# Implication of Regret on Mutual Fund Managers' Risk-Shifting Decision

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**Abstract**

We investigate whether regret can explain mutual fund managers' risk-shifting behavior. We propose a theoretical framework by introducing a modified utility function for mutual fund managers who are both risk averse and regret averse. The empirical tests of the proposed framework imply that mutual fund managers who perform worse than their peers (i.e., who exhibit return-regret) tend to have a positive risk-shifting, whereas those who have a higher portfolio volatility (i.e., who exhibit variance-regret) tend to have a negative risk-shifting behavior over the next period. Furthermore, we document that the effect of variance regret is more significant for institutional funds than for retail funds. Finally, when considering fund flows, the return-regret effect is more significant than the variance-regret effect, confirming that investors' outflows are mainly due fund managers' bad performance relative to their peers. The results are robust to using alternative measures of regret based on funds' potential benchmarks.

**Keywords:** Regret theory; Mutual Funds; Risk shifting.
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# 1 Introduction

*"We must all suffer one of two things: the pain of discipline or the pain of regret or disappointment*[1]*, the difference is discipline weighs ounces while regret weighs tons."*

— Jim Rohn, entrepreneur, author and motivational speaker.

Decision theory and choice under uncertainty are multidisciplinary subjects of research. In economics and finance, rationality of agents is one of the most important assumptions in decision making, and the Expected Utility Theory (EUT) that models individual's preferences under uncertainty, is critically based on the rationality of agents. However, there are documented empirical evidences of deviations from rationality such as the Allais' Paradox, the Ellsberg Paradox, and preference reversals.[2] Prospect Theory (PT) developped by Kahneman and Tversky (1979) was the first model of decision under uncertainty that deviates from the assumption of rational expected utility of agents. PT assumes that agents' utility is defined over their gains or losses in comparison with some reference point, and not over the value of their financial assets as in the Expected Utility Hypothesis. It also assumes that people's utility from gain is lower that their disutility from the same amount of loss. Regret Theory (Bell, 1982; Loomes and Sugden, 1982) addresses violations of EUT by considering that individuals may display regret when their decisions turn out to be wrong, even when they appeared correct at the time they were made. Although conceptually regret is a phenomenon that is observed ex-post, it influences agents' decision making ex-ante.

The notion of regret could be particularly important for mutual fund managers, given their characteristics as an investor type, and the implication of regret can shed important insights on fund managers' decision-making process and risk-taking behavior. Current lit-

[1]The concepts of regret and disappointment are different in a sense where disappointment arise from the consequences of an exogenous situation, whereas regret results from own decisions and actions. In this paper, we solely focus on the implication of regret in mutual fund managers' risk-shifting behavior.

[2]The Allais' Paradox is a counterexample of the independence axiom of the Expected Utility Theory, where agents, who have preference of a lottery A over a lottery B, will see their preference modified if an irrelevant third lottery is mixed with the previous ones. The Ellsberg Paradox appears when agents prefer taking risk on situations where they know specific odds, rather than an alternative risky scenario with ambiguous odds. Preference reversal arises when agent modify their preferences after the outcomes are known.

erature on risk-shifting has documented that the performance-based compensation affects managers' risk-taking behavior. Depending on the compensation structure, mutual fund managers tend to risk-shift their portfolios, generally toward the direction in which the performance alters the incentive (Javadekar, 2016; Chen and Pennacchi, 2009; Lee et al., 2018, Lines, 2016, Orphanides, 1996). The risk-shifting behavior could also be a consequence of the investment delegation. When a mutual fund records inferior performance relative to its peers, this can have consequences on the fund's capital flows. Thus, fund flows may act as implicit incentives for the manager to distort asset allocation choices (Basak, Pavlova and Shapiro, 2003).

Our paper contributes to the literature by examining mutual funds' the risk-shifting behavior from the regret perspective. We propose a theoretical framework, considering a modified utility function for the mutual fund manager, taking into account the regret that she would experience as a result of her investment decisions in the previous period. Mutual fund managers who record bad performances in a given period can experience regret that may subsequently alter their investment decisions over the next period, which in turn can lead them to take more risk than initially anticipated. On the other hand, if a mutual fund manager performs badly relative to her peers, this can also have consequences on the capital outflows, and the regret of poorly performing managers could prompt them to modify their strategies to avoid, or at least minimize potential outflows from the fund as a result of poor performance.

We test empirically the main hypotheses derived from the above theoretical framework and our findings are summarize as follows. First, due to the role of regret in their modified utility functions, mutual fund managers who perform worse than their peers (i.e., who exhibit return-regret) in one period tend to have a positive risk-shifting (i.e., they take more risk during the subsequent period), whereas those who exhibit a higher portfolio volatility relative to their peers (i.e., who exhibit variance-regret) tend to negatively shift their risk during the next period (i.e., they take less risk during the subsequent period). Second, we find that the effect of variance-regret is more significant for institutional funds than for retail funds, mainly because of the sophistication of these investors. Finally, when considering fund flows, we find that the return-regret effect is more significant than the variance-regret effect, confirming that investors' outflows are mainly due to their bad performance relative to their peers.

The remainder of the paper is organized as follows. Section 2 overviews the literature on regret theory and its application in financial decision-making. Section 3 outlines the theoretical framework and its testable hypotheses. Section 4 presents data, methodology and the results of the empirical analysis. We present a robustness test in section 5 and finally, Section 6 offers concluding remarks.

# 2 Literature Review

Regret has a long standing root in psychology and social sciences. Experiments show that agents anticipate and experience regret when they are able to compare a bad outcome to a better outcome that would have resulted from a forgone option. It is also shown that the effect of potential regret is reduced when people do not expect to observe the outcome of the option they will choose or the one that they did not choose, implying that, in those cases they would think more in terms of expected utility (Ritov and Baron, 1995; Zeelenberg, 1999). Anticipated regret can also force participants toward the safest option, leading them to make regret-minimizing choices, rather than risk-minimizing choices (Zeelenberg et al., 1996). Anticipated regret can also lead both risk averse and risk seeking choices (Zeelenberg, 1999). Nicolle et al. (2011) show that emotion of regret is higher when errors arise from rejection rather acceptance of the status quo. Furthermore, Pieters and Zeelenberg (2005) show that the decision process and the decision outcome can be two independent sources of regret.

In machine learning, the notion of regret is used to define the regret bound, which measures the performance of an online algorithm relative to the performance of a competing prediction mechanism, called a competing hypothesis. The competing hypothesis can be chosen in hindsight from a class of hypotheses, after observing the entire sequence of question/answer pairs. Over the years, competitive analysis techniques have been refined and extended to numerous prediction problems (Azar et al., 2017 ; Alquier and Pontil, 2017 ; Jaksch et al. 2010 ; Blum and Mansour, 2007 ; Chang and Kaelbling, 2005).

In economic decision theory, the Expected Utility Theory (von Neumann and Morgenstern, 1947 ; Savage, 1951) is the mainstream theory concerning investor's choice under uncertainty. However, empirically, as mentioned in the first paragraph, basic axioms of EUT are violated because of the non-rationality of agents. Bell (1982) was the first to introduce the notion of "regret", treating it as a second attribute of concern to the decision maker, by incorporating anappropriate trade-off between regret and the payoff of the final asset[3]. Loomes and Sugden (1982) at the same time introduce an alternative theory of rational choice under uncertainty. They still assume that the investors' utility depends on their trivial wealth, however they can express regret after the outcomes of their decisions are known, even if their decision appeared rational when they were made. This assumption implies that the individual's utility function among other things should also depend on the realization of the not chosen alternatives[4]. In a follow-up paper, Loomes and Sugden (1987) examine the relationship between the regret theory and the skew-symmetric bilinear utility function, developed by Fishburn (1982, 1983, 1984). This function can be interpreted as a measure of the decision maker's intensity if she has a preference of a prospect over another. Sugden (1993) extends previous work and presents a set of axioms which imply a for of regret theory [5].

Implications of regret in financial decision-making has also been examined in various setting. Dodonova and Khoroshilov (2002) present a model that analyses how the behavior

[3]Bell(1982) highlights two important points: Regret symmetry: the individual can equally experience regret or hapiness for taking or not taking actions, and the alternatives are considered to have equal risk; and dominance of a scenario over another, compared to the status quo, help the individual take action.

[4]In their model, they define a choiceless utility function for any individual, that assign a real-valued utility index to every conceivable consequence. This concept of choiceless utility relies on what individual would derive from a consequence if he experienced without having chosen it, or that this consequence has been imposed. However, if an individual experiences a particular consequence as a result of an act of choice under uncertainty, then she might experience regret or rejoice depending on taking the decision with the best outcome or not. This regret/rejoice is incorporated by a modified utility function.

[5]He uses axioms similar to those of Expected Utility Theory (Savage, 1951), except the transitivity axiom, which is dropped.

of stock returns is affected by the presence of regret-averse investors in the market. Their model explains empirical puzzles, like the excess volatility and the time-series correlation of stock returns; and predicts that high dispersion of the realized stock returns positively affect future trading volumes. Michenaud and Solnik (2008) develop a model that consider two forms of risk: the traditional risk (or the volatility) and the regret risk. The authors apply their model to currency hedging and observe that an investor considering both forms of risk may not fully hedge a position in a situation in which a full hedge is the correct position (based solely on traditional risk). The two forms of risk are partially substitutable, but regret aversion either increase or decrease an investor's optimal risk exposure, relative to investors who focus solely on traditional risk.

