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Institutional Investment and Intermediation in the Hedge Fund Industry

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Institutional Investment and Intermediation in the Hedge Fund Industry

Abstract

Using new data on the hedge fund investments of institutional investors, this paper is the first to examine the determinants and consequences of intermediation in the hedge fund industry. Our empirical analysis reveals several findings consistent with predictions from the theoretical literature. First, larger investors are more likely to invest directly with hedge funds instead of using intermediated channels. Second, institutions investing directly tend to outperform their intermediary-using counterparts. The inferior performance of institutions using intermediaries reflects: (i) worse performance on their few direct hedge fund investments and (ii) their larger allocation to funds of hedge funds that are known to perform worse than direct hedge fund investments. Taken together, these findings suggest an equilibrium in which larger institutions enjoy economies of scale, enabling direct investment into relatively better performing hedge funds. As institutional size and the number of hedge fund investments increase, the returns from direct investment do exhibit a decline, suggesting eventual scale diseconomies.

Institutional Investment and Intermediation in the Hedge Fund Industry

Lured by the promise of superior absolute returns and low correlation with traditional asset markets, a significant amount of investment in the hedge fund industry has been made in recent years by institutional investors, including pension funds, university endowments, foundations, and family offices. In their October 2012 report, Preqin estimates that 65% of the hedge fund assets now come from institutional investors, with public pension funds being the most prominent group of investors.[1] However, despite the growing body of academic research on hedge funds, there is little known about the investment experience of these institutional investors due to paucity of data. This paper provides the first study of institutional investment in the hedge fund industry. Specifically, it focuses on the choice between direct and intermediated investment through funds of hedge funds and on the advisory role of investment consultants.

The paper employs new data from Preqin which provides information about the characteristics and hedge fund investments of institutional investors such as pension funds, university endowments, and foundations for 2010. The institutional characteristics include the size and stated intermediation preferences. Investors self-characterize themselves as being indirect, direct, and hybrid based on their expressed preference for intermediated, non-intermediated (or direct), and sometimes-intermediated investments, respectively. Using this novel data, we document several interesting findings that are generally consistent with the predictions from the recent theoretical work on intermediation in investment management (e.g., Stoughton, Wu, and Zechner, 2011).

[1] See http://www.preqin.com/docs/reports/Preqin_Special_Report_Hedge_Funds_October_2012.pdf for details.

First, we find that larger investors are more likely to invest directly with hedge funds instead of using the intermediated channel of investing through funds of hedge funds (FOFs). This suggests that size is a major determinant of disintermediation, consistent with economies of scale associated with managing large portfolios of direct hedge fund investments. In contrast, the use of advisors, such as investment consultants, does not appear to be strongly affected by investor size. If anything, smaller institutions that intermediate their investments through FOFs are somewhat less likely to employ investment consultants. Examining variations in intermediary use across different types of investors, we find that university endowments and foundations tend to invest directly whereas pension funds, both public and private, are more inclined towards intermediated investment.

Second, institutions with a preference for investing directly tend to perform better than their indirect counterparts in terms of both raw and style-adjusted returns. Using the 2010 snapshot of institutions' hedge fund investments, we estimate their performance in the subsequent year.[2] Our analysis indicates that the stronger performance of the direct investors stems from two sources: (1) Direct investors' hedge fund investments outperform indirect investors' hedge fund investments by 21.6 basis points per month (in raw returns), or about 2.6% per year, suggesting returns to specialization for the investors focused on making direct investments; (2) Direct investors' performance is also enhanced by their greater allocation to hedge fund investments compared to indirect investors (78.1%

[2] Using out-of-sample, forward-looking performance measures minimizes the effect of selection and timing biases that are common in self-reported hedge fund databases (e.g. Aiken, Clifford, and Ellis, 2013; Fung and Hsieh, 2000; and Agarwal, Fos, and Jiang, 2013).

versus 31.9%).[3] We find that hedge fund investments outperform FOF investments (in our sample the unconditional outperformance is 37.1 basis points per month, or about 4.5% per year).[4] This confirms the previously documented gap between FOF and hedge fund returns (e.g., Brown, Goetzmann, and Liang, 2004) holds for institutional investors as well. We note that, despite the gap, institutional investors appear to pick better performing FOFs: the FOFs selected by investors in our sample outperform the average FOF returns by 15.3 basis points a month (i.e., FOF style-adjusted returns are 15.3 basis points). This suggests some institutional ability to pick among the better funds from the FOF universe. Finally, we find that investment consultants do not appear to improve the performance of institutions' hedge fund investments and are actually weakly associated with worse performance.

To test the robustness of the above findings that are based on a snapshot of investment information in 2010, we hand-collect time-series data for a subset of the largest investors that publicly report details of their hedge fund and FOF holdings in their annual reports. We continue to find that direct investors outperform their indirect counterparts in the hedge fund investments by 42.6 and 53.2 basis points per month using raw and style-adjusted returns, respectively. The direct investors' outperformance in this sample is similar to that from the 2010 snapshot. It is driven by greater reliance on direct hedge fund investment and by the selection of better performing hedge funds. The time-series also suggests that the largest investors stating a preference for intermediated

[3] It should be noted, however, that the estimated performance differences are likely to overstate the benefits of size since we do not account for the investment in developing internal expertise that could be important for an institution seeking to invest directly.

[4] The underperformance from investing through FOFs seems to be greater than the additional layer of fees charged by FOFs indicating substantial costs of intermediation in the hedge fund industry. The average management fee, incentive fee, and annual returns of FOFs in our sample are 1.2%, 7.2%, and 4.0% respectively. This implies a total fee of about 13 basis points per month (1.2% ÷ 12 + 7.2% x 4.0% ÷ 12) for FOFs, substantially lower than the 37.2 basis points of estimated underperformance.

investments do better in their FOF investments than those expressing a preference for direct investing. This result provides limited support to specialization paying off in the FOF arena.

Taken together, these findings are consistent with an equilibrium in which larger institutions enjoy economies of scale by investing directly with hedge funds. Their scale can perhaps make it feasible for them to invest in developing in-house expertise to gather information and better select among funds.[5] Using plausible assumptions, we estimate the breakeven point above which direct investment is cost effective is around a $200 million hedge fund allocation.

However, the economies of scale do not continue indefinitely: returns to size diminish for larger sized investors, indicating that they eventually face scale diseconomies. A potential reason for scale diseconomies may be that larger investors seem to invest with a larger number of hedge funds, possibly to limit their exposure to any particular fund. However, diversifying across a number of hedge funds may be costly in terms of average fund performance, given the difficulty of identifying a sufficiently large number of well-performing hedge funds. Additionally, the performance may suffer to the extent that large institutions are subject to the typical problems, such as monitoring and weak incentives, associated with large organizations (e.g. Chen, Hong, Huang, and Kubik, 2004, in the context of mutual funds).

The remainder of the paper is organized as follows. Section I shows how our investigation contributes to the existing literature. Section II describes the data. Section III examines the relation between intermediation and performance of institutions

[5] Operationally, direct investment capabilities most likely include an in-house team that initiates investments into hedge funds and subsequently monitors performance and manages the hedge fund portfolio.

investing in hedge funds. Section IV models the determinants of directness of hedge fund investment. Section V analyzes economies and diseconomies of scale in the context of hedge fund investments. Section VI analyzes a hand-collected time-series data on hedge fund holdings for a sub-sample of the largest institutional investors in the Preqin sample to test the robustness of our results using the 2010 data. Section VII discusses the key findings and Section VIII offers concluding remarks.

I. Literature Review

There are a number of theoretical studies on delegated portfolio management (Bhattacharya and Pfleiderer, 1985; and Stoughton, 1993) and organization of investment management firms (Massa, 1997; Nanda, Narayanan, and Warther, 2000; Mamaysky and Spiegel, 2002; Gervais, Lynch, and Musto, 2005; and Binsbergen, Brandt, and Koijen, 2008). In contrast, intermediation in the investment management industry has received somewhat less attention in the theoretical literature. Inderst and Ottaviani (2009) analyze the possibility of 'misselling' when firms hire the same agent for both marketing and providing product advice. Inderst and Ottaviani (2012) model the compensation structure of financial advisors as intermediaries to propose how customers can mitigate the inherent conflicts of interest arising from the advisors being compensated by the product providers.

Our paper is most closely related to Stoughton, Wu, and Zechner (2011). Their model predicts that if it is costly to locate higher quality fund managers, the choice between direct and indirect (or intermediated) investment will depend upon investor size since search costs are more easily offset by better performance on a larger investment.

