Fund Selection, Style Allocation, and Active Management Abilities: Evidence from Funds of Hedge Funds' Holdings*

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January 2018

Abstract

This study examines whether funds of hedge funds (FOHFs) provide superior before-fee performance through managers' fund selection, style allocation, and active management abilities. Using reported holdings of SEC-registered FOHFs, we find that FOHF managers have fund selection abilities, as hedge funds held by FOHFs outperform their style indices and over half of the individual hedge funds in the TASS database. We also find that FOHF managers add value through active management of FOHFs' holdings, while evidence on their style allocation abilities is mixed. Our findings help explain why FOHFs continue to survive and suggest FOHF fee structure reform merits consideration.

Key Words: Funds of Hedge Funds, Holdings, Fund Selection, Style Allocation, Active Management.

JEL Classification: G23

* We thank Mara Faccio, John McConnell, Xiaoyan Zhang, and Lu Zheng for helpful comments and suggestions. All remaining errors are ours.

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This study examines whether funds of hedge funds (FOHFs) provide superior before-fee performance through managers' fund selection, style allocation, and active management abilities. Using reported holdings of SEC-registered FOHFs, we find that FOHF managers have fund selection abilities, as hedge funds held by FOHFs outperform their style indices and over half of the individual hedge funds in the TASS database. We also find that FOHF managers add value through active management of FOHFs' holdings, while evidence on their style allocation abilities is mixed. Our findings help explain why FOHFs continue to survive and suggest FOHF fee structure reform merits consideration.

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The SEC defines a fund of hedge funds (FOHF hereafter) as a hedge fund that utilizes a multi-manager, multi-strategy approach by investing all, or a significant portion, of its assets in hedge funds.[1] FOHFs offer several benefits to hedge fund investors. First, they provide diversification against risks associated with individual hedge funds. Second, they lower investors' due diligence and fund selection costs. Third, they facilitate access to individual hedge funds by allowing investors to bypass individual funds' minimum investment requirements and by providing access to funds that are otherwise closed to new investors. These benefits helped to attract substantial capital to the FOHF industry in the years preceding the most recent financial crisis, as total assets under management (AUM) in the FOHF industry ballooned from $108.75 billion in 2000 to $1.2 trillion in 2007 according to Barclay Hedge.[2]

Nevertheless, a notable drawback to investing in FOHFs is their double layered fee structure, where investors pay both the fees charged by the FOHF and the fees charged by the individual hedge funds held by the FOHF. Using reported returns in commercial databases, prior research shows that FOHFs provide lower returns than individual hedge funds on an after-fee basis and that FOHFs' additional layer of fees contributes to lower returns (e.g., Amin and Kat (2003), Brown, Goetzmann, and Liang (2004) and Liang (2004)).[3] Practitioners often deride FOHFs for their lackluster performance and double layered fee structure and cite these factors as drivers of large-scale FOHF share redemptions in the aftermath of the financial crisis.[4] Indeed, many large institutions are increasingly making direct investments in individual hedge funds to bypass FOHF fees, and there is some evidence that large institutions' direct investments are outperforming their FOHF investments on an after-fee basis (e.g., Agarwal, Nanda, and Ray (2013)).

Given the performance drag imposed by FOHFs' additional layer of fees, a pertinent question arises as to whether there is merit to reforming the fee structure in the FOHF industry. Investors in individual hedge funds have pushed hard for fee structure reform in recent years due to sluggish fund performance, and many funds have responded by lowering fees and adding flexibility to their fee arrangements.[5] Whether

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[1] See "Implications of the Growth of Hedge Funds" (https://www.sec.gov/news/studies/hedgefunds0903.pdf) for more details.

[2] https://www.barclayhedge.com/research/indices/ghs/mum/HF_Money_Under_Management.html

[3] Note that there is debate about whether FOHFs "deserve" their fees. For example, Ang, Rhodes-Kropf and Zhao (2008) argue that prior studies' use of hedge fund returns from commercial databases are inappropriate for benchmarking FOHF performance, as commercially-available hedge funds do not capture the available set of hedge fund investments an investor can achieve on her own without recourse to FOHFs.

[4] See Julie Steinberg, "Funds of Hedge Funds Come With Heaps of Fees", December 4, 2013 (https://www.wsj.com/articles/funds-of-hedge-funds-come-with-heaps-of-fees-1386176762?tesla=y), and Carleton English, "Investors Say Stop Paying 'Funds of Hedge Funds,'" July 18, 2016 (http://nypost.com/2016/07/18/investors-say-stop-paying-funds-of-hedge-funds/), among others.

[5] See Jeff Cox, "Hedge Fund Fees Are Falling As Shutdowns Hit a Post-Crisis High," March 17, 2017 (https://www.cnbc.com/2017/03/17/hedge-fund-fees-falling-as-shutdowns-hit-a-post-crisis-high.html); "Survey: Three Quarters of Hedge Funds Willing to Cut Fees", March 21, 2017 (http://www.institutionalinvestor.com/article/3671205/investors-pensions/survey-three-quarters-of-hedge-funds-willing-to-cut-fees.html); and Alicia McElhaney, "No 2-and-20? No Problem," August 25, 2017 (http://www.institutionalinvestor.com/article/3745818/asset-management-hedge-funds-and-alternatives/no-2-and-20-no-problem.html), among others.

similar reforms are worth pursuing in the FOHF industry hinges critically on the ability of FOHFs to add value before fees, as there would be little justification for fee reform if FOHFs do not add value with their holdings. Evidence on this point is scarce, however, largely because commercial databases only provide FOHF-level data on an after-fee basis, thereby obscuring holding-level contributions to performance as well as the skills FOHF managers employ to add value. Nonetheless, the potential for FOHFs to add value before fees is suggested by prior research (e.g., Fung et al. (2008) and Brown, Fraser, and Liang (2008)) and by the fact that FOHFs continue to manage $360 billion in assets as of the end of 2016 (Barclay Hedge), supported by large capital inflows from institutional investors such as pension funds.[6]

In this paper, we use a hand-collected set of holding-level data to investigate whether FOHF managers add value before fees through their fund selection, style allocation, and active management abilities. *Fund selection abilities* refer to selecting individual funds that can deliver superior performance. *Style allocation abilities* refer to allocating capital based on the performance of different investment styles. *Active management abilities* refer to directing capital flows of existing holdings (at the fund and style level) to maximize portfolio performance. We obtain holding-level data for the years 2004 through 2015 from the quarterly filings of FOHFs that register with the SEC, as these filings require FOHFs to report detailed information on their holdings.[7] In addition to purging the effects of FOHF-level fees on performance, hand-collected holding-level data are less susceptible to survivorship and backfill biases and they allow for insights into FOHF managers' skills, which differ from those of individual hedge fund managers in that they pertain to the selection and management of hedge funds rather than individual securities. While holding-level data have been used to show FOHF managers skillfully sell off funds with poor future performance (e.g., Aiken, Clifford, and Ellis (2015)), it remains unclear whether FOHF managers possess skills that can provide superior before-fee performance, which is critical to considerations of the merits of FOHF fee structure reform.

An issue we encounter with SEC filing data is that FOHFs do not report the performance of their holdings, nor do they report holding-level capital flows. As a result, we need to estimate holding-level returns and capital flows using other reported information, such as a holding's cost basis and current market value. Common methodologies employed in the literature (e.g., Aiken, Clifford, and Ellis (2013) and Agarwal, Aragon, and Shi (2016)), work reasonably well when funds maintain or increase their investments, but run into problems when funds decrease their investments. Therefore, we modify common

[6] See Katia Porzecanski and Terrence Dopp, "BlackRock Fund-of-Funds to Get Up to $1 Billion From New Jersey," August 3, 2016 (https://www.bloombergquint.com/business/2016/08/03/blackrock-fund-of-funds-to-get-up-to-1-billion-from-new-jersey).

[7] Over the past decade, many FOHFs voluntarily registered with the SEC as investment companies under the Investment Company Act of 1940. The primary incentive for a FOHF to register with the SEC is to bypass legal restrictions that unregistered FOHFs face when they raise capital (e.g., restrictions on the type and quantity of investors that can contribute capital). See Aiken, Clifford, and Ellis (2015), among others, for a discussion.

methodologies using the algorithm in Agarwal, Daniel, and Naik (2009) to allow us to calculate fund returns and flows more accurately.

Our first set of tests follows the analysis in Daniel et al. (1997; DGTW hereafter). DGTW use mutual fund holdings to examine whether fund managers have characteristic selection (*CS*) and characteristic timing (*CT*) abilities. We modify these measures using style indices provided by Hedge Fund Research (HFR hereafter) and Credit Suisse to examine FOHF managers' abilities. Specifically, our modified *CS* measure examines whether FOHF managers can select individual hedge funds that outperform their corresponding style indices, while our modified *CT* measure examines whether FOHF managers can time the performance of different investment styles and allocate capital accordingly. Here, we classify individual funds into four general styles using the style classifications developed by Agarwal, Daniel, and Naik (2009) . We find that our modified *CS* measures are positive and significant with both indices, suggesting FOHF managers have fund selection abilities. However, our modified *CT* measures are insignificant, inconsistent with FOHF managers skillfully timing style performance.[8] In addition, we regress our modified *CS* and *CT* measures on the seven factors used in Fung and Hsieh (2004) and find that our modified *CS* measure remains positive and significant, suggesting risk is unlikely to explain our findings.

One potential concern with our modified DGTW measures is that they may be sensitive to the choice of style benchmark. For example, HFR and Credit Suisse indices only use hedge funds with at least $50 million in assets. As a result, small hedge funds are excluded from these indices, which can impose a positive bias on our measures if larger funds suffer from diseconomies of scale. We address this concern by benchmarking FOHF holding performance against individual hedge funds of varying sizes from the Lipper TASS database. To assess FOHF managers' fund selection abilities, we rank TASS funds into percentiles based on their cumulative quarterly returns and assign each FOHF holding to a corresponding percentile based on its performance. Under this approach, we measure fund selection ability as the average percentile ranking of all FOHF holdings. We find that the average performance ranking (with 100 being the top ranking) for FOHFs in our sample is 52, which is statistically higher than 50.[9] Thus, we continue to find that FOHF managers have fund selection abilities when using the universe of TASS funds as our benchmark.

[8] One possible reason for the lack of style timing ability is that fund selection is more important than style timing in the hedge fund industry. We examine this possibility in section V.A.3.

[9] Additionally, we construct style indices using the universe of TASS funds by assigning funds to one of the four general styles and then compute style returns as the equal-weighted average return of funds within each style. We find that our modified *CS* measure using the style index constructed from the universe of TASS hedge funds is positive and significant. Please refer to Section V Robustness Tests.

