Do Mutual Fund Investors Still Trust Standard Risk-Adjusted Performance Measures?

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Abstract

We study the relationship between the past performance of mutual funds and their capital flows (i.e. their subscriptions and redemptions). Testing the most traditional risk-adjusted performance measures, we identify the ones which best explain the flows of US equity mutual funds. The risk-adjusted performance measures which have the highest explanatory power are Jensen's alpha, the Sharpe ratio and the M-squared. We observe that the average excess return carry more or less the same explanatory power than the previous measures. We may conclude that fund managers who want to maximize their assets under management must mainly focus their efforts on improving these standard performance measures. In the same time, they must pay attention to their raw performance as well as their tracking error. Furthermore, we demonstrate that, even in a period of turbulent markets, the flow-performance relation remain convex, leading fund managers to shift risks at the end of the year in order to finish among the top performers.

Keywords: Mutual funds; Flows; Risk-adjusted performance measures.

JEL classification: G11; G12

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1 Introduction

Numerous studies have been carried out on the relationship between fund asset flows and past performance. In the seventies, Spitz (1970) and Smith (1978) found a positive linear relationship between a fund's past performance and its money flows. Since the beginning of the nineties, researchers focus on the potential nonlinearity of the relationship. Several papers concerning mutual funds, as those of Chevalier and Ellison (1997) and Sirri and Tufano (1998), report convex relations for sample periods spanning the seventies, eighties and nineties. Various measures of raw and risk-adjusted performance are used in these papers. However, no author has singled out a particular performance measure for its distinctive efficiency in explaining the flow-performance relationship. Two key issues are examined in this paper. First, using recent data including the crisis period, we attempt to identify the risk-adjusted performance measures which best explain capital flows. Second, we explore the shape of the flow-performance relationship in these agitated years.

First signs of nonlinearities appear with the paper of Ippolito (1992) who demonstrates that the slope of the relationship is stronger for funds with positive rather than negative excess return. Sirri and Tufano (1998) also show that flows are much less sensitive to past return for poor performers. They study the flows of funds into and out of 690 equity mutual funds for the 1971-1990 period and they report a highly convex relationship between a fund's growth rate and its past performance, as measured by return, excess return and Jensen's alpha.

A potential agency conflict between mutual fund investors and mutual fund companies is highlighted by Chevalier and Ellison (1997). They argue that, although investors would expect mutual fund companies to use their judgments to maximize their risk-adjusted expected returns, fund managers are guided by their own profits. Since managers' compensation usually include a fixed percentage of asset under management, they have an incentive to take all required actions to maximize the total assets of the fund. The shape of the flow-performance relationship (percentage flow vs. prior year excess return) is analyzed for a sample of growth and growth and income funds containing 3,036 fund-years observed over the period 1982-1992. The authors report significant nonlinearities, with the overall sensitivity of the relationship and its shape depending on the fund age. Their estimates indicate that incentives to alter the riskiness of their portfolios are stronger for young funds than for older funds. Young funds have an incentive to gamble and try to catch the market if they are few points behind. They may also have an incentive to play it safe if they are few points ahead of the market. The strongest incentive is for the funds which are well ahead of the market. Those tend to gamble in an attempt to be listed as "top performers" of the year.

Lynch and Musto (2003) focus on explaining why the relationship is convex. They first argue that the relation between past and future performance of all but the worst funds is also convex. Second, they show that the convexity of the flow-performance relation is a direct consequence from the strategic environment of financial advisors. These tend to discard strategies with bad past performance. Therefore, future performance and net new investment are relatively insensitive to past returns, which leads to the convexity in the flow performance-relationship.

For the 1987-1994 period, Del Guercio and Tkac (2002) compare the relationship between asset flow and past performance in the pension fund and mutual fund segments of the money management industry. Based on surveys realized in the mid-nineties, they identify three likely differences in the flow-performance relation of pensions funds and mutual funds. First, they report that tracking error and performance relative to a market index are likely to be related to the flows of pension funds (and not the flows of mutual funds), both because of their incorporation of risk adjustments and because of agency problems between a company's senior corporate management, its corporate treasurer and the outside pension fund managers. Since the corporate treasurer must defend his choices in front of senior management in the event of poor performance, he may be tempted to choose pension fund managers and strategies that decrease his own job risk. For example, the corporate treasurer might choose pension fund managers who beat their market benchmark regularly, even if those are not top performers among their peers, because outperforming a benchmark may be a convincing evidence of competency, if the treasurer is called by the senior management to justify his decisions. Tracking error captures a similar idea because it dynamically measures the volatility of a portfolio's deviation from benchmark returns. Second, risk-adjusted and quantitative performance measures, such as Jensen's alpha and tracking error, are likely to be related to flow in the pension segment. Third, the flows of mutual funds are likely to be more closely related to raw returns and summary performance measures, such as Morningstar's stars. Although their hypothesizes regarding the pension fund segment were verified, this was not the case for mutual funds. They report that mutual fund flow is unrelated to tracking error and has a strong relationship with excess return, but they also find a significant positive relation between asset flows and Jensen's alpha. While this result is consistent with previous literature, it is surprising given survey evidence that mutual fund investors did not use risk-adjusted performance measures when assessing funds. The authors provide evidence suggesting that the strong statistical relation between mutual fund flow and Jensen's alpha is due to a high correlation between alpha and Morningstar's star rating. Finally, they also report a flow-performance relation which is highly convex for mutual funds, implying that in this segment winners take all.

Through its methodology, our paper is closely related to the work of Del Guercio and Tkac (2002). Hence, we will be able to compare our results for the period 2004-2010 with those they obtained for the period 1987-1994. We work with a sample of 1,137 mutual funds and we propose to analyze the relationship between performance and asset flows. Since the performance literature does not specify which measures are most appropriate, we will test 9 traditional risk-adjusted measures and 3 measures of raw performance. We are interested in both the individual explanatory power of the specified performance measures and by the general shape of the relation in this period of high volatility.

The introduction provided the reader with key concepts to understand the studied relation. The rest of this paper is organized as follows. Section 2 presents survey information from which we build our assumptions. Section 3 presents our sample of mutual fund managers, as well as the measures of flows and the measures of raw and risk-adjusted performance used in the in this study. In Section 4, we try to pinpoint which measure(s) of past performance best explain(s) mutual fund flows and we analyze the shape of the relation. The last section concludes.

2 Survey information

According to a survey[1] realized by the Investment Company Institute in 2006, investors consider a wide range of information before purchasing mutual fund shares. They most frequently review or ask questions about a fund's fees and expenses (74%) and its historical performance (69%). 61% of the panel pay attention to the fund risk and 55% look at the fund performance compared to an index. After purchasing mutual fund, they most frequently are interested in the fund performance (76%) and 35% of the investors pay attention to the fund's ranking among similar funds. Shareholders consult a variety of sources for mutual fund information before and after purchasing shares and one of these sources is usually a professional financial adviser. Shareholders primarily turn to advisers for assistance in understanding and interpreting fund information. Shareholders look for concise investment information and, where possible, graphic presentations. Most shareholders do not consult fund prospectuses or annual reports which they find too long and difficult to understand. Investors choose to work with professional financial advisers because advisers have expertise in areas investors do not. Although it seems likely that few mutual fund investors use risk-adjusted performance measures, it is more likely that their financial advisors consider these measures before advising their clients.