We believe that the hedge fund industry offers an appropriate setting to test the predictions of their model since there are significant search costs in identifying good hedge fund managers due to limited disclosure, a proliferation of funds, and substantial heterogeneity of investment strategies in the hedge fund industry. Our empirical findings support their predictions as we find strong evidence of directness of investments being positively related to the size of the institutional investors.

Stoughton, Wu, and Zechner (2011) also argue that competition among intermediaries will result in stronger returns to direct investment than indirect investment. Consistent with their argument, the performance of indirect hedge fund investments of institutions in our overall sample is worse than that of their direct investments.[6] This is despite the performance of their FOF investments being stronger than that of the typical FOF. The underperformance is greater than the additional layer of fees charged by FOFs, which indicates that fees cannot entirely explain the poor performance of indirect hedge fund investments. Moreover, aggressive marketing to unsophisticated investors could further erode the returns to indirect investment.

Empirically, the findings in our paper complement the growing body of evidence on the potential agency problems and inferior investment performance resulting from intermediation.[7] Chen, Yao, and Yu (2007) find that mutual funds managed by insurance

[6] While our study does not focus on comparing hedge fund and FOF returns, we confirm the findings in the prior literature suggesting FOFs underperform hedge funds (see Brown, Goetzmann, and Liang, 2004; Ang, Rhodes-Kropf, and Zhao, 2008; and Agarwal and Kale, 2007). Unlike this literature, which studies the average performance of all funds, we examine the performance of hedge funds and FOFs in which institutions invest. We find that these investors perform better in their FOF investments than retail investors suggesting their relative sophistication in selecting FOFs. However, despite focusing on the small sample of sophisticated (institutional) investors, we fail to find any evidence of FOFs outperforming hedge funds.

[7] Our paper also contributes to the recent literature on the performance evaluation of institutional investors such as pension funds (Andonov, Bauer, and Cremers, 2012; and Andonov, Eichholtz, and Kok, 2013) and university endowment funds (Brown, Garlappi, and Tiu, 2010), and hiring and firing decisions of plan sponsors (Goyal and Wahal, 2008).

companies underperform their peers. Bergstresser, Chalmers, and Tufano (2009) show that mutual funds sold through brokers perform worse than those that are sold directly to investors even before the returns are adjusted for the costs of distribution. Chen, Hong, and Kubik (2013) find that mutual funds that are outsourced underperform the funds that are managed internally. Del Guercio and Reuter (2013) examine intermediation in the context of retail mutual funds and find this market to be segmented into funds sold through broker channels (intermediated) and those sold directly. They show evidence that direct-sold funds yield higher alphas.

While the basic message of intermediation leading to poorer performance is similar across all these studies (and our study), our study demonstrates this in the context of institutional investors, where, given larger and presumably more sophisticated investors, such a result may not be obvious. Our study also documents the link between disintermediation and size, which, while intuitive, has not been formally documented in an investments setting.

Finally, our study documents economies and diseconomies of scale in the institutional alternative investment setting. Particularly for direct investments, we find clear evidence of increasing returns to scale, followed by diseconomies of scale setting in. These findings are in line with Lopez-de, Phalippou and Gottschalg, 2009 and Cumming and Dai, 2011 (private equity) and Chen, Hong, Huang, and Kubik, 2004 (mutual funds).

II. Data

For this study, we employ new data from Preqin on institutional hedge fund investor characteristics and their hedge fund investments. The data include the type of

investor (endowments, foundations, family offices, public pensions, and private pensions),[8] their size in terms of assets, their hedge fund investments at the fund company level, and their preferences related to intermediation, *i.e.*, direct versus indirect (via FOFs) investment in hedge funds and use of investment consultants. Preqin data therefore offers a rich cross-sectional view of institutions and their hedge fund investments. However, it is limited in terms of its time-series information as the data is available only in a snapshot, with institutional investors' holdings at the beginning of 2010.[9]

We manually match the names of hedge fund companies to merge the Preqin data on the underlying hedge fund investments with the Morningstar Direct database that provides monthly net-of-fee (both management fee and incentive fee) returns on hedge funds and FOFs. For each institutional investor in Preqin for which we can find a matched investment in a hedge fund company, we assign all the funds within that company as investments for that investor, since Preqin provides the name of the company, but not the actual fund(s).[10] This results in a sample of 1,780 investor-investment pairs, including hedge fund and FOF investments made by the 336 investors.

Like most data on hedge funds, investment data in Preqin is self-reported. Hence, it is subject to a host of biases, such as selection and timing. In an effort to minimize the

[8] Examples of large institutional investors with hedge fund investments include endowments of University of Texas and University of Michigan, foundations such as Robert Wood Johnson and J. Paul Getty Trust, private pensions which are largely corporate pension plans including those of Boeing and Chrysler, and public pensions such as California Public Employees' Retirement System (CALPERS) and New York State Common Retirement Fund.

[9] For a subset of the largest 22 investors within the Preqin sample, we also hand collect time-series data on their hedge fund and fund of hedge fund investments from the annual reports of the investors. We use these data to conduct robustness tests that are reported in Section VI of the paper.

[10] On average, there are approximately five investments per company. In the time-series data that we collect, we repeat our analysis for a subset of investors for which we have investment data at the fund level. For this subset of investors, investor return computed at the company level and that computed at the fund level exhibit a pairwise correlation of 58.3%, confirming that company-level returns are a reasonable proxy for fund-level returns. As an additional robustness test, we repeat the cross-sectional analysis by aggregating observations at the fund family level (each observation is an investor-investment fund firm, rather than an investor-investment fund). These results are presented in the Appendix, and are qualitatively similar.

impact of these biases, we conduct all performance analysis on a forward-looking basis and draw conclusions principally from cross-sectional comparisons across investors within the Preqin database. We also repeat our analyses using hand-collected time-series data from the annual reports of a sub-sample of investors. Since this data is largely free of any reporting biases, findings from this analysis should further mitigate concerns about data biases.

We present the summary statistics of the 336 investors in Panel A of Table I. The table presents the average size of the investors (in logarithm of $million) separately for endowments, foundations, private pensions, and public pensions. We classify all other classes of investors, that have fewer than 30 investors each, as "Other" investors. These include sovereign wealth funds, superannuation schemes, family offices, government agencies, and insurance companies. We observe that both public and private pensions are larger than the endowments and foundations.

In terms of size, investors in our sample are similar, or larger, than the universe of institutional investors. Endowments in our sample have a mean (median) size of $1.2 billion ($383 million).[11] In a recent news article report of 1,189 ranked colleges that reported endowment figures to U.S. News, the average endowment was roughly $313,182,000.[12] Foundations in our sample have a mean (median) size of $1.1 billion ($469 million). Foundation Center reports the average foundation size to be $8.4 million,

[11] Out of the 63 endowments in our sample, 19 feature in the top 100 endowments of the 2011 ranking of US and Canadian endowments by National Association of College and University Business Officers (NACUBO).

[12] See "10 Colleges With Largest Financial Endowments," US News, November 27th 2012, available at http://www.usnews.com/education/best-colleges/the-short-list-college/articles/2012/11/27/10-colleges-with-largest-financial-endowments

although there is considerable dispersion around that number.[13] It is not surprising to observe both endowments and foundations in our sample to be considerably larger than average, reflecting the fact that larger institutions are typically likely to invest in alternative investments, such as hedge funds. Private pensions in our sample have a mean (median) size of $8.0 billion ($1.9 billion) and public pensions in our sample have a mean (median) size of $13.5 billion ($2.5 billion). The average size of pension funds in our sample is comparable to the $13.3 billion figure reported in Andonov, Eichholtz, and Kok (2013).

Panel B of Table I presents the intermediation preferences of different types of institutional investors. Investors self-classify as "Indirect," "Hybrid," or "Direct" investors, with respect to how they view their hedge fund investing activities. Indirect investments are through FOFs while hybrid is a combination of both direct and indirect investment in hedge funds. We report the fraction of investors self-reporting into these three categories. In the last two columns of Panel B, we also report the fraction of investors reporting the use of investment consultants and the revealed directness of the investors' investments, measured by the fraction of direct hedge fund investments in their portfolio (Direct HF Frac). We compute *Direct HF Frac* as the number of direct hedge fund investments divided by the total number of hedge fund investments, which includes both direct hedge fund as well as FOF investments.