With regard to style allocation abilities, we begin by assigning hedge funds in the TASS database to four general styles using the algorithm in Agarwal, Daniel, and Naik (2009). We use the total of TASS hedge fund assets in each style to represent the market shares of the four general styles. For each FOHF, we then calculate differences between style weights and style market shares and multiply these differences by style returns. Summing these products across the four general styles for each FOHF provides a second measure of style allocation abilities. In contrast to our modified *CT* measure, this measure examines whether abnormal style weights generate superior performance. On average, we find that this measure is significantly positive using HFR and Credit Suisse index returns. Thus, our results suggest that FOHF managers' portfolio-level style weighting decisions provide an additional source of value added for investors.

Our last set of tests uses holding-level capital flows to examine FOHF managers' active management abilities. In contrast to Aiken, Clifford and Ellis (2015), who examine "hiring" and "firing" decisions of FOHF holdings, we focus on how FOHF managers actively adjust their portfolio holdings, which can be additional purchases or partial redemptions of existing holdings. We follow Zheng (1999) and partition FOHF holdings into two groups based on the direction of flows in the prior quarter, that is, we assign funds with positive flows (i.e., additional purchases of existing holdings) to one group, negative flows (i.e., partial redemptions of existing holdings) to a second group, and form asset-weighted portfolios for each group. We then measure the performance difference between the two portfolios and interpret it as a measure of active management ability. When we use style-adjusted returns, we find these measures are positive and significant, suggesting managers have active management abilities. We apply a similar approach at the style level (i.e., flows are measured at the style level) but do not find these measures to be significant. Thus, as in the DGTW case, we do not find that FOHF managers have significant style timing abilities.

Our study contributes to the literature in several ways. First, our study contributes to the literature on funds of hedge funds by showing that managers of registered FOHFs have skills that significantly enhance FOHF performance before fees. Thus, our findings help explain why FOHFs continue to survive in recent years and they suggest fee structure reform in the FOHF industry merits consideration.[10] Second, our study is among the very few that examine FOHFs using holding-level data. Relative to FOHF-level data, holding-level data provide greater opportunities for researchers to examine the skills that FOHF managers employ to add value for investors. Aiken, Clifford, and Ellis (2015) use holding-level data to show that FOHF managers divest from hedge funds that subsequently underperform and fail more often,

[10] The asset-weighted average of before-fee returns of FOHFs in our sample is about 6.95% per year. If we assume that FOHFs charge a 1% management fee and a 10% incentive fee (which are industry standard rates), then the after-fee performance of FOHFs in our sample is about 5.25% per year. This is lower than the asset-weighted average return of individual hedge funds (about 5.75% per year) from the Lipper TASS database used in our analysis.

suggesting FOHF managers skillfully monitor their portfolio holdings. Our findings complement those of Aiken, Clifford, and Ellis (2015) by showing that FOHF managers also have skills in selecting and actively managing their existing holdings and that these skills add value by facilitating superior FOHF performance before fees. Lastly, our study offers methodological refinements for calculating the returns and capital flows of FOHF holdings. Common methodologies employed in the literature encounter difficulties in calculating returns and flows when FOHFs adjust the cost basis of their holdings, particularly for decreases in holdings (e.g., Aiken, Clifford, and Ellis (2013) and Agarwal, Aragon, and Shi (2016)). We follow Agarwal, Daniel, and Naik (2009) and adapt their capital flow algorithm to the FOHF setting, which both facilitates and improves return and flow calculations when FOHFs adjust their existing holdings.

I. Data and Methodology

A. Data collection

Because the SEC does not provide identifiers for registered FOHFs, we use line items reported in Form N-SAR filings to identify FOHFs among all registered investment companies. First, we identify closed-end funds using Item 27, as FOHFs commonly register as closed-end funds. Next, we identify funds with minimum initial investment requirements using Item 61 of the filing. This step differs from prior studies that use a $0.00 closing price as the second filter (e.g., Aiken, Clifford, and Ellis (2013, 2015) and Agarwal, Aragon, and Shi (2016)). While there is intuitive appeal to using a $0.00 closing price filter, we find several cases where registered FOHFs report non-zero closing prices.[11] Therefore, to avoid omitting valid observations, we use minimum initial investment requirements, which are common among hedge funds, as the second filter rather than a $0.00 closing price.

After applying these filters, we are able to identify 458 closed-end funds with minimum initial investment requirements.[12] As these closed-end funds consist of FOHFs, mutual funds, funds of mutual funds, and other private equity funds, we use the following additional criteria to identify FOHFs. First, we exclude funds that primarily hold assets other than hedge funds, which we identify using holdings data reported in forms N-CSR, N-CSRS, and N-Q. Funds that fail to raise capital and thus report zero holdings throughout their lifetime are also excluded. This leave us with 187 funds. Second, we identify funds with

[11] For instance, DB Hedge Strategies Fund (CIK number 1145546) reports a closing price of $1,233.13 for the period ended September 30th 2006, Cantor Opportunistic Alternatives Fund (CIK number 1373925) reports a closing price of $92.45 for the period ended March 31st 2012, and Alternative Investment Partners Absolute Return Fund (CIK number 1327228) reports a closing price of $1,626.72 for the period ended June 30th 2015, among others.

[12] To mitigate concerns that our minimum initial investment requirement filter removes valid FOHF observations, we manually inspect all closed-end funds without minimum initial investment requirements for the years 2006, 2008, 2010, and 2012. The only funds meeting these criteria are master funds of certain feeder funds. However, because we eventually replace feeder fund data with master fund data, we ultimately retain these valid observations.

master-feeder structures. Feeder funds normally invest 100% in their master funds.[13] Thus, if a master fund and its corresponding feeder funds meet our selection criteria up to this point, we retain the master fund and remove the feeder funds from our sample. Conversely, if only the feeder funds remain, we replace the feeder funds with their corresponding master funds. This procedure reduces our sample to 116 funds. Finally, we exclude funds that do not report costs, values, or investment styles for their holdings. This brings us to a final sample of 96 FOHFs covering a sample period spanning 2004-2015.

For all registered FOHFs in our final sample, we collect quarterly holdings data from Form N-CSR, N-CSRS, and N-Q filings. In these filings, FOHFs report the names, investment styles, costs, and quarter-end values of the underlying hedge funds in their holdings. Here, "costs" represent cost positions in the underlying hedge funds. Thus, an increase in cost indicates a FOHF invests more in an underlying hedge fund, while a decrease in cost suggests a partial redemption from an underlying hedge fund. In terms of investment styles, because FOHFs categorize their holdings in different ways, we consolidate reported styles into four general styles using the classifications in Agarwal, Daniel, and Naik (2009), that is, Directional Traders, Relative Value, Security Selection, and Multi-Process.[14] If we cannot map the reported style of an underlying hedge fund in the filing data to a general style, we check the Lipper TASS database and assign a general style based on the self-reported style in the database. Observations with undetermined investment styles are excluded.

B. Returns and Flows Algorithm

Because FOHFs do not report underlying hedge fund returns, we estimate these returns based on reported costs and values. We do not use returns reported in commercial databases (e.g., Lipper TASS) because Aiken, Clifford, and Ellis (2013) show that 51% of FOHF fund-quarter holdings are excluded from commercial databases. Aiken, Clifford, and Ellis (2013) estimate underlying hedge fund returns using changes in reported value (assuming fund flows occur at the end of the quarter) with adjustments for changes in reported cost. This method works reasonably well when reported costs stay the same or increase

[13] For example, Arden Sage Multi-Strategy TEI Institutional Fund (CIK number 1441466), a feeder fund of Arden Sage Multi-Strategy Master Fund, states that "the Fund accomplishes its investment objective by investing substantially all of its assets in the Master Fund" in the "Organization" section of its N-CSRS.

[14] Directional Traders usually bet on the direction of market prices of currencies, commodities, equities, and bonds in the futures and cash markets. Relative Value strategies take positions on spread relationships between prices of financial assets or commodities and aim to minimize market exposure. Security Selection managers take long and short positions in undervalued and overvalued securities, respectively, and reduce the systematic market risks in the process. Multi-process strategies involve multiple strategies employed by the funds. For details, see Agarwal, Daniel, and Naik (2009) Appendix B. FOHFs also hold funds in some other styles and "Cash and Equivalents". The average FOHF size with and without assets in other styles and cash and equivalents are $379.67 million and $346.08 million, respectively. Thus, our sample captures the bulk of FOHF holdings.

over the quarter. However, when reported costs decrease (i.e., when there are share redemptions), the return calculation is likely to be problematic because it does not capture the change in value for redeemed shares.

To mitigate this issue, we follow the algorithm in Agarwal, Daniel, and Naik (2009). We start by treating the first reported cost of an underlying hedge fund as the initial investment in that fund. When there is a subsequent increase in reported cost (i.e., inflows due to additional purchases), we treat the increase as a new investment position in the fund. When there is a subsequent decrease in reported cost (i.e., outflows due to partial redemptions), we use a "first in, first out" (FIFO) rule and assume shares are redeemed starting from the oldest investment positions (for further details and an illustrative example of the FIFO procedure, please refer to the Appendix). When an underlying hedge fund is held by multiple FOHFs, multiple return estimates may arise because FOHFs invest in this fund at different times over the quarter. In such cases, we use the median return as the fund's estimated return.

After we estimate returns for each underlying hedge fund in a FOHF's holdings, we compute the capital flow of underlying hedge fund *i* in quarter *t* as in Sirri and Tufano (1998):

$$Flow_{i,t} = \frac{Value_{i,t} - Value_{i,t-1} \times (1 + Return_{i,t})}{Value_{i,t-1}}. \quad (1)$$

Notice that capital flows refer to additional purchases or partial redemptions of the underlying hedge funds.

C. Summary Statistics

Table I presents the summary statistics for our sample. Panel A shows that the mean number of hedge fund holdings among registered FOHFs is 26.7, while the mean number of reported styles (general styles) is 4.5 (2.8). On a per-style basis, the mean number of hedge funds is 7.5 per reported style and 10.7 per general style. Panel A of Figure 1 shows that the average number of FOHF holdings changes over time. At the beginning of our sample period (i.e., 2004), FOHFs hold around 20 hedge funds on average. This number increases to more than 30 during the 2010-2012 period before decreasing to roughly 25 funds by the end of our sample period (i.e., 2015). In contrast, Panel B of Figure 1 shows that the average number of general styles in FOHFs' holdings is mostly around three for the full sample period. This implies that FOHFs provide diversification because the four general styles are quite different.

Returning to Panel A of Table I, hedge funds held by registered FOHFs have a mean quarterly return of 1.3% and a median quarterly return of 1.6%. We also calculate FOHF returns as the asset-weighted returns of underlying hedge funds. Mean and median FOHF quarterly returns in our sample are 1.8% and 2.2%, respectively.

