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Investor Overconfidence, Over-extrapolation Bias, Mutual Fund Flow and Performance

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by

Jie Gao

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DEDICATION

To

my parents and friends

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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ABSTRACT OF THE DISSERTATION

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Professor David Hirshleifer, Chair

I examine how mutual fund investor overconfidence and over-extrapolation bias affect mutual fund flow and future performance. By generalizing the model of Berk and Green (2004), I show that when investors over-extrapolate fund past return and/or are overconfident, fund flows no longer eliminate fund outperformance efficiently as predicted in their theory. Instead, fund future performance can be positively predicted by unit value-added, a variable that represents fund past performance, and negatively predicted by unit fee-added, a variable that represents fund flow activities. Using the U.S. actively managed mutual funds data, I find that the skill-competition variable constructed based on my model predicts fund future risk-adjusted performance. In addition, I find that investor overconfidence dominates over-extrapolation bias when investors make an investment decision on actively managed mutual funds.

Introduction

Berk and Green (2004) applies rational expectation equilibrium in the mutual fund industry to explain the puzzling return-chasing behavior of mutual fund investors. The paper points out that the non-persistent mutual fund performance does not imply that managers lack skill. Instead, the non-persistent performance is the result of mutual fund investors' rational competition for a scarce resource, fund manager skill, which subsequently eliminates fund outperformance with flows.

This process is analogous to investors pushing up the stock prices of firms with better prospects to generate high future cash flows, thereby eliminating any opportunities to earn risk-adjusted returns by investing in such stocks. While extensive studies find that investors in the stock market misprice firms due to various psychological biases, little research has explored the effect of investor irrationality in the mutual fund industry. This study addresses this issue by examining how mutual fund investor overconfidence and over-extrapolation bias affect investment decisions and future fund performance.

I focus on investor overconfidence and investor over-extrapolation as the psychological biases in this study for two reasons. First, overconfidence is probably the most robust human trait documented in the psychology of judgment (De Bondt and Thaler, 1995; Moore, Tenney, and Haran, 2015). Heath and Tversky (1991) finds that people are more confident of their predictions in fields where they have self-declared expertise, holding their actual predictive ability constant. Investors who pursue an actively managed mutual fund instead of index funds are most likely to believe they have superior abilities in picking out skilled managers and are therefore more likely to experience overconfidence. Over-extrapolative bias is also pervasive in human judgment and decisions (Barberis and Thaler, 2003; Gilovich, Vallone, and Tversky, 1985; Hirshleifer, 2001; Tversky and Kahneman, 1974). The human brain has a limited information processing power and therefore often use representative heuristics as a short-cut when processing large or complicated information. However, the use of the representativeness heuristic can cause trend-chasing because people are too ready to recognize a certain pattern (Daniel, Hirshleifer, and Subrahmanyam, 2001). As investment decisions are usually difficult and require a large amount of information, investors are more likely to apply representativeness heuristic and experience over-extrapolation bias when making investment decisions.

Second, many studies have documented the existence of overconfident and over-extrapolating investors in the stock market. Barber (1999) and Barber and Odean (2000) both find that investors trade excessively due to overconfidence, which eventually leads to lower profits. Greenwood and Shleifer (2014) analyzes six surveys on investor expectation and finds that investors form beliefs about future stock market returns by extrapolating past returns. Ertan et al. (2017) discovers investors' extrapolative behavior around earnings announcements. In addition, investor overconfidence and over-extrapolation bias are found to be able to explain several puzzling market phenomenon, such as the predictive ability of price scaled fundamental variables, high volatility and momentum, when combined with traditional asset pricing models (Barberis et al., 2015;

Daniel, Hirshleifer, and Subrahmanyam, 1998, 2001; Hong and Stein, 1999). As the investor base in the mutual fund industry overlaps heavily with the investor base in the stock market, it is natural to wonder how this investor overconfidence and over-extrapolation bias displayed in the stock market will affect the investment decisions on the mutual funds and future fund performance.

In the stock market, investors react to information through stock price. They reward good investment opportunities with higher market prices and punish bad ones with lower market prices (Berk and van Binsbergen, 2017). Investor irrationalities can affect investors' trading behavior, which will directly affect the return of the assets. Comparatively, the mechanism through which investor irrationalities affect the rational expectation equilibrium in the mutual fund industry is quite different. The price for a skilled manager in the mutual fund industry is relatively fixed (the management fee is relatively stable over time) and therefore investors can only react to information about manager skill through flows. Investors flow into funds with outperformance and flow out of funds with underperformance. In this way, the misevaluation of manager skill due to investor irrationality can only be observed from mutual fund flows.

To examine the effect of investor overconfidence and over-extrapolation bias on mutual fund flow and performance, I first introduce a generalization of the Berk and Green (2004) model, where I assume that mutual fund investors can observe private information in addition to fund historical return when making an investment decision. This private information can be viewed as the information that is not readily available and that investors need to spend extra effort and resources to obtain. As discussed in Daniel, Hirshleifer, and Subrahmayam (1998), if an investor overestimates his ability to generate information, or to identify the significance of existing data that others neglect, he will underestimate the forecast error of signals or assessments with which he has greater personal involvement. Therefore, I further assume that mutual fund investors are overconfident about their private information and overestimate the precision of this private information. On the other hand, if investors over-extrapolate fund past performance, they believe that past fund performance can predict fund future performance more accurate than it actually does. Hence, I assume that over-extrapolating mutual fund investors will overestimate the precision of the information contained in fund past performance.

The model shows that when mutual fund investors are overconfident about their private information, or over-extrapolation fund past performance, or both, their assessment of manager skill will deviate from the rational expectation of manager skill. As a result, fund flow can no longer eliminate fund outperformance effectively. Furthermore, fund future performance can be predicted by unit value-added, which is the fund value-added scaled by fund size, and unit fee-added, which is the incremental dollar fee scaled by fund size. This unit value-added is closely related to fund past performance and therefore represents the information about manager skill contained in the fund past performance. Similarly, the unit fee-added is closely related to fund dollar flow and therefore represents investors' reaction to the private information and prior belief about manager skill contained in the fund flow activities. The predictive direction of unit value-added and unit fee-added will depend on the relative strength of investor overconfidence and investor over-extrapolation bias.

When investors are dominated by overconfidence, unit value-added can positively predict fund future performance and unit fee-added can negatively predict fund future performance. Controlling for unit fee-added, a higher unit value-added implies high manager skill and will positively predict fund future performance due to investors' relative overreaction to private information and under-reaction to the information contained in fund past performance. Controlling for unit value-added, a higher positive unit fee-added implies a larger positive deviation from the supply of capital under the rational case due to investors' overreaction to the private information. Similarly, a lower negative unit fee-added implies a larger negative deviation from the supply of capital under the rational case due to investors' overreaction to the private information. In this way, controlling for unit value-added, unit fee-added will negatively predict fund future performance.

On the other hand, when investors are dominated by over-extrapolation bias, unit value-added can negatively predict fund future performance. In addition, unit fee-added can negatively predict fund future performance if overconfidence is weakly dominated by over-extrapolation bias and positively predict fund future performance if overconfidence is strongly dominated by over-extrapolation bias. Controlling for unit fee-added, a higher unit value-added implies high manager skill and will negatively predict fund future performance due to investors' relative overreaction to the information contained in fund past performance. In this case, the predictive direction of unit fee-added will depend on whether the relative overreaction to the private information from investor overconfidence is higher than the relative underreaction to investors' prior belief about manager skill. If investor overconfidence is weak, both prior information and the private information about manager skill are relatively underweight and therefore fund unit fee-added positively predicts fund future performance. However, if investor overconfidence is large enough to the point where the flows are driven more by the relative overreaction to the private information than by the relative underreaction to the prior belief, fund unit fee-added will negatively predict fund future performance.

In addition, the model shows that the predictive ability of fund unit value-added and fund unit fee-added are correlated with investor overconfidence and investor over-extrapolation bias. As investors become more overconfident about their private information, they will underweight the manager skill information contained in the fund past performance more. Therefore, the predictive power of unit value-added increases (become more positive) due to investors' increased under-reaction to the information in the past fund performance. In addition, the predictive power of unit fee-added decreases (become more negative) due to investors' increased overreaction to the private information. The same logic applies to the effect of investor over-extrapolation bias. As investor over-extrapolate fund past performance more, they will relatively overweight the manage skill information contained in the fund past performance more and under-react moreto the private information. In this way, the predictive power of unit value-added decreases (become more negative) and the predictive power of unit fee-added increases (become more positive).

Using U.S. actively managed mutual fund data, I test the model by regressing fund future performance on fund unit value-added and fund unit fee-added, controlling for other factors that could affect fund future performance. The results show that the coefficient for unit value-added is significantly positive and the coefficient for unit fee-added is significantly negative. This result suggests that mutual fund investors are not entirely rational and are dominated by overconfidence when making an investment decision on mutual funds. A one standard deviation increase in unit value-added constructed using CAPM alpha (peer-adjusted net return) as the past performance measure will lead to a 0.15% (0.13%) increase in fund Carhart alpha in the next quarter and a one standard deviation increase in fund unit fee-added will lead to a 0.03% (0.03%) decrease in fund Carhart alpha in the next quarter.

These results are different from previous studies that examine the predictive ability of past fund performance or past fund flow in that according to my model, the future fund performance has to be predicted using both a variable that represents past fund performance and a variable that represent flow activities at the same time. Even if a mutual fund has a skilled manager and generates a high performance this period, this does not necessarily predict high performance in the future since investors could compete away the outperformance generated by this skilled manager. Therefore, when predicting future fund performance with past fund performance or past fund flow alone, the predictability of one variable will be significantly tempered by the other. In this way, the best predictor of fund future performance has to contain both past fund performance and fund flow activities.

Therefore, I further construct a variable, skill-competition measure (SC measure), that combines fund unit value-added and fund unit fee-added. According to my model, this SC measure should be able to positively predict fund future performance. To construct this predictor, I first estimate the coefficients for fund value-added and fund fee-added using the previous two years observations of all mutual funds. I then construct the SC measure with the estimated coefficients and realized fund unit value-added and fund unit fee-added of the quarter. Next, I sort mutual funds into decile portfolios at the end of each quarter. The strategy of long the extreme high SC measure (constructed using CAPM alpha as the past performance measure) funds and short the extreme low SC measure can generate a significant 1.12% Carhart alpha for the equal-weighted strategy and a significant 0.94% Carhart alpha for the value-weighted strategy in the next quarter. However, the returns of the long-short strategy mainly come from the short side portfolio.

In addition, my model predicts that the predictive power of fund unit value-added and fund fee-added co-vary with investor sentiment. To be more specific, the predictive power of fund unit value-added is positively correlated with investor overconfidence and negatively correlated with investor over-extrapolation bias; the predictive power of fund unit fee-added is negatively correlated with investor overconfidence and positively correlated with investor over-extrapolation bias. Using aggregate market return as the proxies for investor overconfidence, I confirm that the predictive power of fund unit value-added and fund unit fee-added co-move significantly with investor overconfidence in the direction predicted by my model.

This study provides a new perspective on the application of rational expectation equilibrium in the mutual fund industry. In contrast with the conclusion in Berk and Green (2004), I find that fund future performance is predictable when mutual fund investors are not fully rational. In addition, this paper points out that the key to identifying funds with persistent performance is not picking out skilled managers but finding mis-evaluated funds. Even though it is rational for investors to chase fund performance according to Berk and Green (2004), it does not necessarily mean that they chase fund performance efficiently. Using both theoretical modeling and empirical testing, I find that when investors are not fully rational as suggested in Berk and Green (2004), fund future performance can be predicted by fund unit value-added and fund unit fee-added. In addition, the predictive directions of unit value-added and unit fee-added depend on the relative strength of investor overconfidence and over-extrapolation bias when investors make mutual fund investment decision.

This paper is not the first to study how investors allocate investment between funds based on available information. Berk and Green (2004) develops a parsimonious model and explains several puzzling phenomena in the mutual fund industry, e.g. mutual fund investors' return-chasing behavior, the non-persistent mutual fund performance, and high fund manager income. Berk and Green (2004) points out that the non-persistence of mutual fund performance is the result of a rational expectation equilibrium where investors rationally anticipate the value of a scarce resource, mutual fund manager skill in this case, and compete away any abnormal return generated by this resource through mutual fund flows. Mutual fund managers, as the possessor of the scarce resource, collect all the rent as their own rewards, thus the high income.

This model provides a new understanding of the mutual fund industry and from then on, multiple studies test and provide further evidence supporting the Berk and Green (2004) model. Berk and van Binsbergen (2015) redefines manager skill based on the Berk and Green (2004) model and identified persistent manager skill up to ten years in the industry. Pastor, Stambaugh, and Taylor (2015) tests the decreasing return to scale assumption in the Berk and Green (2004) model and find a significant decreasing return to scale at the industry level, while there is no significant result identified at the fund level. My research is related to these studies in that the model developed in this study is based on the framework of Berk and Green (2004). However, instead of working under a pure rational assumption, I introduce investor overconfidence and over-extrapolation bias as a source of irrationality into the original model and provide interesting implications for fund flow and future performance.