Panel B shows that public and private pensions are slightly less direct in their hedge fund investments compared to endowments and foundations in terms of both their stated and revealed intermediation preferences. The fractions of public and private

[13] The Foundation Center reports total foundation assets of $643 BN in 2010, spread over 76,610 foundations. http://foundationcenter.org/findfunders/statistics/pdf/02_found_growth/2010/04_10.pdf

pensions stating a preference for indirect investments are 64% and 60% respectively, versus 42% and 58% for endowments and foundations. Similarly, the actual fractions of direct hedge fund investments for public and private pensions are 43% and 35%, respectively, compared to 48% and 51%, for endowments and foundations. Overall, 54% of investors classify themselves as indirect investors, 34% as hybrid investors, and 12% as direct investors, 64% use investment consultants, and 47% of hedge fund investments are direct (see last row of Panel B).

Panel C shows a positive correlation between the stated and revealed intermediation preferences. Investors stating their preferences as direct show the highest percentage of hedge fund investment while indirect investors show the least (78.1%, versus 31.9%), with the hybrid investors falling in between the two (59.2%). In contrast, hybrid and direct investors are most likely to use investment consultants compared to indirect investors (75.2% and 70.7% versus 55.4%). This is not surprising as additional advisory services from investment consultants may be less important for indirect investors that rely on FOFs.

III. Intermediation and Performance of Hedge Fund Investments

In this section, we analyze how directness of hedge fund investments affects the performance of different institutions that invest in hedge funds. We use both stated and revealed preferences of institutions' directness of hedge fund investments as measures of intermediation. We perform our analysis in a multivariate setting where we include intermediation (stated or revealed) together with other independent variables. As noted above, our performance measures are forward looking: since our data corresponds to a

snapshot of institutional investor positions as of 2010, we measure performance for the 12 months subsequent to the snapshot.

We estimate the following regression using investor-investment pair data:

$$Performance_{i,j} = \alpha + \beta\ stated\ intermediation\ pref_i + \gamma\ investment\ info_{i,j} + \vartheta\ size_i + \delta\ investor\ type_i + \varepsilon_{i,j} \quad (1)$$

Here $Performance_{i,j}$ is the average monthly raw or style-adjusted return for each investor-investment pair (*i,j*) for the 12 months following the snapshot date; $stated\ intermediation\ pref_i$ are the self-reported intermediation preferences (indirect, hybrid, or direct) for institutional investor *i*; $investment\ info_{i,j}$ is an indicator variable, *FOF investment dummy*, which takes a value of 1 if investor *i's* investment *j* is a FOF and 0 if it is a hedge fund; $Size_i$ is the logarithm of the assets under management in millions of dollars as of 2010; and $Investortype_i$ indicates a type *i* institutional investor, where the type can be endowment, foundation, private/public pension or other. We cluster the standard errors at the investor level.

Panels A and B of Table II present the results from regression in equation (1) for raw returns and style-adjusted returns, respectively. Model 1 of Panel A shows that returns are significantly lower by 37.1 bps per month for investments in FOFs compared to those in hedge funds. A directionally positive coefficient of 0.126 (*t*-stat = 1.409) on the direct dummy suggests that self-characterized direct investors outperform their indirect counterparts, even after controlling for whether the investment is a hedge fund or a FOF.

We also conduct our analysis separately for hedge fund investments and FOF investments by estimating the regression in equation (1) for the two subsamples, and

report the results in Models 2 and 3 of Panel A of Table II. We find that only for direct investments in hedge funds do the coefficients on hybrid and direct dummies remain positive (0.173 and 0.216) and significant at the 5% level. Finally, the use of investment consultants is associated with directionally worse performance for hedge fund investments (coeff. = –0.246, *t*-stat = –1.620) but not for FOF investments (coeff. = –0.011, *t*-stat = –0.120). In part, the weaker performance may be reflective of the lower investment ability of investors that tend to employ investment consultants.

We repeat our analysis with style-adjusted returns in Panel B of Table II, and find results that are broadly consistent with those using raw returns as the dependent variable. In Model 1 using all investments, both the hybrid and direct dummies are weakly positive (0.083 and 0.150, respectively) confirming that self-characterized hybrid and direct investors outperform indirect investors.

Separating the hedge fund and FOF investments in Models 2 and 3 of Panel B of Table II again yields similar results as in Panel A. We find that only for direct investments in hedge funds do the coefficients on hybrid and direct dummies remain positive (0.221 and 0.266) and significant at the 5% level. The use of investment consultants continues to predict worse performance for hedge fund investments (coeff. = –0.303, *t*-stat = –1.686) but not for FOF investments (coeff. = –0.013, *t*-stat = –0.134).

The FOF indicator is directionally positive (coeff. = 0.090, *t*-stat = 1.638) in Model 1. This is in contrast to the negative coefficient observed when using raw returns. Since we are using style-adjusted returns here, this suggests that institutional investors exhibit some ability of selecting relatively better FOFs compared to the universe of FOFs.

However, this ability to select the better FOFs is not different across direct, hybrid and indirect investors, as reflected in the analysis of the sub-sample of FOFs (Model 3).

So far, we have analyzed the association between self-characterized directness of institutional investors and future performance in a multivariate setting. We next examine if actual directness of hedge fund investments provides different evidence. For this purpose we estimate the following regression:

$$Performance_{i,j} = \mu + \rho\ revealed\ intermediation\ pref_i + \varphi\ investment\ info_{i,j} + \phi\ size_i + \zeta\ investor\ type_i + \varsigma_{i,j} \quad (2)$$

Where $revealed\ intermediation\ pref_i$ is the revealed intermediation preference for institutional investor *i,* computed as the number of direct hedge investments in investor *i*'s portfolio divided by the total number of investments (sum of hedge fund and fund of hedge fund investments) in investor *i*'s portfolio. All other variables are as defined above, in Equation (1).

Panels A and B of Table III report the results for returns and style-adjusted returns, respectively. In Model 1 of Panel A, we observe that the coefficient on the fraction of direct investments is positive and significant at the 10% level (coeff. = 0.165, *t*-stat = 1.842), indicating that the more direct an investor, the better is the investment's performance. When we compare the same coefficient in Models 2 (HF investments only) and 3 (FOF investments only), we observe that this finding is driven by hedge fund investments and not FOF investments. In other words, there is little difference in the performance of FOF investments across the three types of institutional investors (direct, hybrid, and indirect) but the hedge fund investment performance is increasing with the fraction of direct investments (coefficient = 0.303, *t*-stat = 2.567). As was the case with

the results for stated directness in Table II, we observe that the FOF indicator variable (1 if the investment is a FOF and 0 if the investment is a hedge fund) is negative and significant at the 1% level (–0.320, *t*-stat = –5.849) for the combined sample of hedge funds and FOFs.

Panel B of Table III reports the findings with style-adjusted returns. Notable results include positive and significant coefficient on the fraction of direct investments (coeff. = 0.197, *t*-stat = 2.010) in Model 1. As before, this result is due to the hedge fund investments performing better with greater degree of direct investing (coeff. = 0.340, *t*-stat = 2.427). Consistent with the stated-preference specification, the FOF indicator is positive and significant in Model 1 (coeff. = 0.153, *t*-stat = 2.553), reflecting institutions' ability to select relatively better FOFs.

Taken together, the findings in this section confirm that direct investors perform better than indirect ones. Hedge fund investments of direct investors tend to outperform the hedge fund investments made by indirect investors. Consistent with economies of scale, the outperformance is increasing in the fraction of the investors' investments that are direct. Institutional investors select relatively better performing FOFs. Their returns on FOF investments are not, however, affected by whether they are direct or indirect investors. These findings remain unchanged whether we use stated or revealed preferences for direct investments.

IV. Determinants of directness

Our findings so far naturally elicit the question: Since direct investing seems to yield better returns, why don't more investors invest directly? In order to answer this

question, we examine the determinants of investor directness. We also examine determinants of investment consultant use. Table IV presents the results of the following multivariate regressions examining the determinants of investor directness.

$$\begin{aligned} Stated\ Directness_i = \eta_1 + \Delta_1 Size_i + \zeta_1 Revealed\ intermediation\ pref_i + \Gamma_1 IC\ use_i \\ + \chi_1 Investortype_i + \Theta_{i,j} \end{aligned} \quad (3)$$

$$\begin{aligned} Revealed\ Directness_i = \eta_2 + \Delta_2 Size_i + \zeta_2 Stated\ intermediation\ pref_i + \Gamma_2 IC\ use_i \\ + \chi_2 Investortype_i + \Theta'_{i,j} \end{aligned} \quad (4)$$

$$\begin{aligned} IC\ Use_i = \eta_3 + \Delta_3 Size_i + \zeta_3 Stated\ intermediation\ pref_i \\ + \Gamma_3 Revealed\ intermediation\ pref_i + \chi_3 Investortype_i + \Theta''_{i,j} \end{aligned} \quad (5)$$

$Stated\ Directness_i$ is a variable that takes the value 0 if an investor is indirect, 1 if the investor is hybrid and 2 if direct. $Revealed\ Directness_i$ is the fraction of direct hedge fund investments made by institutional investor *i*; $IC\ Use_i$ is an indicator variable that takes a value of 1 if an institutional investor *i* expresses a preference to use an investment consultant, and 0 otherwise; and other variables are as defined before for equation (1).