[Insert Table I about here]

[Insert Figure 1 about here]

Turning to flow data, the average flow of hedge funds held by FOHFs is 1.6% per quarter, while the median flow is 0. One possible reason for the zero median is that most hedge funds have share restrictions with some also having explicit lockup periods. Thus, FOHFs might not be able to adjust their investments each quarter. In addition, some hedge funds are closed to new investment, in which case FOHFs can only redeem previous investments in those funds. Nevertheless, observing zero median flow does not necessarily indicate that FOHFs do not actively manage their holdings. For example, around 40% of fund-quarter observations in our sample have increases or decreases in costs, indicating additional purchases or partial redemptions, respectively. Moreover, Figure 2 shows that the average FOHF adds/drops at least one fund from its holdings every quarter, with the most active quarters averaging around three to four adds/drops. Given that FOHFs hold an average of 26.7 hedge funds at any given time, these changes are quite significant.[15]

Table I, Panel B compares registered FOHFs with FOHFs reported in the Lipper TASS database. In our subsequent analysis, we use hedge fund data (both individual hedge funds and FOHFs) from the Lipper TASS database to facilitate some of the analysis. We require TASS hedge funds to report monthly net-of-fee returns in US dollars (USD), have at least $5 million in assets, and have at least one year of returns data. Observations with missing fund returns, fund assets, or investment style information are deleted. We mitigate survivorship bias by including defunct funds in the sample, and we mitigate backfill bias by excluding observations that predate the fund's TASS database add-date. If the add-date is not available, we exclude the first 18 months of fund data. We also winsorize fund returns at both the 1% and 99% level to mitigate the influence of outliers.

The mean and median sizes of FOHFs in our sample are $346.1 million and $98.6 million, respectively, both of which are larger than the corresponding means and medians in the TASS database. Fee structures of registered FOHFs and TASS FOHFs appear to be quite similar. FOHFs commonly charge a management fee between 1% and 1.5% and an incentive fee of 10%.[16] Registered FOHFs also have higher minimum investment requirements on average.

II. FOHF Managers' Abilities: Modified DGTW Measures

The literature commonly uses equity holdings of individual mutual funds and hedge funds to examine whether fund managers have stock selection and timing abilities. For example, DGTW use mutual fund holdings to examine whether mutual fund managers have characteristic selection (*CS*) and characteristic timing (*CT*) abilities. In our setting, we are interested in whether FOHFs have fund selection

[15] Similar add/drop frequencies are reported in Aiken, Clifford, and Ellis (2015).
[16] Among the 96 FOHFs in our sample, 90 FOHFs report the management fee percentage in their N-2 filings, and 29 FOHFs also report the incentive fee percentage.

and style allocation abilities with respect to individual hedge funds. Therefore, for our first approach, we follow DGTW and modify their *CS* and *CT* measures as follows:

$$CS_{j,t} = \sum w_{i,j,t-1} * (Ret_{i,t} - Ret_t^k), \quad (2)$$

$$CT_{j,t} = \sum (w_{i,j,t-1} - w_{i,j,t-5}) * Ret_t^k, \quad (3)$$

$$GT_{j,t} = \sum (w_{i,j,t-1} - w_{i,j,t-5}) * Ret_{i,t}, \quad (4)$$

where $w_{i,j,t-1}$ and $w_{ij,t-5}$ are the weights of hedge fund *i* in FOHF *j* in quarters *t*-1 and *t*-5, respectively. $Ret_{i,t}$ and Ret_t^k are the returns of hedge fund *i* and the returns of its corresponding general style index *k* in quarter *t*. Our modified *CS* measure in equation (2) allows us to examine whether hedge funds held by FOHFs outperform their corresponding general style indices. Thus, positive *CS* measures would indicate that FOHF managers pick hedge funds with better performance than their corresponding style index (i.e., FOHF managers have fund selection abilities). The modified *CT* measure in equation (3) examines whether FOHFs place more weight on styles with better performance (i.e., FOHF managers have style timing abilities). We also calculate a modified *GT* measure as in equation (4) based on Grinblatt and Titman (1993). The *GT* measure provides an indication of FOHF managers' abilities to actively manage their portfolio holdings.

To calculate the *CS* and *CT* measures above, we need returns of corresponding style indices. In this study, we use indices and their returns provided by Hedge Fund Research (HFR) and Credit Suisse. HFR and Credit Suisse indices are publically available to investors and commonly used in practice. Because HFR and Credit Suisse define style categories differently, we group HFR styles and Credit Suisse styles into four general styles based on the classification in Agarwal, Daniel, and Naik (2009). We then calculate the return of each general style as the equal-weighted average return of indices in that general style. Because HFR and Credit Suisse calculate their indices differently, we compute separate *CS* and *CT* measures for each index provider.[17]

Table II, Panel A reports mean *CS* (i.e., fund selection) and *CT* (i.e., style allocation) measures using HFR and Credit Suisse style indices. The mean *CS* measure based on HFR (*CS_HFR*) is 46 bps per quarter, while the mean *CS* measure based on Credit Suisse (*CS_CS*) is 36 bps per quarter. Both measures are statistically significant and suggest that FOHF managers, on average, pick funds that outperform their style benchmarks. The mean *GT* measure is 12 bps per quarter and is statistically significant. This suggests

[17] To be more specific, we use the HFRI indices and the Credit Suisse Hedge Fund Index. To be included in the HFRI indices, a hedge fund must report monthly after-fee returns in U.S. dollars, have at least $50 million in assets, and have at least 12 months of active trading. The HFRI indices we use are equally-weighted. For more details, see https://www.hedgefundresearch.com/hfri-index-methodology. To be included in the Credit Suisse Hedge Fund Index, a hedge fund must have at least $50 million in assets, a one-year minimum track record, and current audited financial statements. The Credit Suisse Hedge Fund Index is asset-weighted. For more details, see https://lab.credit-suisse.com/#/en/index/HEDG/HEDG/methodology.

that FOHF managers add value when they adjust portfolio weights over time. However, we do not find evidence that FOHF managers have style timing abilities, as the mean *CT* measures based on HFR (*CT_HFR*) and Credit Suisse (*CT_CS*) are both slightly negative and statistically insignificant.

[Insert Table II about here]

The lack of evidence supporting FOHFs' style timing abilities might reflect particular aspects of their underlying hedge funds. For example, as noted earlier, most hedge funds have share restrictions, such as redemption and notice periods. The most common redemption periods in the TASS database are 30 days or 90 days, with a notice period of 30 days. Moreover, some funds have lockup periods, with 12 months being the most common duration among funds in the TASS database, while other funds are closed to additional investment. Thus, FOHF managers may not be able to adjust their investment positions as frequently as they would like. Another reason for the lack of evidence on style allocation abilities is that fund selection might be more important than style allocation in the hedge fund industry. Reddy, Brady, and Patel (2007) show that performance differences between managers are much larger than performance difference between styles, consistent with stronger preferences for fund selection over style allocation. We examine this possibility in greater detail in Section V.A.

To examine whether the evidence of FOHF manager fund selection abilities in Panel A is explained by risk, we form equal-weighted portfolios of FOHFs every quarter and regress these portfolios' *CS* and *CT* measures on the seven factors employed in Fung and Hsieh (2004). The set of factors comprises the equity market factor (*S&P*), measured as the S&P 500 index monthly total return, the size spread factor (*SML*), constructed as the difference between the Russell 2000 index monthly total return and the S&P 500 monthly total return, the bond market factor (*BD10Y*), which is the monthly change in the 10-year Treasury constant-maturity yield, the credit spread factor (*CredSpr*), calculated as the monthly change in Moody's Baa yield less the 10-year Treasury constant-maturity yield, and three trend-following risk factors, namely, the excess returns on portfolios of look-back straddle options on currencies (*PTFSFX*), commodities (*PTFSCOM*), and bonds (*PTFSBD*). Table II, Panel B reports the results of these regressions. After risk adjustment, the alphas of the *CS_HFR*, *CS_CS*, and *GT* measures are 66, 56, and 14 bps per quarter, respectively, and all three alphas are statistically significant. Meanwhile, the alphas of *CT_HFR* and *CT_CS* are not significantly different from zero. Thus, the results in Panel B suggest that FOHF managers have selection abilities and can pick individual hedge funds with good performance. However, we do not find evidence that they have significant style allocation abilities.

III. FOHF Managers' Abilities: Comparisons with Hedge Funds in TASS

The approach adopted in Section II to measure FOHF managers' abilities uses style indices as performance benchmarks. Although the HFR and Credit Suisse indices are useful in that they are publicly

available and commonly used by investors, they are not without their limitations. For example, both indices exclude hedge funds with under $50 million in assets, which can impart a downward bias on benchmark performance as larger funds are more likely to suffer from diseconomies of scale. Similarly, while our first approach shows that hedge funds held by FOHFs outperform their style indices, it does not provide a sense of how well those hedge funds perform relative to the universe of hedge funds. Therefore, for our second approach, we compare hedge funds in FOHF holdings to individual hedge funds reported in the Lipper TASS Hedge Fund Database, which is one of the most commonly used hedge fund databases in the literature. The TASS database covers a very large number of hedge funds and thus provides a representative sample of the hedge fund universe.

To assess FOHF managers' fund selection abilities using TASS hedge funds as performance benchmarks, we rank the quarterly cumulative returns of individual hedge funds in the TASS database into percentiles each quarter. Then, we rank the return of each FOHF holding in the corresponding quarter based on the percentile cutoffs. In cases where the return of a FOHF holding is larger (smaller) than the highest (lowest) hedge fund return in TASS, we assign a ranking of 100 (1) to the holding. We measure FOHF managers' fund selection abilities in a given quarter using the average percentile ranking of FOHF holdings in that quarter. Figure 3 plots the average FOHF managers' fund selection ability over time. The plot shows that the average percentile ranking of FOHF holdings is above the 50th percentile for most of our sample period. Thus, funds selected by FOHFs perform well relative to hedge funds in the TASS database.

[Insert Figure 3 about here]

Panel A of Table III provides summary statistics for FOHF holding rankings after pooling all FOHF-quarter observations together. The mean and median percentile rankings are both 52, and the mean ranking is statistically higher than the 50th percentile. Consistent with Figure 3, these results suggest that hedge funds held by FOHFs tend to outperform funds in the TASS database. Moreover, the inter-quartile range of percentile rankings spans from 45 to 59, which suggests that FOHF managers select funds that deliver reliable performance with minimal downside risk. Assuming that the TASS database provides a representative sample of the hedge fund universe, these results further support the view that FOHFs have fund selection abilities.[18]

[Insert Table III about here]

We can also use funds in the TASS database to benchmark FOHFs' style allocation abilities. To do this, we assign TASS hedge funds to the four general styles used earlier and compute each style's market share based on the total hedge fund assets in that style. If a FOHF has style allocation abilities, then styles

[18] In section V.B.2, we use TASS hedge funds to construct our own style indices and calculate our modified CS and CT measures using these indices in place of the HFR and CS indices (see section V.B.2 for details). Table VIII shows that our TASS-based CS measures are positive and significant, consistent with FOHFs having fund selection abilities.

with superior performance should exhibit higher FOHF asset weights relative to their market shares. Specifically, we construct a style allocation ability measure as follows:

$$SA_{j,t} = \sum_{k=1}^{4}\left(w_{k,t-1}^{j} - w_{k,t-1}^{TASS}\right) * Ret_{k,t}, \quad (5)$$

where $w_{k,t-1}^{j}$ ($w_{k,t-1}^{TASS}$) is the weight of style *k* in FOHF *j* (the TASS universe) at time *t*-1. $Ret_{k,t}$ is the return of style *k* at time *t*, measured using HFR and Credit Suisse style index returns.