Surveys realized in December 2007 and 2010, regarding the opinion of investors of the mutual fund industry, have two common findings. Mutual fund owners report that investment performance is the most influential of the many factors that shape their opinions of the fund industry. The "favorability" rating of mutual fund companies moves with stock market performance as measured by the level of the S&P500 (investors have a better opinion of the industry when the level of the S&P500 is high).

3 Data description

Using Bloomberg's screener, we create a selection of equity mutual funds in value and growth investment categories. We retrieve information about total net assets, returns and non-performance manager characteristics for the period 2001-2010. We keep only funds which have at least four years of consecutive monthly returns with the last observation corresponding to the end of a given year. This allows us to compute performance measures over a three year period ending in December and to use this observation of past performance to predict the annual flow of the following year. We also retrieve the fund inception date in order to compute the fund age.

3.1 Measures of flows

We use two measures of flow. The first is the annual net dollar flow, defined as the change in total net assets minus appreciation. The second is the net percentage flow which scales net dollar flow by total net assets in year $t-1$. This second measure can be interpreted as the

[1] The survey information comes from the following publications of the Investment Company Institute: "Understanding Investor Preferences for Mutual Fund Information" (August, 2006), "Why Do Mutual Fund Investors Use Professional Financial Advisers?" (April, 2007), "Shareholder Sentiment About the Mutual Fund Industry, 2007", "Ownership of Mutual Funds, Shareholder Sentiment, and Use of the Internet, 2010".

percentage growth of a fund that is due to new investments. Formally, we have:

$$Dollar\ flow_{i,t} = TNA_{i,t} - TNA_{i,t-1}(1 + R_{i,t}) \tag{1}$$

$$Percentageflow_{i,t} = \frac{Dollar\ flow_{i,t}}{TNA_{i,t-1}} \tag{2}$$

where $TNA_{i,t}$ is fund i's total net assets and $R_{i,t}$ is the fund's return over the prior year. Since we have no information regarding the timing of new investments, we assume that new money comes in at the end of each year. Young and small funds Chevalier and Ellison (1997), as well as fund mergers and splits Elton et al. (2001), may lead to extreme values of flows. Similarly to Huang et al. (2007), we filter out the top and bottom 1% tails of the dollar and percentage flow data in order to prevent a potential impact from these outliers.

Most papers in the mutual fund flow-performance literature analyzed only percentage flows. Del Guercio and Tkac (2002) focus on the dollar measure because it better addresses their question of interest: "what drives investment dollars across the two industry segments (pension fund and mutual fund)?" They note that in previous studies, percentage flow may be preferable when dollar flow is positively related to fund size, whereby larger funds attract higher flows regardless of performance. While they indeed observed a strong positive univariate correlation between dollar flows and fund size in the mutual fund segment, the pension fund segment displayed the opposite relation. The univariate correlation between fund size and dollar flow was a statistically significant -0.314. Controlling for a potential size effect in a multiple regression format, rather than by scaling the flows, preserves this information for analysis. We observed that in our recent period of study mutual fund dollar flows are no longer positively related to the total net assets. We even observe a significant negative correlation between dollar flows and total net assets which justifies the use of the dollar flow measures and the use of asset size as a control variable (see Table 1).

3.2 Measures of performance

Since a goal of this paper is to infer which performance measures best predict asset flows, we test a set of traditional (Jensen's alpha, Sharpe's ratio,...) and more sophisticated (mutli-factor alpha, Sharpe MVaR,...) performance measures. We test the three same performance measures as Del Guercio and Tkac (2002) in order to compare the results they obtain for the sample period 1987-1994 with those we obtain on more recent data (2004-2010). Jensen (1968)'s alpha and excess return over the S&P500[2] are used respectively to test the influence of risk-adjusted and raw past performance on the funds' asset flows. The tracking error is also used to test the importance for a mutual fund manager to follow a benchmark. Moreover, we test 8 other risk-adjusted performance measures: Sharpe (1966)'s ratio, M-squared (Modigliani and Modigliani, 1997), Sortino ratio (Sortino and Price, 1994), Sharpe MVaR (Gregoriou and Gueyie, 2003), Treynor (1965)'s ratio, one-factor information ratio or "appraisal ratio" (Treynor and Black, 1973), four-factor alpha, four-factor information ratio. We also test two other measures of raw performance: the annual return and the average excess return over the risk-free rate. Excess return over the S&P500 and annual return are computed from prior year data. All other measures are computed using a 36-month time window. For the metrics of our analysis which rely on the one-factor model, we build the market risk premium as the

[2] For a discussion on the S&P500 as the benchmark in the analysis, see Del Guercio and Tkac (2002).

difference between the S&P500 and the risk-free rate. For the four-factor model, we augment the single-factor model with the size and book-to-market factors of Fama and French (1993) as well as the Carhart (1997) momentum factor available on the Kenneth French's website[3]. All the performance measures are annualized, and lagged so as to be observable to the client before the purchasing or selling decision. Another reason, underlined by Del Guercio and Tkac (2002), to use only lagged performance measures is to decrease the possibility that we are capturing the effect of flows on performance, rather than the effect of performance on flows. Edelen (1999) demonstrates that the additional trading costs and the cash balances necessary to manage flow affect fund performance. Thus, funds with higher asset flows this year may be more likely to have poorer performance this year, which in turn could impact the flows of the following year. We control for this possibility by including lagged flow in all our regressions. We also control for the impact of the fund age[4], as Chevalier and Ellison (1997) show that this variable influences the shape of flow-performance relationship.

3.3 Summary statistics

At the end, we have a total of 1,137 funds and 3,719 observations (manager-years) spanning the period 2004-2010[5]. Among our fund sample, 77% are still active at the end of the sample period (23% are dead) and 56% are growth funds (44% are value funds). Since our sample of fund managers contains both active and dead funds, our results will not suffer from any survivorship bias[6]. Because managers join the database at different times in their history (i.e., not just when the fund starts up initially), our results may suffer from back-fill bias. For example, managers may have a greater incentive to volunteer information to Bloomberg after a period of good performance. However, a back-fill bias is likely to be less severe in a study of the relation between flow and performance than in a study that attempts to characterize the average performance of fund managers (Del Guercio and Tkac, 2002).

Descriptive statistics about manager characteristics are reported in Table 1 and Table 2 shows the correlations between these variables.