We estimate two versions of these equations. The results are presented in Table IV. Panel A presents estimates with the other measures of directness as explanatory variables and Panel B presents estimates without controlling for other measures of directness.

In Panel A, the column labeled "Stated" shows the results from an ordered logistic regression estimating equation (3) above. Larger investors are more likely to self-characterize as being direct (coeff. = 0.320, t-stat = 3.151). The column labeled "Revealed" shows the findings from the OLS regression in equation (4) above, where the dependent variable is the fraction of investor's direct hedge fund investments. Larger

investors tend to have a higher fraction of direct hedge fund investments in their portfolios (coeff. = 0.083, *t*-stat = 5.326). This suggests that the choice of investing directly into hedge funds and not using an intermediary is driven by size, suggesting economies of scale in direct investment. Such economies of scale could result from, for instance, the cost of hiring/developing a team for managing a direct investment program. Such costs might be expected to have a relatively large fixed component, if there was say, a minimum efficient size for the investment team. In other words, direct investment would be economical if the size of the investor's hedge fund portfolio was large enough for the increased returns to offset the fixed cost of hiring a team. We also find a positive relation between stated and revealed intermediation preferences in the first two specifications, in line with the univariate results in Panel C of Table I.

Our third specification in Table IV, Panel A, labeled "IC Use" models the determinants of the stated use of investment consultants by institutional investors, and reports the results from the logistic regression in equation (5) above. While investment consultants do not constitute a full-service intermediary like FOFs, they do have the mandate to advise institutional investors on their hedge fund and FOF investments.

We find that "hybrid" investors are more likely to use investment consultants (coeff. = 0.857, *t*-stat = 1.790), and investors with higher realized directness measures are less likely to use investment consultants (coeff. = –1.088, *t*-stat = –2.237). This is consistent with direct investors developing greater internal capability to invest in hedge funds, reducing the need for external advice. Additionally, the univariate results in Table 1, Panel C indicate that investment consultants are less likely to employed by indirect investors (55.4%) compared to hybrid (75.2%) and direct (70.7%) investors. Hence, there

is a type of inverted-U in the use of investment consultants with hybrid investors relying on them to a greater extent. Indirect investors rely on the intermediation services of FOFs, while direct investors have the scale to justify developing internal capabilities.

As a robustness check for the result linking large investor size and directness, we repeat our analysis without controlling for other measures of directness in Panel B. Our results are robust: largest investors are more likely to self-characterize as being direct (coefficient = 0.461, *t*-stat = 5.209) and they also have a larger fraction of direct HF investments in their portfolio (coefficient = 0.106, *t*-stat = 7.284).

V. Economies and diseconomies of scales

As we have seen, there appear to be economies of scale in terms of hedge fund investments, with larger institutions more likely to invest directly in hedge funds. This is presumably because their scale makes it cost-effective to develop the internal capacity to evaluate hedge fund quality and invest directly – rather than relying on intermediated investment through FOFs.

We now take a closer look at the scale effects of hedge fund investing by institutional investors. Specifically, do the economies of scale persist as institutions increase in size – or are the benefits of scale eventually exhausted and displaced by scale diseconomies. The presence of such diseconomies would not be surprising since in general, the literature finds that the returns from managing money tend to decrease with the size of assets under management. For instance, evidence of diseconomies have been documented in the context of private equity (Lopez de Silanes, Phalippou, and Gottschalg, 2009; and Cumming and Dai, 2011) and mutual funds (Chen, Hong, Huang,

and Kubik, 2004).

There are reasons to expect diseconomies to emerge in the context of institutional investment in hedge funds. One reason is potential agency problems between the decision makers in an institution and the actual beneficiaries/governing board of the institution. As a consequence, to control for potential agency concerns, portfolio managers in such institutions are often required to be prudent in terms of the positions that they take in any one investment. Hence, as evidenced by our data, we might expect larger institutional investors to be obliged to take positions in a larger number of funds, whether they invest directly or indirectly. Larger investors, therefore, have to bear the burden of uncovering a larger number of attractive hedge fund investments. This is likely to become increasingly difficult, especially within a larger organization that is faced with the usual problems of incentivizing and monitoring a team of portfolio managers in the organization, limits to human attention, and so forth.[14]

Our results provided in Table V suggest that institutional investor performance is affected by scale: there are both economies and diseconomies of scale. In Panel A, we use fund returns as the performance metric. In the first column (including both HFs and FOFs), we include size and its quadratic term as explanatory variables. As indicated, size is estimated with a significant positive coefficient (0.151), while its quadratic term is estimated with a significant negative coefficient (–0.010), indicating economies as well as diseconomies of scale. Columns 2 and 3 provide the regression results for HF and FOF

[14] Another reason for diseconomies of scale could involve larger investors overinvesting in hedge funds, leading to the hedge funds themselves experiencing diseconomies of scale. However, the correlation between investor size and investment size is –3% (hedge funds) and 3% (FOFs), suggesting this is unlikely to be the case.

subsamples, respectively. The estimated coefficients for both the HF subsample exhibit a similar pattern with significant positive (negative) coefficients on size (size squared). There are no significant effects of size on FOF investment returns in this specification, although directional coefficients indicate a similar pattern of economies, followed by diseconomies of scale.

Columns 4, 5 and 6 add in indicator variables for the number of investments each investor has. Once again, size is estimated with a significant positive coefficient (0.108), while its quadratic term is estimated with a significant negative coefficient (–0.006). Based on these estimated coefficients, it would appear that expected returns achieve a maximum at around a size of 9 (where size is in terms of logarithm of assets), i.e., $8.1 billion. In our sample, only 20% of investors are above this size threshold. Note that in this specification, both HF and FOF investments display positive linear coefficients on size and negative quadratic coefficients on size squared, confirming the existences of economies of scale, up to a point, and diseconomies of scale above that for both types of investments.

In terms of the number of investments, we observe diseconomies of scale when the number of investments is above the 90th percentile (coefficient of –0.299 significant at the 1% level). For HF investments, we see that investors experience economies of scale, and these persist even when the number of investments is large (coefficients 0.437, 0.328, and 0.441, all significant at the 5% level or better). However, in the case of FOF investments, investors falling in the median to 75th percentile category experience the best outcomes (coefficient = 0.190, *t*-stat = 2.479) while those with the most number of

FOF investments (> 90th percentile) experience the worst outcomes (coefficient = –0.344, t-stat = –6.916) suggesting diseconomies. The results using style-adjusted returns in Panel B are similar to those using returns in Panel A.

VI. Time series analysis

The main results presented so far have been cross-sectional, using a snapshot of institutional investments in hedge funds as of 2010 from Preqin. To corroborate our findings, we also hand collect time-series data on hedge fund investments for a subset of the largest 125 institutional investors from Preqin between 2002 and 2011. This time-series data offers several advantages to shed light on the issue of intermediated investment. First, using the panel data allows us to examine the effect of intermediation on performance over a longer time period. Second, this data has information on the investments at the hedge fund level rather than at the company level. Finally, this data has been collected from annual reports and is therefore less susceptible to self-reporting biases.

From the annual reports, we are able to obtain the hedge fund and FOF investments of 22 of the largest 125 institutional investors from Preqin. We then match these investments with the hedge funds and FOFs in the Morningstar hedge fund database at the fund level. This yields a total of 671 investor-investment-year observations in the pooled time-series cross-sectional data, which we use to confirm our main results regarding the effects of direct investment in hedge funds.

Of the 22 investors for which we have this data, 20 are public pension funds and the remaining 2 are state investment agencies. All but one of these investors used

investment consultants. Given the high incidence of pension funds and investment consultant use in this sub-sample, it is not possible to analyze the effects of investor type and investment consultant use on performance in this sample.

We present the summary statistics and univariate analyses of this data in Table VI. Panel A presents the distribution of investor-investment pairs across calendar time. Not surprisingly, we have more data for the recent years when more investors report their hedge fund investments in their annual reports. Although we try to collect time-series data for the last 10 years, less than 5% of the observations are from before 2006, with the oldest reports dating to 2002.

Panel B presents the distribution of investors across self-characterized directness, revealed directness preferences, and performance. The sample is well-distributed across self-stated directness preferences, with 4 investors characterizing their investments as indirect, 11 as hybrid and 7 as direct. Raw return performance analyses echoes our findings from the overall Preqin sample. There is a monotonic relationship between directness and performance. When examining style-adjusted returns, we find that indirect and direct investors have higher style-adjusted returns than hybrid investors, suggesting, for larger investors, there may be returns to specialization, even in indirect investments.