Panel B of Table III shows that the mean value of *SA* using HFR and Credit Suisse style indices is 6 and 23 bps per quarter, respectively. Both means are statistically significant. These results suggest that FOHFs, on average, allocate assets to styles with better performance. Note that the *SA* measures focus on FOHF managers' abilities to add value based on style weighting decisions at a given point in time, while our modified *CT* measures from earlier focus on FOHF managers' abilities to time style performance.

IV. FOHF Managers' Abilities: Evidence Based on Capital Flows

For our third approach, we use holding-level capital flows to examine FOHF managers' abilities following Zheng (1999), who examines whether mutual funds that receive more money outperform funds that lose money (i.e., the smart money effect). We adapt her approach to our setting and examine whether capital flows (i.e., additional purchases and partial redemptions of existing FOHF holdings) improve FOHF performance. This approach focuses on flows rather than portfolio weights and thus facilitates an assessment of FOHF managers' active management abilities. We emphasize that our approach examines adjustments to existing portfolio holdings, whereas Aiken, Clifford and Ellis (2015) examine active management abilities through portfolio holding "hiring" and "firing" decisions.

Each quarter, we partition FOHF holdings into two groups based on the direction of capital flow from the previous quarter. Specifically, we assign funds with positive flows to one group, negative flows to another group, and form asset-weighted portfolios for each group. We then compare the performance of each portfolio. If FOHF managers have active management abilities, then we should observe higher performance in positive capital flow portfolios.

Table IV, Panel A presents our "smart money" results using three different return measures: raw returns, HFR-adjusted returns, and CS-adjusted returns. HFR-adjusted returns (CS-adjusted returns) are fund returns minus the returns of the fund's corresponding style based on HFR indices (Credit Suisse indices). On average, the raw returns of funds with positive flows are 28 bps per quarter higher than the raw returns of funds with negative flows, although this difference is not statistically significant. Using HFR-adjusted returns and CS-adjusted returns, mean performance differences are 51 and 48 bps per quarter, respectively, and both differences are statistically significant at the 5% level. These results provide some evidence that FOHF managers are smart and allocate more assets to holdings with good future performance.

[Insert Table IV about here]

Next, we employ a similar approach at the style level and form two asset-weighted portfolios based on the direction of capital flows to each general style. Again, we are interested in the performance difference between the positive flow and negative flow portfolios, with a positive difference suggesting FOHF managers are smart and allocate more money to better performing styles. Table IV, Panel B reports these differences. The mean raw return difference is -22 bps per quarter, while the corresponding differences based on HFR-adjusted (CS-adjusted) returns are 9 (2) bps per quarter. All three differences are statistically insignificant at the 5% level. Thus, we do not find evidence that FOHF managers allocate assets to better-performing styles.

V. Additional Analysis and Robustness Tests

A. Additional Analysis

A.1. Fund Characteristics

So far, our results suggest that, on average, FOHF managers have fund selection abilities. Moreover, our evidence suggests FOHFs' active management of existing holdings (e.g., via additional purchases and partial redemptions) improves FOHF performance. Thus, a natural question for investors is how to identify FOHF managers with superior skills.

To address this question, we regress our skill measures on various fund characteristics. The skill measures that we consider include: the modified CS measures (*CS_HFR* and *CS_CS*), the average percentile ranking of FOHF holdings relative to funds in the TASS database, and the performance difference between positive-flow and negative-flow hedge funds among FOHF holdings. In turn, we consider the following fund characteristics: fund assets, the number of fund holdings, the number of general styles, and capital flows. In addition, we include a concentration index, *General Style HHI*, to indicate whether a FOHF focuses on certain general styles. The index is calculated as the sum of squared weights of each general style. We also include a dummy variable, *Single-Fund Family*, to indicate whether the management firm of a FOHF has multiple funds under management. *Single-Fund Family* equals one if a FOHF indicates in their N-SAR filing that they are not part of a family of investment companies and zero otherwise.[19] In all regressions, year fixed effects are included. Following Petersen (2009), we cluster standard errors by FOHF and by year.

Table V presents the results of these regressions. In regressions (1) and (2), the dependent variables are *CS_HFR* and *CS_CS*, respectively. The coefficient on fund assets is positive in both cases and significant in the *CS_HFR* case. These results suggest that larger FOHFs may have better fund selection

[19] Item 19.A of the Form N-SAR filing asks "Is Registrant part of a family of investment companies? (Y/N)."

abilities, consistent with Brown, Fraser, and Liang (2008), who argue that larger FOHFs are more likely to absorb fixed costs associated with due diligence and thus have better performance. The coefficients on the number of hedge funds in FOHFs' holdings are both -0.005 and significant. In economic terms, a one standard deviation increase in the number of holdings would lead to a 0.1% decrease in quarterly returns, which is quite significant given that the mean FOHF return in our sample is 1.8% per quarter. These negative coefficients are consistent with Brown, Gregoriou, and Pascalau (2012), who find that the benefits of diversification diminish once FOHFs' holdings exceed 20 funds. Rounding out the *CS* regression results, the coefficients on the number of general styles are both significantly positive. These results suggest that style diversification benefits investors by improving FOHF performance.

[Insert Table V about here]

We find similar results when we use the average percentile ranking of FOHF holdings as the dependent variable. First, we see a positive and significant coefficient on fund assets, suggesting larger FOHFs have higher average performance rankings. Next, we find a negative and significant coefficient on the number of holdings, which suggests there are diminishing returns to subsequent holdings. In this case, a one standard deviation increase in the number of holdings reduces the average performance ranking by two percentiles. Lastly, we find a significantly positive coefficient on the number of general styles. Thus, when FOHFs invest in more general styles, average fund performance improves.

In regressions (4) to (6), the dependent variables are the performance differences between positive-flow portfolios and negative-flow portfolios using raw returns (4), HFR-adjusted returns (5), and CS-adjusted returns (6). The coefficients on fund size are negative in all three cases and significant in cases (5) and (6). These results suggest that larger FOHFs may have lower active management abilities. By contrast, the coefficients on the number of holdings are positive and significant. In economic terms, a one standard deviation increase in the number of holdings increases the positive-flow/negative-flow performance difference by 25 bps per quarter. These results suggest that the benefits of actively managing existing holdings increase when FOHFs hold more underlying hedge funds. One possible explanation for this positive effect is that additional holdings better facilitate active management activities when existing holdings have share restrictions, as is common among hedge funds. Lastly, the positive and significant coefficients on *Single-Fund Family* suggest that fund managers generate better performance through active management when they focus on one FOHF.

In summary, our analysis suggests there is significant cross-sectional variation in FOHF managers' abilities. Consistent with prior literature, we find that larger FOHFs exhibit better fund selection abilities, possibly reflecting the benefits of scale to absorbing fixed costs associated with due diligence activities. Moreover, we find that the effect of the number of holdings on performance is nuanced. While we find that a higher number of funds is associated with lower fund selection abilities on average, we also find that

adding funds adds value by circumventing frictions to active management imposed by share restrictions among existing holdings.

A.2. Closed Hedge Funds

We discussed earlier how investing in FOHFs provides access to hedge funds that are otherwise closed to new investment. Because hedge funds are likely to suffer from diseconomies of scale, closing off new investment can help to restrict excessive fund growth and maintain performance. Thus, closed funds may provide stronger and more stable performance relative to funds that are open to new investment. In this section, we examine this possibility.

To identify closed hedge funds, we match by name hedge funds in FOHFs' holdings to hedge funds in the TASS database. Because the TASS database provides the dates on which a fund closes and re-opens to new investment, we can identify hedge funds that are closed to new investment at any given point in time. In our sample, 64 FOHFs invest in closed hedge funds, though most only invest in one or two at a time.

We first examine the performance of closed funds relative to other hedge funds in FOHFs' holdings. Because FOHFs hold 26.7 hedge funds on average, we rank their holdings into deciles (rather than percentiles) based on quarterly returns. Panel A of Table VI provides the distribution of closed fund rankings within a FOHF. The mean and median rankings of closed funds are 5.86 and 6, respectively, and the mean ranking is statistically higher than 5. Thus, closed funds typically outperform open funds within a given FOHF. In Panel B, we examine the performance of closed funds relative to individual hedge funds in the TASS universe, as in Section III. The mean and median percentile rankings of FOHF closed funds are 55 and 56, respectively, and the mean is statistically higher than 50. These results suggest FOHFs select closed funds with superior performance on average.

[Insert Table VI about here]

A.3. Fund Selection vs. Style Allocation

As mentioned earlier, one possible explanation for finding stronger evidence of fund selection abilities relative to style allocation abilities is that fund selection is more important than style allocation in the hedge fund industry. To explore this possibility, we follow Reddy, Brady, and Patel (2007) and assign hedge funds in the TASS database to four general styles each quarter and then calculate the median and inter-quartile range (IQR) of fund returns for each style. Figure 4 presents the time-series average of medians and IQRs of fund returns over our sample period. The IQRs are quite large, ranging from 4.32% in Relative Value funds to 7.77% in Directional Traders funds, with an average IQR of about 6% across the four styles. In contrast, median returns are quite similar across the four styles, with an average of about 1.22%. Thus, the results are consistent with the literature and support the view that picking the right fund is more important than picking the right style when investing in hedge funds.

[Insert Figure 4 about here]

B. Robustness Tests

B.1. Sub-periods

As discussed earlier, the FOHF industry was growing fast prior to the 2008-2009 financial crisis, but tapered off in its aftermath. To examine whether our results are driven by pre-crisis observations, we divide our sample into three sub-periods, which we label: "Before Crisis" (i.e., from 2004 to 2007), "Crisis" (i.e., 2008 and 2009), and "After Crisis" (i.e., from 2010 to 2015). After splitting our sample into these sub-periods, we repeat our previous tests for each sub-period.

Table VII, Panel A shows our modified DGTW measure results for different sub-periods. We find positive and significant *CS* measures in the Before Crisis and After Crisis sub-periods, suggesting FOHF managers have significant fund selection abilities in the years before and after the financial crisis. It is interesting to see stronger selection ability results in the years after the crisis. The differences in *CS* measure means before and after the crisis are 21 bps per quarter for *CS_HFR* and 14 bps per quarter for *CS_CS*, with the *CS_HFR* difference being significant at the 5% level. One possible explanation for the superior post-crisis measures is that the crisis weeded out underperforming FOHFs, leaving only the good FOHFs to survive. In terms of our *CT* measures (i.e., style allocation abilities), we find that FOHFs actually have significantly negative measures before the crisis, although the magnitudes are much smaller than those of the *CS* measures. During and after the crisis, both *CT* measures are statistically insignificant. Thus, FOHFs do not show any style allocation abilities in any sub-period.