In more recent work on regret theory, Bleichrodt et al. (2010) conduct an experiment allowing regret to be quantitatively observable, and showing that agents are disproportionately averse to large regrets, which is the main assumption of the regret theory. Diecidue and Somasundaran (2017) present a new behavioural foundation for regret theory with the central axiom being the trade-off consistency, relying on the expriment of Bleichrodt et al. (2010). This axiom renders regret to be observable at the individual level and implies that regret theory minimally deviates from EUT by relaxing transitivity only. Their behavioural foundation is the first to allow for a continuous regret theory representation and to separate "ration" utility from regret. Their axioms capture that the only difference between EUT and regret theory lies in abandoning transitivity. Finally, Arisoy and Bali (2018) study the impact of regret for volatility-risk-averse investors and find that regret-averse and volatility risk-averse investors are willing to pay high prices for stock with low volatility-regret-risk and they accept to hold stocks with high volatility-regret risk if they are compensated for it.

# 3 Theoretical Framework

Under the Expected Utility Theory (henceforth EUT), to say that an action $A_1$ is preferred to another action $A_2$ is equivalent to say that the utility derived from the consequences of $A_1$

is greater than the utility derived from the consequences of $A_2$, both utilities being weighted by the probabilities of state occurrences. This can be formulated by equation (1):

$$A_1 \succeq A_2 \Leftrightarrow \sum_{j=1}^{n} p_j C\left[A_1(s_j)\right] \geq \sum_{j=1}^{n} p_j C\left[A_2(s_j)\right] \tag{1}$$

where $A_i$ is the action that can be chosen by the agent, $C(\cdot)$ is her von Neumann-Morgenstern utility function that depends on her actions and determines the risk attitude toward those actions, $s_j$ and $p_j$ are respectively the state of nature and its probability of occurrence.
Regret Theory is the first normative theory of choices under uncertainty that offers an answer to the empirical violations of the EUT. In this theory, Loomes and Sugden (1982) generalize the EUT by assuming that the utility of the consequence of $A_1$ is affected by what would have happened if $A_2$ had been chosen instead of $A_1$, and vice versa. They introduced a strictly increasing function, denoted $Q$, that captures the level of regret or rejoicing (the inverse situtio of regret) as the difference between the two utilities:

$$A_1 \succeq A_2 \Leftrightarrow \sum_{j=1}^{n} p_j Q\left\{C\left[A_1(s_j)\right] - C\left[A_2(s_j)\right]\right\} \tag{2}$$

The regret function $Q(\cdot)$ is considered as a modified utility function, that is monotonically increasing and concave, with $Q(0) = 0$. $C\left[A_1(s_j)\right] - C\left[A_2(s_j)\right]$ capture the utility gain or loss of having chosen the action $A_1$ rather than the action $A_2$[6].

Quiggin (1994) extend the modified utility function from a pairwise choice to a general choice set, allowing the agents to select their investment from a set of various available investments, with $x_i$ as outcome, by adding the assumption that choices should not be influenced by the availability of alternatives wich are statewise dominated. He shows, as well, that if irrelevance of statewise dominated alternatives holds, regret must be determined solely by the best attainable outcome in each state of the world. Thus, the modified utility

[6]If $Q$ is linear, then equation (2) would only be a linear transformation of equation (1), meaning that it does not offer any generalization relative to the EUT, and the choiceless utility function $C(\cdot)$ captures all the relevant decisions. However, if $Q$ is non-linear, then we would experience new implications an a new decision theory.

function for a general choice problem would be defined as:

$$u(x_t) = v(x_t) + f(v(x_t) - v(max[x_t])) \tag{3}$$

where $v(x_t)$ is the choiceless utility of choosing the investment that pays $x_t$, and $max[x_t]$ is the best ex-post outcome that can be obtained among all possible investments (or the foregone alternatives). The difference between the two captures the non-positive regret term, and regret-averse agents anticipate this level of regret by taking it into account when making an investment decision and choosing their optimal portfolio (by maximizing their expected modified utility across all possible investment choices).

In the present work, we study one type of decision maker, the mutual fund manager, who invests on behalf of the final investor and is compensated for it, with a management fee and, in some cases, with a performance fee. We consider the risk aversion and the regret aversion as the main determinants of fund managers' investment decision-making. In our setting, there can be managers that are risk neutral, risk averse or risk seeker. However, by definition, a fund manager can only be regret averse or regret neutral, not a regret seeker. Risk aversion is captured in the choiceless utility function whereas the regret aversion is reflected by the non-positive regret term introduced by equation (3). The way in which we define our theoretical framework permits us to take into account all type of mutual fund managers. For example, the modified utility of a regret neutral fund manager would be equal to her choiceless utility because, even if the non-positive regret term exists, the expression $f(v(x_t)-v(max[x_t])$, from equation (3), is null. When considering the risk aversion, defining the type of mutual fund managers would be determined by defining their choiceless utility function regarding their risk attitude.

To derive our testable hypotheses regarding the risk-shifting behavior, we assume the mutual fund manager as the decision maker who can be risk averse and regret averse. We consider her choiceless von Neumann-Morgenstern utility function $v_{it}(\cdot)$, in a mean-variance framework, i.e. the fund manager only cares about the first two moments of the return distribution of her portfolio, defined by equation (4):

$$v(R_{it}, \sigma_{it}^2) = E[R_{it}] - \frac{1}{2} b_i \ \sigma_{it}^2 \tag{4}$$

where $R_{it}$ and $\sigma_{it}^2$ are respectively the return and variance of the mutual fund manager $i$ at the period $t$ and $b_i$ its level of risk aversion. This function is increasing with the return of the fund manager and has a negative relation with its variance.

We assume that mutual fund managers can experience regret if their performance is worse than the maximum return of their peers during that period. And because they evolve in a mean-variance framework, they also experience regret when they face a greater volatility than the minimum volatility of their peer funds. We consider that mutual fund managers are taking the regret that they could experience ex-post as a determinant in their investment decision making process ex-ante. Using Quiggin (1994) framework, we can rewrite the modified utility function of the mutual fund manager, using equations (3) and (4):

$$u(R_{it}, \sigma_{i,t}^2) = E[R_{it}] - \frac{1}{2} b_i \sigma_{it}^2 + f\left[v(R_{it}, \sigma_{i,t}^2) - v(max[R_t, \sigma_t^2])\right] \tag{5}$$

with the modified utility $u(R_{it}, \sigma_{i,t}^2)$ taking into consideration the choiceless utility $v(R_{it}, \sigma_{it}^2)$ and a function $f$[7] of the non-positive regret term defined by Quiggin.

When considering mutural funds, the best ex-post outcomes should be the performance of the best mutual funds from the same universe (with the same investment style, following the same benchmark, ...etc.). Hence, equation (5) can be reformulated as:

$$\begin{aligned} u(R_{it}, \sigma_{i,t}^2) = v(R_{it}, \sigma_{i,t}^2) &+ f_1 \left[R_{i,t-1} - R_{Top\ decile\ peers,\ t-1}\right] \\ &+ f_2 \left[\sigma_{i,t-1}^2 - \sigma_{Bottom\ decile\ peers,\ t-1}^2\right] \end{aligned} \tag{6}$$

where $\left[R_{i,t-1} - R_{Top\ decile\ peers,\ t-1}\right]$ and $\left[\sigma_{i,t-1}^2 - \sigma_{Bottom\ decile\ peers,\ t-1}^2\right]$ capture the degree of regret or decrease of the choiceless utility function defined in equation (4), experienced

[7] This function $f$ must be linear and additive.

respectively over the return and the variance of the fund $i$, recorded during the previous period $(t-1)$, and the function $f(\cdot)$ is any linear transformation of that degree of regret. The modified utility function in equation (6) implies that mutual fund managers have more determinants to their decision-making process, that is now not limited to the mean-variance framework but considers the level of future regret experienced when their own performance, or risk exposure, is worse than the ex-post performance of the best peer mutual fund managers.

Regret-averse mutual fund managers, who care about the foregone alternatives, i.e. the maximum return and/or the minimum variance of the peer funds, would experience a different risk-taking behavior from those who are neutral to regret, either by increasing their risk exposure in order to record a better return, or by lowering their risk levels, to decrease their overall variance in order to reach the minimum variance of the peer funds. Thereby, the risk-shifting behavior is positively related to the level of regret experienced in terms of the performance, and negatively related to the regret experienced regarding the volatility of the fund. This lead to the following hypothesis:

$H_1$*: Mutual fund managers that display regret because of the low performance (high variance) of their fund would adjust their risk-taking behavior in order to minimize their future regret.*

Risk and return have confounding effects. The effect of regret arising from return (positive risk-shifting behavior) can be offset by the effect of regret arising from variance (negative risk-shifting behavior). One could argue that those measures should not be taken separately when making investment decisions. Thus, a mutual fund manager would be more concerned by its relative performance, regarding its risk, rather than its absolute performance, or absolute risk. In this case, we would modify equation (6) to take into account a regret measure that will consider the relative return, giving the following equation:

$$u(R_{it}, \sigma^2_{i,t}) = v(R_{it}, \sigma^2_{i,t}) + f\left[SR_{i,t-1} - SR_{Top\ decile\ peers,\ t-1}\right] \tag{7}$$

where $[SR_{i,t-1} - SR_{Top\ decile\ peers,\ t-1}]$ capture the degree of regret or decrease of the choiceless utility function, experienced on the Sharpe Ratio[8] of the fund $i$ during the previous period $(t-1)$, and the function $f(\cdot)$ is any linear transformation of that degree of regret. As for the return and variance-based regret measure, a mutual fund manager that records a lower Sharpe Ratio than her peers, would experience regret that would be taken into account in her subsequent actions, and thus, the risk-shifting behavior is positively related to the level of regret experienced in terms of the Sharpe Ratio, giving the following hypothesis:

$H_2$*: When mutual fund managers experience regret due to higher Sharpe Ratio than their peers, they would modify their risk shifting behavior in order to minimize their future regret.*

We can derive another hypothesis that could be tested empirically. We know that regret can be expressed mainly because of the fear of loss of the current direct or indirect incentives (performance-based compensation, reputation, inflows/outflows...etc.). Mutual fund managers can adjust their holdings to try to achieve a better performance during the period in an attempt to increase or at least maintain these incentives. The shift in holdings can be motivated by regret due to the foregone opportunities for some mutual fund managers to attain better incentives. In another hand, inflows and outflows determines the attractiveness of a mutual fund, and can be a proxy for the performance of the fund manager. When a mutual fund records outflows, its manager would experience regret due to the fact that she has not been able to maintain the level of assets under management. We can either face the situation where the fund has not recorded any outflows, but no inflows have been observed neither. The fund manager would then react more aggressively in her strategies, modifying her risk behavior, in order to record a better performance, and hence, attract flows. By considering fund flows as a proxy for the fund's incentives, it leads to the following hypothesis:

$H_3$*: When experiencing regret, mutual fund managers that record a outflows (inflows) during the period would modify their risk shifting behavior in order to increase their attractiveness,*

[8]The Sharpe Ratio is defined as the average return earned in excess of the risk free rate, per unit of total risk.

*and thus limiting their outflows (increasing their inflows).*

In the following section, we use our theoretical framework as a the foundation of the empirical analysis. However, for this paper, we will choose to study the direct impact of regret on the risk-shifting behavior. To do so, we will define a risk-shifting measure as a dependent variable, that we will try to explain giving the regret experienced by the decision maker, here the mutual fund manager.

# 4 Empirical Analysis

## 4.1 Data Sources and Summary Statistics

To test our hypotheses, we construct our sample from two major sources. The first source is Center for Research in Security Prices (CRSP) Survivorship-bias-free US Mutual Fund database that includes all funds' characteristics and returns, at a monthly and quarterly frequencies, from January 1991 to December 2017. The second source is Thomson Reuters for the mutual funds' holdings (CDA/ Spectrum S12), as reported quarterly to the SEC by the institutions. However, there are potential exclusions from this source that include: small holdings (typically under 10,000 shares or USD 200,000), cases where there may be confidentiality issues, reported holdings that could not be matched to a master security file, and cases where two or more managers share control (since the SEC requires only one manager in such a case to include the holdings information).

The databases are merged using CUSIP number of funds and we excluded index funds from the sample (if they have "index", "indx" or "idx" in the fund's name). We also excluded from the sample funds that have less than 5 millions USD of assets under management during the whole life of the fund. Regarding the investment objective codes relative to each fund, we used Thomson Reuters' classification described in Table A.1 in the Appendix. For the robustness tests, we used the CRSP objective codes, which is a mapping of Strategic Insights, Wiesenberger, and Lipper objective codes into a continuous series (see Table A.2 in the Appendix for the objective codes used). Last, the prices of the stocks held by the mutual funds and the risk free rate quotations (90 days TBill) are extracted from the CRSP database.

As showed in Table 1, our sample has 744 funds, with a mean of 219.45 millions USD of asset under management. The mean fund return per share is 0.65% and the mean volatility of fund returns is 2.82%. It is interesting as well to note that the fund return per share varies from -3.94% for the bottom decile to 6.57% for the top decile, whereas the volatility of fund returns varies from 0.65% to 5.04% . This shows that we have major record differences between the funds in our sample, in term of return and variance, that would lead regret averse fund managers to experience regret, and thus to modify their risk taking behavior in order to minimize their future regret.

## 4.2 Variable Construction and Models

The risk borne by a fund would be defined by the assets held in their portfolios. The risk evolves regarding to the change in holdings of the fund. Thus, to measure the risk-shifting of a mutual fund, we construct the measure following the methodology of Huang et al. (2011), that compares the current holding volatility based on the most recently disclosed positions by the fund ($\sigma_{i,t}^{H}$), with the volatility of the fund's past realized returns ($\sigma_{i,t}^{R}$). The holdings being disclosed quarterly to the SEC by the mutual funds, the risk-shifting measure is computed on a quarterly frequency. For a fund $i$ at time $t$, we would have :

$$RS_{i,t} = \sigma_{i,t}^{H} - \sigma_{i,t}^{R} \tag{8}$$

As mentioned in the theoretical framework, our principal objective is to test whether the mutual fund managers display a modification of their risk exposure when experiencing regret. We assume that a fund manager would experience regret if she performs less than her peers, with the same investing style or the same investment objectives. She would also experience regret if she records a higher volatility than her peers, and thus exposing her portfolio to more risk than funds with the same investing style. Our hypothesis is that the fund manager that have experienced regret, from its return or volatility, would modify her portfolio composition, and hence her risk-shifting measure in order to minimize her future regret. Giving the confounding effets of the risk and return, we choose, in a first step, to test these effects separately, and we propose the following ordinary least squared (OLS) models:

$$RS_{i,t} = \alpha_{i,t} + \beta_{i,t}^{RREG}\left[R_{i,t-1} - (R_{Top\ Decile\ Peers,\ t-1})\right] + Controls_{i,t} \tag{9}$$

$$RS_{i,t} = \alpha_{i,t} + \beta_{i,t}^{VREG}\left[\sigma^2_{i,t-1} - \left(\sigma^2_{Bottom\ Decile\ Peers,\ t-1}\right)\right] + Controls_{i,t} \tag{10}$$

where $R_{i,t-1}$ and $\sigma^2_{i,t-1}$ are respectively the return and the variance of the fund $i$ at time $t-1$, $R_{Top\ Decile\ Peers,\ t-1}$ and $\sigma^2_{Bottom\ Decile\ Peers,\ t-1}$ are the best outcomes of the peers[9] of the fund $i$. Hense, the quantites $\left[R_{i,t-1} - (R_{Top\ Decile\ Peers,\ t-1})\right]$ and $\left[\sigma^2_{i,t-1} - \left(\sigma^2_{Bottom\ Decile\ Peers,\ t-1}\right)\right]$ capture the level of regret of fund $i$ at time $t$. By construction, return regret is always negative, and variance regret is always positive . The controls that we use in equation (9) are the expense ratio, the turnover ratio, the age (the log number of years from the inception of the fund) and the size (the log total net asset of the period)[10].

Because of the confounding effects of risk and return, we propose two tests that includes both effects. First, we will use both the return regret and the variance regret as independent variables:

$$\begin{aligned} RS_{i,t} = \alpha_{i,t} &+ \beta_{i,t}^{RREG}\left[R_{i,t-1} - (R_{Top\ Decile\ Peers,\ t-1})\right] \\ &+ \beta_{i,t}^{VREG}\left[\sigma^2_{i,t-1} - \left(\sigma^2_{Bottom\ Decile\ Peers,\ t-1}\right)\right] + Controls_{i,t} \end{aligned} \tag{11}$$

The second test that we conduct uses the Sharpe Ratio in the measure of the level of regret, that would combine both effects arising from risk and return, using the following OLS test:

$$RS_{i,t} = \alpha_{i,t} + \beta_{i,t}^{SRREG}\left[SR_{i,t-1} - (SR_{Top\ Decile\ Peers,\ t-1})\right] + Controls_{i,t} \tag{12}$$

[9]The peers are defined as the funds with the same investment objective codes as the fund $i$, as classified by Thomson Reuters (see Table A.1 in the Appendix).

[10]We use the same controls in every OLS model in the present paper.

where $SR_{i,t-1}$ is the Sharpe Ratio[11] of the fund $i$ at time $t-1$, and $SR_{Top\ Decile\ Peers,\ t-1}$ as the best outcomes of the peers of the fund $i$. As earlier, the difference between the two Sharpe Ratios captures the level of regret of the fund $i$ at time $t$, and by construction, this level of regret is negative.