There has been extensive evidence of investor behavioral biases in the stock market while very few studies have been done on the mutual fund industry, albeit these two markets share large overlapping investor base. Sirri and Tufano (1998) attributes the convex flow performance relationship in the mutual fund industry to search cost and limited attention. Solomon, Soltes, and Sosyura (2014) finds that mutual fund flows can be significantly affected by media coverage on a fund's holdings, suggesting the existence of an attention bias among mutual fund investors when allocating capital. Bailey, Kumar, and Ng (2011) uses US discount brokerage investors sample and constructs proxies for several behavioral biases, such as limited attention, home bias, and overconfidence. Their study finds that biased mutual fund investors trade funds more frequently, tend to time their buys and sells badly, and prefer high expense funds and active funds rather than index funds.

In comparison with the purely empirically approach of these studies, my research starts with a behavioral model of irrational mutual fund investors and further supports my model with empirical tests. In addition, this study is, to my knowledge, the first to investigate the effect of investor overconfidence and over-extrapolation bias on mutual fund flow and future fund performance. Moreover, my study examines the interaction effect between investor overconfidence and investor over-extrapolation bias on investment decisions. The results from my study provide guidance on which psychology bias is more dominant in investors' investment decision process.

My research also contributes to the literature on mutual fund performance persistence. Carhart (1997) finds that most of the performance persistence ("hot hand" phenomenon) identified in previous studies can be largely explained by the momentum factor in individual stocks. Later, Cohen, Coval, and Pastor (2005), Kacperczyk, Sialm, and Zheng (2005) and Avramov and Wermers (2006), find predictability in performance even after controlling for momentum. However, Fama and French (2008) and Barras, Scaillet, and Wermers (2009) apply advanced methodologies and find little evidence of performance persistence. According to the model in this study, fund future performance cannot be predicted without taking both past fund performance and past fund flow activities into consideration. The measure constructed based on my model, which include both fund past performance (unit value-added) and fund flow activities (unit fee-added), can significantly predict fund future risk-adjusted net return.

My study is also related to the strain of research on 'smart money' effect. Gruber (2011) and Zheng (1998) find that mutual fund flow can positively predict future fund performance in the short term and therefore argue that the money is 'smart'. However, Sapp and Tiwari (2004), Wermer (2003) and Lou (2012) later find that the smart money effect can be fully explained by temporary price pressure and stock return momentum. On the other hand, Frazzini and Lamont (2008) argues that high mutual fund flows represent high investor sentiment and fund flows are dumb in the long run. Flows in my study represent irrational investor reaction to information about manager skill. According to my model, the predictability of fund flow for future return cannot be correctly specified without taking current fund performance into consideration. Instead of examining fund flow being 'smart' or not, I am essentially testing whether fund flows are fully rational and reacting to information efficiently. Controlling for fund past performance with unit value-added, fund flow can represent the investors' aggregate relative overreaction or underreaction to the private information and prior belief.

The rest of the paper is organized as follows: Section I presents the theoretical model and its implications. Section II describes the data and methodology used in empirical tests. Section III reports the results of empirical tests. Section IV concludes the paper.

I. The Model

I consider a model with three dates, t = 0, 1, 2. All investors can choose between an actively managed mutual fund and an index fund that has the same risk as the actively managed mutual fund (benchmark). As discussed in the introduction, this model is aimed to examine how mutual fund investors irrationality affects fund future performance. I introduce both investor over-extrapolation and overconfidence as the source of irrationality in the model.

Let $\mathrm{V_t}$ denotes the dollar amount of money manager could extract from the capital market after cost at time *t.* Following Berk and van Binsbergen (2017), I call $\mathrm{V_t}$ value added and use it as the manager skill measure.

$$\mathrm{V_t}|\mu = \mu + \varepsilon_t, \tag{1}$$

where μ is the unobserved true manager skill and ε_t is a normally distributed noise term with mean zero and variance σ_ε^2. Mutual fund investors can learn about μ through realized fund returns and their private signal about manager skill.

Therefore, fund dollar return at time t is,

$$\mathrm{R_t} = V_t - q_{t-1} f \tag{2}$$

And fund net return at time t is,

$$\mathrm{r_t} = \frac{R_t}{q_{t-1}} = \frac{V_t}{q_{t-1}} - f, \tag{3}$$

where f is a fixed percentage management fee charged by the mutual fund.

1.1. Timing

At time 0, mutual fund investors have a prior belief that a manager's true ability $\mu = \mu_0 + \omega$ and is normally distributed with mean μ_0 and variance σ_0^2.

At time 1, mutual fund investors observe the benchmark-adjusted net return of the actively managed portfolio, r_1 and a private signal about manager skill, S_1. Mutual fund investors obtain the private information through their own investigation and research. I assume that $S_1 = \mu + \xi$ and is also normally distributed,

$$S_1 \sim N(\mu, \sigma_s^2) \tag{4}$$

It is more convenient to use precision instead of variance in the following analysis. Therefore, I further define $v_0 = 1/\sigma_0^2$, $v_\varepsilon = 1/\sigma_\varepsilon^2$, $v_s = 1/\sigma_s^2$.

In the model, I allow investors' perceived signal precision to be different from the true signal precision due to different psychological biases. At time 1, mutual fund investors' perceive signal precision for V_1 and S_1 are denoted as v'_ε and v'_s, respectively. Specifically, I assume that overconfident mutual fund investors overestimate the quality of their private signal (Daniel, Hirshleifer, and Subrahmanyam, 2001). Therefore, when investors are overconfidence, their perceived precision of S_1, v'_s, is higher than the true signal precision, v_s. On the other hand, if investors over-extrapolate past return, they believe that fund past returns predict fund future returns more accurately than they actually do. In this way, when investors over-extrapolate fund past performance, their perceived precision of V_1, v'_ε, is higher than the true precision of V_1, v_ε.[1]

I further assume that $\mathrm{Cov}(\varepsilon_t, \varepsilon_s) = 0$ for $t \neq s$, $\mathrm{Cov}(\varepsilon_t, \xi) = 0$ for $t = 1, 2$, $\mathrm{Cov}(\varepsilon_t, \omega) = 0$ for $t = 1, 2$ and $\mathrm{Cov}(\xi, \omega) = 0$.

After observing fund past performance and a private signal about manager skill, mutual fund investors update their belief about manager skill and flow in or out of the mutual fund. Since at time t, q_{t-1} and f are all known to the investors, after observing net return r_1, the investors are able to back out V_1. Let $\bullet$ denote $\mathbb{I}$ or $\mathbb{R}$. When $v'_\varepsilon = v_\varepsilon$ and $v'_s = v_s$, $\bullet$ denotes $\mathbb{R}$. Otherwise, $\bullet$ denotes $\mathbb{I}$. Then, using the Bayesian updating rule from DeGroot (1970), the updated belief about manager skill is,

$$\mathbb{E}^\bullet[V_2|r_1, S_1] = \mathbb{E}^\bullet[V_2|R_1, S_1] = (\frac{v_0}{v'})\mu_0 + (\frac{v'_\varepsilon}{v'})V_1 + (\frac{v'_s}{v'})S_1, \quad (5)$$

where $v' = v_0 + v'_\varepsilon + v'_s$.

At time 2, mutual fund investors receive a net return of r_2.

1.2. Mutual Fund Flows

Following Berk and Green (2004), I assume that investors supply capital with infinite elasticity to a fund if they have a positive excess expected return for the fund, given the observed signals and investors' perceived signal distribution.

[1] Since fund net return $r_t = \frac{V_t}{q_{t-1}} - f$, investors' over-extrapolating past return, r_1, is equivalent to over-extrapolating V_1.

Since all mutual fund investors are identical in my model, instead of solving for individual investment, I only need to solve for the aggregate mutual fund dollar flow at time $\mathrm{t} = 1$. Due to the competitive supply of capital,

$$\mathbb{E}^{\bullet}[r_2|r_1, S_1] = 0 \tag{6}$$

Therefore, using equations (3) and (6),

$$\mathbb{E}^{\bullet}\left[\frac{V_2}{q_1'} - f \middle| R_1, S_1\right] = 0 \tag{7}$$

Since fund size before time 2 are all observable and f is also observable, we can rewrite equation (7),

$$\mathbb{E}^{\bullet}[V_2|R_1, S_1] = q_1' f \tag{8}$$

From equation (5) and equation (8), we have,

$$q_1' f = \frac{\upsilon_0}{\upsilon'}\mu_0 + \frac{\upsilon_\varepsilon'}{\upsilon'}V_1 + \frac{\upsilon_s'}{\upsilon'}S_1 \tag{9}$$

Replace V_1 and S_1 with $\mathrm{V}_1 = (r_1 + f)\mathrm{q}_0$ and $\mathrm{S}_1 = (s_1 + f)q_0$. Since $\mathbb{E}^{\bullet}[r_1] = 0$, $q_0 f = \mathbb{E}^{\bullet}[R_1] = \mu_0$. Then,

$$q_1' f = q_0 f + \frac{\upsilon_\varepsilon'}{\upsilon'}r_1 q_0 + \frac{\upsilon_s'}{\upsilon'}s_1 q_0 \tag{10}$$

Lemma 1*: At time $t = 1$, fund flow is a linear function of the fund net return, r_1, and the private signal, s_1.*

$$q_1' - q_0 = \frac{\upsilon_\varepsilon'}{\upsilon' f}r_1 q_0 + \frac{\upsilon_s'}{\upsilon' f}s_1 q_0 \tag{12}$$

Funds with positive net returns receive inflows and funds with negative net returns experience outflows. In addition, a positive private signal increases fund dollar flow and a negative one reduces fund dollar flow. This form of result is similar to the results in Berk and Green (2004), where mutual fund flows react to information through flows rationally.

1.3. Fund Future Performance

Given the dollar flow derived in equation (12), I can solve the expected fund future performance.

Lemma 2*: At time $t = 1$, the expected fund future performance given the information investors received and investors' belief about the distribution of the information is*

$$\mathbb{E}[r_2 q_1' | r_1, S_1] = \frac{v_\varepsilon v_s' - v_s v_\varepsilon'}{v v_s'} r_1 q_0 + \left(\frac{v_s v'}{v v_s'} - 1 \right) (q_1' - q_0) f, \qquad (13)$$

where $\mathrm{v} = \mathrm{v}_0 + \mathrm{v}_\varepsilon + v_s$.

From equation (13), we can see that the expected fund future value-added is a linear combination of fund value-added last period and fund incremental dollar fee received last period. Since investors care more about fund return instead of fund value-added in reality, I rewrite equation (13) into equation (14) and discuss model results for expected fund future return instead of expected fund future value-added.

$$\mathbb{E}[r_2 | r_1, S_1] = \frac{v_\varepsilon v_s' - v_s v_\varepsilon'}{v v_s'} \frac{r_1 q_0}{q_1'} + \left(\frac{v_s v'}{v v_s'} - 1 \right) \frac{(q_1' - q_0) f}{q_1'} \qquad (14)$$

The $\mathbb{E}[r_2 | r_1, S_1]$ in equation (14) is different from the one in equation (6) and does not necessarily equal to zero. $\mathbb{E}[r_2 | r_1, S_1]$ is the rational fund expected performance at time 2 given the information investors received and investors' belief about the distribution of the information at time 1. To simplify the discussion in the future, I call $\frac{r_1 q_0}{q_1'}$ unit value-added and $\frac{(q_1'-q_0)f}{q_1'}$ unit fee-added.

Proposition 1: *When mutual fund investors are rational, fund future performance cannot be predicted.*

When mutual fund investors are rational, $v_\varepsilon' = v_\varepsilon$ and $v_s' = v_s$. Then according to equation (14),

$$\mathbb{E}[r_2|r_1, S_1] = 0 \tag{15}$$

In this case, mutual fund investors react rationally to all information through fund flows and therefore fund future performance cannot be predicted. This result is the same as the one derived in Berk and Green (2004).

Proposition 2: *When mutual fund investors are overconfident but do not over-extrapolate fund past performance, fund future performance is positively predicted by unit value-added and negatively predicted by unit fee-added in a bivariate regression.*

When mutual fund investors are overconfident about their private information but do not over-extrapolate fund past performance, $\mathrm{v}_\varepsilon' = \mathrm{v}_\varepsilon$ and $\mathrm{v}_\mathrm{s}' > \mathrm{v}_\mathrm{s}$. Then according to equation (14),

$$\mathbb{E}[r_2|r_1, S_1] = \frac{v_\varepsilon}{v}\left(1 - \frac{v_s}{v_s'}\right)\frac{r_1 q_0}{q_1'} + \left(\frac{v'' v_s}{v v_s'} - 1\right)\frac{(q_1' - q_0)f}{q_1'} \tag{16}$$

$$\beta_1 = \frac{v_\varepsilon}{v}\left(1 - \frac{v_s}{v_s'}\right) > 0 \textit{ and } \beta_2 = \left(\frac{v'' v_s}{v v_s'} - 1\right) < 0$$

,where $\mathrm{v}'' = \mathrm{v}_0 + \mathrm{v}_\varepsilon + \mathrm{v}_\mathrm{s}'$.