[Insert Table VII about here]

Panel B of Table VII shows the sub-period results comparing FOHFs' holdings to hedge funds in the TASS database. The average percentile rankings of FOHF holdings before and after the crisis are 52.9 and 52.4, respectively. Both are significantly higher than the 50th percentile. Thus, our main results are not driven by pre-crisis observations. Turning to style allocation measures, we do not find evidence that FOHFs have style allocation abilities before or during the crisis. However, we do see significantly positive mean *SA* measures after the crisis (20 bps per quarter using HFR indices and 42 bps per quarter using Credit Suisse indices).

Panel C of Table VII examines performance differences between FOHF holdings with positive flows and those with negative flows over the three sub-periods. Prior to the crisis, performance differences between positive-flow and negative-flow portfolios are positive for all three return measures, but only the raw return measure is statistically significant. During the crisis, performance differences are all positive, with statistically significant differences in the cases of HFR-adjusted returns (190 bps per quarter) and CS-

adjusted returns (161 bps per quarter). After the crisis, all three performance differences are statistically insignificant, although differences based on style-adjusted returns are positive.

Panel D of Table VII presents sub-period results for performance differences between styles with positive flows and styles with negative flows. We do not find any significant results before or after the crisis. During the crisis, the mean raw return-based performance difference between positive-flow and negative-flow style portfolios is negative and significant. However, this result is driven by the poor performance of the hedge fund industry as a whole during the crisis. After style adjustment, we find that performance differences are positive using both the HFR and CS indices.

B.2. Alternative Style Returns

In this section, we repeat our earlier analysis using an alternative method of measuring style returns. Specifically, we assign TASS database hedge funds to one of the four general styles, and we then compute equal-weighted average returns within each style. This approach better reflects the performance of smaller hedge funds relative to the HFR and Credit Suisse style indices, as both indices exclude hedge funds with less than $50 million in assets.

Results based on this alternative approach are summarized in Table VIII. Panel A shows summary statistics for our modified DGTW measures. The *CS* measure based on equal-weighted TASS style returns (*CS_TASS*) is 33 bps per quarter and statistically significant, while the *CT* measure (*CT_TASS*) is slightly negative and insignificant. These results are consistent with Table II and suggest that FOHFs have fund selection abilities but not style allocation abilities. In Panel B, we form portfolios of FOHFs every quarter and regress portfolio DGTW measures on the seven factors used in Fung and Hsieh (2004). The risk-adjusted *CS* measure is still positive and significant, while the risk-adjusted *CT* measure is insignificant. These results provide further evidence that FOHFs have fund selection abilities.

[Insert Table VIII about here]

In Panel C, we examine performance differences between positive-flow and negative-flow portfolios at the fund and style level using our alternative style return method. The performance difference between hedge funds with positive flows and those with negative flows is 44 bps per quarter and is statistically significant. The performance difference at the style level is also positive but is not statistically significant. These results are consistent with Table IV. When FOHFs actively adjust their holdings through additional purchases and partial redemptions, they add positive value at the individual fund level, but not at the style level.

VI. Conclusion

This study uses holding-level data collected from SEC filings of registered FOHFs to examine whether FOHF managers' skills facilitate superior before-fee performance. We find that registered FOHFs

have significant fund selection abilities. Individual hedge funds held by registered FOHFs outperform not only their style indices but also the majority funds in the TASS database. In addition, registered FOHFs' holdings with positive flows outperform those with negative flows. Thus, registered FOHFs are smart in that they add value when they adjust their holdings over time. Lastly, evidence on registered FOHFs' style allocation abilities is mixed, which may reflect lower importance placed on style allocation abilities (relative to fund selection abilities) in the hedge fund industry.

Overall, our findings suggest that FOHF fee structure reform merits consideration. While we only examine a subset of FOHFs, our results offer some evidence that FOHF managers have fund selection and active management abilities that can deliver superior before-fee performance. Whether and how to reform the fee structure in the FOHF industry awaits future research. Our study also has several important implications for FOHF investors. For example, when choosing among different FOHFs, our analysis suggests that FOHFs with larger size and multiple general styles are more likely to have better performance. Moreover, while our evidence suggests that excessive holdings can hurt FOHF performance, higher levels of holdings can provide managers with greater flexibility to adjust their investments and add value for investors.

Appendix

As described in Section I.A, funds of hedge funds (FOHFs hereafter) report the cost and value of each individual hedge fund in their quarter-end holdings. However, the returns of each hedge fund are not reported. Aiken, Clifford, and Ellis (2013) estimate returns for each FOHF holding using the holding's change in value with adjustments for changes in cost (fund flows are assumed to occur at the end of the quarter).[20] While their method works reasonably well when costs stay the same or increase over the quarter, it becomes problematic when reported costs decrease because the calculations do not capture changes in value for redeemed shares.

To resolve this issue, we follow Agarwal, Daniel, and Naik (2009) and make the following assumptions. First, we treat the initial reported cost of a hedge fund as the initial investment in that fund, and we treat each subsequent increase in reported cost as new investments (i.e., inflows due to additional purchases). Second, we assume that any additional purchases or partial redemptions occur at the end of each quarter. Third, when there is a decrease in reported cost (i.e., outflows due to partial redemptions), we assume outflows follow a "first in, first out" (FIFO) rule. That is, we assume that a FOHF sells its earliest hedge fund investments first.

We demonstrate our algorithm using the example in Table AI. In this example, a FOHF invests in a hedge fund over 5 quarters and the return of the fund is 10% each quarter. Columns 1 through 3 list the time, total cost and total value of the fund at quarter-end (these items are reported in a FOHF's quarterly filings with the SEC). In quarter 1, the total cost is \$100, which we treat as the first investment in the fund (made at the beginning of the quarter). The total value of the fund at the end of quarter 1 is \$110. Thus, the return of the fund in quarter 1 is (110-100)/100=10%.

In quarter 2, the total cost increases to \$150, or a \$50 increase. We treat the \$50 increase as the second investment in the fund. Meanwhile, the total value is \$171, which is the sum of the values of the first investment (171-50=\$121) and the second investment (\$50). Notice that the cost and value of the second investment is the same because we assume additional purchases occur at quarter-end. Thus, the return of the fund in quarter 2 is (121-110)/110=10%.

In quarter 3, the total cost increases to \$250, or a \$100 increase, which we treat as the third investment. Here, we can calculate the "before-flow" value of the fund at the end of quarter 3 as the total value (\$288.10) minus the quarter-end investment (\$100), or \$288.10 - \$100 =\$188.10. Using this before-flow value (\$188.10) and the quarter 2 values for investment 1 (\$121) and investment 2 (\$50), we can solve for the fund's rate of return in quarter 3 (r_3) using the following equation: $121 \times (1+r_3) + 50 \times (1+r_3) =$

[20] Specifically, Aiken, Clifford, and Ellis (2013) calculate the return of fund i in quarter t as $Return_{i,t} = \frac{Value_{i,t} - Change\ in\ Cost_{i,(t-1,t)}}{Value_{i,t-1}} - 1$.

$188.1. Solving for r_3 in this equation yields a return of 10%. Thus, the values of investment 1 and 2 at the end of quarter 3 are $121 × (1+10%) = $133.10 and $50 × (1+10%) = $55, respectively.

In quarter 4, the total cost decreases from $250 to $200, implying a share redemption of $50. Following the FIFO rule, the FOHF reduces the cost basis of its first investment by $50, implying a 50% reduction in the first investment's cost basis ((100-50)/100 = 50%). In this case, the before-flow value of the fund at the end of quarter 4 is the total value ($243.71) plus the value of the redeemed shares (133.1 × (1+r_4) × 50%). Using before-flow values, we can calculate the fund's rate of return by solving for r_4 in the following equation: 133.1 × (1+r_4) + 55 × (1+r_4) + 100 × (1+r_4) = $243.71 + 133.1 × (1+$r_4$) × 50%. Solving for r_4 in this equation yields a return of 10%. Thus, the values of investments 1 through 3 at the end of quarter 4 are $133.10 × (1+10%) × 50% = $73.21, $55 × (1+10%) = $60.50, and $100 × (1+10%) = $110.00, respectively.[21]

Finally, in quarter 5, the total cost decreases from $200 to $100, or a $100 redemption. Because the cost bases of the first and second investments are $50 each at the beginning of quarter 5, the FIFO rule implies that both investments are completely divested at the end of quarter 5. Thus, the total value at the end of quarter 5 ($121) is simply the value of the third investment. Thus, we can calculate r_5 by solving 110 × (1+r_5) = $121, or r_5 = 10%. Note that the flows attributable to this redemption are 73.21 × (1+10%) + 60.50 × (1+10%) = $147.08.

Using this methodology, we can measure returns and flows more accurately. Otherwise, we would likely understate outflows and thus bias our calculation of returns. For example, if we use the methodology in Aiken, Clifford, and Ellis (2013), the return calculation for quarter 4 in our example would give us (234.71-288.1+50)/288.1=1.95%, which is much lower than 10%. This is because the actual outflows are $73.21, rather than the $50 change in reported cost. Notice that the return calculation is correct when there is an increase in cost, such as in quarters 2 and 3.

[21] Before redemption, the value of the first investment is 133.1 x (1+10%) = $146.42. However, because the FOHF reduces the cost basis of the first investment by 50%, only half of this value remains at quarter-end ($73.21).

Table AI
Returns and Flows of FOHF's Holdings

This table presents an example of how we calculate returns and flows of hedge funds in FOHFs' holdings. Items from the quarterly filings of FOHFs are reported in columns 1 to 3 (i.e., time period, total cost, and total value). We follow Agarwal, Daniel, and Naik (2009) and make three key assumptions. First, we treat the initial reported cost of a hedge fund as the initial investment in that fund and we treat each subsequent increase in reported cost as new investments (i.e., inflows due to additional purchases). Second, we assume that any additional purchases or partial redemptions occur at the end of each quarter. Third, when there is a decrease in reported cost (i.e., outflows due to partial redemptions), we assume outflows follow a "first in, first out" (FIFO) rule. That is, we assume that a FOHF sells its earliest hedge fund investments first.