In the hypothesis $H_3$, when experiencing regret, mutual fund managers that record a outflows (inflows) during the period would modify their risk-shifting behavior in order to increase their attractivity, and thus limiting their outflows (increasing their inflows). To test this hypothesis, we construct the Inflow/Outflow variable as the change in the quarterly total net asset of the fund $i$,

$$IN/OUT_{t+1} = \frac{TNA_{i,t+1} - TNA_{i,t}}{TNA_{i,t}} \quad (13)$$

and use this variable in the following OLS models:

$$IN/OUT_{i,t} = \alpha_{i,t} + \beta_{i,t}^{RREG}\left[R_{i,t-1} - (R_{Top\ Decile\ Peers,\ t-1})\right] + Controls_{i,t} \quad (14)$$

$$IN/OUT_{i,t} = \alpha_{i,t} + \beta_{i,t}^{VREG}\left[\sigma_{i,t-1}^2 - \left(\sigma_{Bottom\ Decile\ Peers,\ t-1}^2\right)\right] + Controls_{i,t} \quad (15)$$

$$\begin{aligned} IN/OUT_{i,t} = \alpha_{i,t} + \beta_{i,t}^{RREG}\left[R_{i,t-1} - (R_{Top\ Decile\ Peers,\ t-1})\right] \\ +\beta_{i,t}^{VREG}\left[\sigma_{i,t-1}^2 - \left(\sigma_{Bottom\ Decile\ Peers,\ t-1}^2\right)\right] + Controls_{i,t} \end{aligned} \quad (16)$$

$$IN/OUT_{i,t} = \alpha_{i,t} + \beta_{i,t}^{SRREG}\left[SR_{i,t-1} - (SR_{Top\ Decile\ Peers,\ t-1})\right] + Controls_{i,t} \quad (17)$$

$$RS_{i,t} = \alpha_{i,t} + \beta_{i,t}^{IN/OUT} IN/OUT_{i,t-1} + Controls_{i,t} \quad (18)$$

[11]The Sharpe Ratio of a fund $i$ at time $t$ is computed as $SR_{i,t} = \frac{R_{i,t} - 90days\ TBill_t}{\sigma_{i,t}}$

## 4.3 Results and Discussion

### Regret and risk-shifting

Table 2 presents the relation between regret and the fund risk-shifting, and gives the loadings of coefficients in regressions outlined by equations (9), (10), (11), (12) and (18). In the results in columns (1), (2), (5) and (6), return-regret is negatively related to risk-shifting, confirming the hypothesis that fund managers who experience return-regret tend to positively shift their level of risk, and are willing to invest in more risky assets during the subsequent period. Because riskier assets are expected to earn more than safer assets, as an expected payoff for the risk taken, fund managers would increase their risk exposure to be able to perform better than the previous period, and thus minimize their level of regret over the next period. On the other hand, in columns (3), (4), (5), and (6), variance-regret loadings are negative. Fund mangers who experience variance-regret, due to a higher portfolio variance relative to their peers, fund managers tend to lower their variance in the subsequent period, and therefore negatively shift their level of risk. However, ceteris paribus, variance regret has a greater effect on the risk-shifting level than return regret ($\beta^{RREG} = -0.0704$ and $\beta^{VREG} = -1,5077$). When considering both return-regret and variance-regret as the independent variables (as in equation (11)), the effect of return regret is minimized ($\beta^{RREG} = -0.0095$), whereas variance regret loading is comparable to the loading of equation (10), in column (3).This result shows that fund managers that are risk averse tend to be more regret averse than managers that are neutral or that have a risk appetite. In this case, the variance regret would have a dominant effect on the risk-shifting.

Column (7) shows the loadings of equation (12) and, as per the return regret, the risk-adjusted-return-regret, or the Sharpe Ratio-regret, is negatively related to the risk-shifting. When compared to their peers, fund managers who experience regret, either because of a lower performance, or a higher variance, or both, tend to have a positive risk-shifting in their portfolio during the subsequent period. However, none of the coefficients loadings are statistically significant when using the full sample.

In order to further understand the impact of each type of regret, we decompose our sample by their client structure. Table 3 presents the results for retail funds, non-retail funds, institutional funds and non-institutional funds.[12] In columns (1) and (3) of Panel A, it is interesting to note that the loadings of return regret and variance regret are positive, whereas they were negative for the full sample in Table 2. Retail fund managers have a negative risk-shifting behavior when they experience return-regret and tend to positively shift their risk following a variance-regret. On the other hand, in Panel B, one can see that $\beta^{RREG}$ and $\beta^{VREG}$ loadings for non-retail funds are negative, greater in absolute value, and statistically significant at the 1% level for $\beta^{VREG}$. For example, $\beta^{RREG}$ for retail funds is 0.1944 where as for non-retail funds, $\beta^{RREG} = -0.3164$. The contrast is even more greater for $\beta^{VREG}$, from 0.3314 for retail funds to $-6.4546$ for non-retail funds. Similarly, in column (5), when both return-regret and variance-regret are taken into account jointly, the loadings in Panel A are positive, but the variance-regret loading is higher than for equation (10) ($\beta^{VREG} = 1.3208$ against 0.3314 in column (3)). In Panel B, the loading for the variance-regret is about the same than for equation (3) and statistically significant (at 1% level), whereas $\beta^{RREG}$ is higher and even positive.

The results imply that, when the final investor is a retail customer, the fund manager is more willing to lower her risk exposure when experiencing return-regret, and to positively shift the risk of her overall portfolio when facing variance regret. On the contrary, for non-retail funds[13], fund managers would increase their risk-shifting when facing return regret, and decrease it when experiencing variance-regret, and when considered jointly, the return-regret would even have a further negative impact on the risk-shifting behavior amplifying the negative impact of the variance-regret. One explanation would be that retail investors can be considered as less sophisticated investors that delegate their money to mutual funds for management, whereas non-retail investors, like institutionals, are assumed to be more sophisticated investors with a greater knowledge of financial markets. Hence, retail investors

[12] We choose to separate each type of fund for the analysis, and not consider that non-retail funds are necessarily institutional funds (and vice versa), to avoid a further loss of data. Indeed, in the CRSP Survivorship-bias-free US Mutual Fund database, not all funds were flagged as retail or institutional. There were even funds classified as both retail and institutional funds.

[13] Non-retail clients could be either institutional or any other type of client, not specified in the data base.

would be more attracted by higher level of returns, regardless of the risk taken by the fund manager, either because they do not have access of this type of information, or they are not qualified enough to assess the management risk-taking behavior. More sophisticated investors would be aware of the consequences of a risky portfolio, and are not willing to keep risky assets when investing in mutual funds. The results support these explanations and show that managers of retail funds are limiting their risk exposure to probably avoid further bad performance already reported in the previous period. Non-retail fund managers would, however, be more focused on the variance of their peers, and variance-regret would lead them to decrease drastically their level of risk.
These explanations are confirmed in the results of Panel C and Panel D (see Table 3), however with a lower magnitude.[14] The results are also reflected in the risk-adjusted-return-regret, or the Sharpe ratio regret, with an overall statistical significance at 5% level.

**Regret and fund flows**

Table 4 displays the results of equations (14), (15), (16) and (17) for the full sample. The results confirm the link between regret and fund flows, especially between return-regret and fund flows when regret loading is positive and statistically significant (at 10% level). Results imply that for a fund manager who experience regret due to her performance, her fund flows are likely to decrease in the subsequent period, however when she experience regret due to the variance of her portfolio, then the fund would record a positive fund flow, either due to an increase in the levels of inflows, a decrease of the level of outflows or a good performance during the period that would have increase the total net asset, compared to the previous period. The results are similar when return regret and variance regret are considered jointly (equation (16)), with slightly lower loadings.

Table 5 shows the relation between regret and fund flows for different client structures. In Panel A, both return-regret and variance-regret have a negative impact on fund flows of retail funds, and this effect is even bigger when the measures are considered jointly. The

[14]The difference in magnitude is likely due to the way the funds are classified in the original database.

results are different for non-retail funds. In Panel B, return-regret loading is positive, as in Panel A, but variance-regret loading is positive meaning that a higher variance-regret would lead to an increase in net fund flows. Both measures are statistically significant, and when considered jointly, only return-regret loading is statistically significant, and the impact of variance-regret seems to be offset by the return-regret.

One interpretation could be that if fund managers do not perform as good as their peers, and hence experience regret, they can face fund outflows, or at least a decrease in fund inflows, regardless of their client structure. When experiencing variance regret, the client structure seems to matter, since for retail fund it leads to a decrease in fund flows and for non-retail funds, an increase in fund flows. These results confirm that the performance is the main determinant of fund inflows and outflows, even if it seems that there can be some sophisticated investors who can be looking for riskier investments among mutual funds, for various reasons, like diversification, and that they are not able to invest in more complex structures, as hedge funds or private equity, because of legal restrictions for instance. Hence, mutual funds that record higher variance than their peers (that exhibit variance-regret) could potentially attract these type of investors. Again, these results are confirmed when analyzing the client structure by institutional funds and non-institutional funds, with a higher statistical significance, and with almost the same level of loadings.[15]

# 5 Robustness test

In the model proposed in this paper, we assume that the notion of regret is a relative disposition, meaning that regret arises when a fund manager realizes that he underperformed relative to her peers. One could argue that a fund manager's ambition is to satisfy her clients objectives, and thus outperforming, or at least, performing as good as the prospectus' benchmark. In that case, an absolute regret arises if the fund manager can not achieve her clients'

[15] A final point to emphasize regarding these results is the difference of scale between the loadings of retail funds (non-institutional funds) and non-retail funds (institutional funds). This difference is essentially due to the difference in scale of the amounts invested by each client category.

objectives. In the following section, we propose to modify our theoretical framework and testable models in order to account for this source of regret.