We next perform multivariate analysis by estimating the regressions in equations (1) and (2) for stated and revealed directness preferences, and report the results in Tables VII and VIII respectively. The structure of these two tables is analogous to Tables II and III, using raw returns in Panel A and style-adjusted returns in Panel B. However, we exclude investor types and investment consultant use, since most investors in this sample are pension funds and, with one exception, use investment consultants.

Analysis of self-stated directness suggests that the more direct investors perform better on their hedge fund investments. Panel A of Table VII shows that direct investors' hedge fund investments' raw returns are significantly higher than indirect investors' hedge fund investments' returns by 42.6 basis points per month (*t*-stat = 2.529). Panel B tells a similar story for style-adjusted returns with direct hedge fund investments performing better by 53.2 basis points per month (*t*-stat = 3.613). These findings resonate well with the cross-sectional evidence using the 2010 snapshot data. Table VIII shows that when we switch from stated to revealed directness preference and use fraction of direct investments instead of an indicator variable for direct investments, we continue to find that direct hedge fund investments perform better using raw returns (coeff. = 1.062, *t*-stat = 5.655; see Panel A) and style-adjusted returns (coeff. = 1.145, *t*-stat = 6.604; see Panel B).

The performance of FOF investments across direct and indirect investors in the subsample with time-series data, however, differs from the cross-sectional results. We find limited evidence of FOF investments by direct investors underperforming those by the indirect investors. When we use the stated directness preferences in Table VII, we find negative and significant coefficient on the indicator variable for direct investments using raw returns (coeff. = –0.229, *t*-stat = –2.813; see Panel A) and style-adjusted returns (coeff. = –0.249, *t*-stat = –2.747; see Panel B). These results though do not hold when we use revealed directness metrics in Table VIII. Specifically, the coefficient on the fraction of direct investments is statistically insignificant in both Panel A (coeff. = –0.074, *t*-stat = –0.262) and Panel B (coeff. = –0.034, *t*-stat = –0.151). These results suggest that, at least for this sub-sample of larger institutional investors, there is

specialization in both direct and indirect investment styles. Deviations from the specialization lead to sub-par performance.

We also examine effect of scale of performance for this sample. These findings are presented in Table X. Since these investors are 22 of the largest investors in our original sample, we expect any findings relating performance to scale to be muted. Directionally, coefficients on size (all positive) and size-squared (all negative) continue to support the existences of economies and diseconomies, even in this subsample. However, these coefficients are only significant for all investments and FOF investments, using style-adjusted returns as the measure of performance.

Examining the number of investments, investors with more than the median number of overall investments experience worse outcomes.[15] Splitting the sample into hedge fund and FOF investments, we find this result is driven largely by hedge fund investments. This suggests only diseconomies of scale in terms of the number of direct investments. Since these are the largest investors, with the most investments, the lack of evidence for economies of scale is unsurprising.

VII. Discussion of results

We have three main findings that shed light on the economics of intermediation. First, indirect investors tend to underperform their direct counterparts in their hedge fund investments. Second, this underperformance stems from a higher fraction of FOFs in the indirect investors' portfolio as well as from their direct hedge fund holdings performing

[15] Due to the relatively small sample of 22 investors, we use only two breakpoints here for the number of investments: median and the 75th percentile to create three groups: below median, median to 75th percentile, and above 75th percentile.

worse than those of their direct investor counterparts. Third, investor size is the key determinant of the ability to invest directly.

These three findings resonate well with the economies of scale required to maintain a team dedicated to picking hedge funds and managing a portfolio of direct hedge fund investments. However, in equilibrium, this would suggest that the returns from direct hedge fund investing to the marginal investor, after subtracting the cost of having an internal team to become a direct investor should equal the returns from investing as an indirect investor through FOFs and poorly picked hedge funds. Conservatively assuming the difference in returns for investments by direct and indirect investors to be 21.6 bps per month as shown in Panel A of Table II, investors should consider moving to a direct platform if the following inequality holds:

$$\textit{Hedge Fund Assets} \times 21.6\ bp \times 12 \geq \textit{Cost of internal team} \qquad (6)$$

As a concrete example, an investor with total assets of $5 billion, and a 10% allocation to hedge funds should consider moving to a direct platform as long as an internal team costs less than $12.96 million dollars a year ($5 billion x 10% x 21.6 bp/month x 12 months = $12.96 million per year). While the costs of running teams vary, anecdotal evidence suggests $5 million a year is ballpark estimate for a fledgling hedge fund investing team.[16] The $5 million cost of managing an internal team translates into a breakeven point of $192 million of hedge fund allocation above which implementing a direct hedge fund investment program becomes economical.

Another motivation for intermediation, aside from avoiding costs associated with maintaining an internal team, could involve career concerns. The portfolio manager for a

[16] The $5 million estimate was obtained from conversations with industry participants and from examining hedge fund investment team compositions at select institutional investors.

large institutional investor would likely be more insulated from performance of hedge fund investments if the ultimate choice of making these investments was delegated to an intermediary. While it is difficult to measure the value of such benefits to the portfolio manager, anecdotal evidence suggests career concerns to be one of the reasons why institutional investors rely on investment consultants and FOFs.

VIII. Conclusion

Our study finds that intermediated hedge fund investment underperforms when institutional investors choose to invest in the hedge fund industry indirectly through funds of hedge funds. We find that size is a strong predictor of directness, suggesting economies of scale in implementing a direct investment strategy. These findings contribute to a growing body of work questioning the role and value added by intermediaries in investment, both in the hedge fund sphere and more generally. However, the link between investor size and intermediation documented in our study provides insight into why indirect investors tolerate worse outcomes: the existence of economies of scale, as reflected in the minimum hedge fund allocation required to fund a cost-effective direct investing team.

So why then do we not observe a clear cut-off, above which all hedge fund investors invest only directly? One possibility that we test and document relates to diseconomies of scale that set in for larger investors: it is possible that institutional investors that are very large and, on the margin, not doing especially well on additional hedge fund investments, may well decide to become more hybrid and allocate some of their funds to be managed by FOFs. For the very largest of investors, we find some

evidence of benefits of specialization in FOF investments, possibly through their ability to select better FOFs. As a consequence, large institutions may be able to outsource their hedge fund investing without significantly suffering from inferior performance. Finally, another reason for investing through FOFs may be related to the career concerns of decision makers at the institutions. This is supported by the anecdotal evidence based on our personal communication with portfolio managers at various institutions.

Nonetheless, the underperformance of indirect investors' FOF and hedge fund investments make direct investing a compelling proposition. Using plausible assumptions, we estimate that the breakeven point at which the benefits from direct investments outweigh the costs of an internal team is about a $200 million allocation to hedge funds. Indirect investors that have not explored direct hedge fund investing and are larger than this threshold should consider developing direct investment capabilities. This may require the use of incentive-based compensation contracts for in-house investment professionals that mitigate the negative effects of their career concerns.

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Table I: Summary Statistics

This table presents the summary statistics for the investor-investment pairs in our sample. Panel A presents the summary statistics of the average investor size (in logarithm of assets in million dollars) for the different types of investors (endowments, foundations, private and public pension plans, and others). Panel B presents the averages of the fraction of investors self-characterizing as indirect, hybrid, and direct, the fraction of investors using investment consultants, and the fraction of actual direct hedge fund investments. Panel C reports the averages of the fraction of hedge funds investments and investment consultant use for the three categories of self-characterized directness.

Panel A – Investor characteristics

	Count	Mean Size (log $M)
Endowment	48	6.10
Foundation	38	6.16
Private pension	47	7.94
Public pension	127	8.00
Other	76	8.90
Total	336	7.37

Panel B –Investors preferences

	Indirect	Hybrid	Direct	Inv. Cons.	Direct HF Frac
Endowment	0.42	0.42	0.17	0.77	0.48
Foundation	0.58	0.32	0.11	0.55	0.51
Private pension	0.64	0.26	0.11	0.55	0.35
Public pension	0.60	0.28	0.12	0.76	0.43
Other	0.45	0.43	0.12	0.46	0.57
Total	0.54	0.34	0.12	0.64	0.47

Panel C – Performance: Stated and Revealed Intermediation Preferences

	% HF investment	% IC Use
Indirect	31.9	55.4%
Hybrid	59.2	75.2%
Direct	78.1	70.7%
Total	46.7	64.0%

Table II: Multivariate Analysis of Stated Intermediation and Performance of Hedge Fund Investments: Cross-Sectional Evidence

This table provides the results of regressions of returns and style-adjusted on investment preferences of institutional investors. Panel A presents results with investment-level average returns as the dependent variable and Panel B presents results with investment-level style-adjusted returns as the dependent variable. Explanatory variables include stated intermediation preferences (whether investors self-characterize as indirect, hybrid, or direct investors and whether they use investment consultant), an indicator variable for whether an investment is a FOF, the size of investor in 2010 (logarithm of assets under management in millions of dollars), and investor type dummies. Results are presented for all investments (including an indicator variable for whether the investment is in a FOF), hedge fund investments only, and FOF investments only, in Models 1, 2, and 3 respectively. The standard errors are clustered at the investor level. The *t*-statistics are reported in the parentheses. Statistical significance of 1%, 5%, and 10% is indicated by ***,**, and * respectively. All dependent variables are winsorized at the 1% level.

