Style Dispersion and Mutual Fund Performance*

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Abstract

We estimate investment style dispersions for individual actively managed equity mutual funds, which describe how widely fund investments are distributed around the core fund style along the dimensions of size, book-to-market, and momentum, respectively. We find that high style dispersions, especially that along the size dimension, are associated with superior fund performance, consistent with high-ability fund managers taking advantage of opportunities to invest outside the core size style. We also find that the superior fund performance is related to the distance of deviation, not the mere fact of deviation, from the core size style. We conclude that investment style dispersions are an important fund characteristics indicating fund manager investment ability and fund performance.

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1 Introduction

A mutual fund's investment style (e.g., large-cap or small-cap, value or growth), which is indicated by the fund's name or prospectus, describes the primary asset class the fund invests in. In practice, the fund can invest substantial amounts in other asset classes. Figure 1 (the panel on the right) provides a snapshot taken by Morningstar of Fidelity Contrafund's (managed by William Danoff) stockholdings along the dimensions of size and book-to-market as of September 30, 2012. Despite the fact that Morningstar categorizes the fund as a large-cap growth fund, more than 40% of its portfolio is invested in other asset classes.

[**Insert Figure 1 here.**]

While numerous studies in the mutual fund literature examine fund investment style and its relation with fund performance,[1] the literature has little to say about fund investment style dispersions, which describe how widely fund investments are distributed around the core fund style along the dimensions of size, book-to-market, etc. In this article, we make an initial attempt to estimate individual funds' investment style dispersions. We then examine the relations between investment style dispersions and fund performance. Our findings on these relations are broadly consistent with economic intuition and theory. We conclude that investment style dispersions are an important fund characteristics indicating fund manager investment ability and fund performance.

We conduct our empirical analysis using actively managed open-end U.S. domestic equity mutual fund data for the period of 1980 to 2009. Particularly, we exclude index funds and sector funds because these funds need to hold various stocks in the stock market or in certain industries, so their high style dispersions are mechanically determined. The

[1]See, e.g., Brown and Goetzmann (1997); Carhart (1997); Daniel et al. (1997); and Chan et al. (2002).

fund performance can be measured using the abnormal return of the four-factor model of Carhart (1997) .

We start our analysis by estimating individual funds' investment style dispersions in size, value, and momentum based on the average distance of fund stockholdings from the core fund style along the dimensions of size (market capitalization), book-to-market, and momentum (a stock's lagged 1-year return), respectively. Here, we consider not only the style dispersions in size and value as depicted in Figure 1 and used by major fund trackers such as Morningstar, but also the style dispersion in momentum because prior research on fund investment style finds that momentum is also a useful style descriptor.

See Figure 1 (the panel on the left) for an illustration of size dispersion. Size dispersion captures two facts. The first is whether a fund manager deviates from the core size style. For example, if a large-cap fund manager invests only in large-cap stocks, then her size dispersion is zero. If she also buys mid-cap or small-cap stocks, then her size dispersion is greater than zero. The second is how far she deviates from the core size style. Buying small-cap stocks represents a greater deviation from the core size style than buying mid-cap stocks, and therefore increases size dispersion to a greater extent.

Next, we examine the relations between investment style dispersions and fund performance using portfolio and regression approaches. Our major finding is that only high style dispersion along the dimension of size is associated with superior fund performance. Specifically, in the portfolio analysis, we sort funds into deciles based on each style dispersion. We find that funds with high size dispersion significantly outperform funds with low size dispersion, after using various factor models to control for risk and style differences. Particularly, the decile 10 (1) funds sorted based on size dispersion produce a significantly positive (insignificant) Carhart abnormal return. In the regression analysis, we use the Fama-MacBeth (1973) cross-sectional regression approach to control for other fund characteristics that can be related to fund performance. The relation between size dispersion and the Carhart abnormal return remains positive and significant. We find no significant evidence that value and momentum dispersions are related to the Carhart abnormal return.

What explains this? Intuition suggests that there are benefits and costs for fund managers investing outside the core fund style. An important benefit is that investing outside allows fund managers to explore valuable investment opportunities in a larger space. This tends to lead to good fund performance. A cost is that fund managers with a lack of sufficient expertise in other asset classes may trade with counterparts who have informational advantages. If these fund managers want to overcome such informational disadvantages, they have to deploy valuable resources (e.g., manpower) away from the core fund style. This tends to lead to poor fund performance.[2] Therefore, only fund managers with high investment ability can and should take advantage of investing outside.