As investors are overconfident and overestimate the precision of their private information, they relatively underreact to the information contained in fund past performance while overreacting to the private information when accessing fund future performance. Therefore, controlling for fund unit fee-added, unit value-added positively predict fund future performance since a high unit value-added suggests a high manager skill and investors underreact to this information. On this other hand, controlling fund unit value-added, unit fee-added negatively predict fund future performance since a high unit fee-added suggests a high manager skill but investors overreact to this information.

Proposition 3: *When mutual fund investors over-extrapolate fund past performance but are not overconfident about their private information, fund future performance is negatively predicted by unit value-added and positively predicted by unit fee-added in a bivariate regression.*

When mutual fund investors are overconfident but do not over-extrapolate fund past performance, $v'_\varepsilon > v_\varepsilon$ and $v'_s = v_s$. Then according to equation (14),

$$\mathbb{E}[r_2|r_1, S_1] = \frac{v_\varepsilon - v_\varepsilon^{'}}{v}\frac{r_1 q_0}{q_1'} + \frac{v_\varepsilon^{'} - v_\varepsilon}{v}\frac{(q_1' - q_0)f}{q_1'} \tag{17}$$

$$\beta_1 = \frac{v_\varepsilon - v_\varepsilon^{'}}{v} < 0 \;\; and \;\; \beta_2 = \frac{v_\varepsilon^{'} - v_\varepsilon}{v} > 0$$

As investors over-extrapolate fund past performance and overestimate the precision of fund past performance, they relatively overreact to the information contained in fund past performance while underreact to the private information when accessing fund future performance. Therefore, controlling for fund unit fee-added, unit value-added negatively predict fund future performance since a high unit value-added suggests a high manager skill and investors overreact to this information. On the other hand, controlling fund unit value-added, unit fee-added positively predict fund future performance since a high unit fee-added suggests a high manager skill but investors underreact to this information.

Proposition 4: *When mutual fund investors over-extrapolate fund past performance and are overconfident about their private information, there are two different scenarios.*

1) *If $v_s'/v_s \geq v_\varepsilon'/v_\varepsilon$, which means investors are more overconfident about their private information than over-extrapolating fund past performance, fund future performance can be positively predicted by unit value-added and negatively predicted by unit fee-added.*
2) *If $v_s'/v_s < v_\varepsilon'/v_\varepsilon$, which means investors are less overconfident about their private information than over-extrapolating fund past performance, unit value-added negatively predict fund future performance. In addition, unit fee-added positively predict fund future performance if v_s'/v_s is smaller than k and negatively predict fund future performance if v_s'/v_s is larger than k. if v_s'/v_s equals to k, unit fee-added cannot predict fund future performance.*

$$k = \frac{v_0 + v_\varepsilon'}{v_0 + v_\varepsilon} \tag{18}$$

When mutual fund investors are overconfident about their private information and over-extrapolate fund past performance, $\mathrm{v}_\varepsilon' > \mathrm{v}_\varepsilon$ and $\mathrm{v}_s' > \mathrm{v}_s$. Then according to equation (14),

$$\mathbb{E}[r_2|r_1, S_1] = \frac{v_\varepsilon v_s' - v_s v_\varepsilon'}{v v_s'} \frac{r_1 q_0}{q_1'} + \left(\frac{v_s v'}{v v_s'} - 1\right) \frac{(q_1' - q_0) f}{q_1'} \tag{19}$$

When mutual fund investors suffer from both investor overconfidence and over-extrapolation bias, the prediction direction of unit value-added and unit fee-added then depend on the relative strength of two biases.

If $\frac{v_s'}{v_s} \geq \frac{v_\varepsilon'}{v_\varepsilon}$,

$$\beta_1 = \frac{v_\varepsilon v_s' - v_s v_\varepsilon'}{v v_s'} \geq 0 \text{ and } \beta_2 = \left(\frac{v_s v'}{v_s' v} - 1\right) < 0 \tag{20}$$

If investors are dominated by overconfidence, they relatively overreact to their private information and underreact to fund past performance. Therefore unit value-added positively predict fund future performance and unit fee-added negatively predict fund future performance. When v_s'/v_s equals to $v_\varepsilon'/v_\varepsilon$, there exists a special case where unit value-added cannot predict fund future performance.

If $\frac{v_s'}{v_s} < \frac{v_0 + v_\varepsilon'}{v_0 + v_\varepsilon}$,

$$\beta_1 = \frac{v_\varepsilon v_s' - v_s v_\varepsilon'}{v v_s'} < 0 \text{ and } \beta_2 = \left(\frac{v_s v'}{v_s' v} - 1\right) > 0 \tag{21}$$

On the other hand, if investors are strongly dominated by over-extrapolation bias, they relative overreact to fund past performance and underreact to their private information. Therefore unit value-added negatively predict fund future performance and unit fee-added positively predict fund future performance.

If $\frac{v_0 + v_\varepsilon'}{v_0 + v_\varepsilon} \leq \frac{v_s'}{v_s} < \frac{v_\varepsilon'}{v_\varepsilon}$,

$$\beta_1 = \frac{v_\varepsilon v_s' - v_s v_\varepsilon'}{v v_s'} < 0 \text{ and } \beta_2 = \left(\frac{v_s v'}{v_s' v} - 1\right) \leq 0 \tag{22}$$

When over-extrapolation bias only weakly dominates investors' decision process, both unit value-added and unit fee-added negatively predict fund future performance. In this case, even though investor overconfidence is dominated by over-extrapolation bias, investors' private information is still relatively overweigh compared to the rational case. Therefore fund flows represent investor's overreaction to the private information and negatively predict fund future performance. When v_s'/v_s equals to *k*, there exists a special case where unit fee-added cannot predict fund future performance.

This model can also incorporate limited attention to some extent. If mutual fund investors have limited attention and ignore the information about manager skill S_1, it is equivalent to the case where investors believe the precision of this skill-related information is zero. In other words, investors' perceived precision of the information, v_s', equals to zero. In this case, the expected fund future performance is not well defined since both the coefficient for unit value-added and unit fee-added goes to infinity. However, we can discuss a less extreme situation where the perceived precision of the information v_s' is smaller than the actual precision, v_s.

If investors over-extrapolate fund past performance and have limited attention, $v_\varepsilon' > v_\varepsilon$ and $v_s' < v_s$. Then according to equation (14),

$$\mathbb{E}[r_2|r_1, S_1] = \frac{v_\varepsilon v_s' - v_s v_\varepsilon'}{v v_s'} \frac{r_1 q_0}{q_1'} + \left(\frac{v_s v'}{v v_s'} - 1\right) \frac{(q_1' - q_0)f}{q_1'}$$
$$\beta_1 = \frac{v_\varepsilon v_s' - v_s v_\varepsilon'}{v v_s'} < 0 \text{ and } \beta_2 = \left(\frac{v_s v'}{v v_s'} - 1\right) > 0 \tag{23}$$

This result is exactly the same as the result when investors' over-extrapolation bias strongly dominate their overconfidence. The intuition is also the same. Since investors have limited attention and underreact to the received information, they relatively overreact to the information contained in fund past performance. Therefore, fund unit value-added negatively predict fund future performance and fund unit fee-added positively predict fund future performance.

***Corollary 1**: The incremental predictive ability of unit value-added increases with investor overconfidence and the incremental predictive ability of unit fee-added decreases with investor overconfidence.*

$$\frac{\partial \frac{v_\varepsilon v_s' - v_s v_\varepsilon'}{v v_s'}}{\partial v_s'} > 0 \ \ and \ \frac{\partial \left(\frac{v_s v'}{v v_s'} - 1\right) a}{\partial v_s'} < 0 \tag{24}$$

As investors become more overconfident, they will overreact to the private information more and thus relatively intensify their under-reaction to the skill information contained in fund past performance. In this way, predictability of unit value add on future fund performance will increase with the increase of investor overconfidence. On the other hand, as investors become more overconfident, the aggregate flow will contain more irrational investor flow caused by the overreaction to investors' private information and therefore intensify the negative effect of the unit fee-added on future fund performance.

***Corollary 2**: The incremental predictability of unit value-added decreases with investor over-extrapolation bias and the incremental predictability of unit fee-added increases with investor over-extrapolation bias.*

$$\frac{\partial \frac{v_\varepsilon v_s' - v_s v_\varepsilon'}{v v_s'}}{\partial v_\varepsilon'} < 0 \ \ and \ \ \frac{\partial \left(\frac{v_s v'}{v v_s'} - 1\right) a}{\partial v_\varepsilon'} > 0 \tag{25}$$

As investors over-extrapolate past performance more strongly, they will overreact to the fund past performance information more and thus relatively intensify their under-reaction to the skill information contained in their private information. In this way, predictability of unit value add on future fund performance will decrease with the increase of investor over-extrapolation bias. On the other hand, as investors over-extrapolate past performance more strongly, the aggregate flow will contain more irrational investor flow caused by underreaction to investors' private information and therefore intensify the positive effect of the fund dollar flow on future fund performance.

II. Data and Methodology

2.1. Data

I obtain mutual fund monthly returns and fund characteristics from CRSP mutual fund database. Carhart four-factor monthly returns are obtained from Kenneth French's web site. My sample includes 3809 U.S. actively managed equity funds during 1991 and 2017. Table 1 reports summary statistics of these observations.

The average size of mutual funds in my sample is 1822.47 million while the median fund size is only 359.1 million. Average monthly net flow is -0.44%. This is consistent with the result in Barber, Huang and Odean (2016) that average flow is slightly negative (-0.533%). The average fund age is 201 months (16.7 years) and 59% of the funds have either a front-end or back-end load. On average, U.S. actively managed mutual funds have an annual expense ratio of 1.4.4%. The monthly net returns of mutual funds are on average positive (0.85% per month). However, both CAPM-adjusted and the four-factor-adjusted net return are slightly negative (-0.08% CAPM alpha and -0.10% Carhart alpha per month). This confirms that mutual fund industry on average does not generate risk-adjusted return after fee. The loadings on Carhart four factors are 0.9868, 0.2094, -0.0040, and 0.0175 respectively, suggesting that mutual funds on average hold the market portfolio with a slight tilt towards small stocks. Overall, my sample is comparable to previous studies.

2.2. Mutual Fund Performance

In the model, $\mathrm{r_t}$ is the benchmark-adjusted net return at time *t* and appears on both the left-hand side and right-hand side of equation (14). Therefore, to avoid the serial correlation problem in the empirical tests, I use different benchmarks to adjust fund net return on the left-hand side and right-hand side of equation (14) respectively. Following the convention in mutual fund literature, I use is the Carhart model return as the benchmark return to adjust fund future performance on the left-hand side of equation (14). I first regress monthly fund net returns on Carhart four-factors returns to estimate mutual fund factor loadings. I use a 24-month rolling regression window. Then Carhart model adjusted return (Carhart alpha) of fund *i* at month *t* is calculated as follow.

$$\alpha_{i,t}^{Carhart} = (R_{it}^{N} - R_{rf,t}) - \hat{\beta}_{mktrf,i} * (R_{mkt,t} - R_{rf,t}) - \hat{\beta}_{smb,i} * R_{smb,t} - \hat{\beta}_{hml,i} * R_{hml,t} - \hat{\beta}_{umd,i} * R_{umd,t} \tag{26}$$

, where R_{it}^{N} is net return of fund *i* at month t, $\hat{\beta}_{mktrf,i}$, $\hat{\beta}_{smb,i}$, $\hat{\beta}_{hml,i}$, and $\hat{\beta}_{umd,i}$ are the estimated factor loadings from the rolling regression, $R_{mkt,t}$, $R_{smb,t}$, $R_{hml,t}$, and $R_{umd,t}$ are the realized factor returns at month *t*, and $R_{rf,t}$ is the 1-month T-bill rate in month *t*. Then quarterly mutual fund performance is the accumulated monthly Carhart alpha during the quarter.

For the performance measure on the right-hand side of equation (14), I use two different benchmarks. Recent studies find that investors care most about market risk when evaluating funds (Barber, Huang and Odean, 2016; Berk and Van Binsbergen,2016). Therefore, the first benchmark I use is the CAPM model. Similar to the procedure used to generate Carhart alpha, I regress fund net returns on market returns to estimate market beta[2] of each fund. Then the CAPM model adjusted return (CAPM alpha) of fund *i* at month *t* is calculated as follow.

$$\alpha_{i,t}^{CAPM} = (R_{it}^{N} - R_{rf,t}) - \hat{\gamma}_{mktrf,i} * (R_{mkt,t} - R_{rf,t}) \tag{27}$$

[2] To avoid confusion, I use γ to represent the estimated market factor loading instead of β in equation 26.

