,097	41,097	41,097	41,097
R^2	0.0105	0.0101	0.0105	0.0116
Note:				*p<0.1; **p<0.05; ***p<0.01