First, we modify equation (6) by defining the degree of of regret as the decrease of the choiceless utility function, defined as any function $f(\cdot)$ as a linear transformation of the difference between the return (variance) of the fund and the return (variance) of its benchmark.

$$u(R_{it}, \sigma^2_{i,t}) = v(R_{it}, \sigma^2_{i,t}) + f_1 \left[R_{i,t-1} - R_{Benchmark_i,\ t-1}\right] + f_2 \left[\sigma^2_{i,t-1} - \sigma^2_{Benchmark_i,\ t-1}\right] \tag{19}$$

The empirical test would consist of the following ordinary least squared models :

$$RS_{i,t} = \alpha_{i,t} + \beta^{RREG_B}_{i,t} \left[R_{i,t-1} - (R_{Benchmark_i,\ t-1})\right] + Controls_{i,t} \tag{20}$$

$$RS_{i,t} = \alpha_{i,t} + \beta^{VREG_B}_{i,t} \left[\sigma^2_{i,t-1} - \left(\sigma^2_{Benchmark_i,\ t-1}\right)\right] + Controls_{i,t} \tag{21}$$

$$RS_{i,t} = \alpha_{i,t} + \beta^{RREG_B}_{i,t} \left[R_{i,t-1} - (R_{Benchmark_i,\ t-1})\right] + \beta^{VREG_B}_{i,t} \left[\sigma^2_{i,t-1} - \left(\sigma^2_{Benchmark_i,\ t-1}\right)\right] + Controls_{i,t} \tag{22}$$

where $R_{i,t-1}$ and $\sigma^2_{i,t-1}$ are respectively the return and the variance of the fund $i$ at time $t-1$, $R_{Benchmark_i,\ t-1}$ and $\sigma^2_{Benchmark_i,\ t-1}$ are the return and the variance of the identified benchmark of the fund $i$. Like the previous tests, the quantities $\left[R_{i,t-1} - (R_{Benchmark_i,\ t-1})\right]$ and $\left[\sigma^2_{i,t-1} - \left(\sigma^2_{Benchmark_i,\ t-1}\right)\right]$ can be either positive or negative but, by construction, return regret is always negative, and variance regret is always positive.

We propose to test, as well, the effect of regret, with respect to the potential benchmark, to the fund flows, as follow:

$$IN/OUT_{i,t} = \alpha_{i,t} + \beta^{RREG_B}_{i,t} \left[R_{i,t-1} - (R_{Benchmark_i,\ t-1})\right] + Controls_{i,t} \tag{23}$$

$$IN/OUT_{i,t} = \alpha_{i,t} + \beta^{VREG_B}_{i,t} \left[\sigma^2_{i,t-1} - \left(\sigma^2_{Benchmark_i,\ t-1}\right)\right] + Controls_{i,t} \tag{24}$$

$$IN/OUT_{i,t} = \alpha_{i,t} + \beta^{RREG_B}_{i,t} \left[R_{i,t-1} - (R_{Benchmark_i,\ t-1})\right] \tag{25}$$

$$+\beta_{i,t}^{VREG_B}\left[\sigma_{i,t-1}^2-\left(\sigma_{Benchmark_i,\ t-1}^2\right)\right]+Controls_{i,t}$$

where $IN/OUT_{i,t}$ is the fund flow measure defined in equation (13).

Finally, to be able to run the empirical test, we need to identify the benchmark index for each fund. We follow the methodology of Cremers and Petajisto (2009), that consist of identifying the potential benchmark of each fund as being the one having the lowest tracking error with that fund. The tracking error, or the tracking error volatility, as defined by Grinold and Kahn (1999), is the time-series standard deviation of the difference between the fund return ($R_i$) and the index return ($R_{index}$):

$$Tracking\ error = Stdev\left[R_i - R_{index}\right] \tag{26}$$

To identify the potential benchmarks of our sample of funds, we calculate the tracking error of these funds with respect to 19 indexes, commonly used as mutual funds' benchmarks. These indexes are: S&P 500, S&P500/Barra Growth, S&P500/Barra Value, S&P MidCap 400, S&P SmallCap 600, Russell 1000, Russell 2000, Russell 3000 and Russell MidCap indexes plus the value and growth component of each index, and finally the Wilshire 5000 and Wilshire 4500. We identify for each fund the lowest tracking error during the time period and, therefore, we assume that the index having the lowest tracking error with the fund is the potential benchmark. The rational behind this methodology is that an active fund manager tend to deviate from its benchmark in order to outperform it but, even if she aims for a higher expected return, she would like to maintain a low tracking error to minimize the risk of underperforming her benchmark.

Table 6 presents the results of the OLS regressions showing the relation between regret (with respect to the potential benchmark) and the fund risk-shifting. Return regret's coefficient is negative, confirming that a regret that would arise when a fund manager underperfom her potential benchmark would lead her to positively shift his overall risk. However, the variance regret's coefficient is positive, translating a positive risk-shifting when a fund manager experience variance regret, with respect to her potential benchmark. When considering the client structure (Table 7), a clear pattern seems to appear since, for institutional funds (non-retail funds), the return regret's loading is almost negligible, while the variance regret has a greater impact for retail funds (non-institutional funds) than for non-retail funds (institutional funds), while everything else is held equal. A potential explanation to these results is that institutional funds are looking for performance when investing in active mutual funds, hence, a comparison of an active fund performance to its potential benchmark is not meaningful for this type of investor, but are rather seeking the best performing funds from the universe of active funds. This outcome would dissipate the effects of a return regret that would arise from underperforming the potential benchmark. Regarding the variance regret, it seems that this regret would less positively impact non-retail (institutional) fund mangers' risk-shifting than retail (non-institutional) fund managers' risk-shifting, and once again, as earlier, this could be explained by the degree of sophistication of the final investor, who can be more vigilant to the level of risk of her overall portfolio.

Finally, the relationship between regret, with respect to the potential benchmark, and fund flows are more robust and straightforward. When experiencing return regret, variance regret or both, funds record outflows during the subsequent period (see Table 8 and Table 9), and the coefficients are statistically significant at, at least 5% level. These results confirm the previous one discussed in section 4.

# 6 Conclusion

This paper studies the implications of potential regret on fund managers' risk-shifting behavior. We propose a theoretical framework, considering a modified utility function for mutual fund managers, who are both risk averse and regret averse. Our setting implies that, when compared to their peers, fund managers can experience regret due to achieving lower returns, higher risk, or both. Indeed, mutual fund managers who experience bad performances during one period can experience regret that would affect their subsequent actions, as an attempt to maintain their current incentives, leading them to take more risk than initially anticipated. On the other hand, if a mutual fund manager performs worse than her peers, this can have important consequences on the fund capital flows, and the regret of the bad performing managers could lead them to modify their strategies to avoid, or at least minimize their potential outflows.

We empirically test these hypotheses and find that, due to the role of regret in their modified utility functions, mutual fund managers who perform worse than their peers (i.e., who exhibit return-regret) tend to have a positive risk-shifting (i.e., they take more risk during the subsequent period), whereas those who have a higher portfolio volatility (i.e., who exhibit variance-regret) tend to negatively shift their risk during the next period (i.e., they take less risk during the subsequent period). Furthermore, we find that the effect of variance-regret is more significant for institutional funds than for retail funds, mainly because of the sophistication of the former. Regarding the implications of regret on fund flows, we document that return-regret effect is more significant than the variance-regret effect, confirming that investors' outflows are mainly due to funds' bad performance relative to their peers. These results are mainly confirmed when the regret measures are defined over the potential benchmark of the funds, except for the return regret for institutional funds (non-retail funds), which seems to have a insignificant impact on the fund's risk-shifting behavior.

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**Table 1:** Summary statistics

This table reports the main statistics for the fund characteristics in our sample. This sample is constructed form two main data sources, and covers the period from January 1991 to December 2017.

| | Mean | St.Dev. | P10 | P50 | P90 |
|---|---|---|---|---|---|
| Total Net Asset (in millions) | 219.45 | 365.82 | 0.70 | 26.50 | 999.60 |
| Fund Return per Share (%) | 0.65 | 4.44 | -3.94 | 0.17 | 6.57 |
| Volatility of Fund Return (%) | 2.82 | 1.84 | 0.65 | 2.59 | 5.04 |
| Fund Age (in years) | 7.93 | 5.74 | 2 | 7 | 18 |
| Expense Ratio (%) | 1.30 | 0.59 | 0.69 | 1.21 | 2.09 |
| Turnover Ratio (%) | 80.15 | 76.27 | 19.00 | 56.00 | 155.00 |
| Income Yield (%) | 1.47 | 1.88 | 0.21 | 0.89 | 3.87 |
| Amount of Fund invested in Common Stocks (%) | 71.59 | 34.49 | 0.00 | 86.79 | 98,11 |
| Amount of Fund invested in Preferred Stocks (%) | 0.11 | 0.51 | 0.00 | 0.00 | 0.39 |
| Amount of Fund invested in All Bonds (%) | 4.30 | 19.84 | 0.00 | 0.00 | 0.58 |
| Amount of Fund invested in Convertible bonds (%) | 0.02 | 0.08 | 0.00 | 0.00 | 0.06 |
| Amount of Fund invested in Cash (%) | 4.93 | 12.50 | -2.60 | 2.31 | 11.42 |
| Amount of Fund invested in Other Securities (%) | 4.93 | 12.50 | -2.60 | 2.31 | 11.42 |
| Number of Funds | 744 | | | | |