[Insert Table 1 here]

[Insert Table 2 here]

The typical mutual fund manager has $234 million of assets under management but the distribution has a strong positive skewness. Del Guercio and Tkac (2002) also report an asset size distribution which is positively skewed and the median for their sample period was $167.9 million. These same authors report a dollar flow distribution which is centered approximately at zero and appears to be asymmetric. The top 5% experience net inflows nearly three times larger than the outflows at the bottom 5%. In contrast, the distribution of

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[3]Size and the book-to-market factors as well as the risk-free rate are retrieved from the Kenneth French's website: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

[4]Fund age is obtained as the number of complete years between the fund's inception date and the beginning of the year in which we measure the flow.

[5]The period 2001-2003 is used to compute the performance measures which should explain the flows of 2004.

[6]In any case, several studies, including those of Sirri and Tufano (1998), Chevalier and Ellison (1997) and Goetzmann and Peles (1997), have confirmed that survivorship bias does not affect inferences on the flow-performance relationship.

flows is more symmetric in this study and the median dollar flow is negative (-$9.5 million). This is explained by the massive withdrawals that occurred as a consequence of the recent crisis.

The correlation analysis reveals several facts. First, all variables that we want to use in order to explain the flows are correlated (at least at the 10% level) with both dollar and percentage flows. Performance measures and lagged flows are positively correlated with dollar and percentage flows, while the fund's age and asset size are negatively correlated with the flows. Performance measures which share similarities (those using the average return as numerator on one side and those involving alpha and its derivatives on the other side) exhibit high pairwise correlations. These measures will not be used simultaneously in our regressions and the other pairwise correlations are not high enough to cause concern over multicollinearity problems in our regressions.

4 Analysis of the flow-performance relationship

4.1 Which measures of past performance best explain capital flows?

In this section, we are interested in determining which measures of past performance explain mutual fund inflows and outflows most effectively.

In order to observe which raw and risk-adjusted performance measures explain the flows of mutual funds, we apply the linear regression framework of Del Guercio and Tkac (2002). These regression specifications relate both dollar and percentage cross-sectional flows, pooled over 7 years, to lagged performance measures. In addition to control variables for fund age, asset size and lagged flow, time-style interaction dummies are included in the pooled regression, one for each year (2004-2010) and style (value or growth) style combination. For example, $V04 = 1$ if this observation is a value manager in year 2004 and 0 otherwise. It should be noted that one dummy (i.e. G10) must be omitted to be able to observe the intercept of the regression. This specification fits a distinct intercept for each time-style category of data. The time component of the interaction term picks up any cross-sectional correlations in the observations due to differing average flows across sample years. The style component adjusts for the fact that in any given year, growth funds may experience average flow that is significantly different from that of value funds, or of general equity funds. Combining the time and style components adjusts for both of these potential effects. Including this set of interaction terms reduces this source of correlation in the residuals, mitigates bias and increases the precision of our estimated coefficients. Several of the interaction term dummies are significant in all specifications, suggesting that the correction is necessary. In addition, all t-statistics reported in the tables are based on a correction for heteroskedasticity using White (1980) method.

Table 3 reports the results of pooled time-series cross-sectional regressions of annual dollar flow and percentage flow on performance manager characteristics. We start with the specification of Del Guercio and Tkac (2002) who use as performance characteristics Jensen's alpha, excess return over the S&P500 and the tracking error. We then try alternative specifications by replacing the initial measure of risk-adjusted performance (Jensen's alpha) by others. We also test alternative measures of raw performance.

[Insert Table 3 here]

In all specifications, raw and risk-adjusted performance are positively related to dollar and percentage flows while tracking error is negatively related with flows. These three relations are statistically significant for most of the specifications[7]. Concerning the explanatory power, we observe that the adjusted R^2 is very close for all specifications, dollar and percentage flow regression being considered separately.

These results, when compared to those obtained by Del Guercio and Tkac (2002) for the sample period 1987-1994, provide signs that the mutual fund investor might have become more sophisticated. In some sense, the average client of mutual funds in these recent years tends to look like the average client of pension funds ten years ago. Indeed, authors of the previous study have shown that both Jensen's alpha and tracking error had the expected relation (positive for alpha and negative for tracking error) with pension fund flows. They interpret the signs and significance of the coefficients on alpha and tracking error as evidence of the use of a one-factor information ratio (or appraisal ratio) in pension fund managers evaluation. Our results would suggest that it is now the case for mutual fund managers as well[8]. Contrary to their hypothesizes based on survey evidence, they found that lagged excess return was significantly related to pension fund manager flow and Jensen's alpha was significantly related to mutual fund manager flow. Hence, both unadjusted and risk-adjusted returns were related to manager flow in both segments. The same conclusion holds here for mutual funds. The significance of excess returns for pension managers suggests that beating a benchmark is an important but discrete event for pension managers. Regarding the strong statistical relation between mutual fund flow and Jensen's alpha, the authors argued that this was a consequence of the high correlation between alpha and Morningstar's star rating. These two last arguments might hold for this study of flows of mutual funds in the recent years. However, it should be noted that when we use annual return instead of excess return to evaluate the effect of raw performance, the results are the same. Hence, "pure" raw performance matters to investors. A final argument in favor of the sophistication of the mutual fund investors is the diminution of the explanatory power of the various specifications. For the mutual fund segment, authors of the previous study reported adjusted R^2 of 0.505 and 0.245 for the dollar percentage flow regressions respectively, while these coefficients were only equal to 0.118 and 0.109 for the pension fund segment.

Furthermore, we test alternative specifications in order to distinguish the explanatory power of various performance and non-performance manager characteristics. Table 4 shows the results of these alternative specifications.

[Insert Table 4 here]

Performance manager characteristics have a higher explanatory power in the percentage flow regression than in the dollar flow regression, while the opposite is true for non-performance characteristics.

The top 4 performance measures in terms of individual explanatory power are the same for dollar and percentage flows. These measures are Jensen's alpha, the average excess return, M-

[7] The beta associated to tracking error is not significantly different from zero in five cases out of twenty-two. We also observe that the beta associated to the average excess return is not significantly different from zero in the dollar flow regression when the influence of Jensen's alpha is considered simultaneously.

[8] Del Guercio and Tkac (2002) reported that tracking error was either insignificantly different from zero or significantly positive, suggesting that mutual fund investors were not using tracking error as a risk-adjusted performance measure.

squared and the one-factor information ratio. This would suggest that a mutual fund manager who wish to increase the level of its assets should pay the most attention to these measures. He should however be aware that his flows are driven by its raw and risk-adjusted performance simultaneously. Hence he should keep in mind the results of Table 3.

The conclusions which can be drawn from the regression of flows on non-performance manager characteristics are similar to those obtained with through correlation analysis: fund age and asset size are negatively related to flows, while these lasts are positively related to lagged flows. Hence the older and the bigger the fund is, the less it will collect new investments (dollar flows) and the less will be its growth rate (percentage flows). The higher "total" explanatory power for the dollar flow regression compared to the percentage flow regression (see Table 3) comes from the individual explanatory power of the lagged flows. Indeed, although both dollar and percentage flows are autocorrelated, the explanatory power of lagged flows is higher for dollar flows than for percentage flows. According to Del Guercio and Tkac (2002), an explanation for the autocorrelation of the flows is mutual fund investors tend to choose a fund and then continue to invest automatically for a number of years without much further scrutiny.