He and Xiong (2012) consider another cost: if a fund manager can invest outside the core fund style, she may become more opportunistic and spend less effort acquiring information. They develop an agency-based model to show that in equilibrium, asset management firms allow only the fund managers with exceptional talent to invest outside the core fund style. These firms incentivize other fund managers to invest primarily in the core fund style using narrow mandates and tight tracking error constraints.[3]

Our evidence on the positive relation between size dispersion and the Carhart abnormal return is consistent with the above intuition and He and Xiong's (2012) equilibrium result

[2]Research in the corporate context documents that managing a portfolio of unrelated businesses is associated with a decrease in firm value (see, e.g., Lang and Stulz, 1994; Berger and Ofek, 1995). Villalonga (2004) provides contrary evidence.

[3]He and Xiong (2012) also suggest that loose investment mandates and tracking error constraints indicate high fund manager investment ability and superior fund performance. Testing this is difficult due to limited data on these constraints. Almazan et al. (2004) examine some constraints, such as whether funds can borrow debt, trade derivatives, or take short positions. We are not aware of any data on the tolerance of tracking errors.

that only high-ability fund managers can and will take advantage of opportunities to invest outside the core size style, producing superior fund performance. It is not clear why these fund manages won't take advantage of opportunities to invest outside the core value and momentum styles. In this case, value and momentum dispersions may be due to diversification purposes or may be just an unintentional choice.

Finally, an interesting implication of the above intuition and He and Xiong's (2012) equilibrium result is that while fund managers who invest *far* outside the core fund style can produce superior fund performance because they have high investment ability, fund managers who merely invest outside are not necessarily capable of producing the same level of fund performance. We find evidence consistent with this implication using size dispersion.

Specifically, we decompose size dispersion into two parts: a "deviation-only" measure capturing how likely a fund manager invests outside, and a "distance-only" measure capturing how far the fund manager invests outside. A straightforward proxy of the deviation-only measure is Active Share proposed by Cremers and Petajisto's (2009), which is computed as the share of an individual mutual fund's portfolio holdings that differ from the benchmark index holdings. The construction of Active Share treats far and near deviations from the benchmark index equally and, therefore, does not account for the distance of deviation. We use the part of size dispersion that is orthogonal to Active Share to proxy the distance-only measure. We find using a regression analysis that the Carhart abnormal return is significantly positively related to only the distance-only measure, not the deviation-only measure (Active Share).[4] This result also evidences that size dispersion is a distinct fund characteristics from Cremers and Petajisto's Active Share, because it

[4]Cremers and Petajisto (2009) document similar evidence. They find that Active Share can predict funds' relative performance over their benchmarks, but this relation is not robust after controlling for risk and style differences using the Carhart four-factor model (page 3357, lines 4-6).

contains material information about the Carhart abnormal return but Active Share does not contain this information.

We also investigate fund managers' stock selection ability using holding-based performance measures proposed by Daniel et al. (DGTW, 1997). We find that while near the core size style fund managers with high size dispersion exhibit slightly better stock selection ability than fund managers with low size dispersion, far from the core size style their stock selection ability is significantly better. This result suggests an interesting investment dynamics of fund investment. Specifically, some fund managers have higher investment ability regardless of the size style. They explore investment opportunities throughout the universe of stocks along the size dimension. Other fund managers have lower investment ability, and tend to stick to the core size style. When running out of opportunities in the core size style, they also explore opportunities outside but mainly near the core size style.

We summarize our major findings as follows.

(i) High style dispersion along the dimension of size, not value or momentum, is associated with superior fund performance (measured by the Carhart abnormal return). This finding supports the view that fund managers with high investment ability take advantage of opportunities to invest outside the core size style, producing superior fund performance.

(ii) The Carhart abnormal return is significantly positively related to the distance of deviation, not the mere fact of deviation, from the core size style. This finding supports the view that fund managers who merely invest outside of the core size style do not necessarily produce superior fund performance; fund managers who invest *far* outside do.

Overall, our findings suggest that investment style dispersions can be an important fund characteristics indicating fund manager investment ability and fund performance.

Our study belongs to a growing mutual fund literature examining the effect of managerial talent and fund strategies on fund performance. The general idea put forward by this literature is that if mutual fund managers make natural and easy investments, they produce only average fund performance. To produce superior fund performance, fund managers must deviate from natural and easy investments. If their strategies are correct, these investments should deliver above-average performance.