, where $\hat{\gamma}_{\mathrm{mktrf,i}}$ is the estimated market factor loading from the rolling regression. Then quarterly mutual fund performance is the accumulated monthly CAPM alpha during the quarter.

As CAPM alphas are still eliminated using a similar procedure as the one for Carhart alphas, the fund performance measure could still be autocorrelated in the neighboring month. To mitigate this problem, I use a model-free benchmark, peer-group net return, as the second benchmark for mutual fund performance. Funds targeting the same benchmark index tend to have similar risk and style. To construct the peer-group net return, I first obtain mutual fund benchmark index from Prof. Cremer's website[3]. Then peer-group net return is calculated as the equal-weighted net return of all mutual funds that target the same benchmark index. Finally, fund peer-group-adjusted net return (PA) is calculated as follow.

$$\alpha_{\mathrm{i,t}}^{\mathrm{PA}} = R_{i,t} - \bar{R}_{i,t}^{peer} \quad (28)$$

, where $R_{i,t}$ is the net return of fund *i* at month *t* and $\bar{R}_{i,t}^{peer}$ is the average net return of all mutual funds that target the same index as fund *i* at month *t*. Then quarterly mutual fund performance is the accumulated monthly PA during the quarter.

[3] Prof. Cremer provides funds' benchmark indices from 1990 to 2015. (https://activeshare.nd.edu/data/)

2.3. Methodology

2.3.1. Testing the Model

According to **Proposition 2 – Proposition 4**, when investors are not fully rational, fund future performance can be predicted by unit value-added and unit fee-added. Therefore, I first double sort all mutual funds by unit value-added and unit fee-added measured over the past two years into 25 (5 unit value-added groups × 5 unit fee-added) portfolios. Then I examine the equal-weighted and value-weighted portfolio performance of these 25 portfolios in the next quarter. If the investors are dominated by overconfidence, the portfolio return should increase with fund past performance quintile within each dollar flow quintile and decrease with past fund dollar flow quintile within each past fund performance quintile. On the other hand, if the investors are strongly dominated by over-extrapolation bias, the portfolio return should decrease with fund past performance quintile within each dollar flow quintile and increase with past fund dollar flow quintile within each past fund performance quintile. If the investors are only weakly dominated by over-extrapolation bias, the portfolio return should decrease with fund past performance quintile within each dollar flow quintile and also decrease with past fund dollar flow quintile within each past fund performance quintile. If the investors are rational, we should not observe any return patterns for these 25 portfolios.

I also conduct panel regression of quarterly fund performance on past unit value-added and past unit fee-added to control for other fund characteristics. Base on my model, I would expect to see a significant positive coefficient for fund unit value-added and a significant negative coefficient for fund unit fee-added if investors are dominated by overconfidence. However, if investors are strongly dominated by over-extrapolation bias, I would expect to see a significant negative coefficient for fund unit value-added and a significant positive coefficient for fund unit fee-added. If investors are only weakly dominated by over-extrapolation bias, I would expect to see a significant negative coefficient for fund unit value-added and a significant negative coefficient for fund unit fee-added. The regression controls for fund age measured by the natural logarithm of age, fund size measured by the natural logarithm of asset under management at the quarter end before the measurement period for unit value-added and unit fee-added, lagged expense ratio, a load indicator that equals to 1 if any share class of the fund includes a front or rear load, fund flow at the quarter end before the measurement period, fund activeness by fund turnover rate, portfolio size by the number of stocks in the portfolio, and standard deviation of fund net return over past year. I also include time fixed effect in the regression and cluster the standard error on fund. The regression is as follow,

$$\begin{aligned}\alpha_{i,t+1}^{\text{Carhart}} = \alpha + \beta_1 \frac{\sum_{j=0}^{k} MTNA_{i,t-j} \times \alpha_{i,t-j}^{B}}{MTNA_{i,t}} \\ + \beta_2 \frac{\left(MTNA_{i,t} - MTNA_{i,t-k}\right) \times f}{MTNA_{i,t}} + Controls_{i,t} + \varepsilon_{i,t+1}\end{aligned} \tag{29}$$

, where $\alpha_{i,t+1}^{\text{Carhart}}$ is the Carhart alpha for fund *i* at quarter *t+1*, $\alpha_{i,t-j}^{B}$ is the fund benchmark adjusted net return for fund *i* at quarter *t-j*, $MTNA_{i,t}$ and $MTNA_{i,t-k}$ are the fund asset under management for fund *i* at quarter *t* and quarter *t-k*. Therefore, $\sum_{j=0}^{k} MTNA_{i,t-j} \times \alpha_{i,t-j}^{B}$ represents the value created by the fund manager and $\left(MTNA_{i,t} - MTNA_{i,t-k}\right) \times$

f represents the incremental dollar fee collected during past k quarters. I report the regression results in Table 3.

2.3.2. Predicting Fund Future Performance

Based on **Lemma 1** and equation (14), I can construct a fund performance predictor, skill-competition measure (SC measure), as follow,

$$\begin{aligned} \mathrm{SC_{i,t}} = \widehat{\beta_{1,t}} \frac{\sum_{j=0}^{k} MTNA_{i,t-j} \times \alpha_{i,t-j}^{B}}{MTNA_{i,t}} \\ + \widehat{\beta_{2,t}} \frac{\left(MTNA_{i,t} - MTNA_{i,t-k}\right) \times f}{MTNA_{i,t}} \end{aligned} \tag{30}$$

where, $\widehat{\beta_{1,t}}$ and $\widehat{\beta_{2,t}}$ are the coefficients estimated using regression (29) on past two-year observations of all mutual funds. This SC measure should be able to positively predict fund future performance.

I examine the predictability of SC measure using both portfolio and regression approach. I first construct decile portfolios based on SC measure at each quarter end and examine the long-short portfolio performance in the next quarter. Even though in reality we cannot short mutual funds, this trading strategy approach can still provide a straightforward indication of how well the SC measure predicts mutual fund performance. The results are reported in Table 4.

Next, I conduct the panel regression of future fund performance on SC measure, controlling for other factors that could potentially affect fund future performance. The controls includes fund age measured by the natural logarithm of age, fund size measured by the natural logarithm of asset under management at the quarter end before the measurement period for unit value-added and unit fee-added, lagged expense ratio, a load indicator that equals to 1 if any share class of the fund includes a front or rear load, fund flow at the quarter end before the measurement period, fund activeness by fund turnover rate, portfolio size by the number of stocks in the portfolio, and standard deviation of fund net return over past year. I also include time fixed effect in the regression and cluster the standard error on fund. The regression is as follow,

$$\alpha_{\mathrm{i,t}}^{\mathrm{Carhart}} = \alpha + \beta\, \mathrm{SC}_{\mathrm{i,t-1}} + Controls_{i,t-1} + \varepsilon_{i,t} \tag{31}$$

I measure $\mathrm{SC}_{\mathrm{i,t-1}}$ over past 24 months and report the results in Table 5.

2.3.3. Overconfidence vs. Over-extrapolation

Corollary 1 states that as investors become less overconfident, the coefficient for unit value-added decreases and the coefficient for unit fee-added increases. This implies that the coefficient for unit value-added is positively correlated with investor overconfidence and the coefficient for unit fee-added is negatively correlated with investor overconfidence. Similarly, **Corollary 2** implies that the coefficient for unit value-added is negatively correlated with investor over-extrapolation bias and the coefficient for unit fee-added is positively correlated with investor over-extrapolation bias. Therefore, the coefficients for fund value-added and fund fee-added should correlate with investor sentiments.

To test **Corollary 1** and **Corollary 2**, I use the aggregate market return as a the proxy for investor overconfidence. Barber and Odean (2002) finds that high past return can make investors become more overconfident and thus trade more aggressively.

Statman, Thorley, and Vorkink (2006) and Griffin, Nardari, and Stulz (2007) also identify strong positive relations between market returns and future trading activities. Therefore, I use market return over past two years as the proxy for investor overconfidence.

To test **Corollary 1**, I conduct the following regression.

$$
\begin{aligned}
\alpha^{\mathrm{B}}_{\mathrm{i,t+1}} = \alpha &+ \beta_1 \frac{\sum_{j=0}^{k} MTNA_{i,t-j} \times \alpha^{B}_{i,t-j}}{MTNA_{i,t}} \\
&+ \beta_2 \frac{\left(MTNA_{i,t} - MTNA_{i,t-k}\right) \times f}{MTNA_{i,t}} \\
&+ \lambda_1 \frac{\sum_{j=0}^{k} MTNA_{i,t-j} \times \alpha^{B}_{i,t-j}}{MTNA_{i,t}} \times MKT_t \\
&+ \lambda_2 \frac{\left(MTNA_{i,t} - MTNA_{i,t-k}\right) \times f}{MTNA_{i,t}} \times MKT_t + \ Controls_{i,t} \\
&+ \varepsilon_{i,t+1}
\end{aligned} \tag{32}
$$

where $Sent_t$s the proxy for investor sentiment at time t.

Corollary 1 predicts a positive λ_1 and a negative λ_2 respectively if the proxies represent investor overconfidence. The controls includes fund age measured by the natural logarithm of age, fund size measured by the natural logarithm of asset under management at the quarter end before the measurement period for unit value-added and unit fee-added, lagged expense ratio, a load indicator that equals to 1 if any share class of the fund includes a front or rear load, fund flow at the quarter end before the measurement period, fund activeness by fund turnover rate, portfolio size by the number of stocks in the portfolio, and standard deviation of fund net return over past year. I also include fund fixed effect in the regression and cluster the standard error on time.

III. Results

3.1. Testing the Model

To test the predictability of unit value-added and unit fee-added, I first double sort funds into 25 portfolios based on fund unit value-added and fund unit fee-added measured over past two years. Then I examine the future performance of these 25 portfolios. The results are reported in Table 2, Panel A reports results using CAPM alpha as the past performance measure when constructing fund unit value-added, Panel B reports results using peer-adjusted net return as the past performance measure when constructing fund unit value-added.

From Panel A, we can see that quarterly Carhart alpha increases with the increase of past unit-added within each unit fee-added quintile. Top quintile mutual funds can generate 0.36% to 0.91% (equal-weighted) and 0.43% to 1.27% (value-weighted) higher Carhart alpha every quarter than bottom quintile funds. In addition, quarterly Carhart alpha decreases with the increase of fund fee-added within each fund value-added quintile except for the lowest fund value-added quintile. Top quintile mutual funds underperform bottom quintile funds by 0.07% to 0.23% (equal-weighted) and 0.18% to 0.50% every quarter. However, among funds with the lowest value-added, fund future performance increases with the increase of unit fee-added. The results using peer-adjusted net return as the performance measure to construct fund value-added (Panel B) are similar to the results in Panel A.

These results are mostly consistent with **Proposition 2** and **Proposition 4**, which states that when investors are only overconfident about their private information or they are more overconfident about their private information than they over-extrapolate fund past return, fund value-added positively predict fund future performance and fund fee-added negatively predict fund future performance. The return pattern is quite different for funds with the lowest value-added. A potential explanation is liquidity problem. Funds with the lowest value-added are usually the ones experience large outflow, which could create severe liquidity problem for the fund. If the managers have to fire sell assets to meet the liquidity needs, then fund future performance will further deteriorate with excess outflow. In this way, fund with the highest outflow will have the lowest return among funds with the lowest past performance.

Next, I conduct regression of fund future performance on fund unit value-added and fund unit fee-added measured over past two years. The results are reported in Table 3. Column (1), (2), and (3) reports the results for unit value-added constructed using CAPM alpha as the past performance measure and Column (4), (5), and (6) reports the results for unit value-added constructed using peer-adjusted net return as the past performance measure. The results are largely consistent with **Proposition 2** and **Proposition 4**. Fund unit value-added significantly positively predicts fund future performance and fund unit fee-added significantly negatively predicts fund future performance. A one standard deviation increase in unit value-added constructed using CAPM alpha (peer-adjusted net return) as the past performance measure will lead to a 0.15% (0.13%) increase in fund Carhart alpha in the next quarter and a one standard deviation increase in fund unit fee-added will lead to a 0.03% (0.03%) decrease in fund Carhart alpha in the next quarter. Including fund characteristics and style fixed effects as controls reduce by do not eliminate the predicting power of fund unit value-added and unit fee-added. In the robustness tests, I also examine unit value-added and unit fee-added measured over different periods. The results are reported in Table 8, column (1) – column (6). The results show that the predicting powers of unit value-added and unit fee-added are not sensitive to the length of the measurement period.