Finally, we wish to determine whether mutual fund investors are influenced by the level of raw performance or if flow is affected by the discrete event of beating the benchmark. For this purpose, we make a change in the specifications of Table 3: we add a dummy variable that takes the value 1 if the excess return over the S&P500 is positive and 0 otherwise. Table 5 report the results of these new specifications.

[Insert Table 5 here]

Mutual fund investors pay more attention to the fact that the manager beats the benchmark than to the level of raw performance achieved by the manager. When we take into account the discrete event of beating the benchmark, the raw performance is no longer significant in the dollar flow regressions. In the percentage flow, the levels of significance of excess return and annual return decrease in regard to the results of Table 3. Average return keeps a high level of significance which can partly be explained by the fact that the average return is computed over a 3-year period while the outperformance dummy is calculated from the past year excess performance of each fund. These results are consistent with survey data but differ from those reported by Del Guercio and Tkac (2002) for mutual funds. At that time, beating the benchmark was important for pension fund investors but not for mutual fund investors.

4.2 Does the shape of the flow-performance relation remain convex when the crisis is included in the sample period?

In order to answer this question, we apply the two same techniques as Sirri and Tufano (1998) on our sample of mutual fund managers for the period 2004-2010. With the first technique, we track the flows absorbed by funds sorted according to their past performance. The second technique is more formal and rely on a piecewise regression over performance quintiles. The second one is extended to a multivariate framework as suggested by Del Guercio and Tkac (2002) to take into account the fact that an investor might pay attention at several measures of performance (raw and risk-adjusted) at the same time to take its purchasing or selling decision.

The first approach leads to a clear visual representation of the flow-performance relationship. For each year from 2004 to 2010, funds are ordered within one of two objective categories (value and growth) and divided into 10 equal groups based on their lagged performance (Jensen alpha and average excess return). For each of these 10 groups, the mean flow of the funds in that group is calculated. Figures 1 and 2 illustrate the results of these calculations.

[Insert Figure 1 here]

[Insert Figure 2 here]

When past performance is measured by Jensen's alpha (a risk-adjusted performance measure) or the average excess return (a raw performance measure), the observed flow-performance relation is convex for both dollar and percentage flows. Similar graphs, built using the other risk-adjusted performance measures, lead to the same shape of the flow-performance relation, except with the Sortino ratio, which is not surprising given its low explanatory power. When build the performance ranking with annual return or excess return, the first group (the worst performers) suffers from disproportionately higher outflows.

The second approach relies on a piecewise linear framework and confirms our conclusions regarding the preceding graphs. Table 6 presents the results of pooled time-series cross-sectional regressions of annual dollar flow and annual percentage flow on measures of the fractional performance rank of fund i in the preceding years. A fund's fractional rank ($RANK_t$) represents its percentile performance relative to other funds with the same investment objective in the same period and ranges from 0 to 1. In this table, fractional ranks are defined on the basis of a fund's Jensen alpha and average excess return. The coefficients on fractional ranks are estimated using a piecewise linear regression framework over five quintiles. For example, the 5^{th} or bottom performance quintile is defined as $min(RANK_t, 0.2)$, the 4^{th} performance quintile is defined as $min(0.2, RANK_t - bottom\ performance\ quintile)$ and so forth, up to the top performance quintile. The implication for the fractional ranks classification is that for a perfect linear performance-flow relationship, the sensitivity to the five performance quintiles will be identical. For a convex performance-flow relationship, the coefficients of the 2^{nd} and top performance quintiles will be higher than the coefficients of the 4^{th} and bottom performance quintiles (Xiong, 2009). Since we observed in Section 3 that multiple performance and control variables are important determinants of mutual fund flow, we adopt a multivariate framework as in the paper of Del Guercio and Tkac (2002), rather than the univariate approach of Sirri and Tufano (1998). Table 6 reports the results of these regressions.

[Insert Table 6 here]

While controlling for non-performance characteristics as well as excess return and tracking error, the piecewise regression framework indicates a convex relationship between flows (dollar and percentage) and most of the tested risk-adjusted performance measures. A convex relationship is also observed between percentage flows and the average excess return. These results are consistent with those of Sirri and Tufano (1998), those obtained by Chevalier and Ellison (1997) for "old" funds and those obtained by Del Guercio and Tkac (2002) for mutual funds.

5 Conclusions

Our empirical findings analyzing mutual funds aim to improve our understanding of the flow-performance relationship. Our paper has two main objectives. First, we wish to identify the risk-adjusted performance measures that best explain money flows of mutual funds. Second, we want to determine the general shape of the relation a period of high market volatility. Through its methodology, our paper is closely related to the work of Del Guercio and Tkac (2002). Hence, we are be able to compare our results for the period 2004-2010 with those they obtained for the period 1987-1994. We work with a sample of 1,137 US equity mutual funds and we propose to analyze the flow-performance relationship by testing 9 traditional risk-adjusted performance measures and 3 measures of raw performance. Two measures of flows are used: dollar and percentage flows (assets growth rate). Our results are similar with these two measures. Our sample of mutual fund managers contains both active and dead funds so that our results do not suffer from survivorship bias.

Our results may be interesting for academics and practitioners. We show that both raw and risk adjusted pas performance, as well as the tracking error, influence the selling and purchasing decisions of mutual fund investors. Raw and risk-adjusted performance are positively related to dollar and percentage flows while tracking error is negatively related with flows. This is consistent with survey evidence that investors pay attention to historical performance, performance relative to a market index, performance relative to peers and fund risks. The relation between flows and risk-adjusted performance measures might also come from the correlation of these measures with Morningstar's stars and from the consultation of financial advisers.

The signs and significance of the coefficients on alpha and tracking error would suggest the use of a one-factor information ratio (or appraisal ratio) in mutual fund managers evaluation as it was already the case for the pension fund managers ten years ago.

The significance of excess returns over the S&P500 shows the importance for the manager to beat the market benchmark.

The risk-adjusted performance measures which have the highest explanatory power are Jensen's alpha, the Sharpe ratio and the the M-squared. We observe that the average excess return carry more or less the same explanatory power than the previous measures. We may conclude that fund managers who want to maximize their assets under management must mainly focus their efforts on improving these standard performance measures. In the same time, they must pay attention to their raw performance as well as their tracking error.

Regarding non-performance manager characteristics, the older and the bigger the fund is, the less it will collect new investments (dollar flows) and the less will be its growth rate (percentage flows). The higher "total" explanatory power for the dollar flow regression compared to the percentage flow regression comes from the individual explanatory power of the lagged flows. Indeed, although both dollar and percentage flows are autocorrelated, the explanatory power of lagged flows is higher for dollar flows than for percentage flows.