## **Table 2:** Relation between regret and fund risk-shifting

This table presents the results of the following OLS regressions, in order:

$$RS_{i,t} = \alpha_{i,t} + \beta_{i,t}^{RREG}\left[R_{i,t-1} - \left(R_{Top\ Decile\ Peers,\ t-1}\right)\right] + Controls_{i,t}$$

$$RS_{i,t} = \alpha_{i,t} + \beta_{i,t}^{VREG}\left[\sigma^2_{i,t-1} - \left(\sigma^2_{Bottom\ Decile\ Peers,\ t-1}\right)\right] + Controls_{i,t}$$

$$RS_{i,t} = \alpha_{i,t} + \beta_{i,t}^{RREG}\left[R_{i,t-1} - \left(R_{Top\ Decile\ Peers,\ t-1}\right)\right] + \beta_{i,t}^{VREG}\left[\sigma^2_{i,t-1} - \left(\sigma^2_{Bottom\ Decile\ Peers,\ t-1}\right)\right] + Controls_{i,t}$$

$$RS_{i,t} = \alpha_{i,t} + \beta_{i,t}^{SRREG}\left[SR_{i,t-1} - \left(SR_{Top\ Decile\ Peers,\ t-1}\right)\right] + Controls_{i,t}$$

$$RS_{i,t} = \alpha_{i,t} + \beta_{i,t}^{IN/OUT} IN/OUT_{i,t-1} + Controls_{i,t}$$

where $RS_{i,t}$ is the risk shifting measure detailed in subsection 4.2, $R_{i,t-1}$ and $\sigma^2_{i,t-1}$ are respectively the return and the variance of the fund $i$ at time $t-1$, $R_{Top\ Decile\ Peers,\ t-1}$ and $\sigma^2_{Bottom\ Decile\ Peers,\ t-1}$ are the best outcomes of the peers, $SR_{i,t-1}$ is the Sharpe Ratio of the fund $i$ at time $t-1$, and $SR_{Top\ Decile\ Peers,\ t-1}$ as the best outcomes of the peers of the fund $i$, and $IN/OUT_{t+1}$ is the fund flow measure. Standard errors are presented in squared brackets. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

| | Fund Risk-Shifting | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Return Regret | -0.0704 | -0.0536 | | | -0.0095 | -0.0188 | | | | |
| | [0.4085] | [0.4130] | | | [0.4110] | [0.4156] | | | | |
| Variance Regret | | | -1.5077 | -0.8724 | -1.5048 | -0.8666 | | | | |
| | | | [1.1568] | [1.1353] | [1.1654] | [1.1432] | | | | |
| Sharpe Ratio Regret | | | | | | | -0.0048 | -0.00340 | | |
| | | | | | | | [0.0160] | [0.0161] | | |
| Fund In/Out | | | | | | | | | -0.0001 | -0.0001 |
| | | | | | | | | | [0.0004] | [0.0004] |
| Intercept | 0.0153 | 0.1709 *** | 0.0374 | 0.1955 *** | 0.0373 | 0.1953 *** | -1.6121 *** | 0.3045 ** | 0.0002 | 0.1622 *** |
| | [0.0734] | [0.0213] | [0.0751] | [0.0380] | [0.0754] | [0.0385] | [0.5064] | [0.1488] | [0.0875] | [0.0256] |
| Controls | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No |
| $R^2$ | 0.031 | 0.00 | 0.034 | 0.001 | 0.034 | 0.001 | 0.035 | 0.001 | 0.034 | 0.003 |

**Table 3:** Relation between regret and fund risk-shifting, for different client structures

This table presents the results of the same OLS regressions as in Table 2, however this time, each regression is depending on the client structure, as classified by CRSP. Panel A represents the results of those regressions for retail funds, while Panel B represents results for non-retail Funds. Standard errors are presented in squared brackets. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% percent levels, respectively.

| | Fund Risk-Shifting | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| **Panel A: Retail funds** | | | | | | | | | | |
| Return Regret | 0.1944 | 0.1593 | | | 0.1901 | 0.1540 | | | | |
| | [0.2691] | [0.2702] | | | [0.2678] | [0.2687] | | | | |
| Variance Regret | | | 0.3314 * | 1.4513 * | 1.3208 * | 1.4464 * | | | | |
| | | | [0.7659] | [0.7655] | [0.7666] | [0.7665] | | | | |
| Sharpe Ratio Regret | | | | | | | 0.0079 ** | 0.0057 | | |
| | | | | | | | [0.0041] | [0.0040] | | |
| Fund In/Out | | | | | | | | | -0.0616 | -0.0393 |
| | | | | | | | | | [0.0497] | [0.0494] |
| Intercept | 0.00322 | 0.1324 *** | -0.0128 | 0.0959 *** | -0.0094 | 0.0980 *** | -0.0231 | 0.1188 *** | -0.0456 | 0.1471 *** |
| | [0.0853] | [0.0281] | [0.0868] | [0.0337] | [0.0867] | [0.0339] | [0.0770] | [0.0236] | [0.1218] | [0.0408] |
| Controls | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No |
| $R^2$ | 0.043 | 0.002 | 0.040 | 0.002 | 0.041 | 0.003 | 0.046 | 0.005 | 0.043 | 0.004 |
| **Panel B: Non-retail funds** | | | | | | | | | | |
| Return Regret | -0.3164 | -0.4330 | | | 0.0557 | -0.2148 | | | | |
| | [0.7694] | [0.7891] | | | [0.7752] | [0.7989] | | | | |
| Variance Regret | | | -6.4546 *** | -4.0050 * | -6.4864 *** | -3.8939 | | | | |
| | | | [2.4017] | [2.3879] | [2.4457] | [2.4266] | | | | |
| Sharpe Ratio Regret | | | | | | | 0.0153 | 0.0086 | | |
| | | | | | | | [0.0129] | [0.0130] | | |
| Fund In/Out | | | | | | | | | -0.0001 | -0.0001 |
| | | | | | | | | | [0.0004] | [0.0005] |
| Intercept | -0.3132 ** | 0.2234 *** | -0.2274 | 0.3406 *** | -0.2270 | 0.3369 | -0.2850 ** | 0.2128 *** | -0.2198 | 0.1937 *** |
| | [0.1598] | [0.0380] | [0.1613] | [0.0790] | [0.1617] | [0.0802] | [0.1420] | [0.0347] | [0.2135] | [0.0500] |
| Controls | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No |
| $R^2$ | 0.065 | 0.001 | 0.084 | 0.008 | 0.084 | 0.009 | 0.058 | 0.001 | 0.059 | 0.001 |

**Table 3:** Relation between regret and fund risk-shifting, for different client structures (cont.)

This table presents the results of the same OLS regressions as in Table 2, however this time, each regression is depending on the client structure, as classified by CRSP. Panel A represents the results of those regressions for retail funds, while Panel B represents results for non-retail Funds. Standard errors are presented in squared brackets. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% percent levels, respectively.

| | Fund Risk-Shifting | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| **Panel C: Institutional funds** | | | | | | | | | | |
| Return Regret | -0.7098<br>[0.6752] | -0.8269<br>[0.6871] | | | -0.4969<br>[0.6845] | -0.7176<br>[0.6977] | | | | |
| Variance Regret | | | -4.1017 *<br>[2.1773] | -2.3551<br>[2.1327] | -3.8110 *<br>[2.2154] | -1.9721 *<br>[2.1648] | | | | |
| Sharpe Ratio Regret | | | | | | | 0.0065 **<br>[0.0115] | 0.00001<br>[0.0115] | | |
| Fund In/Out | | | | | | | | | -0.0001<br>[0.0004] | -0.00003<br>[0.0004] |
| Intercept | -0.2066<br>[0.1405] | 0.1971 ***<br>[0.0333] | -0.1573<br>[0.1424] | 0.2684 ***<br>[0.0713] | -0.1610<br>[0.1426] | 0.2556 ***<br>[0.0723] | -0.1862<br>[0.1256] | 0.1871 ***<br>[0.0307] | -0.08011<br>[0.2051] | 0.1711 ***<br>[0.0524] |
| Controls | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No |
| $R^2$ | 0.055 | 0.004 | 0.062 | 0.004 | 0.064 | 0.007 | 0.046 | 0.000 | 0.041 | 0.001 |
| **Panel D: Non-institutional funds** | | | | | | | | | | |
| Return Regret | 0.6431<br>[0.4560] | 0.5812<br>[0.4557] | | | 0.6421<br>[0.4561] | 0.5795<br>[0.4557] | | | | |
| Variance Regret | | | 0.7293<br>[1.3197] | 0.8056<br>[1.3103] | 0.7360<br>[1.3164] | -0.8090<br>[1.3081] | | | | |
| Sharpe Ratio Regret | | | | | | | 0.0138 **<br>[0.0070] | 0.0107<br>[0.0069] | | |
| Fund In/Out | | | | | | | | | -0.0707<br>[0.0817] | -0.0399<br>[0.0806] |
| Intercept | -0.0152<br>[0.1637] | 0.1855 ***<br>[0.0521] | -0.0318<br>[0.1644] | 0.1593 ***<br>[0.0602] | -0.0229<br>[0.1656] | 0.1668<br>[0.0608] | 0.0002<br>[0.1301] | 0.1560 ***<br>[0.0391] | -0.0651<br>[0.2218] | 0.2135 ***<br>[0.0750] |
| Controls | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No |
| $R^2$ | 0.035 | 0.006 | 0.028 | 0.001 | 0.033 | 0.003 | 0.040 | 0.008 | 0.031 | 0.002 |