These results are both complementary to and different from the results in previous studies about fund performance persistence and smart money effect. The unit value-added in my model is analogous to the fund performance and the unit fee-added is analogous to the dollar flow examined in previous studies. On the one hand, my results confirm the existence of funds with persistent performance and the predictive ability of fund past dollar flow (hence the smart money effect). On the other hand, these results also suggest that the predictive power of fund past performance and fund past dollar flow were not correctly specified in previous studies. As both fund past performance and fund past dollar flow are critical in determining fund future performance, the predictive ability of one factor, when used as the predictor for fund future performance alone, will be significantly tempered by the other factor. For example, if fund past performance were used to predict fund future performance alone, a high past performance can imply both high manager skill and investor overreaction to a piece of positive information. A Similar argument can also be applied to the scenario of predicting fund future performance with fund past dollar flow alone.

In the model, I assume that investors are overconfident about their private information. Instead of private information about individual funds, it could also be the private information about different investment styles or active mutual fund industry as a whole. Therefore, I aggregate funds and examine the predicting power of unit value-add and unit fee-added at the investment style level and at the industry level respectively. The results are reported in Table 4. We can see that the predictive powers of unit fee-valued and unit fee-added are largely eliminated when funds are aggregated by investment style or by the entire industry. This suggests that investors do not over-extrapolate the return of a certain style or the return of the actively managed mutual fund industry. In addition, investors are not overconfident about the information about investment style and the actively managed mutual fund industry. Or investors simply do not have private information about investment style or actively managed mutual fund industry.

In the robustness tests, I further divide the sample into two sub-periods at the year 2003 and conduct regression (29) using observations in these two sub-periods respectively. The results are reported in Table 8, Column (7) - (10). We can see that the results are much stronger for more recent observations.

3.2. Predicting Fund Future Performance

Next, I examine the predictability of SC measure constructed based on my model. I first estimate the coefficients for fund unit value-added and fund unit fee-added using past 24 months observations of all mutual funds and then construct $SC_{i,t}$measure with estimated coefficients and realized unit value-added and unit fee-added this quarter. The SC measure is constructed with a measurement period of two years using CAPM alpha as the performance measure and peer-adjusted net return as the performance measure respectively. Finally, I construct decile portfolios based on SC measure at each quarter end and examine equal-weighted and value-weighted portfolio performance in the next quarter. The results are reported in Table 5.

The results in Table 5 shows that the fund performance increases with the increase of SC measure. The equal-weighted long-short portfolio constructed based on SC measure using CAPM alpha as the past performance measure can generate a marginal significant 0.48% Carhart alpha in the next quarter. However, the long-short portfolio alpha mostly comes from the underperformance of low SC measure funds and Decile 1 portfolio experience significantly negative performance (-0.69%) in the next quarter. I further sort the observations in the top decile and bottom decile portfolio into three groups based on SC measure. Portfolio 1-A (1-C) contain the observations that have the lowest (highest) SC measure in the bottom decile portfolio and portfolio 10-A (10-C) contain the observations that has the lowest (highest) SC measure in the top decile portfolio. The strategy of long the extreme high SC measure funds and short the extreme low SC measure can generate a much stronger performance: 1.12% Carhart alpha for equal-weighted strategy and 0.94% Carhart alpha for value-weighted strategy. The results using peer-adjusted net return as the performance measure when constructing SC measure are much weaker.

I also examine the cumulative 6-month, 12-month, 24-month and 60-month performance of the decile portfolios and the long-short strategies based on SC measure. The results are reported in Table 5. Figure 1 summarizes the cumulative returns of equal-weighted and value-weighted long-short strategies over different periods. We can see that the cumulative Carhart alpha of the long-short strategy that longs the top decile portfolio and shorts the bottom decile portfolio increases at first and then decreases as time goes on, which suggests that the irrational flows are gradually get corrected over time. This reverse pattern is more obvious for the strategy that longs the extreme high SC measure funds and short extreme low SC measure funds. It is surprising to see that when SC measure is constructed using peer-adjusted net return, the long-short strategy can actually generate a significant negative return after five years, suggesting an over-correction in the long-run.

Next, I conduct panel regression (31), which tests the predictability of SC measure controlling for other fund characteristics. The results are reported in Table 6. Column (1) – column (3) reports the results using CAPM alpha as the performance measure, Panel B reports the results using peer-adjusted net return as the performance measure when constructing the SC measure. The results show that SC measure can significantly positively predict fund future performance. A 1% increase in SC measure using CAPM alpha (peer-adjusted net return) as the past performance measure over past two years will increase fund Carhart alpha by 0.26% (0.14%) in the next quarter. The results using SC measure constructed over past one year is weaker compared to the ones using SC measure constructed over longer periods.

Overall, the results in Table 5 and Table 6 are consistent with the **Proposition 2-Proposition 4**, which states that SC measure can positively predict fund future performance when investors are overconfident about their private information and over-extrapolate fund past performance.

3.3. Investor Overconfidence vs. Over-extrapolation Bias

Next, I test **Corollary 1** and **Corollary 2** by examining the correlation between the coefficient of fund unit value-added and investor sentiment, and the correlation between the coefficient of fund unit fee-added and investor sentiment. According to **Corollary 1**, when investors become more overconfident, they will overestimate the precision of their private signal more. In this way, the coefficient for fund unit value-added will become larger (more positive) and the coefficient for fund unit fee-added will become smaller (more negative) as the overconfidence increases. On the other hand, according to **Corollary 2**, when investors over-extrapolate fund past performance more, they will overreact more to the information contained in fund past performance. Then, the coefficient for fund unit value-added will become smaller (more negative) and the coefficient for fund unit fee-added will become larger (more positive). Therefore, using different proxies for investor sentiment, I would expect to see a positive (negative) coefficient for the interaction between fund unit value-added and investor sentiment and a negative (positive) coefficient for the interaction between fund unit fee-added and investor sentiment in regression (32), if the investor sentiment measure proxies for investor overconfidence (investor over-extrapolation bias).

The results are reported in Table 9. Fund unit value-added and unit fee-added are constructed using CAPM alpha and the measurement period is two years. Column (1) to

(4) report the results using the Investor Sentiment Index as the investor sentiment proxy and Column (5) to (8) reports the results using aggregate market return over past two years as the investor sentiment proxy. The results show that the predictive power of fund unit value-added significantly positively comove with investor sentiment proxies and the predictive power of fund unit fee-added significantly negatively comove with investor sentiment proxies. These results prove that the predictive ability of unit value-added and unit fee-added are correlated with investor sentiment. In addition, these results also suggest that the Investor Sentiment Index and the aggregate market return are more likely to be correlated with investor overconfidence than with investor over-extrapolation bias. In future studies, I will use survey data (Greenwood and Shleifer, 2014) or the DOX measure developed in Cassella and Gulen (2018) as the proxy for investor over-extrapolation bias.

IV. Conclusion

In this study, I examine how investor overconfidence and over-extrapolation bias affects mutual fund flow and future performance. I first develop a model in which investors are overconfident about their private information and over-extrapolation fund past performance. The model shows that when investors are irrational, mutual fund flows can no longer eliminate fund outperformance effectively. Instead, fund future performance can be predicted by a variable that combines past fund performance, measured by fund unit value-added and fund flow activities, measured by fund unit fee-added.

I test the model implications with a sample of U.S. actively managed mutual fund data. I find that controlling for fund flow activities using fund unit fee-added, fund past performance, measured by unit value-added can positively predict fund future performance. In addition, controlling for fund past performance, fund flow activities can negatively predict fund future performance. The predictive power of fund unit value-added and fund fee-added covary significantly with investor overconfidence. I also construct a SC measure based on fund past performance and fund flow activities and tests the predictability of this SC measure. The equal-weighted long-short strategies based on the SC measure can generate a significant positive Carhart alpha of 1.12% every quarter. However, the performance of the long-short strategies mainly comes from the short side portfolios. To control for other factors that could potentially affect fund performance, I also conduct panel regressions of fund future performance on the SC measure. A 1% increase in SC measure using CAPM alpha as the past performance measure over past two years will increase fund Carhart alpha by 0.26% in the next quarter.

Overall, the evidence above is consistent with the hypothesis that investor overconfidence and over-extrapolation bias affects the allocation of capital among managers and equilibrium performance in the mutual fund industry. When investors supply capital inefficiently due to investor irrationality, fund performance is no longer unpredictable as stated in Berk and Green (2004). Moreover, investor overconfidence plays a dominant role in investors' investment decision and fund future performance can be positively predicted by fund unit value-added negatively predicted by fund unit fee-added.

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Panel A: Fund Characteristics	N	Mean	STD	P25	Median	P75
MTNA	375254	1822.47	6468.76	110.50	359.10	1217.40
Total Flow	375250	-0.44%	10.99%	-1.65%	-0.61%	0.51%
Age	375240	201.65	166.15	94.00	154.00	247.00
Load	375254	0.59	0.49	0	1	1
Expense Ratio	368836	1.41%	4.09%	0.93%	1.15%	1.40%
Turnover Ratio	108518	84.47%	223.82%	30.00%	57.00%	97.00%
Raw Return	375252	0.85%	5.08%	-1.69%	1.23%	3.75%
Net Return	375248	0.74%	5.07%	-1.79%	1.12%	3.63%
PA Net Return	375248	0.00%	2.55%	-1.06%	-0.01%	1.05%
CAPM Alpha	375248	-0.08%	2.57%	-1.13%	-0.10%	0.91%
Carhart Alpha	375248	-0.10%	2.22%	-0.97%	-0.10%	0.75%
MKTRF Loading	375254	0.9868	0.2245	0.8973	0.9926	1.0800
SMB Loading	375254	0.2094	0.3869	-0.0806	0.1075	0.4818
HML Loading	375254	-0.0040	0.3771	-0.2083	0.0064	0.2107
UMD loading	375254	0.0175	0.2187	-0.0754	0.0058	0.1009

Panel B: Performance Correlation	Raw Return	Net Return	Peer-adjusted Net Return	CAPM Alpha	Carhart Alpha
Raw Return	1	0.9981	0.5019	0.4577	0.3437
Net Return	0.9981	1	0.5029	0.4587	0.3445
Peer-adjusted Net Return	0.5019	0.5029	1	0.8254	0.6081
CAPM Alpha	0.4577	0.4587	0.8254	1	0.6778
Carhart Alpha	0.3437	0.3445	0.6081	0.6778	1

Table 1: Descriptive statistics for the mutual fund sample obtained from the CRSP Survivor-Bias Free U.S. Mutual Fund Database. Panel A reports the fund characteristics statistics across fund-month observations. The sample includes all U.S. equity mutual funds that existed at any time during January 1990 to December 2017. I exclude sector funds, international funds, specialized funds, bond funds, balanced funds, and index funds. I also remove observations with monthly asset under management less than $5 million. The final sample consists of 3809 fund-entities comprising 375,254 fund-months observations. MTNA is the monthly total net asset under management in million. Total Flow is calculated as $\frac{\mathrm{MTNA_t} - MTNA_{t-1}(1+r_t) - MGTNA_t}{MTNA_{t-1}}$, where $MGTNA_t$ is the increase in fund's TNA due to mergers during month t. Dollar flow represents $\mathrm{MTNA_t} - MTNA_{t-1}$. Age is the number of months the fund exists after the first offering date. Load equals to one if any share class of the fund contains a front-end or rear-end load. Turnover is the minimum of aggregate purchases or sales of securities during the year, divided by the average MTNA. Peer-adjusted net return is measured as the difference between the net

return of each mutual fund by the average net return of all mutual funds that target the same benchmark index. The benchmark index are obtained from Prof. Cremer's website (https://activeshare.nd.edu/). Loadings of CAPM Model and Carhart Four Factor Model are estimated using previous 24 months observations. I calculate monthly Carhart (CAPM) alpha by subtracting monthly net return by risk free rate and estimated loadings time realized factor returns respectively each month. Panel B reports the correlation among different performance measure.