Using two different techniques (a simple one and a multivariate one to take into account the simultaneous effects of raw and risk-adjusted performance), we show that the flow-performance relation is convex for the period 2004-2010, when past performance ranking are built with most of the traditional risk-adjusted performance measures. This is consistent with previous studies and with the argument stating that mutual fund managers have an incentive to modify their risks at the end of the year in order to finish among the top performers and to collect most of the new investments.

Appendix: Risk-adjusted performance measures

In this section, we describe the selection of commonly used risk-adjusted performance measures that have been tested in this study. All measures have been computed using the past 36-month observations.

Sharpe ratio

Our first performance measure is the Sharpe ratio computed as:

$$Sharpe\ ratio_i = \frac{E[R_{i,t} - Rf_t]}{\sqrt{Var[R_{i,t} - Rf_t]}} \tag{3}$$

where $R_{i,t}$ is the return of fund i at time t and Rf_t the risk-free rate at time t.

M-squared

$$M_i^2 = \frac{E[R_{i,t} - Rf_t]\sqrt{Var[Rm_t - Rf_t]}}{\sqrt{Var[R_{i,t} - Rf_t]}} \tag{4}$$

where Rm_t is the return of the market portfolio (here the S&P500) at time t.

Sortino ratio

$$Sortino\ ratio_i = \frac{E[R_{i,t} - Rf_t]}{\sqrt{SV[R_{i,t} - Rf_t]}} \tag{5}$$

where the numerator is computed using the last month observations and SV is the semi-variance used to focus on the downside risk and computed as follows:

$$SV[R_{i,t} - Rf_t] = E[(max(Rf_t - R_{i,t}, 0))^2] \tag{6}$$

Sharpe MVaR

Instead of the volatility, this modification of the Sharpe ratio uses the modified value-at-risk as denominator.

$$Sharpe\ MVaR_i = \frac{E[R_{i,t} - Rf_t]}{MVaR[R_{i,t} - Rf_t]} \tag{7}$$

with

$$MVaR[R_{i,t} - Rf_t] = z_{CF}\sqrt{Var[R_{i,t} - Rf_t]} \tag{8}$$

where z_{CF} is a Cornish-Fisher approximation of the quantile α% of the excess return distribution, computed as:

$$z_{CF} = z_\alpha - \frac{1}{6}(z_\alpha^2 - 1)S + \frac{1}{24}(z_\alpha^3 - 3z_\alpha)K - \frac{1}{36}(2z_\alpha^3 - 5z_\alpha)S^2 \tag{9}$$

where z_α is positive and is the α% quantile of a standard normal distribution (e.g. if $\alpha = 99\%$ then $z_\alpha = 2.33$), S is the standardized skewness of the excess return distribution, K is the standardized excess kurtosis of the excess return distribution. In our computations, we take α equal to 99%. Indeed, Lejeune (2011) demonstrated that levels of confidence below 95.84% should never be used if we want to stay consistent with the investors' preferences for kurtosis.

Measures from the one-factor model: Jensen's alpha, Treynor ratio, Tracking error and one-factor information ratio

This set of measures can be obtained with the following empirical regression (i.e. a traditional CAPM):

$$R_{i,t} - Rf_t = \alpha_i + \beta_i(Rm_t - Rf_t) + \epsilon_{i,t} \tag{10}$$

where α_i is the Jensen alpha of fund i, β_i is the beta of fund i, Rm_t is the return of the market portfolio (here the S&P500) at time t and $\epsilon_{i,t}$ is the residual of the regression of fund i at time t. The other measures are obtained as follows:

$$Tracking\ error_i = \sqrt{Var[\epsilon_{i,t}]} \tag{11}$$

$$One - factor\ information\ ratio_i = \frac{Jensen\ alpha_i}{Tracking\ error_i} \tag{12}$$

$$Treynor\ ratio_i = \frac{E[R_{i,t} - Rf_t]}{\beta_i} \tag{13}$$

Measures from the multi-factor model: four-factor alpha and four-factor information ratio

This second alpha measure is based on the Fama and French/Carhart model:

$$R_{i,t} - Rf_t = \alpha_i^{4F} + \beta_{1,i}(Rm_t - Rf_t) + \beta_{2,i}SMB_t + \beta_{3,i}HML_t + \beta_{4,i}WML_t + \epsilon_{i,t}^{4F} \tag{14}$$

where α_i^{4F} is the four-factor alpha of fund i, SMB_t and HML_t are the "Small minus Big capitalization" and the "High minus Low Book-to-Market ratio" risk premia of Fama and French (1993) and WML_t is the momentum factor of Carhart (1997) at time t. The four-factor information ratio is obtained as follows:

$$Four - factor\ information\ ratio = \frac{\alpha_i^{4F}}{\sqrt{Var[\epsilon_{i,t}^{4F}]}} \tag{15}$$

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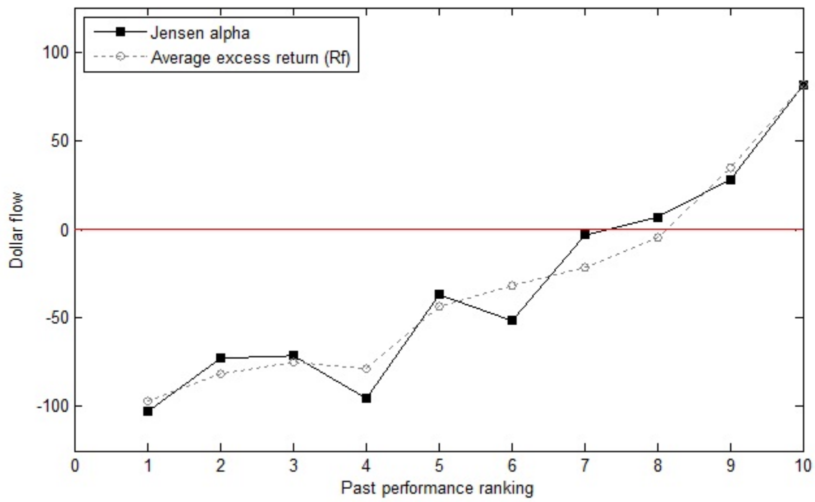
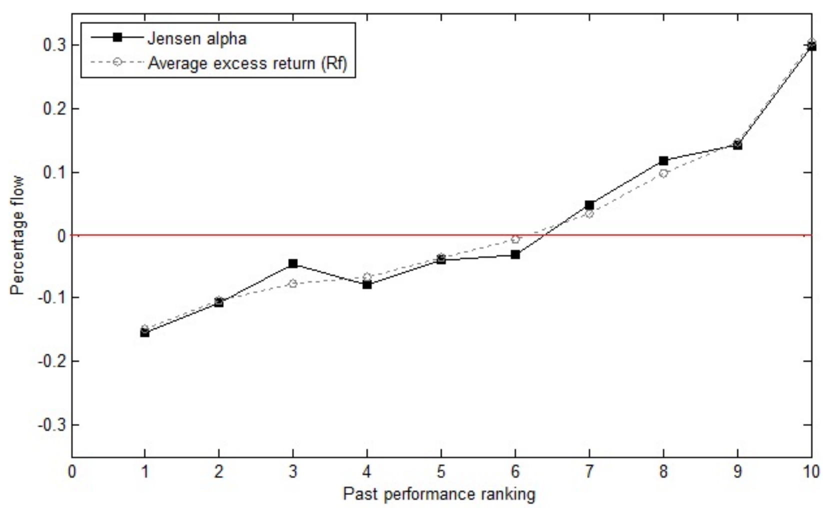
Figures

Figure 1: The average dollar flow of mutual funds as a function of their relative raw and risk-adjusted performance



For each year from 2004 to 2010, funds are ordered within one of two objective categories (value and growth) and divided into 10 equal groups based on their lagged performance (Jensen alpha and average excess return). For each of these 10 groups, the mean dollar flow of the funds in that group is calculated. Dollar flows are expressed in $millions.