**Table 4:** Relation between regret and fund flows

This table presents the results of the following OLS regressions, in order:

$$IN/OUT_{i,t} = \alpha_{i,t} + \beta_{i,t}^{RREG}\left[R_{i,t-1} - (R_{Top\ Decile\ Peers,\ t-1})\right] + Controls_{i,t}$$
$$IN/OUT_{i,t} = \alpha_{i,t} + \beta_{i,t}^{VREG}\left[\sigma_{i,t-1}^2 - \left(\sigma_{Bottom\ Decile\ Peers,\ t-1}^2\right)\right] + Controls_{i,t}$$
$$IN/OUT_{i,t} = \alpha_{i,t} + \beta_{i,t}^{RREG}\left[R_{i,t-1} - (R_{Top\ Decile\ Peers,\ t-1})\right]$$
$$+\beta_{i,t}^{VREG}\left[\sigma_{i,t-1}^2 - \left(\sigma_{Bottom\ Decile\ Peers,\ t-1}^2\right)\right] + Controls_{i,t}$$
$$IN/OUT_{i,t} = \alpha_{i,t} + \beta_{i,t}^{SRREG}\left[SR_{i,t-1} - (SR_{Top\ Decile\ Peers,\ t-1})\right] + Controls_{i,t}$$
$$IN/OUT_{i,t} = \alpha_{i,t} + \beta_{i,t}^{RS} RS_{i,t-1} + Controls_{i,t}$$

where $RS_{i,t}$ is the risk shifting measure detailed in subsection 4.2, $R_{i,t-1}$ and $\sigma_{i,t-1}^2$ are respectively the return and the variance of the fund $i$ at time $t-1$, $R_{Top\ Decile\ Peers,\ t-1}$ and $\sigma_{Bottom\ Decile\ Peers,\ t-1}^2$ are the best outcomes of the peers, $SR_{i,t-1}$ is the Sharpe Ratio of the fund $i$ at time $t-1$, and $SR_{Top\ Decile\ Peers,\ t-1}$ as the best outcomes of the peers of the fund $i$, and $IN/OUT_{t+1}$ is the fund flow measure. Standard errors are presented in squared brackets. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

| | Fund Flows (In/Out) | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Return Regret | 74.9315 * | | 68.48431 * | | |
| | [39.7879] | | [40.0219] | | |
| Variance Regret | | 181.5825 | 159.3036 | | |
| | | [112.8889] | [113.4682] | | |
| Sharpe Ratio Regret | | | | 0.4925 | |
| | | | | [0.6765] | |
| Fund Risk-Shifting | | | | | 0.0018 |
| | | | | | [0.4825] |
| Intercept | 1.5925 | -1.6378 | -0.7421 | 1.0019 | 0.9652 |
| | [7.1521] | [7.3299] | [7.3376] | [7.1613] | [7.2358] |
| Controls | Yes | Yes | Yes | Yes | Yes |
| $R^2$ | 0.007 | 0.006 | 0.0101 | 0.002 | 0.002 |

**Table 5:** Relation between regret and fund flows, for different client structures

This table presents the results of the same OLS regressions as in Table 4, however this time, each regression is depending on the client structure, as classified by CRSP. Panel A represents the results of those regressions for retail funds, while Panel B represents results for non-retail Funds. Standard errors are presented in squared brackets. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% percent levels, respectively.

| | Fund Flows (In/Out) | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| **Panel A: Retail funds** | | | | | |
| Return Regret | 0.6630 ** | | 0.6829 ** | | |
| | [0.3060] | | [0.3057] | | |
| Variance Regret | | -1.1358 | -1.2177 | | |
| | | [0.8344] | [0.8293] | | |
| Sharpe Ratio Regret | | | | 0.0046 | |
| | | | | [0.0048] | |
| Fund Risk-Shifting | | | | | -0.0410 |
| | | | | | [0.0672] |
| Intercept | 0.0082 | -0.0026 | 0.0134 | -0.0044 | -0.0062 |
| | [0.0625] | [0.0625] | [0.0625] | [0.0626] | [0.0626] |
| Controls | Yes | Yes | Yes | Yes | Yes |
| $R^2$ | 0.037 | 0.027 | 0.045 | 0.024 | 0.022 |
| **Panel B: Non-retail funds** | | | | | |
| Return Regret | 158.5195 ** | | 137.0543 * | | |
| | [80.8959] | | [82.1190] | | |
| Variance Regret | | 452.4657 * | 374.2287 | | |
| | | [255.4724] | [259.0626] | | |
| Sharpe Ratio Regret | | | | 1.2658 | |
| | | | | [1.5523] | |
| Fund Risk-Shifting | | | | | -3.5143 |
| | | | | | [5.8438] |
| Intercept | -3.4100 | -9.4977 | -8.3811 | -3.3972 | -4.5255 |
| | [16.8047] | [17.1595] | [17.1265] | [16.8854] | [16.9780] |
| Controls | Yes | Yes | Yes | Yes | Yes |
| $R^2$ | 0.014 | 0.012 | 0.021 | 0.005 | 0.004 |

**Table 5:** Relation between regret and fund flows, for different client structures (Cont.)

This table presents the results of the same OLS regressions as in Table 2, however this time, each regression is depending on the client structure, as classified by CRSP. Panel A represents the results of those regressions for retail funds, while Panel B represents results for non-retail Funds. Standard errors are presented in squared brackets. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% percent levels, respectively.

| | Fund Flows (In/Out) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | | (2) | | (3) | | (4) | | (5) |
| **Panel C: Institutional funds** | | | | | | | | | |
| Return Regret | 159.3538 | * | | | 138.4437 | * | | | |
| | [82.2914] | | | | [83.5513] | | | | |
| Variance Regret | | | 455.3875 | * | 374.3864 | | | | |
| | | | [266.686] | | [270.4234] | | | | |
| Sharpe Ratio Regret | | | | | | | 1.2811 | | |
| | | | | | | | [1.5821] | | |
| Fund Risk-Shifting | | | | | | | | | -3.6398 |
| | | | | | | | | | [6.1697] |
| Intercept | -4.1258 | | -9.6505 | | -8.6045 | 1-4.1665 | | -5.1613 | |
| | [17.1251] | | [17.4396] | | [17.4041] | | [17.2068] | | [17.2890] |
| Controls | Yes | | Yes | | Yes | | Yes | | Yes |
| $R^2$ | 0.015 | | 0.012 | | 0.021 | | 0.005 | | 0.004 |
| **Panel D: Non-Institutional funds** | | | | | | | | | |
| Return Regret | 0.6534 | ** | | | 0.6712 | ** | | | |
| | [0.3008] | | | | [0.3006] | | | | |
| Variance Regret | | | -1.0632 | | -1.1398 | | | | |
| | | | [0.8170] | | [0.8121] | | | | |
| Sharpe Ratio Regret | | | | | | | 0.0044 | | |
| | | | | | | | [0.0047] | | |
| Fund Risk-Shifting | | | | | | | | | -0.0332 |
| | | | | | | | | | [0.0489] |
| Intercept | 0.0081 | | -0.0026 | | 0.0130 | | -0.0044 | | -0.0061 |
| | [0.0617] | | [0.0617] | | [0.0617] | | [0.0618] | | [0.0618] |
| Controls | Yes | | Yes | | Yes | | Yes | | Yes |
| $R^2$ | 0.035 | | 0.025 | | 0.042 | | 0.022 | | 0.021 |

**Table 6:** Relation between regret and fund risk-shifting (Robustness test)

This table presents the results of the following OLS regressions, in order:

$$RS_{i,t} = \alpha_{i,t} + \beta_{i,t}^{RREG_B}\left[R_{i,t-1} - \left(R_{Benchmark,\ t-1}\right)\right] + Controls_{i,t}$$
$$RS_{i,t} = \alpha_{i,t} + \beta_{i,t}^{VREG_B}\left[\sigma^2_{i,t-1} - \left(\sigma^2_{Benchmark,\ t-1}\right)\right] + Controls_{i,t}$$
$$RS_{i,t} = \alpha_{i,t} + \beta_{i,t}^{RREG_B}\left[R_{i,t-1} - \left(R_{Benchmark,\ t-1}\right)\right] + \beta_{i,t}^{VREG_B}\left[\sigma^2_{i,t-1} - \left(\sigma^2_{Benchmark,\ t-1}\right)\right] + Controls_{i,t}$$

where $RS_{i,t}$ is the risk shifting measure detailed in subsection 4.2, $R_{i,t-1}$ and $\sigma^2_{i,t-1}$ are respectively the return and the variance of the fund $i$ at time $t-1$, $R_{Benchmark,\ t-1}$ and $\sigma^2_{Benchmark,\ t-1}$ are respectively the return and the variance of the potential benchmark identified following the methodology detailed in section 5. Standard errors are presented in squared brackets. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

| | Fund Risk-Shifting | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Return Regret | -0.2958 | | -0.3044 |
| | [0.1345] | | [0.1348] |
| Variance Regret | | 0.1453 | 0.2677 |
| | | [0.2939] | [0.2817] |
| Intercept | -0.0933 | -0.0226 | -0.0141 |
| | [0.0200] | [0.1911] | [0.2056] |
| Controls | Yes | Yes | Yes |
| $R^2$ | 0.37 | 0.22 | 0.37 |

**Table 7:** Relation between regret and fund risk-shifting, for different client structures (Robustness test)

This table presents the results of the same OLS regressions as in Table 6, however this time, each regression is depending on the client structure, as classified by CRSP. Panel A represents the results of those regressions for retail funds, Panel B represents results for non-retail Funds, Panel C represent institutional funds' results and Panel D, non-institutional funds' results. Standard errors are presented in squared brackets. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% percent levels, respectively.