Panel A

	Returns		
	All investments	HFs only	FOFs only
	(1)	(2)	(3)
Stated intermediation preferences			
Hybrid	0.071	0.173**	0.020
	(1.221)	(1.988)	(0.316)
Direct	0.126	0.216**	–0.092
	(1.409)	(2.402)	(–0.398)
Investment Consultant Use	–0.094	–0.246	–0.011
	(–1.060)	(–1.620)	(–0.120)
Investment information			
FoF Investment dummy	–0.371***		
	(–7.667)		
Investor characteristics			
Size	–0.005	0.001	–0.019
	(–0.348)	(0.058)	(–0.851)
Investor Type Dummies	Yes	Yes	Yes
R-squared	0.095	0.040	0.004
N	1780	830	950

Panel B

	Style-adjusted returns		
	All investments	HFs only	FOFs only
	(1)	(2)	(3)
Stated intermediation preferences			
Hybrid	0.083	0.221**	0.016
	(1.317)	(2.075)	(0.252)
Direct	0.150	0.266**	–0.094
	(1.508)	(2.501)	(–0.403)
Investment Consultant Use	–0.109	–0.303*	–0.013
	(–1.095)	(–1.686)	(–0.134)
Investment information			
FoF Investment dummy	0.090		
	(1.638)		
Investor characteristics			
Size	–0.004	0.003	–0.018
	(–0.252)	(0.126)	(–0.821)
Investor Type Dummies	Yes	Yes	Yes
R-squared	0.016	0.045	0.005
N	1780	830	950

Table III: Multivariate Analysis of Revealed Intermediation and Performance of Hedge Fund Investments: Cross-Sectional Evidence

This table provides the results of regressions of returns and style-adjusted returns on revealed investment preferences of institutional investors. Panel A presents results with investment-level average returns as the dependent variable and Panel B presents results with investment-level style-adjusted returns as the dependent variables. Explanatory variables include revealed intermediation preferences (Direct HF Fraction computed as the fraction of direct HF investments an investor holds and an indicator variable for the use of investment consultant), an indicator variable for whether an individual investment is a FOF, the size of investor in 2010 (logarithm of assets under management in millions of dollars), and investor type dummies. Results are presented for all investments (including a dummy for whether the investment is in a FOF), hedge fund investments only, and FOF investments only, in Models 1, 2, and 3 respectively. The standard errors are clustered at the investor level. The *t*-statistics are reported in the parentheses. Statistical significance of 1%, 5%, and 10% is indicated by ***,**, and * respectively. All dependent variables are winsorized at the 1% level.

Panel A

	Returns		
	All investments	HFs only	FOFs only
	(1)	(2)	(3)
Revealed intermediation preferences			
Direct HF Fraction	0.165*	0.303**	–0.078
	(1.842)	(2.567)	(–0.447)
Investment Consultant Use	–0.068	–0.137	–0.016
	(–0.792)	(–0.990)	(–0.164)
Investment information			
FoF Investment dummy	–0.320***		
	(–5.849)		
Investor characteristics			
Size	–0.014	–0.021	–0.014
	(–0.833)	(–1.296)	(–0.621)
Investor Type Dummies	Yes	Yes	Yes
R-squared	0.094	0.040	0.004
N	1780	830	950

Panel B

	Style-adjusted returns		
	All investments	HFs only	FOFs only
	(1)	(2)	(3)
Revealed intermediation preferences			
Direct HF Frac.	0.197**	0.340**	–0.080
	(2.010)	(2.427)	(–0.461)
Investment Consultant Use	–0.078	–0.169	–0.017
	(–0.807)	(–1.028)	(–0.176)
Investment information			
FoF Investment dummy	0.153**		
	(2.553)		
Investor characteristics			
Size	–0.014	–0.023	–0.013
	(–0.778)	(–1.108)	(–0.598)
Investor Type Dummies	Yes	Yes	Yes
R-squared	0.016	0.042	0.006
N	1780	830	950

Table IV: Determinants of intermediation

This table provides the results of a regression of how intermediated each investor's investments are on the investment preferences of institutional investors. Panel A examines the measures of directness individually. The first column present the results of an ordered logistic regression where the dependent variable is 0, 1, and 2 if the investor self characterizes as indirect, hybrid and direct respectively. The second column shows the results from the regression of the fraction of direct hedge fund investments for each investor on the investment preferences. The third column presents results of a logistic regression where the dependent variable is whether the investor uses an investment consultant (IC). Panel B presents similar analyses, but ontrols for other measures of directness. The standard errors are clustered at the investor level. The *t*-statistics are reported in the parentheses. Statistical significance of 1%, 5%, and 10% is indicated by ***,**, and * respectively.

Panel A: Joint Analysis

	Stated	Revealed	IC Use
Investor characteristics			
Size	0.320***	0.083***	0.229
	(3.151)	(5.326)	(1.639)
Stated intermediation preferences			
Investment Consultant Use	0.895*	–0.165**	
	(1.901)	(–2.297)	
Hybrid		0.204***	0.857*
		(2.893)	(1.790)
Direct		0.386***	0.998
		(4.490)	(1.345)
Revealed intermediation preferences			
Direct HF fraction	1.563***		–1.088**
	(3.948)		(–2.237)
Investor Type Dummies	Yes	Yes	Yes
Pseudo R-squared / Adj. R-squared	0.143	0.234	0.156
N	196	196	196

Panel B: Independent Analysis

	Stated	Revealed	IC Use
Investor characteristics			
Size	0.461***	0.106***	0.189
	(5.209)	(7.284)	(1.449)
Investor Type Dummies	Yes	Yes	Yes
Pseudo R-squared / Adj. R-squared	0.087	0.149	0.119
N	196	196	196

Table V: Economies and diseconomies of scale

This table provides the results of a regression of performance on investor size and the number of investments. Panels A and B present the results for raw returns and style-adjusted returns, respectively. The first three columns show the effect of investor size (log AUM) and size squared for all investments, HF investments, and FOF investments, respectively. The 4th, 5th and 6th columns add indicator variables for the number of investments each investor has. Investment count measures use indicator variables indicating if an investors' investment count of the stated investment type (all investments, HFs, and FOFs) are below median, median to 75th percentile, 75th percentile to 90th percentile, and above 90th percentile. The indicator variable for below median is excluded. The standard errors are clustered at the investor level. The *t*-statistics are reported in the parentheses. Statistical significance of 1%, 5%, and 10% is indicated by ***,**, and * respectively.

Panel A: Returns

	All Inv.	HF only	FOF only	All Inv.	HF only	FOF only
Investor characteristics						
Size	0.151**	0.371***	0.053	0.108*	0.364***	0.163***
	(2.252)	(3.574)	(0.640)	(1.807)	(3.333)	(2.726)
Size Squared	–0.010**	–0.022***	–0.004	–0.006*	–0.022***	–0.010**
	(–2.467)	(–3.668)	(–0.834)	(–1.683)	(–3.464)	(–2.571)
Number of investments						
Median to 75th percentile				0.064	0.437***	0.190**
				(0.922)	(3.049)	(2.479)
75th to 90th percentile				0.019	0.328**	–0.009
				(0.277)	(2.352)	(–0.167)
Above 90th percentile				–0.299***	0.441***	–0.344***
				(–4.263)	(3.241)	(–6.916)
Investor Type/IC/FOF dummies	Yes/Yes/Yes	Yes/Yes/NA	Yes/Yes/NA	Yes/Yes/Yes	Yes/Yes/NA	Yes/Yes/NA
R-squared	0.095	0.042	0.005	0.142	0.056	0.137
N	1780	830	950	1780	830	950