Figure 2: The average percentage flow of mutual funds as a function of their relative raw and risk-adjusted performance



For each year from 2004 to 2010, funds are ordered within one of two objective categories (value and growth) and divided into 10 equal groups based on their lagged performance (Jensen alpha and average excess return). For each of these 10 groups, the mean percentage flow of the funds in that group is calculated.

Tables

Table 1: Summary statistics of performance and non-performance manager characteristics

	Quantiles					Range		Moments			
	95%	75%	median	25%	5%	min.	max.	mean	std.	skew.	kurt.
Flow measures:											
Dollar flow (in $millions)	295.72	8.96	-9.52	-61.82	-413.37	-1771.02	1694.96	-31.00	267.87	-0.64	15.83
Percentage flow	0.77	0.08	-0.07	-0.19	-0.42	-0.81	3.89	0.02	0.46	3.57	21.97
Performance measures (lagged):											
Jensen's alpha	0.08	0.03	0.01	-0.02	-0.06	-0.17	0.30	0.01	0.04	0.43	5.13
Excess return (S&P500)	0.18	0.06	0.01	-0.04	-0.11	-0.39	0.65	0.01	0.09	1.09	6.79
Tracking error	0.12	0.09	0.07	0.04	0.03	0.01	0.26	0.07	0.03	0.92	4.97
Annual return	0.42	0.20	0.10	-0.01	-0.43	-0.60	0.93	0.05	0.26	-0.54	2.85
Average excess return (Rf)	0.19	0.09	0.03	-0.06	-0.13	-0.25	0.40	0.02	0.10	0.12	2.45
Sharpe ratio	1.56	0.84	0.22	-0.31	-0.72	-1.16	2.71	0.29	0.73	0.34	2.19
M-squared	0.14	0.07	0.02	-0.06	-0.11	-0.17	0.26	0.01	0.08	0.02	2.17
Sortino ratio	3.29	1.42	0.32	-0.38	-0.78	-1.18	6.81	0.67	1.32	1.06	3.70
Sharpe MVaR	0.74	0.35	0.08	-0.09	-0.17	-0.39	1.29	0.16	0.30	0.88	2.99
Treynor ratio	0.16	0.08	0.02	-0.06	-0.12	-1.21	0.35	0.02	0.09	-0.51	10.42
One-factor information ratio	1.13	0.51	0.11	-0.33	-1.08	-2.73	2.95	0.08	0.67	-0.21	3.61
Four-factor alpha	0.06	0.02	0.00	-0.02	-0.07	-0.21	0.14	0.00	0.04	-0.40	5.09
Four-factor information ratio	1.30	0.49	-0.04	-0.59	-1.39	-3.56	3.07	-0.05	0.82	-0.01	3.38
Control variables (lagged):											
Fund age	23.00	12.00	7.00	5.00	3.00	3.00	74.00	9.78	8.29	3.39	19.11
TNA (in $millions)	3730.73	749.13	234.37	73.19	11.17	0.57	48584.59	867.39	2270.13	8.41	110.61
Log TNA	8.22	6.62	5.46	4.29	2.41	-0.56	10.79	5.40	1.74	-0.17	3.02
Lagged dollar flow (in $millions)	310.35	13.74	-7.39	-60.31	-426.99	-1785.31	1693.45	-29.94	284.28	-0.69	15.56
Lagged percentage flow	0.85	0.11	-0.06	-0.18	-0.42	-0.81	3.88	0.04	0.48	3.40	19.50

This table summarizes the distributions of manager characteristics over the 3,719 manager-years used in this study. The sample period is 2004-2010. There are 1,137 mutual funds including both active and dead funds. All flow and performance variables are on an annual basis. The risk-adjusted performance measures are defined in the Appendix.

Table 2: Correlations between performance and non-performance manager characteristics

	Flow measures		Performance measures (lagged)							
	$ flow	% flow	Jensen's alpha	Excess return	Tracking error	Annual return	Average. exc. ret.	Sharpe ratio	M-squared	Sortino ratio
Percentage flow	0.42***									
Jensen's alpha	0.19***	0.26***								
Excess return (S&P500)	0.13***	0.16***	0.59***							
Tracking error	0.04**	0.03*	0.17***	0.24***						
Annual return	0.05***	0.05***	0.27***	0.56***	0.14***					
Average excess return (Rf)	0.06***	0.10***	0.33***	0.18***	-0.09***	0.43***				
Sharpe ratio	0.05***	0.08***	0.29***	0.14***	-0.19***	0.39***	0.96***			
M-squared	0.07***	0.10***	0.35***	0.18***	-0.13***	0.43***	0.98***	0.97***		
Sortino ratio	0.05***	0.08***	0.30***	0.13***	-0.21***	0.29***	0.92***	0.97***	0.93***	
Sharpe MVaR	0.04**	0.07***	0.27***	0.12***	-0.23***	0.27***	0.92***	0.97***	0.93***	0.99***
Treynor ratio	0.07***	0.10***	0.36***	0.17***	-0.13***	0.42***	0.96***	0.95***	0.97***	0.91***
One-factor information ratio	0.19***	0.24***	0.89***	0.53***	0.12***	0.22***	0.32***	0.34***	0.36***	0.36***
Four-factor alpha	0.14***	0.23***	0.6***	0.29***	-0.14***	0.13***	0.31***	0.29***	0.29***	0.27***
Four-factor information ratio	0.14***	0.23***	0.55***	0.29***	-0.03**	0.13***	0.29***	0.29***	0.27***	0.27***
Fund age	-0.04**	-0.07***	0.03*	0.04***	0.00	0.02	-0.05***	-0.05***	-0.05***	-0.04***
TNA	-0.29***	-0.04***	0.07***	0.04**	-0.09***	0.04***	0.06***	0.08***	0.07***	0.07***
Log TNA	-0.2***	-0.12***	0.13***	0.06***	-0.14***	0.08***	0.09***	0.10***	0.09***	0.09***
Lagged dollar flow	0.4***	0.13***	0.19***	0.06***	0.04**	0.00	0.09***	0.08***	0.09***	0.09***
Lagged percentage flow	0.19***	0.28***	0.27***	0.09***	0.01	0.02	0.16***	0.15***	0.16***	0.16***