Panel A:		Fund Unit Fee-added											
		Equal-weighted						Value-weighted					
		1	2	3	4	5	5-1	1	2	3	4	5	5-1
Fund Unit Value-added	1	-1.04%	-0.65%	-0.50%	-0.67%	-0.56%	0.47%	-1.28%	-0.65%	-0.64%	-0.74%	-0.44%	0.83%
		(-3.86)	(-3.29)	(-2.95)	(-3.94)	(-3.17)	(1.87)*	(-4.29)	(-3.16)	(-3.32)	(-4.29)	(-2.15)	(2.80)***
	2	-0.23%	-0.26%	-0.34%	-0.41%	-0.50%	-0.23%	-0.24%	-0.31%	-0.34%	-0.48%	-0.43%	-0.18%
		(-1.79)	(-2.61)	(-3.36)	(-3.27)	(-4.12)	(-1.91)*	(-1.67)	(-2.79)	(-2.79)	(-3.31)	(-3.11)	(-1.12)
	3	-0.31%	-0.31%	-0.29%	-0.28%	-0.43%	-0.12%	-0.21%	-0.24%	-0.10%	-0.17%	-0.43%	-0.22%
		(-2.63)	(-3.44)	(-2.55)	(-3.23)	(-3.38)	(-0.92)	(-1.56)	(-2.39)	(-0.76)	(-1.36)	(-2.89)	(-1.27)
	4	-0.25%	-0.23%	-0.20%	-0.29%	-0.34%	-0.09%	-0.29%	-0.21%	-0.12%	-0.41%	-0.49%	-0.19%
		(-1.53)	(-2.08)	(-1.55)	(-2.15)	(-2.67)	(-0.82)	(-1.63)	(-1.61)	(-0.83)	(-2.62)	(-2.65)	(-1.17)
	5	-0.13%	-0.08%	0.02%	-0.14%	-0.20%	-0.07%	-0.01%	-0.27%	-0.05%	-0.27%	-0.51%	-0.50%
		(-0.66)	(-0.44)	(0.10)	(-0.65)	(-0.80)	(-0.40)	(-0.02)	(-1.30)	(-0.25)	(-1.02)	(-1.73)	(-2.31)***
	5-1	0.91%	0.62%	0.51%	0.53%	0.36%		1.27%	0.43%	0.57%	0.48%	-0.06%	
		(3.12)***	(2.75)***	(2.39)***	(2.31)**	(1.26)		(3.77)***	(1.59)	(2.36)***	(1.76)*	(-0.17)	

Panel B:		Fund Unit Fee-added											
		Equal-weighted						Value-weighted					
		1	2	3	4	5	5-1	1	2	3	4	5	5-1
Fund Unit Value-added	1	-0.97%	-0.69%	-0.55%	-0.51%	-0.53%	0.44%	-1.15%	-0.62%	-0.62%	-0.49%	-0.33%	0.81%
		(-3.94)	(-3.36)	(-3.11)	(-3.28)	(-3.44)	(1.94)*	(-4.26)	(-3.05)	(-3.57)	(-3.36)	(-2.12)	(2.74)***
	2	-0.25%	-0.38%	-0.43%	-0.31%	-0.35%	-0.08%	-0.31%	-0.34%	-0.29%	-0.40%	-0.28%	0.06%
		(-1.61)	(-3.99)	(-4.14)	(-2.62)	(-2.69)	(-0.55)	(-2.04)	(-3.12)	(-2.44)	(-2.61)	(-1.83)	(0.34)
	3	-0.15%	-0.33%	-0.22%	-0.30%	-0.37%	-0.16%	-0.11%	-0.28%	-0.13%	-0.22%	-0.36%	-0.19%
		(-1.26)	(-3.53)	(-2.01)	(-3.34)	(-2.95)	(-1.58)	(-0.90)	(-2.60)	(-1.10)	(-2.06)	(-2.40)	(-1.34)
	4	-0.29%	-0.24%	-0.25%	-0.27%	-0.40%	-0.11%	-0.27%	-0.32%	-0.26%	-0.30%	-0.49%	-0.22%
		(-2.14)	(-2.02)	(-1.77)	(-2.10)	(-3.18)	(-1.09)	(-1.62)	(-2.29)	(-1.71)	(-1.96)	(-3.00)	(-1.18)
	5	-0.17%	-0.03%	-0.15%	-0.16%	-0.33%	-0.15%	0.08%	0.01%	-0.20%	-0.36%	-0.72%	-0.79%
		(-0.94)	(-0.18)	(-0.75)	(-0.71)	(-1.26)	(-0.86)	(0.32)	(0.04)	(-0.96)	(-1.44)	(-2.41)	(-3.60)***
	5-1	0.79%	0.70%	0.37%	0.37%	0.20%		1.23%	0.67%	0.38%	0.15%	-0.38%	
		(2.81)***	(2.80)***	(1.69)*	(1.54)	(0.71)		(3.63)***	(2.84)***	(1.55)	(0.60)	(-1.15)	

Table 2: Quarterly performance of portfolios double sorted on fund unit value-added and fund unit fee-added. Funds are double sorted by fund unit value-added and fund unit fee-added. Fund unit value-added and unit fee-added are measured over the past two years. Panel A reports the results using CAPM alpha as the performance measure when constructing unit value-added. Panel B reports the results using peer-adjusted net return as the performance measure when constructing unit value-added. The table shows the quarterly Carhart alpha of equal-weighted and value-weighted quintile portfolios, followed by t-statistics in brackets based on White's standard errors. *, **, and *** denote significance at the 10%, 5%, and 1% level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Unit Value add$_{t-1}$	0.0015	0.0016	0.0015	0.0013	0.0009	0.0008
	(9.14)***	(6.55)***	(6.54)***	(7.19)***	(3.70)***	(3.48)***
Unit Fee add$_{t-1}$	-0.0003	-0.0002	-0.0002	-0.0003	-0.0002	-0.0001
	(-3.39)***	(-2.85)***	(-2.71)***	(-3.49)***	(-2.01)**	(-1.74)*
Expense Ratio$_{t-1}$		-0.0002	-0.0002		-0.0002	-0.0002
		(-2.48)***	(-3.09)***		(-3.27)***	(-3.89)***
Flow$_{t-1}$		-0.0003	-0.0003		-0.0003	-0.0003
		(-2.05)**	(-2.02)**		(-2.00)**	(-1.99)**
Number of Stocks$_{t-1}$		0.0002	0.0000		0.0002	0.0000
		(1.46)	(0.05)		(1.56)	(0.39)
STD_{t-1}		-0.0010	-0.0012		-0.0010	-0.0012
		(-6.57)***	(-8.07)***		(-6.09)***	(-7.56)***
$Turnover_{t-1}$		-0.0007	-0.0008		-0.0006	-0.0007
		(-4.13)***	(-4.63)***		(-3.94)***	(-4.52)***
$Load_{t-1}$		-0.0001	-0.0005		-0.0004	-0.0005
		(-2.74)***	(-3.37)***		(-2.81)***	(-3.35)***
$\log(Age_{t-1})$		-0.0001	0.0000		-0.0001	0.0000
		(-0.38)	(0.00)		(-0.69)	(-0.34)
$\log(MTNA_{t-1})$		-0.0001	-0.0001		0.0000	0.0000
		(-0.71)	(-0.51)		(-0.44)	(-0.33)
Performance Measure	CAPM Alpha	CAPM Alpha	CAPM Alpha	PA Net Return	PA Net Return	PA Net Return
Style Fixed Effect	No	No	Yes	No	No	Yes

Table 3: Panel regression results of fund future performance on fund unit value-added and fund unit fee-added. This table reports the results of regression (29). The dependent variable is fund Carhart alpha in the next quarter. $\mathrm{Unit\ Value\ add}_{t-1}$ is fund value-added over the past two years scaled by fund size at *t-1*. $\mathrm{Unit\ Fee\ add}_{i,t-1}$ is the fund incremental dollar fee over the past two years scaled by fund size at *t-1*. Turnover and expense ratio are annualized values. $\mathrm{Flow}_{i,t-1}$ is the fund percentage flow over past year. $\mathrm{Number\ of\ stocks}_{i,t-1}$ is the number of stocks in the fund's portfolio in quarter *t-1.* $\mathrm{STD}_{i,t-1}$ is the standard deviation of fund's net return over past one year. Load equals to one if any share class of the fund contains a front-end or rear-end load. Fund age is measured in months. $\log(MTNA_{i,t-1})$ is the log of fund size at the last quarter end before the measurement period. I include time fixed effect and cluster the standard error on funds. *, **, and *** denote significance at the 10%, 5%, and 1% level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Unit Value add$_{t-1}$	0.0053	-0.0158	-0.0145	-0.0485	0.0012	-0.0816	0.1415	0.0391
	(0.19)	(-0.63)	(-0.26)	(-0.73)	(0.01)	(-0.80)	(1.47)	(0.28)
Unit Fee add$_{t-1}$	-0.0862	-0.0969	-0.0431	-0.0565	-0.1406	0.0736	0.0002	-0.0856
	(-1.76)	(-2.16)	(-1.31)	(-1.36)	(-1.24)	(0.49)	(0.00)	(-0.59)
Expense Ratio$_{t-1}$		-0.0909		-0.0274		-0.3149		0.2053
		(-5.21)		(-1.51)		(-1.98)		(1.43)
Flow$_{t-1}$		-0.0506		-0.0738		0.0402		0.2582
		(-1.87)		(-1.94)		(0.24)		(1.42)
Number of Stocks$_{t-1}$		-0.0454		-0.0219		-0.1161		-0.0953
		(-0.85)		(-0.48)		(-0.82)		(-0.50)
STD_{t-1}		0.0301		-0.0842		0.1738		-0.2786
		(1.24)		(-2.51)		(1.27)		(-1.83)
$Turnover_{t-1}$		-0.0362		-0.0403		0.1009		0.0452
		(-1.31)		(-0.87)		(0.54)		(0.20)
$Load_{t-1}$		-0.0020		0.0197		-0.3323		0.0527
		(-0.05)		(0.74)		(-1.08)		(0.14)
$\log(Age_{t-1})$		-0.0942		-0.0514		0.5912		0.1696
		(-2.14)		(-1.24)		(2.59)		(0.56)
$\log(MTNA_{t-1})$		-0.0144		-0.0762		-0.1746		-0.0246
		(-0.43)		(-1.66)		(-1.13)		(-0.16)
Performance Measure	CAPM Alpha	CAPM Alpha	PA Net Return	PA Net Return	CAPM Alpha	CAPM Alpha	PA Net Return	PA Net Return

Table 4: Regression results for funds aggregated by investment style and industry. The dependent variable is the value-weighted Carhart alpha in the next quarter for different investment styles in Column (1) to Column (4). The dependent variable in Column (5) to Column (8) is the value-weighted Carhart alpha in the next quarter for the entire actively managed equity mutual fund industry. The unit value-added and unit fee-added are measured over past two years. The control variables are all aggregate on investment style level or industry level weighted by fund size except for size, $\log(MTNA_{i,t-1})$. Size is calculated as the natural log of the sum of asset under management of all funds within the investment style or within the fund industry. I include time fixed effect for regressions using funds aggregated by investment style and cluster the standard error on investment style. I cluster the standard error on time for regressions using funds aggregated by the industry. *, **, and *** denote significance at the 10%, 5%, and 1% level respectively.

	Equal Weighted					Value Weighted				
Panel A:	**3m**	**6m**	**12m**	**24m**	**60m**	**3m**	**6m**	**12m**	**24m**	**60m**
1-A	-1.29%	-2.28%	-4.51%	-5.89%	-5.49%	-0.96%	-1.79%	-3.86%	-5.54%	-6.14%
	(-3.34)	(-3.81)	(-6.15)	(-5.17)	(-4.00)	(-2.55)	(-2.88)	(-5.02)	(-4.90)	(-4.34)
1-B	-0.65%	-1.18%	-2.22%	-3.34%	-5.21%	-0.85%	-1.44%	-2.52%	-4.05%	-7.74%
	(-3.07)	(-3.63)	(-5.03)	(-4.64)	(-5.04)	(-3.40)	(-4.09)	(-6.08)	(-5.37)	(-6.80)
1-C	-0.25%	-0.70%	-1.26%	-2.48%	-4.85%	-0.27%	-0.61%	-0.79%	-2.03%	-5.93%
	(-1.48)	(-2.68)	(-3.43)	(-4.05)	(-5.82)	(-2.86)	(-3.22)	(-5.32)	(-7.21)	(-5.52)
1	-0.69%	-1.35%	-2.63%	-3.93%	-5.16%	-0.63%	-1.20%	-2.18%	-3.80%	-7.09%
	(-3.09)	(-4.09)	(-6.39)	(-5.90)	(-5.42)	(-2.92)	(-3.86)	(-5.65)	(-6.58)	(-8.96)
2	-0.50%	-0.81%	-1.45%	-2.27%	-4.93%	-0.42%	-0.74%	-1.53%	-2.58%	-5.85%
	(-3.56)	(-4.55)	(-5.50)	(-5.41)	(-7.16)	(-2.70)	(-3.77)	(-5.03)	(-5.88)	(-7.66)
3	-0.22%	-0.50%	-1.11%	-2.28%	-4.35%	-0.27%	-0.51%	-1.15%	-2.19%	-4.68%
	(-2.06)	(-3.37)	(-4.88)	(-6.90)	(-8.00)	(-2.14)	(-3.02)	(-4.82)	(-6.57)	(-7.75)
4	-0.36%	-0.63%	-1.09%	-2.11%	-3.84%	-0.42%	-0.74%	-1.43%	-2.57%	-5.11%
	(-3.62)	(-4.71)	(-5.52)	(-6.87)	(-8.51)	(-3.58)	(-3.78)	(-4.82)	(-5.79)	(-8.02)
5	-0.31%	-0.58%	-1.16%	-2.50%	-4.60%	-0.27%	-0.58%	-1.09%	-2.49%	-4.85%
	(-3.08)	(-4.28)	(-6.43)	(-9.65)	(-11.33)	(-2.77)	(-4.11)	(-5.92)	(-9.61)	(-13.10)
6	-0.29%	-0.55%	-1.23%	-2.42%	-4.64%	-0.10%	-0.34%	-0.88%	-1.99%	-4.43%
	(-3.07)	(-4.11)	(-6.81)	(-10.48)	(-14.93)	(-0.86)	(-2.15)	(-3.88)	(-6.55)	(-10.56)
7	-0.32%	-0.55%	-1.21%	-2.35%	-4.46%	-0.28%	-0.34%	-0.79%	-1.87%	-4.22%
	(-2.94)	(-3.73)	(-7.58)	(-12.60)	(-15.15)	(-2.53)	(-2.29)	(-3.97)	(-8.51)	(-11.91)
8	-0.35%	-0.69%	-1.37%	-2.54%	-4.55%	-0.24%	-0.58%	-1.22%	-2.32%	-4.52%
	(-2.84)	(-4.29)	(-7.18)	(-10.54)	(-15.99)	(-1.80)	(-3.27)	(-5.55)	(-8.10)	(-9.38)
9	-0.29%	-0.56%	-1.00%	-2.24%	-4.20%	-0.41%	-0.80%	-1.26%	-2.39%	-4.44%
	(-2.07)	(-3.06)	(-4.83)	(-8.64)	(-11.00)	(-2.41)	(-3.45)	(-4.92)	(-7.36)	(-9.31)
10	-0.21%	-0.43%	-1.15%	-1.70%	-4.06%	-0.33%	-0.77%	-1.62%	-2.47%	-5.03%
	(-0.94)	(-1.35)	(-3.59)	(-4.34)	(-7.27)	(-1.19)	(-2.21)	(-4.65)	(-4.97)	(-6.43)