Quarter	*Total Cost*	*Total Value*	First Investment		Second Investment		Third Investment		Return	Flow in %	Flow in $
			Cost	Value	Cost	Value	Cost	Value			
1	*100*	*110*	100	110	0	0	0	0			
2	*150*	*171*	100	121	50	50	0	0	10%	45.45%	50
3	*250*	*288.1*	100	133.10	50	55	100	100	10%	58.48%	100
4	*200*	*243.71*	50	73.21	50	60.5	100	110	10%	-25.41%	-73.21
5	*100*	*121*	0	0	0	0	100	121	10%	-60.35%	-147.08

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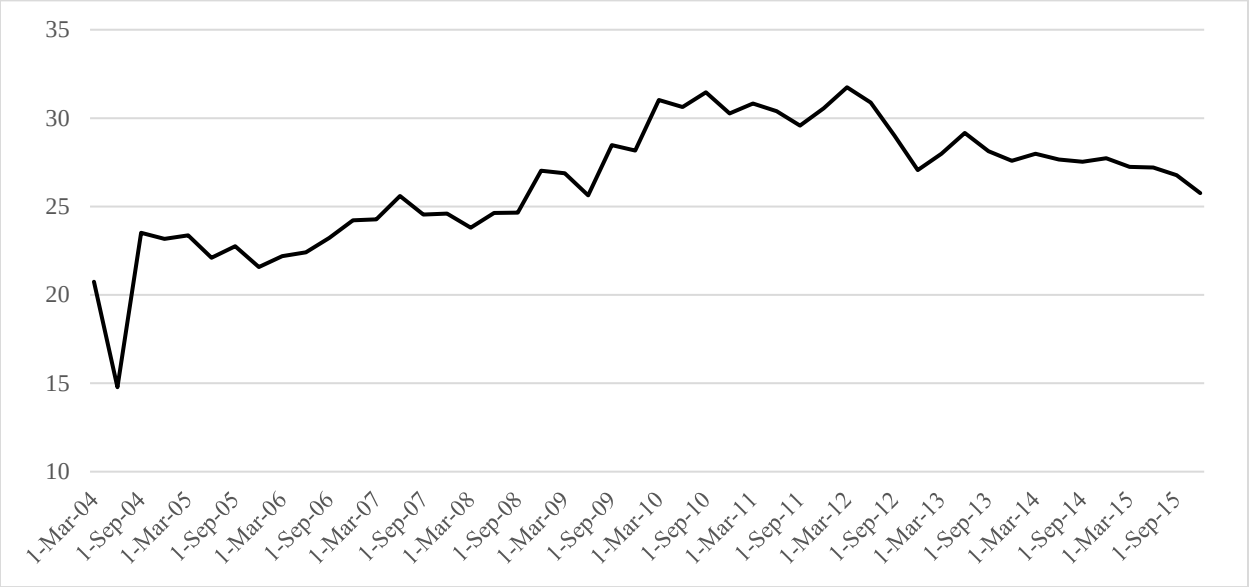
Panel A. Number of Hedge Funds in FOHFs' Holdings



Panel B. Average Number of General Styles in FOHFs' Holdings

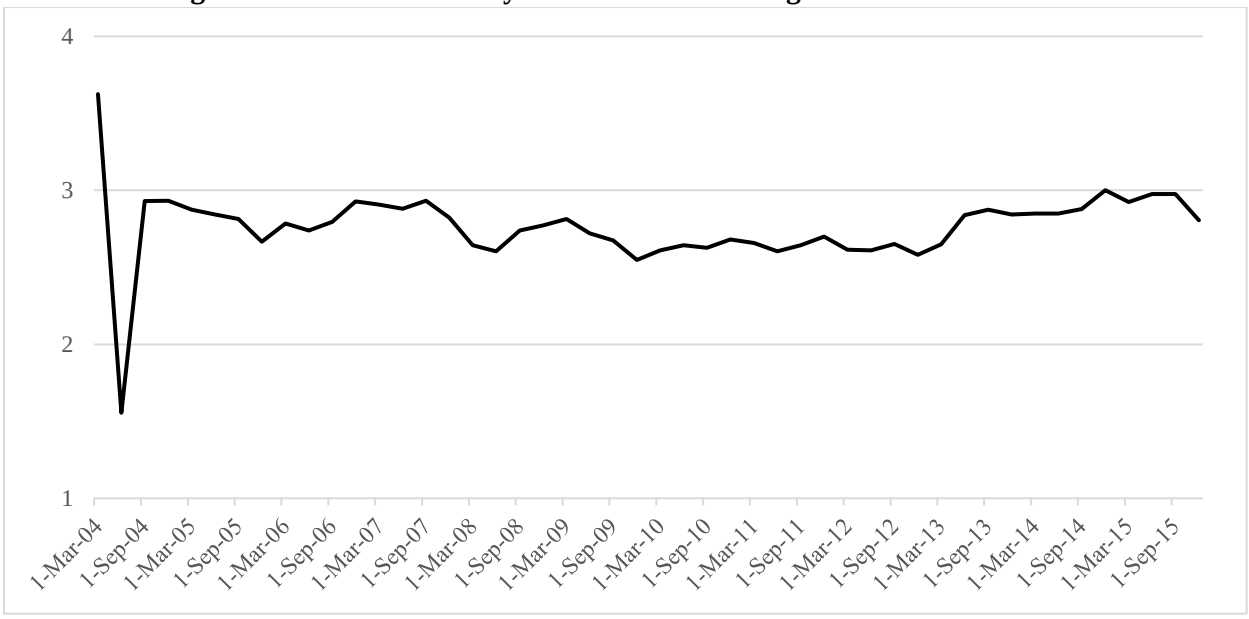


Figure 1. Number of Hedge Funds and General Styles in FOHFs' Holdings. This figure shows how funds of hedge funds' (FOHF) holdings change over time. The sample period is from 2004Q1 to 2015Q4. Data on FOHFs and their holdings are hand-collected from the SEC EDGAR system. Panel A plots the average number of hedge funds held by FOHFs over time. Panel B plots the average number of general styles held by FOHFs over time.

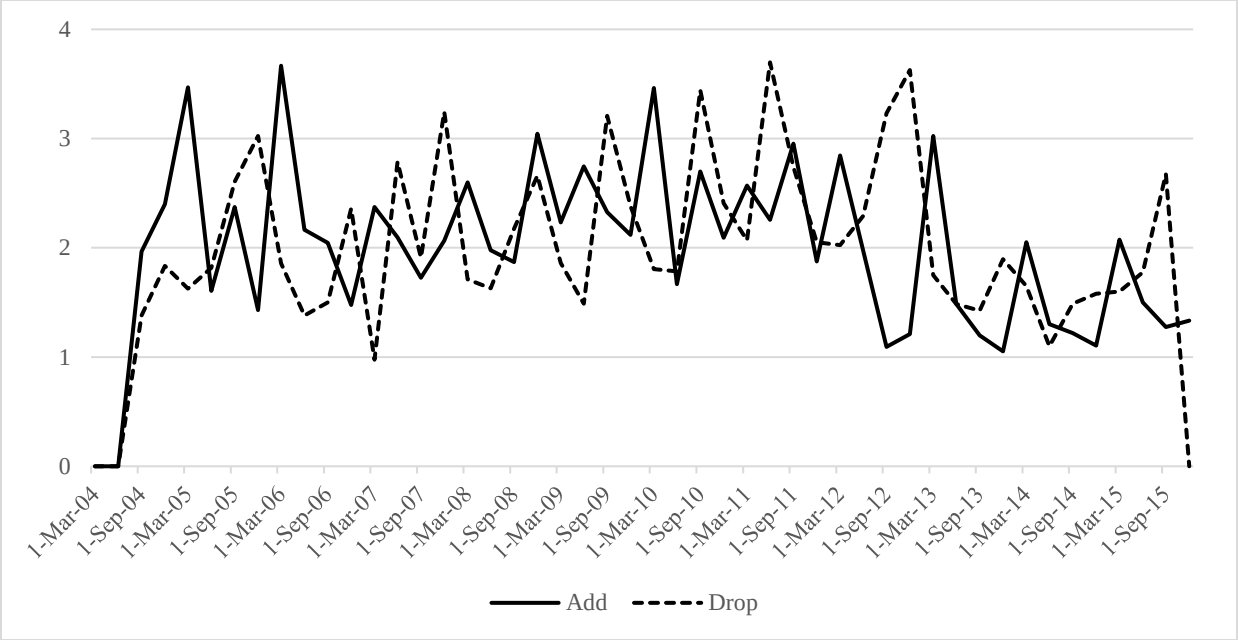


Figure 2. Changes in Holdings. This figure plots the average number of hedge funds added and dropped by FOHFs over our sample period. The sample period is from 2004Q1 to 2015Q4. Data on FOHFs and their holdings are hand-collected from the SEC EDGAR system.

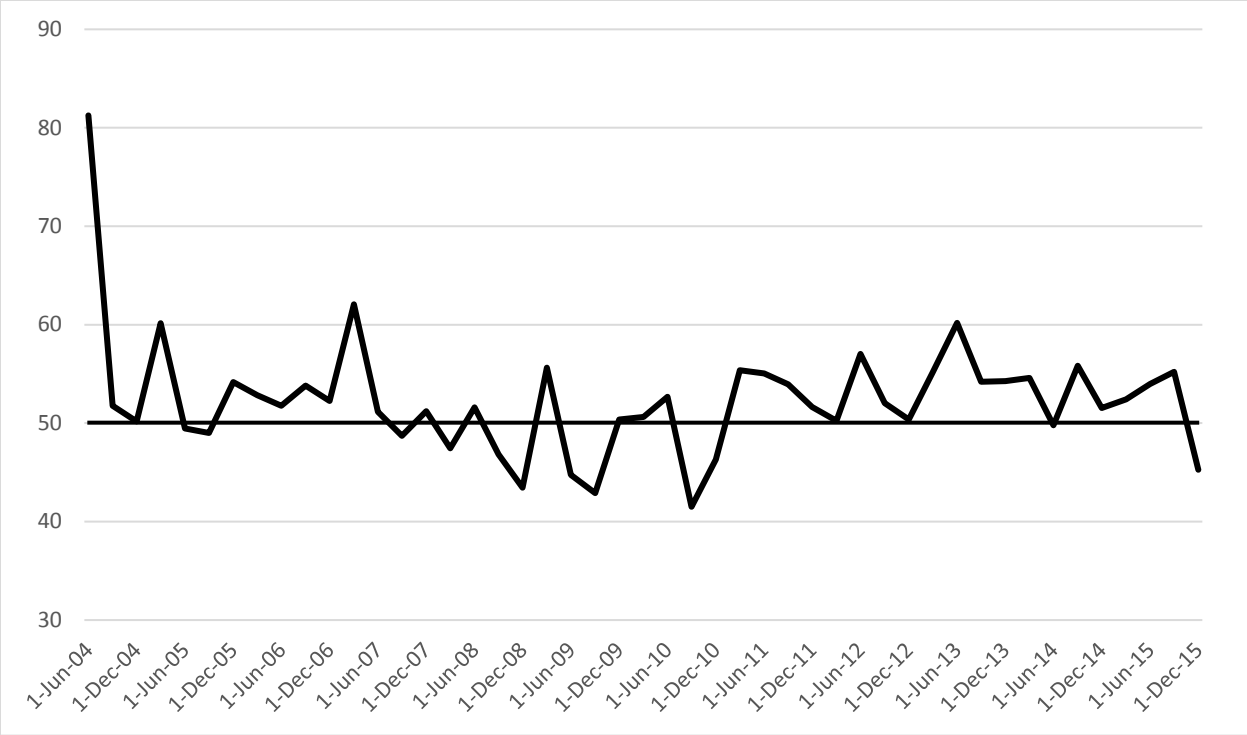


Figure 3. Percentile Rankings of FOHF Holdings. This figure shows the average performance of FOHF holdings relative to hedge funds in the Lipper TASS database over time. The sample period is from 2004Q1 to 2015Q4. Data on FOHFs and their holdings are hand-collected from the SEC EDGAR system. Each quarter, we rank hedge funds in the TASS database into percentiles based on their cumulative quarterly returns, with 100 (1) indicating the highest (lowest) percentile. Then, we assign each FOHF holding to a corresponding percentile rank based on the holding's return and the percentile cutoffs. When the returns of a FOHF holding are larger (smaller) than the highest (lowest) return among TASS funds, we assign that holding to the 100^{th} (1^{st}) portfolio. We measure a FOHF's fund selection ability as the average ranking of its holdings. The figure plots the mean of these FOHF-level measures over time.