	Performance measures (lagged)					Control variables (lagged)			
	Sharpe MVaR	Treynor ratio	1F IR	4F alpha	4F IR	Fund age	TNA	Log TNA	Lagged $ flow
Treynor ratio	0.90***								
1F information ratio	0.33***	0.36***							
4F alpha	0.27***	0.30***	0.55***						
4F information ratio	0.26***	0.27***	0.61***	0.91***					
Fund age	-0.04***	-0.05***	0.03*	0.02	0.03*				
TNA	0.07***	0.07***	0.09***	0.12***	0.13***	0.03			
Log TNA	0.08***	0.10***	0.13***	0.18***	0.16***	0.11***	0.57***		
Lagged dollar flow	0.08***	0.09***	0.2***	0.15***	0.15***	-0.04***	-0.16***	-0.11***	
Lagged percentage flow	0.15***	0.16***	0.26***	0.24***	0.24***	-0.08***	-0.01	0.04**	0.42***

This table presents the correlations between manager characteristics over the 3,719 manager-years used in this study. The sample period is 2004-2010. There are 1,137 mutual funds including both active and dead funds. All flow and performance variables are on an annual basis. The risk-adjusted performance measures are defined in the Appendix. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table 3: Pooled regressions of fund manager flow on lagged performance measures

	Dollar flow								
	Jensen's alpha	Sharpe ratio	M-squared	Sortino ratio	Sharpe MVaR	Treynor ratio	1F IR	4F alpha	4F IR
Intercept	-1.74	31.46*	61.22***	16.02	15.65	37.05	2.31	-11.48	-1.05
Risk-adjusted perf. meas.	879.75***	117.28***	1219.86***	49.69***	225.18***	706.71***	59.27***	668.05***	30.70***
Excess return (S&P500)	167.11***	200.9***	161.55***	257.69***	256.72***	247.26***	188.28***	297.77***	303.86***
Tracking error	-282.98**	-195.37	-303.61***	-169.35	-151.37	-265.83**	-288.64***	-106.10	-210.59*
Control variables included in each regression:	Fund age, asset size, lagged flow, year-style interaction dummies								
Adjusted R^2	0.24	0.24	0.24	0.24	0.23	0.23	0.24	0.24	0.24
	Percentage flow								
	Jensen's alpha	Sharpe ratio	M-squared	Sortino ratio	Sharpe MVaR	Treynor ratio	1F IR	4F alpha	4F IR
Intercept	0.19***	0.26***	0.34***	0.22***	0.22***	0.28***	0.19***	0.15***	0.18***
Risk-adjusted perf. meas.	2.45***	0.29***	2.95***	0.12***	0.57***	1.76***	0.14***	2.44***	0.10***
Excess return (S&P500)	0.39***	0.54***	0.46***	0.67***	0.66***	0.65***	0.52***	0.66***	0.70***
Tracking error	-0.68***	-0.43*	-0.70***	-0.36	-0.31	-0.61**	-0.66***	-0.07	-0.44*
Control variables included in each regression:	Fund age, asset size, lagged flow, year-style interaction dummies								
Adjusted R^2	0.16	0.15	0.16	0.16	0.14	0.14	0.15	0.15	0.15
	Dollar flow			Percentage flow					
	Annual return	Avg. exc. ret. (Rf)		Annual return	Avg. exc. ret. (Rf)				
Intercept	-45.98*	23.24		0.09	0.31***				
Jensen's alpha	879.75***	822.94***		2.45***	1.54***				
Raw perf. meas.	167.11***	259.50		0.39***	1.46***				
Tracking error	-282.98**	-274.08**		-0.68***	-0.81***				
Control variables included in each regression:	Fund age, asset size, lagged flow, year-style interaction dummies								
Adjusted R^2	0.24	0.24		0.16	0.16				

This table presents the results of pooled time-series cross-sectional regressions of annual dollar flow and annual percentage flow on manager characteristics for the sample of 3,719 mutual fund manager-years over the sample period 2004-2010. These managers are from value and growth style categories only. All flow and performance variables are on an annual basis. The risk-adjusted performance measures are defined in the Appendix. Each column represents a separate regression and we include as regressors, but do not report, fund age, asset size, lagged flow, as well as year (2004-2010) and style (growth, value) interaction dummies as control variables. We use the natural log of total net assets in the percentage flow regression and total net assets in the dollar regression. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels, respectively (t-statistics are based on White (1980) standard errors).

Table 4: Importance of performance and non-performance manager characteristics

Table 4a: Comparison of the explanatory power of performance and non-performance characteristics

	Variables included in the regression	Dollar Flow	Percentage Flow
Performance variables only:	Jensen's alpha, excess return (S&P500), tracking error	0.041	0.088
Control variables only:	Fund age, asset size, lagged flow	0.216	0.106
Lagged flow only:	Lagged dollar and percentage flow, respectively	0.165	0.087
One performance measure only:	Jensen's alpha	0.040	0.086
	Excess return (S&P500)	0.019	0.045
	Tracking error	0.003	0.009
	Annual return	0.019	0.045
	Average excess return (Rf)	0.038	0.084
	Sharpe ratio	0.037	0.073
	M-squared	0.043	0.082
	Sortino ratio	0.030	0.062
	Sharpe MVaR	0.029	0.059
	Treynor ratio	0.033	0.065
	One-factor information ratio	0.041	0.077
	Four-factor alpha	0.024	0.074
	Four-factor information ratio	0.023	0.072

Table 4a contains the adjusted R^2 under various regression specifications. We use the natural log of total net assets in the percentage flow regression and total net assets in the dollar regression. Year-style interaction dummies are included in all regression specifications.

Table 4b: Regression of dollar and percentage flows on non-performance manager characteristics

		Dollar Flow	Percentage Flow
Control variables only:	Intercept	15.27	0.19***
	Fund age	-0.53	-0.00***
	Asset size	-0.03***	-0.03***
	Lagged flow	0.35***	0.27***
	Adjusted R^2	0.216	0.106

Table 4b presents the results of pooled time-series cross-sectional regressions of annual dollar flow and annual percentage flow on non-performance manager characteristics for the sample of 3,719 mutual fund manager-years over the sample period 2004-2010. These managers are from value and growth style categories only. All flow and performance variables are on an annual basis. The risk-adjusted performance measures are defined in the Appendix. We also include but do not report year (2004-2010) and style (growth, value) interaction dummies. We use the natural log of total net assets in the percentage flow regression and total net assets in the dollar regression. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels, respectively (t-statistics are based on White (1980) standard errors).