10-A	-0.22%	-0.41%	-1.07%	-2.12%	-3.36%	-0.43%	-0.79%	-1.35%	-2.47%	-4.07%
	(-1.06)	(-1.64)	(-4.30)	(-5.48)	(-5.17)	(-1.75)	(-2.91)	(-3.75)	(-4.64)	(-4.55)
10-B	-0.22%	-0.34%	-1.00%	-1.53%	-3.97%	-0.30%	-0.72%	-1.70%	-2.28%	-4.93%
	(-1.02)	(-1.32)	(-3.55)	(-3.73)	(-6.83)	(-1.11)	(-2.07)	(-4.62)	(-3.88)	(-5.12)
10-C	-0.22%	-0.57%	-1.33%	-1.56%	-4.44%	-0.08%	-0.40%	-1.17%	-1.57%	-6.20%
	(-0.71)	(-1.07)	(-2.43)	(-2.49)	(-4.17)	(-0.20)	(-0.65)	(-1.83)	(-1.93)	(-3.93)
10 – 1	0.48%	0.93%	1.51%	2.23%	1.10%	0.31%	0.42%	0.58%	1.33%	2.07%
	(1.74)*	(2.12)*	(2.96)***	(2.88)***	(1.00)	(0.95)	(0.97)	(1.06)	(1.64)	(1.91)*
10C – 1A	1.12%	1.77%	3.21%	4.33%	1.05%	0.94%	1.43%	2.74%	3.98%	-0.06%
	(2.39)***	(2.15)**	(3.42)***	(3.38)***	(0.61)	(1.71)*	(1.56)	(2.46)***	(2.61)***	(-0.03)

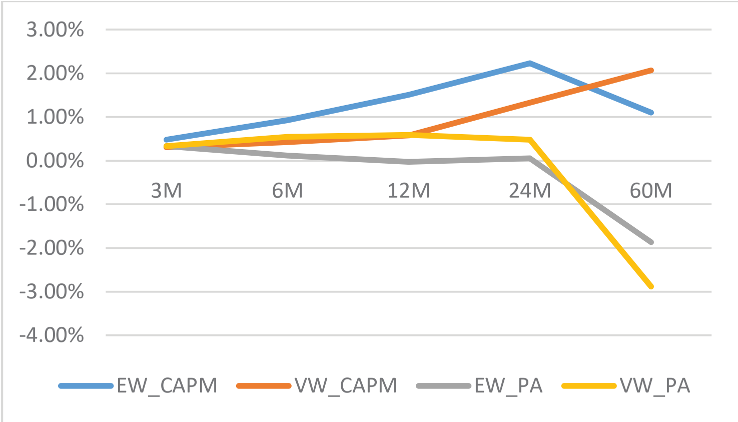
	Equal Weighted					Value Weighted				
Panel B:	**3m**	**6m**	**12m**	**24m**	**60m**	**3m**	**6m**	**12m**	**24m**	**60m**
1-A	-1.20%	-2.12%	-3.91%	-4.58%	-2.84%	-0.98%	-1.71%	-3.50%	-4.18%	-2.13%
	(-2.88)	(-3.17)	(-4.62)	(-3.74)	(-1.86)	(-2.74)	(-2.73)	(-4.28)	(-3.57)	(-1.31)
1-B	-0.40%	-0.68%	-1.58%	-2.58%	-3.69%	-0.41%	-0.87%	-1.91%	-3.38%	-5.95%
	(-1.97)	(-2.41)	(-4.51)	(-4.26)	(-4.09)	(-2.02)	(-2.82)	(-4.99)	(-5.24)	(-6.31)
1-C	-0.48%	-0.87%	-1.50%	-2.46%	-3.98%	-0.54%	-0.93%	-1.43%	-2.26%	-5.32%
	(-3.15)	(-3.63)	(-4.71)	(-5.01)	(-5.18)	(-3.12)	(-2.93)	(-3.03)	(-3.43)	(-5.60)
1	-0.67%	-1.01%	-1.99%	-3.06%	-4.99%	-0.52%	-1.20%	-2.33%	-3.25%	-3.44%
	(-3.04)	(-3.51)	(-5.19)	(-5.37)	(-6.33)	(-2.73)	(-3.73)	(-6.07)	(-5.33)	(-4.00)
2	-0.35%	-0.58%	-1.21%	-2.10%	-5.20%	-0.24%	-0.73%	-1.31%	-2.22%	-4.16%
	(-3.03)	(-3.80)	(-4.88)	(-5.23)	(-8.24)	(-2.18)	(-4.77)	(-5.84)	(-5.28)	(-6.23)
3	-0.27%	-0.77%	-1.31%	-2.47%	-5.65%	-0.44%	-0.58%	-1.18%	-2.51%	-4.57%
	(-2.57)	(-5.22)	(-5.18)	(-6.58)	(-9.79)	(-3.83)	(-3.93)	(-4.84)	(-6.76)	(-7.95)
4	-0.33%	-0.35%	-0.77%	-1.77%	-3.82%	-0.22%	-0.61%	-1.03%	-2.20%	-3.98%
	(-3.50)	(-2.35)	(-3.11)	(-4.75)	(-6.77)	(-2.10)	(-5.43)	(-5.89)	(-8.22)	(-9.51)
5	-0.31%	-0.70%	-1.19%	-2.23%	-4.97%	-0.34%	-0.60%	-1.19%	-2.15%	-4.22%
	(-3.02)	(-4.07)	(-4.91)	(-6.92)	(-8.94)	(-2.89)	(-4.48)	(-6.44)	(-8.67)	(-10.81)
6	-0.28%	-0.25%	-0.65%	-1.82%	-3.71%	-0.14%	-0.49%	-1.12%	-2.11%	-4.39%
	(-2.58)	(-2.00)	(-4.22)	(-8.95)	(-11.61)	(-1.29)	(-3.67)	(-6.99)	(-8.66)	(-12.07)
7	-0.36%	-0.62%	-1.08%	-2.19%	-4.73%	-0.32%	-0.61%	-1.14%	-2.36%	-4.38%
	(-3.04)	(-3.43)	(-4.34)	(-6.80)	(-10.66)	(-2.52)	(-4.12)	(-6.52)	(-10.11)	(-14.13)
8	-0.32%	-0.74%	-1.42%	-2.40%	-5.01%	-0.43%	-0.62%	-1.23%	-2.30%	-4.74%
	(-2.60)	(-3.50)	(-6.18)	(-7.93)	(-9.89)	(-3.19)	(-3.80)	(-6.41)	(-10.11)	(-13.78)
9	-0.29%	-0.50%	-1.02%	-2.16%	-3.88%	-0.22%	-0.54%	-1.10%	-2.33%	-4.59%
	(-1.84)	(-2.26)	(-4.27)	(-6.33)	(-6.43)	(-1.45)	(-2.45)	(-4.73)	(-8.37)	(-10.83)
10	-0.34%	-0.89%	-2.01%	-3.01%	-6.86%	-0.45%	-0.65%	-1.74%	-2.77%	-6.33%

	(-1.53)	(-2.57)	(-5.62)	(-6.42)	(-9.04)	(-1.68)	(-2.03)	(-5.08)	(-7.01)	(-12.15)
10-A	-0.23%	-0.32%	-1.16%	-2.56%	-5.34%	-0.46%	-0.66%	-1.54%	-2.75%	-6.36%
	(-1.02)	(-1.02)	(-3.94)	(-6.40)	(-8.64)	(-1.78)	(-2.30)	(-4.26)	(-5.49)	(-7.46)
10-B	-0.42%	-0.68%	-1.68%	-2.79%	-5.84%	-0.49%	-0.97%	-2.17%	-3.11%	-6.13%
	(-2.01)	(-2.50)	(-5.20)	(-5.38)	(-8.29)	(-1.85)	(-3.06)	(-5.32)	(-4.63)	(-5.61)
10-C	-0.38%	-0.98%	-2.25%	-2.98%	-7.73%	-0.40%	-0.99%	-2.25%	-3.10%	-9.11%
	(-1.24)	(-1.97)	(-4.01)	(-4.93)	(-7.86)	(-1.11)	(-1.69)	(-3.80)	(-4.14)	(-6.77)
10 – 1	0.33%	0.12%	-0.03%	0.05%	-1.87%	0.33%	0.55%	0.59%	0.48%	-2.88%
	(1.15)	(0.32)	(-0.05)	(0.07)	(-1.80)*	(1.15)	(1.34)	(1.29)	(0.69)	(-2.85)***
10C – 1A	0.88%	1.18%	1.69%	1.59%	-4.89%	0.64%	0.76%	1.28%	1.07%	-6.98%
	(1.75)*	(1.45)	(1.78)*	(1.33)	(-2.83)***	(1.24)	(0.94)	(1.24)	(0.77)	(-3.66)***

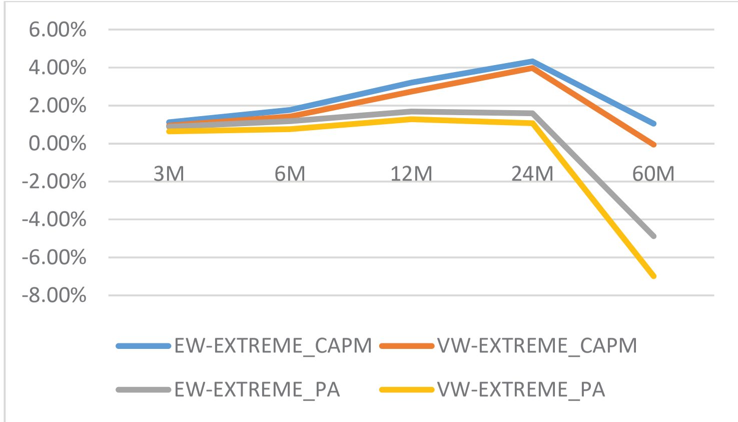
Table 5: Equal-weighted and value-weighted decile portfolio performance constructed based on SC measure over past two years. SC measure are constructed using CAPM alpha as the performance measure. The first four column report the equal-weighted portfolio Carhart alpha and the last four column report the value-weighted portfolio Carhart alpha. The top decile and bottom decile portfolio are further sorted into three portfolios respectively. I report the quarterly Carhart alpha of a strategy that long top decile portfolio and short bottom decile portfolio. In addition, I also report the quarterly Carhart alpha of a strategy that long the top portfolio within the top decile portfolio and short the bottom portfolio of the bottom decile portfolio. The t-statistics are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% level respectively.

Figure 1: Cumulative performance of the long-short portfolios over time. Panel (A) presents the cumulative Carhart alpha of a strategy

(A) Long-Short Portfolio



(B) Extreme Long-Short Portfolio



that long top decile portfolio and short bottom decile portfolio. Blue (Orange) line represent the equal-weighted (value-weighted) results for unit value-added constructed using CAPM alpha as the performance measure. Grey (Yellow) line represent the equal-weighted (value-weighted) results for unit value-added constructed using peer-adjusted net return as the performance measure. Panel (B) presents the cumulative Carhart alpha of a strategy that long the top portfolio within the top decile portfolio and short the bottom portfolio of the bottom decile portfolio.