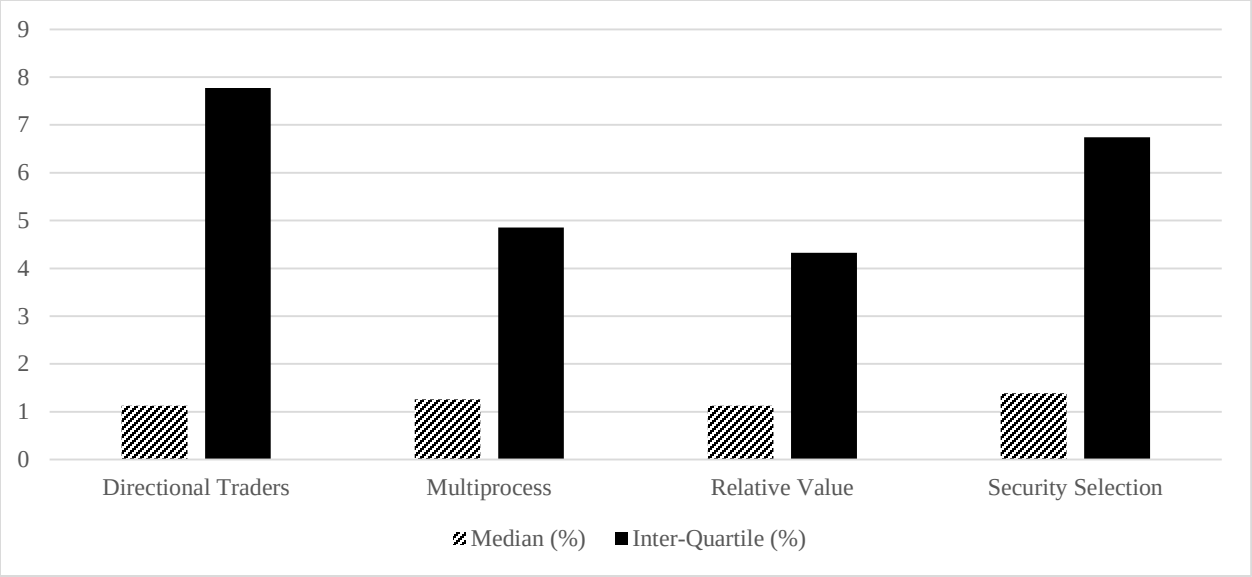


Figure 4. Median and Inter-Quartile Range of Fund Returns by General Style. Each quarter, we calculate the median and inter-quartile range of returns of hedge funds in the TASS database for each general style. The figure graphs the average of these medians and inter-quartile ranges over our sample period (2004Q1 to 2015Q4).

Table I
Summary Statistics

This table reports the summary statistics of our sample. Data on funds of hedge funds (FOHFs) and their holdings are hand-collected from the SEC EDGAR system. The sample period is from 2004Q1 to 2015Q4. Panel A presents summary statistics for holdings of FOHFs. Because FOHFs classify the investment styles of their holdings in different ways, we assign these reported styles into four general styles (i.e., Directional Traders, Relative Value, Multi-process, and Security Selection) based on the classification in Agarwal, Daniel, and Naik (2009). Returns of a holding are calculated using its reported cost basis and current market value from the holding's quarterly SEC filing. The detailed algorithm is discussed in the appendix. Capital flows of a holding are defined in equation (1). A FOHF's return is calculated as the asset-weighted average return of its holdings. Panel B compares SEC-registered FOHFs with FOHFs in the TASS database. Assets of registered FOHFs are the total assets of its holdings. The management fee, incentive fee, and the minimum investment requirement of registered FOHFs are collected from N-2 filings. The management fee is the percentage of fund assets that investors pay to fund managers. The incentive fee is the percentage of fund profits that investors pay to fund managers. The minimum investment requirement is the least amount of money an investor must invest to take part in a hedge fund.

Panel A. Summary Statistics

	N	Mean	Median	P25	P75	Std. Dev.
Number of Hedge Funds in Holdings	1899	26.7	23.0	16.0	32.0	20.6
Number of Reported Styles	1899	4.5	4.0	3.0	6.0	2.8
Number of General Styles	1899	2.8	3.0	2.0	4.0	1.1
Number of Hedge Funds in Reported Style	1899	7.5	5.5	3.9	8.8	6.1
Number of Hedge Funds in General Style	1899	10.7	8.7	6.0	12.5	8.3
Returns of Hedge Funds in Holdings (%)	46943	1.3	1.6	-1.7	4.8	9.4
FOHF Returns (%)	1801	1.8	2.2	0.1	4.1	4.3
Flows of Hedge Funds in Holdings (%)	45035	1.6	0.0	0.0	0.0	163.1

Panel B. Compared with FOHFs in TASS

	Registered FOHFs			FOHFs in TASS		
	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.
Assets ($ millions)	346.1	98.6	749.1	203.3	59.7	487.6
Management Fee (%)	1.3	1.3	1.0	1.3	1.5	0.6
Incentive Fee (%)	9.3	10.0	4.2	7.9	10.0	7.0
Minimum Investment Requirement ($ thousands)	896.0	75.0	3880.0	781.0	200.0	3451.0

Table II

Fund Selection and Style Allocation Abilities: DGTW Measures

This table reports our measures of FOHF managers' abilities based on Daniel et al. (1997) (DGTW here after). Data on funds of hedge funds (FOHFs) and their holdings are hand-collected from the SEC EDGAR system. The sample period is from 2004Q1 to 2015Q4. We modify the *CS* and *CT* measures as in equations (2) and (3) to examine FOHF managers' fund selection and style allocation abilities. To calculate both measures, we use returns of style indices provided by Hedge Fund Research (HFR) and Credit Suisse. *CS_HFR* and *CT_HFR* are based on HFR indices, and *CS_CS* and *CT_CS* are based on Credit Suisse indices. We compute our measures using the two indices separately because the two providers construct their indices differently. We also measure managers' abilities using a modified *GT* measure defined as in equation (4). Panel A reports pooled means of our modified *CS*, *CT* and *GT* measures. In Panel B, we form equal-weighted portfolios of FOHFs every quarter and regress these portfolios' *CS* and *CT* measures on the seven factors employed in Fung and Hsieh (2004). The set of factors comprises the equity market factor (*S&P*), measured as Standard & Poor's 500 index monthly total return, the size spread factor (*SML*), constructed as the difference between the Russell 2000 index monthly total return and S&P's 500 monthly total return, the bond market factor (*BD10Y*), which is the monthly change in the 10-year Treasury constant-maturity yield, the credit spread factor (*CredSpr*), calculated as the monthly change in Moody's Baa yield less the 10-year Treasury constant-maturity yield, and three trend-following risk factors, namely, the excess returns on portfolios of look-back straddle options on currencies (*PTFSFX*), commodities (*PTFSCOM*), and bonds (*PTFSBD*). *t*-statistics are reported in the parentheses. ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively.

Panel A. Pooled Means					
	CS_HFR	*CS_CS*	*CT_HFR*	*CT_CS*	*GT*
Mean	0.4647***	0.3598***	-0.0181	-0.0120	0.1220***
t-stat	7.71	6.42	-0.85	-0.61	4.39

Panel B. Time-Series Regressions					
	CS_HFR	*CS_CS*	*CT_HFR*	*CT_CS*	*GT*
Intercept	0.6642***	0.5559***	0.0038	0.0082	0.1400***
	(4.53)	(4.11)	(0.17)	(0.37)	(3.19)
S&P	-0.0456*	-0.0386	-0.0083**	-0.0065	-0.0126
	(-1.68)	(-1.54)	(-1.98)	(-1.58)	(-1.56)
SML	-0.0801**	0.0274	-0.0058	-0.0053	-0.0008
	(-2.15)	(0.80)	(-1.04)	(-0.96)	(-0.07)
BD10Y	0.8795**	0.5099	-0.1398**	-0.1211*	-0.0079
	(2.27)	(1.43)	(-2.28)	(-2.01)	(-0.07)
CredSpr	1.9635***	0.8919**	-0.1783**	-0.1316*	0.0425
	(4.21)	(2.07)	(-2.51)	(-1.88)	(0.31)
PTFSBD	0.0100	0.0113**	0.0018*	0.0016*	0.0004
	(1.65)	(2.01)	(1.93)	(1.80)	(0.22)
PTFSFX	-0.0066	-0.0016	-0.0001	-0.0001	0.0011
	(-1.31)	(-0.35)	(-0.09)	(-0.07)	(0.67)
PTFSCOM	0.0020	-0.0051	-0.0021*	-0.0024**	-0.0014
	(0.28)	(-0.81)	(-1.88)	(-2.24)	(-0.67)
Observations	47	47	43	43	43
Adj. R-squared	0.661	0.367	0.313	0.256	0.130

Table III
Fund Selection and Style Allocation Abilities: Compared with TASS

This table examines FOHF managers' abilities by comparing FOHF holdings with individual hedge funds in the Lipper TASS database. Data on funds of hedge funds (FOHFs) and their holdings are hand-collected from the SEC EDGAR system. The sample period is from 2004Q1 to 2015Q4. Panel A reports summary statistics of the percentile rankings of FOHF holdings in our sample. Each quarter, we rank hedge funds in the TASS database into percentiles based on their cumulative quarterly returns, with 100 (1) indicating the highest (lowest) percentile. Then, we assign each FOHF holding to a corresponding percentile ranking based on the holding's return and the percentile cutoffs. When the returns of a FOHF holding are larger (smaller) than the highest (lowest) return among TASS funds, we assign that holding to the 100^{th} (1^{st}) portfolio. We measure a FOHF's fund selection ability as the mean ranking of its holdings. Panel B reports summary statistics of FOHFs' style allocation abilities. Each quarter, we assign TASS hedge funds to one of four general styles and compute each style's market share based on the total assets invested in that style. Then we compute the *SA* measure as in equation (5). Style returns used to calculate *SA* measures are provided by HFR and Credit Suisse. ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively.