Table 5: Importance of beating a benchmark

	Dollar flow			Percentage flow		
	Excess return	Annual return	Average return	Excess return	Annual return	Average return
Intercept	-17.38	-34.67	-4.23	0.17***	0.10*	0.27***
Outperform S&P 500 dummy	30.57***	30.57***	35.60***	0.04**	0.04**	0.06***
Raw perf. meas.	65.30	65.30	190.83	0.25*	0.25*	1.34***
Jensen alpha	848.42***	848.42***	719.46***	2.41***	2.41***	1.36***
Tracking error	-263.90**	-263.90**	-277.91**	-0.65***	-0.65***	-0.81***
Control variables included in each regression:	Fund age, asset size, lagged flow, year-style interaction dummies					
Adjusted R2	0.24	0.24	0.24	0.16	0.16	0.16

This table presents the results of pooled time-series cross-sectional regressions of annual dollar flow and annual percentage flow on manager characteristics for the sample of 3,719 mutual fund manager-years over the sample period 2004-2010. These managers are from value and growth style categories only. All flow and performance variables are on an annual basis. Each column represents a separate regression and we include as regressors, but do not report, fund age, asset size, lagged flow, as well as year (2004-2010) and style (growth, value) interaction dummies as control variables. We use the natural log of total net assets in the percentage flow regression and total net assets in the dollar regression. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels, respectively (t-statistics are based on White (1980) standard errors).

Table 6: The effect of relative performance on dollar and percentage flows

Table 6a: Alternative risk-adjusted performance measures

	Dollar flow								
	Jensen's alpha	Sharpe ratio	M-squared	Sortino ratio	Sharpe MVaR	Treynor ratio	1F IR	4F alpha	4F IR
intercept	1.92	-16.5	-16.5	-15.96	-17.26	-7.6	-26.74	17.14	-13.71
Bottom perf. quintile	5.54	89.46	89.46	78.23	75.47	61.3	100.67	-213.85***	-52.78
4th perf. quintile	46.29	34.47	34.47	58.54	59.58	34.55	10.15	146.82*	66.63
Middle perf. quintile	95.43	42.19	42.19	2.50	-32.43	39.62	53.99	-29.65	21.57
2nd perf. quintile	181.29*	189.85*	189.85*	201.92**	219.87**	228.49**	237.22***	292.23***	246.16***
Top perf. quintile	341.15***	400.97***	400.97***	417.31***	385.54***	367.99***	345.04***	77.95	148.46
Excess return (S&P500)	168.64***	170.37***	170.37***	174.82***	197.78***	170.83***	169.74***	304.54***	290.84***
Tracking error	-409.53***	-307.87***	-307.87***	-296.56***	-263.84**	-371.77***	-199.55	-327.23***	-197.27
Control variables included in each regression:	Fund age, asset size, lagged flow, year-style interaction dummies								
Adjusted R^2	0.24	0.24	0.24	0.23	0.24	0.24	0.24	0.24	0.24
Convex relationship	1.00	1.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00

	Percentage flow								
	Jensen's alpha	Sharpe ratio	M-squared	Sortino ratio	Sharpe MVaR	Treynor ratio	1F IR	4F alpha	4F IR
intercept	0.14***	0.14***	0.14***	0.15***	0.15***	0.15***	0.14***	0.14***	0.12***
Bottom perf. quintile	0.37*	0.16	0.16	0.14	0.02	0.21	0.09	-0.05	0.01
4th perf. quintile	-0.02	0.20	0.20	0.17	0.26*	0.14	0.13	0.27**	0.14
Middle perf. quintile	0.33***	0.15	0.15	0.25*	0.24	0.16	0.23	0.15	0.25
2nd perf. quintile	0.42***	0.53***	0.53***	0.39***	0.17	0.59***	0.56***	0.41**	0.45***
Top perf. quintile	0.89***	0.73***	0.73***	0.83***	1.06***	0.75***	0.66***	0.82***	0.69***
Excess return (S&P500)	0.39***	0.43***	0.43***	0.44***	0.49***	0.42***	0.45***	0.67***	0.69***
Tracking error	-0.89***	-0.7***	-0.7***	-0.66***	-0.55**	-0.85***	-0.45*	-0.56**	-0.41
Control variables included in each regression:	Fund age, asset size, lagged flow, year-style interaction dummies								
Adjusted R^2	0.16	0.16	0.16	0.14	0.16	0.17	0.17	0.17	0.17
Convex relationship	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00

Table 6b: Alternative raw performance measures

	Dollar flow			Percentage flow		
	Excess return (S&P500)	Annual return	Average excess return (Rf)	Excess return (S&P500)	Annual return	Average excess return (Rf)
intercept	-14.06	-14.06	37.12*	0.15***	0.15***	0.25***
Bottom perf. quintile	57.62	57.62	-183.8*	0.26	0.26	-0.19
4th perf. quintile	13.81	13.81	126.12	0.05	0.05	0.26*
Middle perf. quintile	171.92**	171.92**	-18.55	0.1	0.10	0
2nd perf. quintile	-28.39	-28.39	90.51	0.20	0.200	0.39***
Top perf. quintile	177.58	177.58	323.24**	0.44*	0.44*	0.78***
Jensen's alpha	763.15***	763.15***	664.28***	2.16***	2.16***	1.49***
Tracking error	-271.27**	-271.27**	-409.53***	-0.67***	-0.67***	-1.04***
Control variables included in each regression:	Fund age, asset size, lagged flow, year-style interaction dummies					
Adjusted R^2	0.24	0.24	0.24	0.17	0.17	0.17
Convex relationship	0.00	0.00	0.00	0.00	0.00	1.00

The table presents the results of pooled time-series cross-sectional regressions of annual dollar flow and annual percentage flow on manager characteristics for the sample of 3,719 mutual fund manager-years over the sample period 2004-2010. These managers are from value and growth style categories only. All flow and performance variables are on an annual basis and are defined in the Appendix. Each column represents a separate regression and we include as regressors, but do not report, year (2004-2010) and style (growth, value) interaction dummies as control variables. Other independent variables include lagged manager characteristics: the fund age, the asset size (we use the natural log of total net assets in the percentage flow regression and total net assets in the dollar regression), the lagged flow (we use the lagged percentage flow in the percentage flow regression and lagged dollar flow in the dollar regression) and measures of the fractional performance rank of fund i in the preceding years. A fund's fractional rank ($RANK_t$) represents its percentile performance relative to other funds with the same investment objective in the same period and ranges from 0 to 1. In this table, fractional ranks are defined on the basis of a fund's Jensen alpha and average excess return. The coefficients on fractional ranks are estimated using a piecewise linear regression framework over five quintiles. For example, the 5th or bottom performance quintile is defined as $min(RANK_t, 0.2)$, the 4th performance quintile is defined as $min(0.2, RANK_t - bottom\ performance\ quintile)$ and so forth, up to the top performance quintile. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels, respectively (t-statistics are based on White (1980) standard errors). The variable "Convex relationship" takes the value "1" or "true" if the coefficients of the 2nd and top performance quintiles will be higher than the coefficients of the 4th and bottom performance quintiles.