	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbf{SC_{i,t-1}}$	0.0477	0.2681	0.1761	0.1361	0.1419	0.1718
	(0.62)	(4.84)***	(3.55)***	(2.15)**	(2.51)***	(2.72)***
$\mathbf{Expense\ Ratio_{i,t-1}}$	-0.0031	-0.0028	0.0002	-0.0033	-0.0032	-0.0005
	(-4.83)	(-4.38)	(0.21)	(-5.09)	(-4.66)	(-0.54)
$\mathbf{Flow_{i,t-1}}$	-0.0171	-0.0092	0.0071	-0.0172	-0.0090	0.0079
	(-3.55)	(-2.25)	(1.55)	(-3.59)	(-2.20)	(1.72)
$\mathbf{Number\ of\ Stocks_{i,t-1}}$	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	(0.50)	(0.51)	(0.22)	(0.39)	(0.64)	(0.25)
$\boldsymbol{STD}_{\mathbf{i,t-1}}$	-0.0618	-0.0562	-0.0224	-0.0617	-0.0570	-0.0260
	(-8.06)	(-8.26)	(-2.99)	(-8.11)	(-8.29)	(-3.55)
$\boldsymbol{Turnover}_{\mathbf{i,t-1}}$	-0.0060	-0.0071	-0.0069	-0.0060	-0.0072	-0.0069
	(-4.26)	(-4.86)	(-4.57)	(-4.29)	(-4.83)	(-4.55)
$\boldsymbol{Load}_{\mathbf{i,t-1}}$	-0.0011	-0.0010	-0.0011	-0.0011	-0.0010	-0.0011
	(-3.81)	(-3.35)	(-3.69)	(-3.80)	(-3.30)	(-3.61)
$\mathbf{log(Age_{i,t-1})}$	-0.0002	0.0001	-0.0001	-0.0002	0.0000	-0.0002
	(-0.79)	(0.26)	(-0.52)	(-0.85)	(-0.04)	(-0.59)
$\mathbf{log}(\boldsymbol{MTNA_{i,t-1}})$	0.0000	-0.0001	0.0001	0.0000	-0.0001	0.0001
	(0.01)	(-0.84)	(0.63)	(0.02)	(-0.71)	(0.60)
Performance Measure	CAPM Alpha	CAPM Alpha	CAPM Alpha	PA Net Return	PA Net Return	PA Net Return
Style Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Measurement Period	12	24	36	12	24	36

Table 6: Panel regression results for SC measure. $\mathrm{SC_{i,t-1}}$ is the skill-competition measure introduced in equation (30) for fund i at time *t-1*. When constructing SC measure, I use CAPM alpha as the performance measure for column (1) – (3) and peer-adjusted net return as the performance measure for column (4) – (6). Turnover and expense ratio are annualized values. $\mathrm{Flow_{i,t-1}}$ is the fund percentage flow over past year. $\mathrm{Number\ of\ Stocks_{i,t-1}}$ is the number of stocks in the fund's portfolio in quarter t-1. $STD_{\mathrm{i,t-1}}$ is the standard deviation of fund's net return over past one year. Load equals to one if any share class of the fund contains a front-end or rear-end load. Fund age is measured in months. $\log(MTNA_{i,t-1})$ is the log of fund size at the last quarter end before the measurement period. I include style fixed effect, time fixed effect and cluster the standard error on funds. *, **, and *** denote significance at the 10%, 5%, and 1% level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Unit Value add$_{t-1}$	0.0011	0.0007	0.0011	0.0002	0.0000	0.0010
	(4.53)***	(2.68)***	(4.58)***	(0.97)	(-0.02)	(4.55)***
Unit Fee add$_{t-1}$	-0.0001	-0.0002	-0.0004	-0.0001	-0.0001	-0.0004
	(-1.58)	(-2.02)**	(-3.00)***	(-0.82)	(-1.21)	(-2.98)***
Expense Ratio$_{t-1}$	-0.0001	-0.0003	0.0000	-0.0001	-0.0003	0.0000
	(-1.61)	(-4.23)***	(0.10)	(-1.83)*	(-4.48)***	(-0.36)
Flow$_{t-1}$	0.0004	-0.0006	0.0003	0.0004	-0.0006	0.0003
	(2.15)**	(-3.31)***	(1.76)*	(2.09)**	(-3.38)***	(1.96)**
Number of Stocks$_{t-1}$	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	(0.71)	(0.49)	(0.60)	(0.74)	(0.71)	(0.60)
STD_{t-1}	-0.0008	-0.0013	-0.0005	-0.0008	-0.0014	-0.0004
	(-4.45)***	(-8.10)***	(-3.08)***	(-4.46)***	(-8.06)***	(-2.73)***
$Turnover_{t-1}$	-0.0005	-0.0007	-0.0006	-0.0005	-0.0007	-0.0006
	(-3.36)***	(-4.52)***	(-3.89)***	(-3.23)***	(-4.51)***	(-3.67)***
$Load_{t-1}$	-0.0005	-0.0005	-0.0005	-0.0005	-0.0005	-0.0005
	(-3.88)***	(-3.71)***	(-3.55)***	(-3.87)***	(-3.69)***	(-3.56)***
$\log(Age_{t-1})$	-0.0001	-0.0001	0.0000	-0.0001	-0.0001	-0.0001
	(-0.76)	(-0.85)	(-0.27)	(-0.90)	(-0.90)	(-0.65)
$\log(MTNA_{t-1})$	0.0000	0.0000	0.0001	0.0001	0.0000	0.0002
	(0.28)	(0.09)	(0.83)	(0.35)	(0.08)	(1.04)
Performance Measure	CAPM Alpha	CAPM Alpha	CAPM Alpha	PA Net Return	PA Net Return	PA Net Return
Style Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Measurement Period	3	12	36	3	12	36

(Continued)

	(7)	(8)	(9)	(10)
$\mathbf{Unit\ Value\ add_{t-1}}$	-0.0014	0.0026	-0.0003	0.0019
	(-1.83)*	(11.59)***	(-0.46)	(9.23)***
$\mathbf{Unit\ Fee\ add_{t-1}}$	0.0005	-0.0004	-0.0001	-0.0003
	(0.67)	(-3.73)***	(-0.15)	(-3.05)***
$\mathbf{Expense\ Ratio_{t-1}}$	0.0000	-0.0002	0.0001	-0.0003
	(0.04)	(-2.41)***	(0.08)	(-3.69)***
$\mathbf{Flow_{t-1}}$	-0.0009	-0.0004	-0.0008	-0.0003
	(-1.74)*	(-2.38)***	(-1.46)	(-2.00)**
$\mathbf{Number\ of\ Stocks_{t-1}}$	-0.0006	0.0001	-0.0007	0.0001
	(-1.13)	(0.71)	(-1.28)	(0.91)
$\boldsymbol{STD_{t-1}}$	0.0008	-0.0012	0.0003	-0.0014
	(1.10)	(-7.48)***	(0.51)	(-8.28)***
$\boldsymbol{Turnover_{t-1}}$	-0.0009	-0.0008	-0.0009	-0.0007
	(-1.63)	(-4.95)***	(-1.55)	(-4.44)***
$\boldsymbol{Load_{t-1}}$	-0.0012	-0.0003	-0.0012	-0.0003
	(-2.11)**	(-2.50)***	(-2.14)**	(-2.30)**
$\mathbf{log(Age_{t-1})}$	0.0011	-0.0001	0.0011	-0.0002
	(2.33)**	(-0.73)	(2.36)***	(-1.18)
$\mathbf{log}(\boldsymbol{MTNA_{t-1}})$	-0.0014	0.0001	-0.0015	0.0001
	(-2.57)***	(0.34)	(-2.62)***	(0.43)
Performance Measure	CAPM Alpha	CAPM Alpha	PA Net Return	PA Net Return
Style Fixed Effect	Yes	Yes	Yes	Yes
Measurement Period	24	24	24	24

Table 7: Robustness tests. Column (1) – (6) report the regression results of fund future performance on unit value-added and unit fee-added measured over different periods. The sample are divided into two sub sample period at year 2003. Column (7) and (9) report the regression results of the first half of the sample and Column (8) and (10) report the regression results of the second half of the sample. Turnover and expense ratio are annualized values. $\mathrm{Flow}_{i,t-1}$ is the fund percentage flow over past year. $\mathrm{Number\ of\ stocks}_{i,t-1}$ is the number of stocks in the fund's portfolio in quarter *t-1.* $\mathrm{STD}_{i,t-1}$is the standard deviation of fund's net return over past one year. Load equals to one if any share class of the fund contains a front-end or rear-end load. Fund age is measured in months. $\log(MTNA_{i,t-1})$ is the log of fund size at the last quarter end before the measurement period. I include time fixed effect and cluster the standard error on funds. *, **, and *** denote significance at the 10%, 5%, and 1% level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Unit Value add$_{t-1}$	0.0062	-0.0414	0.0283	-0.0343	0.0126	-0.0227	0.0647	0.0158
	(0.51)	(-2.23)**	(1.63)	(-1.50)	(1.21)	(-1.32)	(4.61)	(0.75)
Unit Fee add$_{t-1}$	0.0066	0.0336	-0.0113	0.0204	-0.0215	-0.0021	-0.0466	-0.0216
	(0.59)	(1.87)*	(-0.91)	(1.17)	(-1.75)	(-0.11)	(-3.42)	(-1.10)
Unit Value add$_{t-1}$	0.0192	0.0373	0.0287	0.0445				
$\times$ $Sent_{t-1}$	(1.40)	(2.29)**	(2.14)**	(2.59)***				
Unit Fee add$_{t-1}$	-0.0299	-0.0430	-0.0476	-0.0486				
$\times$ $Sent_{t-1}$	(-3.00)***	(-3.56)***	(-4.41)***	(-3.49)***				
Unit Value add$_{t-1}$					0.0478	0.0430	0.0569	0.0423
$\times$ MKT_{t-1}					(4.57)***	(2.85)***	(4.44)***	(2.39)***
Unit Fee add$_{t-1}$					-0.0305	-0.0254	-0.0404	-0.0353
$\times$ MKT_{t-1}					(-2.94)***	(-1.74)*	(-3.53)***	(-2.28)**
Expense Ratio$_{t-1}$		-0.0016		-0.0023		0.0042		0.0066
		(-0.10)		(-0.15)		(0.28)		(0.43)
Flow$_{t-1}$		-0.0218		-0.0156		-0.0199		-0.0151
		(-1.86)		(-1.40)		(-1.70)*		(-1.33)
Number of Stocks$_{t-1}$		-0.0136		-0.0151		-0.0126		-0.0155
		(-1.11)		(-1.25)		(-1.06)		(-1.33)
STD_{t-1}		0.0173		0.0097		0.0189		0.0070
		(1.17)		(0.69)		(1.27)		(0.51)
$Turnover_{t-1}$		-0.0167		-0.0150		-0.0200		-0.0196
		(-1.40)		(-1.27)		(-1.67)		(-1.65)
$Load_{t-1}$		-0.0261		-0.0267		-0.0252		-0.0251
		(-2.14)**		(-2.21)**		(-2.08)**		(-2.10)**
$\log(\text{Age}_{t-1})$		0.0236		0.0227		0.0257		0.0254
		(2.29)**		(2.20)**		(2.47)***		(2.47)***
$\log(MTNA_{t-1})$		-0.0304		-0.0299		-0.0321		-0.0319
		(-2.52)***		(-2.48)		(-2.67)***		(-2.67)***

Performance Measure	CAPM Alpha	CAPM Alpha	PA Net Return	PA Net Return	CAPM Alpha	CAPM Alpha	PA Net Return	PA Net Return
Style Fixed Effect	No	Yes	No	Yes	No	Yes	No	Yes

Table 8: Investor sentiment and the predicting powers of fund unit value-added and unit fee-added. Unit value-added and unit fee-added are measured over past two years. $Sent_{t-1}$ is the investor sentiment index at time t-1. MKT_{t-1} is the aggregate market return over past two years. Turnover and expense ratio are annualized values. $\mathrm{Flow}_{\mathrm{i,t-1}}$ is the fund percentage flow over past year. $\mathrm{Number\ of\ stocks}_{\mathrm{i,t-1}}$ is the number of stocks in the fund's portfolio in quarter *t-1.* $\mathrm{STD}_{\mathrm{i,t-1}}$is the standard deviation of fund's net return over past one year. Load equals to one if any share class of the fund contains a front-end or rear-end load. Fund age is measured in months. $\log(MTNA_{i,t-1})$ is the log of fund size at the last quarter end before the measurement period. I include fund fixed effect and cluster the standard error on funds. *, **, and *** denote significance at the 10%, 5%, and 1% level respectively.