Panel B: Style-adjusted returns

	All Inv.	HF only	FOF only	All Inv.	HF only	FOF only
Investor characteristics						
Size	0.205***	0.498***	0.056	0.164***	0.472***	0.163***
	(2.808)	(4.078)	(0.694)	(2.715)	(3.628)	(2.731)
Size Squared	–0.013***	–0.029***	–0.005	–0.009**	–0.028***	–0.010**
	(–3.011)	(–4.175)	(–0.894)	(–2.549)	(–3.715)	(–2.587)
Number of investments						
Median to 75th percentile				0.029	0.471***	0.206***
				(0.374)	(2.919)	(2.665)
75th to 90th percentile				–0.041	0.318**	0.001
				(–0.518)	(2.075)	(0.011)
Above 90th percentile				–0.370***	0.400***	–0.326***
				(–4.594)	(2.683)	(–6.443)
Investor Type/IC/FOF dummies	Yes/Yes/Yes	Yes/Yes/NA	Yes/Yes/NA	Yes/Yes/Yes	Yes/Yes/NA	Yes/Yes/NA
R-squared	0.019	0.050	0.006	0.073	0.062	0.137
N	1780	830	950	1780	830	950

Table VI: Time series analysis – summary statistic and bivariate analyses

This table presents the summary statistics and performance analyses for the investor-investment-year data collected from annual reports. Panel A presents the distribution of observations across calendar time. Panel B presents the number of investors in this sample, self-stated directness preferences, realized directness preferences and performance as measured by average raw and style-adjusted returns (SARs) for the year following the investment disclosure. Returns and style-adjusted returns have been winsorized at the 1% level.

Panel A – Calendar time distribution of investor-investment pairs

	N
2007 and before	123
2008	81
2009	150
2010	158
2011	159
Total	671

Panel B – Self-characterized intermediation

	N	HF Fraction (%)	Raw Returns (%)	SARs (%)
Indirect	4	22.4	0.395	0.228
Hybrid	11	77.3	0.452	0.051
Direct	7	87.9	0.543	0.245
Total	22	74.1	0.471	0.126

Table VII: The effect of stated intermediation on performance – time series evidence

This table provides the results of regressions of returns and style-adjusted returns on investment preferences of institutional investors using hand-collected time-series investment data. Panel A presents results with investment-level average returns as the dependent variable and Panel B presents results with investment-level average style-adjusted returns as the dependent variable. Explanatory variables include stated intermediation preferences (whether investors self-characterize as indirect, hybrid or direct investors), revealed intermediation preferences reflecting whether an investment is a FOF, the size of investor in 2010 (logarithm of assets under management in millions of dollars), and time dummies. Results are presented for all investments (including a dummy for whether the investment is in a FOF), hedge fund (HF) investments, and FOF investments separately. The standard errors are clustered at the investor level. The *t*-statistics are reported in the parentheses. Statistical significance of 1%, 5%, and 10% is indicated by ***,**, and * respectively. All dependent variables are winsorized at the 1% level.

Panel A: Returns

	All	HF	FOF
Stated intermediation preferences			
Hybrid	–0.069	0.324	–0.172
	(–0.569)	(1.606)	(–1.478)
Direct	0.020	0.426**	–0.229**
	(0.133)	(2.529)	(–2.813)
Investment Type			
FOF Investment dummy	–0.239		
	(–1.614)		
Investor characteristics			
Size	0.053	0.048	0.015
	(1.091)	(0.762)	(0.164)
Time dummies	Yes	Yes	Yes
R-squared	0.148	0.113	0.309
N	671	497	174

Panel B: Style-adjusted returns

	All	HF	FOF
Stated intermediation preferences			
Hybrid	–0.155	0.304*	–0.170
	(–1.253)	(1.746)	(–1.382)
Direct	0.029	0.532***	–0.249**
	(0.178)	(3.613)	(–2.747)
Investment Type			
FOF Investment dummy	0.001		
	(0.005)		
Investor characteristics			
Size	0.008	–0.002	0.011
	(0.172)	(–0.031)	(0.090)
Time dummies	Yes	Yes	Yes
R-squared	0.027	0.050	0.167
N	671	497	174

Table VIII: The effect of revealed intermediation on performance – time series evidence

This table provides the results of regressions of returns and style-adjusted returns on investment preferences of institutional investors using hand-collected time-series investment data. Panel A presents results with investment-level average returns as the dependent variable and Panel B presents results with investment-level average style-adjusted returns as the dependent variable. Explanatory variables include revealed intermediation preferences (Direct HF Fraction computed as the fraction of direct HF-investment-years an investor has divided by the total number of investment-years), whether an investment is a FOF, the size of investor in 2010 (logarithm of assets under management in millions of dollars), and time dummies. Results are presented for all investments (including a dummy for whether the investment is in a FOF), hedge fund (HF) investments, and FOF investments separately. The standard errors are clustered at the investor level. The *t*-statistics are reported in the parentheses. Statistical significance of 1%, 5%, and 10% is indicated by ***,**, and * respectively. All dependent variables are winsorized at the 1% level.

Panel A: Returns

	All	HF	FOF
Revealed intermediation preferences			
Direct HF Fraction	0.667***	1.062***	–0.074
	(2.894)	(5.655)	(–0.262)
Investment Type			
FOF Investment dummy	0.106		
	(0.588)		
Investor characteristics			
Size	0.001	0.008	0.033
	(0.027)	(0.218)	(0.391)
Time dummies	Yes	Yes	Yes
R-squared	0.158	0.130	0.306
N	671	497	174

Panel B: Style-adjusted returns

	All	HF	FOF
Revealed intermediation preferences			
Direct HF Fraction	0.748***	1.145***	–0.034
	(3.380)	(6.604)	(–0.151)
Investment Type			
FOF Investment dummy	0.386*		
	(2.066)		
Investor characteristics			
Size	–0.057	–0.053	0.021
	(–1.622)	(–1.498)	(0.198)
Time dummies	Yes	Yes	Yes
R-squared	0.039	0.069	0.152
N	671	497	174

Table X: Economies and diseconomies of scale (Time series evidence)

This table provides the results of regressions of performance on investor size and number of investments using the time-series sample. Performance measures include raw returns and style-adjsuted returns. The first three columns show the effect of investor size (log AUM), size squared, and number of investments on raw returns, for all investments, HF investments, and FOF investments, respectively. Investment count measures use indicator variables indicating if an investors' investment count of the stated investment type (all investments, HFs, and FOFs) that are below median, median to 75th percentile, and above 75th percentile. The indicator variable for below median is excluded. The 4th, 5th and 6th columns present similar results with style-adjusted returns as the dependent variable. The standard errors are clustered at the investor level. The *t*-statistics are reported in the parentheses. Statistical significance of 1%, 5%, and 10% is indicated by ***,**, and * respectively.

	Returns			Style-adjusted Returns		
	All Inv.	HF only	FOF only	All Inv.	HF only	FOF only
Investor characteristics						
Size	0.327	0.563	0.853	1.192*	1.099	1.754*
	(0.787)	(0.695)	(0.881)	(1.992)	(1.305)	(2.045)
Size Squared	−0.011	−0.020	−0.041	−0.057*	−0.052	−0.086*
	(−0.551)	(−0.549)	(−0.820)	(−1.964)	(−1.295)	(−1.914)
Number of investments (Below Median omitted)						
Median to 75th percentile	−0.383**	−0.393**	0.301	−0.357**	−0.313	0.339*
	(−2.337)	(−2.148)	(1.306)	(−2.275)	(−1.526)	(1.838)
Above 75th percentile	−0.489**	−0.604**	0.168	−0.314**	−0.301*	0.105
	(−2.670)	(−2.466)	(0.655)	(−2.213)	(−1.788)	(0.559)
Year/FOF dummies	Yes/Yes	Yes/NA	Yes/NA	Yes/Yes	Yes/NA	Yes/NA
R-squared	0.161	0.126	0.310	0.035	0.048	0.209
N	671	497	174	671	497	174

Appendix

Table A.III: Multivariate Analysis of Stated Intermediation and Performance of Hedge Fund Investments: Cross-Sectional Evidence (Firm level performance)

This table provides the results of regressions of returns and style-adjusted on investment preferences of institutional investors. Panel A presents results with investment firm-level average returns as the dependent variable and Panel B presents results with investment firm-level average style-adjusted returns as the dependent variable. Explanatory variables includes indicator variables for each investor type, and investor characteristics, including stated intermediation preferences, i.e., whether investors self-characterize as indirect, hybrid, or direct investors, investment information reflecting whether an investment is a FOF, and investor characteristics including the size of investor in 2010 (logarithm of assets under management in millions of dollars). Results are presented for all investments (including an indicator variable for whether the investment is in a FOF), hedge fund investments only, and FOF investments only, in Models 1, 2, and 3 respectively. The standard errors are clustered at the investor level. The *t*-statistics are reported in the parentheses. Statistical significance of 1%, 5%, and 10% is indicated by ***,**, and * respectively. All dependent variables are winsorized at the 1% level.