Previous studies in this literature examine various types of deviations. For example, Kacperczyk et al. (2005) propose a measure of industry concentration, capturing the deviation of a portfolio's industry weights from the industry weights of the total stock market. They find that funds with high industry concentration measures produce higher abnormal return than fund managers with low industry concentration measures. Cremers and Petajisto (2009) propose a measure of Active Share, capturing the deviation of portfolio holdings from the benchmark index holdings. They find that funds with high Active Share values outperform the benchmark index. Coval and Moskowitz (1999, 2001) consider the geographic distance of a fund manager's location and her actual portfolio relative to this distance if she held the total stock market. Other related articles propose to evaluate fund performance using the similarity of fund holdings to star funds (Cohen et al., 2005), funds' use of public information (Kacperczyk and Seru, 2007), trading against fund flows (e.g., buying when the fund has outflows) (Alexander et al., 2007), and the effect of unobserved actions (Kacperczyk et al., 2008).[5]

We contribute to this literature in two ways. First, we examine a new and distinct type of deviation: deviation from the core fund investment style, which is measured by investment style dispersions. To our best knowledge, our study is the first to examine this

[5] In the hedge fund literature, Titman and Tiu (2011) and Sun et al. (2012) investigate whether skilled hedge fund managers are more likely to pursue unique investment strategies. They propose a measure of the distinctiveness of a hedge fund's investment strategy based on historical fund return data and find that a higher measure of strategy distinctiveness is associated with better fund performance.

type of deviation. Second, we point out the importance of the distance of deviation (from the core size style) in producing superior fund performance, and document supporting evidence. Previous studies in the literature seldom take into consideration the distance of deviation. For example, in the construction of industry concentration measure, Kacperczyk et al. (2005) treat both related (near) and unrelated (far) deviations from the industry weights of the total stock market equally. In the construction of Active Share measure, Cremers and Petajisto (2009) treat both near and far deviations from the benchmark index holdings equally. Coval and Moskowitz (1999, 2001) are exceptions.

The remainder of this article is organized as follows. Section 2 describes the data. Section 3 quantifies fund investment style dispersions. Section 4 presents empirical evidence on the relations between investment style dispersions and fund performance. Section 5 investigates the sources of superior fund performance associated with high size dispersion values. Section 6 concludes.

2 Data

We merge the Center for Research in Security Prices (CRSP) Survivorship Bias Free Mutual Fund database with the Thompson Financial CDA/Spectrum holdings database using MFLINKS. Our sample covers the period of 1980 to 2009.

The CRSP mutual fund database includes information on fund investment objective, total net assets (TNA), expense ratio, returns, and other fund characteristics. The CDA/Spectrum database includes information on the stockholdings of mutual funds, which is collected from reports filed by mutual funds with the SEC as well as from voluntary reports generated by the funds. During our sample period, although a large proportion of funds are required by law to disclose their holdings semiannually, most funds in our sample disclose their holdings quarterly. The report dates for the portfolio snapshots may not coincide with the calendar dates of quarter-ends. We compute the fund holdings at the end of a quarter using the latest report in that quarter. If a fund does not report in a quarter, we consider the fund holdings missing for the quarter.

We link fund stockholdings to CRSP stock price data to obtain information on stock prices and returns, market capitalization, and book-to-market. We also require fund TNA computed using holdings data from the CDA/Spectrum database to be between 2/3 and 3/2 of fund TNA obtained from the CRSP mutual fund database to ensure the quality of the matching.

To focus our analysis on actively managed open-end U.S. domestic equity mutual funds, we apply the following filters. First, we eliminate bond funds, balanced funds, money market funds, other funds not invested primarily in equity securities, and international funds. We further eliminate index funds and sector funds because their investment behavior is purely mechanically determined.[6] Second, we exclude observations prior to which fund TNA never surpassed $15 million as suggested by Chen et al. (2004), and observations with a report date prior to the fund organization date in order to control for incubation bias (Evans, 2010). Third, we exclude observations for which fewer than 11 stockholdings could be identified. Fourth, for funds with multiple share classes, we eliminate duplicate funds and compute the fund-level variables by aggregating across the different share classes.[7]

[Insert Table I here.]

Our final sample includes 2,555 distinct funds and 82,512 fund-quarter observations. Panel A of Table I reports summary statistics on fund TNA, age, expense ratio, turnover

[6]Kacperczyk et al. (2008) describe the procedure to screen funds based on investment objectives in detail.