Panel A. Fund Selection Abilities

	Mean	Median	P25	P75	Std. Dev.
Mean FOHF Holding Percentile Ranking	52***	52	45	59	10.49
H_0: Mean Ranking > 50					
t-stat	7.17				

Panel B. Style Allocation Abilities

	Mean	Median	P25	P75	Std. Dev.
SA w/ HFR Index returns	0.0610***	0.0186	-0.3105	0.4546	0.8006
t-stat	3.23				
SA w/ Credit Suisse Index returns	0.2339***	0.2466	-0.3991	1.0606	1.5015
t-stat	6.61				

Table IV
Fund Selection and Style Allocation Abilities: Capital Flows

This table examines FOHF managers' abilities based on holding-level flows. Data on funds of hedge funds (FOHFs) and their holdings are hand-collected from the SEC EDGAR system. The sample period is from 2004Q1 to 2015Q4. Capital inflows represent additional investments in an underlying hedge fund, whereas capital outflows represent partial redemptions. In Panel A, following Zheng (1999), we partition FOHF holdings into two groups each quarter based on the direction of capital flow from the previous quarter. Specifically, we assign funds with positive flows to one group, negative flows to another group, and form asset-weighted portfolios for each group. We then subtract the returns of the negative flow portfolio from the returns of the positive flow portfolio. We use both raw and style-adjusted returns. Style-adjusted returns are the difference between fund returns and the returns of style indices provided by HFR and Credit Suisse. In Panel B, we employ a similar approach at the style level and form two asset-weighted portfolios based on the direction of capital flows to each style. Again, we are interested in the performance difference between the positive-flow and negative-flow portfolios. ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively.

Panel A. Active Management of Individual Hedge Funds

	Returns	HFR-adjusted Returns	CS-adjusted Returns
Positive-Negative	0.2794	0.5065**	0.4793**
t-stat	1.34	2.54	2.41

Panel B. Active Management of General Styles

	Returns	HFR-adjusted Returns	CS-adjusted Returns
Positive-Negative	-0.2228*	0.0877	0.0217
t-stat	-1.76	0.84	0.21

Table V
FOHF Managers' Abilities and FOHF Characteristics

This table reports the results of pooled regressions of FOHF manager ability measures on FOHF characteristics. Data on funds of hedge funds (FOHFs) and their holdings are hand-collected from the SEC EDGAR system. The sample period is from 2004Q1 to 2015Q4. The dependent variables include our modified DGTW measures, FOHF percentile rankings, and active management of FOHF holdings based on capital flows (i.e., the smart money approach as in Table IV). The independent variables include FOHF size, number of holdings, number of general styles, style concentration index, FOHF capital flows, and a single-fund family indicator. The style concentration index is the sum of squared style weights using FOHF holdings. *Single-Fund Family* is an indicator variable that equals one if a FOHF belongs to a single-fund family, and zero otherwise. In all regressions, year fixed effects are included, and standard errors are clustered at both the FOHF and year level. *t*-statistics are reported in the parentheses below. ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	CS_HFR	*CS_CS*	FOHF Percentile Ranking	Smart Money: Return	Smart Money: HFR-adjusted Return	Smart Money: CS-adjusted Return
Log Lagged Fund Assets	0.143*	0.122	1.173***	-0.111	-0.271*	-0.271*
	(1.73)	(1.56)	(2.73)	(-0.91)	(-1.69)	(-1.76)
Lagged Number of Holdings	-0.005***	-0.005***	-0.100***	0.011*	0.012***	0.012***
	(-3.33)	(-2.93)	(-6.083)	(1.91)	(3.70)	(4.08)
Lagged Number of General Style	0.120**	0.149**	1.218***	-0.479	-0.148	-0.195
	(2.34)	(2.56)	(3.54)	(-1.49)	(-0.48)	(-0.69)
Lagged General Style HHI	0.216	-0.018	4.370*	-1.574	-0.494	-0.543
	(0.59)	(-0.06)	(1.90)	(-1.00)	(-0.47)	(-0.53)
Lagged FOHF Flows	-0.305	-0.221	-2.207	1.372	0.738	0.558
	(-1.63)	(-1.13)	(-1.19)	(1.44)	(1.18)	(0.88)
Single-Fund Family	0.024	0.130	-0.729	0.996***	0.738*	0.739*
	(0.12)	(0.49)	(-0.58)	(2.92)	(1.73)	(1.74)
Constant	-3.790***	-2.617*	47.573***	8.130***	7.221***	7.176***
	(-2.82)	(-1.96)	(6.62)	(5.54)	(2.92)	(3.35)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,707	1,707	1,708	1,576	1,576	1,576
Adj. R-squared	0.136	0.051	0.246	0.010	0.005	0.002

Table VI
Closed Hedge Funds

This table examines FOHF holdings that are closed to new investment. Data on funds of hedge funds (FOHFs) and their holdings are hand-collected from the SEC EDGAR system. The sample period is from 2004Q1 to 2015Q4. To identify closed hedge funds, we match by name hedge funds in FOHFs' holdings to hedge funds in the TASS database. Because the TASS database provides the dates on which a fund closes and re-opens to new investment, we can identify hedge funds that are closed to new investment at any given point in time. Panel A reports summary statistics of within-FOHF decile rankings based on holdings' cumulative quarterly returns, with 10 being the highest ranking. Panel B shows closed fund performance percentile rankings relative to funds in the TASS database. In both panels, we examine whether the mean is significant using a *t*-test. ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively.

Panel A. Within a FOHF					
	Mean	Median	P25	P75	Std. Dev.
Return Ranking	5.86***	6	4	8	2.56
t-stat (H_0: Mean>5)	11.65				

Panel B. Compared with TASS					
	Mean	Median	P25	P75	Std. Dev.
Return Ranking	55***	56	38	75	25.20
t-stat (H_0: Mean>50)	7.48				

Table VII
Robustness Tests: Sub-Period Analysis

In this table, we conduct our earlier analysis in three sub-periods. Data on funds of hedge funds (FOHFs) and their holdings are hand-collected from the SEC EDGAR system. We partition our sample period into "Before Crisis" (2004 to 2007), "Crisis" (2008 and 2009), and "After Crisis" (2010 to 2015) sub-periods. Panel A provides results of our modified *CS*, *CT*, and *GT* measures by sub-period. Panel B reports performance rankings of FOHF holdings using individual funds in the TASS database as the benchmark by sub-period. Panels C and D present results based on holding-level capital flows for each sub-period. ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively.

Panel A. Modified DGTW Measures

		CS_HFR	*CS_CS*	*CT_HFR*	*CT_CS*	*GT*
(1) Before Crisis (2004~2007)	Mean	0.3986***	0.2816***	-0.0767***	-0.0654**	0.0855*
	t-stat	4.93	3.51	-2.65	-2.32	1.87
(2) Crisis (2008 and 2009)	Mean	0.1547	0.3075	0.0591	0.0394	0.3783
	t-stat	0.66	1.45	0.76	0.55	3.74
(3) After Crisis (2010~2015)	Mean	0.6114***	0.4208***	-0.0237	-0.0104	0.0448*
	t-stat	9.62	6.96	-1.08	-0.52	1.70
(3) - (1)	Mean	0.2128***	0.1392	0.0534	0.0551	-0.0407
	t-stat	2.03	1.38	1.32	1.48	-0.79

Panel B. Compared with Hedge Funds in TASS

		FOHF Holding Percentile Ranking	*SA*	
			HFR Index	CS Index
(1) Before Crisis (2004~2007)	Mean	52.9***	-0.1051***	0.0114
	t-stat	6.17	-4.25	0.32
(2) Crisis (2008 and 2009)	Mean	47.8***	-0.0755	0.0636
	t-stat	3.77	-1.52	0.77
(3) After Crisis (2010~2015)	Mean	52.4***	0.1996***	0.4151***
	t-stat	7.89	7.32	7.61
(3) - (1)	Difference	-0.5	0.3047***	0.4036***
	t-stat	-0.89	7.38	5.10

Panel C. Capital Flows: Flows of Individual Hedge Funds				
		Return	HFR-adjusted Return	CS-adjusted Return
(1) Before Crisis (2004~2007)	Positive-Negative	0.8515**	0.3818	0.3429
	t-stat	2.27	1.09	0.98
(2) Crisis (2008 and 2009)	Positive-Negative	0.6570	1.9006***	1.6126**
	t-stat	0.91	2.76	2.33
(3) After Crisis (2010~2015)	Positive-Negative	-0.1047	0.0880	0.1548
	t-stat	-0.47	0.41	0.72
(3) - (1)	Difference	-0.9562**	-0.2938	-0.1881
	t-stat	-2.29	-0.74	-0.47

Panel D. Capital Flows: Flows of Styles				
		Return	HFR-adjusted Return	CS-adjusted Return
(1) Before Crisis (2004~2007)	Positive-Negative	0.3032	-0.1470	-0.1512
	t-stat	1.26	-0.84	-0.90
(2) Crisis (2008 and 2009)	Positive-Negative	-1.0497***	0.6039*	0.1460
	t-stat	-2.61	1.78	0.44
(3) After Crisis (2010~2015)	Positive-Negative	-0.1776	0.0179	0.0565
	t-stat	-1.23	0.14	0.47
(3) - (1)	Difference	-0.4808*	0.1649	0.2077
	t-stat	-1.79	0.75	0.98

Table VIII
Robustness Tests: Alternative Style Returns

In this table, we repeat our earlier analysis using alternative style returns. Specifically, we assign hedge funds in the TASS database to one of the four general styles and then compute style returns as the equal-weighted average return of funds within each style. Panel A shows our modified DGTW measures based on the alternative style returns. In Panel B, we form portfolios of FOHFs every quarter and then regress these portfolios' modified DGTW measures on the seven factors used in Fung and Hsieh (2004). *t*-statistics are reported in parentheses. In Panel C, we examine performance differences between positive-flow and negative-flow portfolios at both the holding and style level. Here, we use style-adjusted returns, calculated as the difference between fund returns and the alternative style returns. ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively.

Panel A. DGTW		
	CS_TASS	*CT_TASS*
Mean	0.3280***	-0.0167
t-stat	6.03	-0.92

Panel B. Time-series regressions		
	CS_TASS	*CT_TASS*
Intercept	0.4940***	0.0010
	(3.15)	(0.05)
S&P	-0.0297	-0.0071*
	(-1.02)	(-1.87)
SML	-0.0688*	-0.0059
	(-1.73)	(-1.17)
BD10Y	0.8879**	-0.1299**
	(2.14)	(-2.34)
CredSpr	0.9766*	-0.1543**
	(1.96)	(-2.41)
PTFSBD	0.0036	0.0014*
	(0.55)	(1.74)
PTFSFX	-0.0048	-0.0003
	(-0.88)	(-0.42)
PTFSCOM	0.0048	-0.0020**
	(0.65)	(-1.98)
Observations	47	47
Adj. R-squared	0.252	0.296

Panel C. Capital Flows: Style-adjusted Returns		
	Individual Funds	Styles
Positive-Negative	0.4413**	0.0331
t-stat	2.23	0.33