Panel A

	Returns		
	All investments	HFs only	FOFs only
	(1)	(2)	(3)
Stated intermediation preferences			
Hybrid	0.153**	0.387***	–0.007
	(2.190)	(3.209)	(–0.142)
Direct	0.313***	0.528***	–0.037
	(2.981)	(4.195)	(–0.191)
IC Use	–0.196**	–0.399**	–0.011
	(–2.010)	(–2.424)	(–0.157)
Investment information			
FoF Investment dummy	–0.237***		
	(–4.259)		
Investor characteristics			
Size	0.006	0.001	–0.003
	(0.325)	(0.030)	(–0.171)
Investor Type Dummies	Yes	Yes	Yes
R-squared	0.082	0.056	-0.022
N	434	236	198

Panel B

	Style-adjusted returns		
	All investments	HFs only	FOFs only
	(1)	(2)	(3)
Stated intermediation preferences			
Hybrid	0.167**	0.427***	–0.009
	(2.184)	(3.200)	(–0.171)
Direct	0.359***	0.606***	–0.043
	(3.034)	(4.288)	(–0.213)
IC Use	–0.223**	–0.449**	–0.018
	(–2.022)	(–2.395)	(–0.251)
Investment information			
FoF Investment dummy	0.190***		
	(3.137)		
Investor characteristics			
Size	0.006	0.004	–0.007
	(0.280)	(0.118)	(–0.402)
Investor Type Dummies	Yes	Yes	Yes
R-squared	0.026	0.060	-0.019
N	434	236	198

Table A.IV: Multivariate Analysis of Revealed Intermediation and Performance of Hedge Fund Investments: Cross-Sectional Evidence (Firm level performance)

This table provides the results of regressions of returns and style-adjusted returns on revealed investment preferences of institutional investors. Panel A presents results with investment firm-level average returns as the dependent variable and Panel B presents results with investment firm-level average style-adjusted returns as the dependent variable. Explanatory variables includes indicator variables for each investor type, and investor characteristics, including revealed intermediation preferences (Direct HF Frac., computed as the fraction of direct HF investments an investor holds), whether an individual investment is a FOF, and investor characteristics including the size of investor in 2010 (logarithm of assets under management in millions of dollars). Results are presented for all investments (including a dummy for whether the investment is in a FOF), hedge fund investments only, and FOF investments only, in Models 1, 2, and 3 respectively. The standard errors are clustered at the investor level. The *t*-statistics are reported in the parentheses. Statistical significance of 1%, 5%, and 10% is indicated by ***,**, and * respectively. All dependent variables are winsorized at the 1% level.

Panel A

	Returns		
	All investments	HFs only	FOFs only
	(1)	(2)	(3)
Revealed intermediation preferences			
Direct HF Frac.	0.349***	0.527***	–0.086
	(2.816)	(3.115)	(–0.668)
IC Use	–0.151*	–0.228	–0.014
	(–1.687)	(–1.640)	(–0.195)
Investment information			
FoF Investment dummy	–0.122*		
	(–1.718)		
Investor characteristics			
Size	–0.004	–0.006	0.001
	(–0.176)	(–0.211)	(0.029)
Investor Type Dummies	Yes	Yes	Yes
R-squared	0.080	0.035	-0.015
N	434	236	198

Panel B

	Style-adjusted returns		
	All investments	HFs only	FOFs only
	(1)	(2)	(3)
Revealed intermediation preferences			
Direct HF Frac.	0.337**	0.551***	–0.211
	(2.459)	(2.954)	(–1.560)
IC Use	–0.177*	–0.262	–0.025
	(–1.727)	(–1.621)	(–0.351)
Investment information			
FoF Investment dummy	0.289***		
	(3.757)		
Investor characteristics			
Size	–0.003	-0.003	0.002
	(–0.116)	(-0.098)	(0.106)
Investor Type Dummies	Yes	Yes	Yes
R-squared	0.018	0.033	0.000
N	434	236	198

Table A.VI: Economies and diseconomies of scale

This table provides the results of a regression of how performance is affected by scale. Panel A presents results with investment firm-level average returns as the dependent variable and Panel B presents results with investment firm-level average style-adjusted returns as the dependent variable. The first three columns show the effect of investor size (log AUM), size squared, and number of investments on performance, for all investments, HF investments, and FOF investments, respectively. Investment count measures use dummy variables indicating if an investors' investment count of the stated investment type (all investments, HFs, and FOFs) that are below median, median to 75th percentile, 75th percentile to 90th percentile and above 90th percentile. The dummy variable for below median is excluded. The 4th, 5th and 6th columns show the interaction of size (whree investors are split evenly into large investors and small investors) and number of investments for all investments, HF investments, and FOF investments, respectively. The standard errors are clustered at the investor level. The *t*-statistics are reported in the parentheses. Statistical significance of 1%, 5%, and 10% is indicated by ***,**, and * respectively.

Panel A: Returns

	All Inv.	HF only	FOF only	All Inv.	HF only	FOF only
Investor characteristics						
Size	0.145*	0.371**	0.077			
	(1.768)	(2.374)	(1.167)			
Size Squared	–0.007	–0.024***	–0.004			
	(–1.467)	(–2.633)	(–0.913)			
Number of investments						
50th to 75th percentile	0.135	0.560***	0.203***	0.163*	0.392	0.245**
	(1.606)	(3.289)	(2.758)	(1.703)	(1.558)	(2.606)
75th to 90th percentile	0.155*	0.420**	0.068	0.133	0.414*	0.054
	(1.968)	(2.553)	(1.202)	(1.445)	(1.860)	(0.992)
Above 90th percentile	–0.158	0.778***	–0.242***	–0.212**	0.474**	–0.324***
	(–1.636)	(4.849)	(–4.413)	(–2.043)	(2.180)	(–5.750)
Size dummy (Large =1 Small = 0)						
Size Dummy				0.200*	–0.137	0.015
				(1.665)	(–0.481)	(0.185)
Interaction						
50th to 75th percentile * Size Dum.				–0.178	0.342	–0.132
				(–0.964)	(1.014)	(–0.941)
75th to 90th percentile * Size Dum.				0.058	0.014	0.036
				(0.360)	(0.043)	(0.324)
> 90th percentile * Size Dum.				0.039	0.345	0.135
				(0.226)	(1.152)	(1.358)
Investor Type/IC/FOF dummies	Yes/Yes/Yes	Yes/Yes/NA	Yes/Yes/NA	Yes/Yes/Yes	Yes/Yes/NA	Yes/Yes/NA
R-squared	0.097	0.096	0.135	0.039	0.077	0.133
N	434	236	198	434	236	198

Panel B: Style-adjusted returns

	All Inv.	HF only	FOF only	All Inv.	HF only	FOF only
Investor characteristics						
Size	0.177**	0.422**	0.083			
	(2.044)	(2.482)	(1.213)			
Size Squared	–0.009*	–0.026***	–0.005			
	(–1.711)	(–2.712)	(–1.066)			
Number of investments						
50th to 75th percentile	0.122	0.583***	0.218***	0.228**	0.363	0.247**
	(1.310)	(3.123)	(2.766)	(2.312)	(1.312)	(2.374)
75th to 90th percentile	0.123	0.393**	0.095	0.010	0.336	0.083
	(1.358)	(2.243)	(1.595)	(0.105)	(1.413)	(1.441)
Above 90th percentile	–0.214**	0.757***	–0.212***	–0.246***	0.343	–0.327***
	(–1.991)	(4.361)	(–3.479)	(–2.754)	(1.443)	(–4.923)
Size dummy (Large =1 Small = 0)						
Size Dummy				0.083	–0.202	0.003
				(0.602)	(–0.685)	(0.029)
Interaction						
50th to 75th percentile * Size Dum.				–-0.153	0.454	–0.089
				(–0.780)	(1.233)	(–0.598)
75th to 90th percentile * Size Dum.				0.216	0.126	0.039
				(1.265)	(0.369)	(0.336)
> 90th percentile * Size Dum.				0.074	0.526*	0.181*
				(0.435)	(1.669)	(1.658)
Investor Type/IC/FOF dummies	Yes/Yes/Yes	Yes/Yes/NA	Yes/Yes/NA	Yes/Yes/Yes	Yes/Yes/NA	Yes/Yes/NA
R-squared	0.041	0.078	0.124	0.040	0.067	0.126
N	434	236	198	434	236	198

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