| | Fund Risk-Shifting | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| **Panel A: Retail funds** | | | |
| Return Regret | -0.1288 | | -0.1223 |
| | [0.1737] | | [0.1741] |
| Variance Regret | | 0.4358 | 0.4886 |
| | | [0.4227] | [0.3719] |
| Intercept | 0.0280 | 0.0947 | 0.0191 |
| | [0.0299] | [0.2833] | [0.0305] |
| Controls | Yes | Yes | Yes |
| $R^2$ | 0.11 | 0.06 | 0.11 |
| **Panel B: Non-retail funds** | | | |
| Return Regret | 0.0007 | | -0.0098 |
| | [0.1025] | | [0.1031] |
| Variance Regret | | 0.1958 | 0.3970 * |
| | | [0.2502] | [0.2032] |
| Intercept | 0.0237 | -0.0204 | 0.0168 |
| | [0.0106] | [0.0140] | [0.0112] |
| Controls | Yes | Yes | Yes |
| $R^2$ | 0.69 | 0.40 | 0.70 |
| **Panel C: Institutional funds** | | | |
| Return Regret | 0.0049 | | -0.0036 |
| | [0.1067] | | [0.1071] |
| Variance Regret | | 0.1617 | 0.3743 * |
| | | [0.2597] | [0.2817] |
| Intercept | 0.0263 ** | 0.0232 | 0.0197 |
| | [0.0108] | [0.0144] | [0.0115] |
| Controls | Yes | Yes | Yes |
| $R^2$ | 0.68 | 0.39 | 0.69 |
| **Panel D: Non-institutional funds** | | | |
| Return Regret | -0.1224 | | -0.1170 |
| | [0.1676] | | [0.1680] |
| Variance Regret | | 0.4566 | 0.5105 |
| | | [0.4117] | [0.3617] |
| Intercept | 0.0217 | 0.0077 | 0.0167 |
| | [0.0293] | [0.0277] | [0.0299] |
| Controls | Yes | Yes | Yes |
| $R^2$ | 0.11 | 0.006 | 0.11 |

**Table 8:** Relation between regret and fund flows (Robustness test)

This table presents the results of the following OLS regressions, in order:

$$IN/OUT_{i,t} = \alpha_{i,t} + \beta_{i,t}^{RREG_B}\left[R_{i,t-1} - \left(R_{Benchmark,\ t-1}\right)\right] + Controls_{i,t}$$
$$IN/OUT_{i,t} = \alpha_{i,t} + \beta_{i,t}^{VREG_B}\left[\sigma^2_{i,t-1} - \left(\sigma^2_{Benchmark,\ t-1}\right)\right] + Controls_{i,t}$$
$$IN/OUT_{i,t} = \alpha_{i,t} + \beta_{i,t}^{RREG_B}\left[R_{i,t-1} - \left(R_{Benchmark,\ t-1}\right)\right] + \beta_{i,t}^{VREG_B}\left[\sigma^2_{i,t-1} - \left(\sigma^2_{Benchmark,\ t-1}\right)\right] + Controls_{i,t}$$

where $IN/OUT_{i,t}$ is the fund flow measure, $R_{i,t-1}$ and $\sigma^2_{i,t-1}$ are respectively the return and the variance of the fund $i$ at time $t-1$, $R_{Benchmark,\ t-1}$ and $\sigma^2_{Benchmark,\ t-1}$ are respectively the return and the variance of the potential benchmark identified following the methodology detailed in section 5. Standard errors are presented in squared brackets. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

| | Fund Flows (In/Out) | | | | | |
|---|---|---|---|---|---|---|
| | (1) | | (2) | | (3) | |
| Return Regret | 98.6676 | ** | | | 102.1726 | ** |
| | [42.0527] | | | | [41.3046] | |
| Variance Regret | | | -183.8289 | ** | -238.1369 | *** |
| | | | [85.3547] | | [76.5782] | |
| Intercept | -27.1826 | *** | -28.0587 | *** | -22.8804 | *** |
| | [4.4936] | | [5.3341] | | [4.7626] | |
| Controls | Yes | | Yes | | Yes | |
| $R^2$ | 0.47 | | 0.33 | | 0.48 | |

**Table 9:** Relation between regret and fund flows, for different client structures (Robustness test)

This table presents the results of the same OLS regressions as in Table 8, however this time, each regression is depending on the client structure, as classified by CRSP. Panel A represents the results of those regressions for retail funds, Panel B represents results for non-retail Funds, Panel C represent institutional funds' results and Panel D, non-institutional funds' results. Standard errors are presented in squared brackets. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% percent levels, respectively.

| | Fund Flows (In/Out) | | | | | |
|---|---|---|---|---|---|---|
| | (1) | | (2) | | (3) | |
| **Panel A: Retail funds** | | | | | | |
| Return Regret | 79.5635 | | | | 79.6334 | |
| | [50.3991] | | | | [50.5149] | |
| Variance Regret | | | -275.0437 | *** | -288.273 | *** |
| | | | [85.1411] | | [92.6580] | |
| Intercept | -16.2369 | *** | -8.4893 | | -11.7208 | ** |
| | [5.7081] | | [5.5121] | | [5.9006] | |
| Controls | Yes | | Yes | | Yes | |
| $R^2$ | 0.38 | | 0.18 | | 0.40 | |
| **Panel B: Non-retail funds** | | | | | | |
| Return Regret | 135.6817 | * | | | 137.2008 | * |
| | [81.4229] | | | | [78.6432] | |
| Variance Regret | | | -100.8554 | | -144.7226 | |
| | | | [200.4634] | | [172.5155] | |
| Intercept | -52.8308 | *** | -64.7001 | *** | -48.9100 | *** |
| | [9.9013] | | [11.1750] | | [0.006] | |
| Controls | Yes | | Yes | | Yes | |
| $R^2$ | 0.59 | | 0.54 | | 0.59 | |
| **Panel C: Institutional funds** | | | | | | |
| Return Regret | 121.1947 | | | | 122.499 | |
| | [86.045] | | | | [83.1039] | |
| Variance Regret | | | -88.3554 | | -131.6556 | |
| | | | [209.561] | | [180.9814] | |
| Intercept | -55.8773 | *** | -68.1585 | *** | -52.0806 | *** |
| | [10.3146] | | [11.5695] | | [11.0124] | |
| Controls | Yes | | Yes | | Yes | |
| $R^2$ | 0.63 | | 0.57 | | 0.63 | |
| **Panel D: Non-institutional funds** | | | | | | |
| Return Regret | 90.0375 | * | | | 90.5561 | * |
| | [48.5684] | | | | [48.6773] | |
| Variance Regret | | | -272.2552 | *** | -288.2831 | *** |
| | | | [82.9474] | | [90.0658] | |
| Intercept | -16.0186 | *** | -8.4465 | | -11.4633 | ** |
| | [5.5828] | | [5.3970] | | [5.7710] | |
| Controls | Yes | | Yes | | Yes | |
| $R^2$ | 0.36 | | 0.17 | | 0.39 | |

# Appendix

**Table A.1**
**Thomson Reuters Investment Objective Codes**

This table gives the Investment Objective Codes as provided by Thomson Reuters. The primary source for the Thomson Reuters mutual fund holdings data is SEC N-30D filings. These filings, which include semi-annual reports to shareholders, are required to be filed with the SEC twice a year by mutual fund companies. The Investment Objective Code is reported with the fund characteristics.

| Code | Investment Objective |
|---|---|
| 1 | International |
| 2 | Aggressive Growth |
| 3 | Growth |
| 4 | Growth and Income |
| 5 | Municipal bonds |
| 6 | Bonds and Preferred |
| 7 | Balanced |
| 8 | Metals |
| 9 | Unclassified |

**Table A.2**
**CRSP Objective Codes**

The CRSP US Survivor-Bias-Free Mutual Funds database includes style and objective codes from three different sources: Wiesenberger Objective codes, Strategic Insight Objective codes and Lipper Objective codes. The CRSP Style Code consists of up to four characters, with each position defined. Reading Left to Right, the four codes represent an increasing level of granularity. For example, a code for a particular mutual fund is EDYG, where: E = Equity, D = Domestic, Y = Style, G = Growth. Codes with less than four characters exist, and it simply means that they are defined to a less granular level[16]. The CRSP Objective Codes used in the robustness tests are:

| CRSP Code | Level 1 | Level 2 | Level 3 | Level 4 |
|---|---|---|---|---|
| EDCI | Equity | Domestic | Cap-based | Micro Cap |
| EDCL | Equity | Domestic | Cap-based | Large Cap |
| EDCM | Equity | Domestic | Cap-based | Mid Cap |
| EDCS | Equity | Domestic | Cap-based | Small Cap |
| EDYB | Equity | Domestic | Style | Growth and Income |
| EDYG | Equity | Domestic | Style | Growth |
| EDYH | Equity | Domestic | Style | Hedged |
| EDYI | Equity | Domestic | Style | Income |
| EDYS | Equity | Domestic | Style | Short |
| I | Fixed Income | | | |
| IC | Fixed Income | Corporate | | |
| ICDI | Fixed Income | Corporate | Duration | Intermediate |
| ICDS | Fixed Income | Corporate | Duration | Short |
| ICQH | Fixed Income | Corporate | Quality | High Quality |
| ICQM | Fixed Income | Corporate | Duration | Medium Quality |
| ICQY | Fixed Income | Corporate | Duration | High Yield |
| IF | Fixed Income | Foreign | | |
| IFM | Fixed Income | Foreign | Money Market | |
| IG | Fixed Income | Government | | |
| IM | Fixed Income | Money Market | | |
| IU | Fixed Income | Municipals | | |
| M | Mixed FI and Equity | | | |

[16]This definition is given by the CRSP Survivor-Bias-Free US Mutual Fund Database Guide for SAS and ASCII