[7]For most variables, we use a value-weighted average for the fund-level observations. For fund age, we use the oldest of all share classes.

ratio, New Money Growth (NMG), Industry Concentration Index (ICI), and Active Share. NMG is computed as the growth rate of TNA after adjusting for the appreciation of the mutual fund's assets (R_t), assuming that all the cash flows are invested at the end of the quarter:

$$\mathrm{NMG}_t = \frac{\mathrm{TNA}_t - \mathrm{TNA}_{t-1}(1+R_t)}{\mathrm{TNA}_{t-1}}.$$

ICI is computed following Kacperczyk et al. (2005) as the sum of the squared deviations of the value weights for each of the ten different industries held by the mutual fund, W_{It}, relative to the industry weights of the total stock market, $\bar{W}_{It}$:

$$\mathrm{ICI}_t = \sum_{I=1}^{10} (W_{It} - \bar{W}_{It})^2. \tag{1}$$

Active Share is defined following Cremers and Petajisto (2009) as the share of portfolio holdings that differ from the benchmark index holdings:

$$\text{Active Share}_t = \frac{1}{2} \sum_j |w_{jt} - w_{jt}^{index}|, \tag{2}$$

where w_{jt} and w_{jt}^{index} are the value weights of stock j in the fund and in the (estimated) benchmark index, respectively.[8]

An interesting observation is that in the construction of ICI (Eq. 1), Kacperczyk et al. (2005) treat both related (near) and unrelated (far) deviations from the industry weights of the total stock market equally; in the construction of Active Share (Eq. 2), Cremers and Petajisto (2009) treat both near and far deviations from the benchmark index holdings

[8]Cremers and Petajisto (2009) and Petajisto (2010) describe the computation of Active Share in detail. Data on Active Share for the period of 1990 to 2006 are taken from Antti Petajisto's website, http://www.petajisto.net/data.html.

equally. Therefore, they recognize the fact of deviation, but do not take into consideration the distance of deviation.

3 Style Dispersions

3.1 Constructing Style Dispersions

We construct the investment style dispersion measures for individual mutual funds as follows.

First, in each quarter t, the universe of common stocks listed in CRSP are grouped into quintiles along the dimensions of size (market capitalization), book-to-market, and momentum (a stock's lagged 1-year return). We denote the quintile information of each stock (j) as (s_{jt}, v_{jt}, m_{jt}). For example, the quintile information (1, 5, 1) indicates that the stock has the smallest market capitalization, highest book-to-market, and weakest momentum.

Second, we follow DGTW (1997) to compute the value-weighted average size, value, and momentum scores for each fund using the quintile information of the fund's stockholdings:

$$\begin{aligned} \text{Size score } (\bar{s}_t) &= \sum_j w_{jt} s_{jt}, \\ \text{Value score } (\bar{v}_t) &= \sum_j w_{jt} v_{jt}, \\ \text{Mom score } (\bar{m}_t) &= \sum_j w_{jt} m_{jt}, \end{aligned}$$

where w_{jt} is the value weight of stock j in the fund. These scores, describing the "center" of the fund's stockholdings along the dimensions of size, book-to-market, and momentum, respectively, are used to describe the core fund style. We exclude the fund's short positions (if any) in the computation.

Third, we compute fund investment style dispersions in size, value, and momentum based on the average distance of the fund's stockholdings from the core fund style along the dimensions of size, book-to-market, and momentum, respectively:

$$\begin{aligned}
\text{Size dispersion}_t &= \sum_j w_{jt} |s_{jt} - \bar{s}_t|, \\
\text{Value dispersion}_t &= \sum_j w_{jt} |v_{jt} - \bar{v}_t|, \\
\text{Mom dispersion}_t &= \sum_j w_{jt} |m_{jt} - \bar{m}_t|.
\end{aligned}$$

Three caveats are worth noting.

First, index funds and sector funds need to hold various stocks in the stock market or in certain industries, so their high style dispersions are mechanically determined. We exclude these funds from our sample (see the sample selection procedure in Section 2).

Second, while it would be ideal to have a catchall dispersion measure that combines the information contained in the size, value, and momentum dispersion measures, we do not know how to construct such a combination reasonably. We tried some ad hoc approaches, e.g., taking a simple average (not reported in order to save space). Our main results remain the same.

Third, there can be alternative ways to specify the style dispersions. For example,

$$\begin{aligned}
\text{Size dispersion}_t^{Alt} &= \sqrt{\sum_j w_{jt} (s_{jt} - \bar{s}_t)^2}, \\
\text{Value dispersion}_t^{Alt} &= \sqrt{\sum_j w_{jt} (v_{jt} - \bar{v}_t)^2}, \\
\text{Mom dispersion}_t^{Alt} &= \sqrt{\sum_j w_{jt} (m_{jt} - \bar{m}_t)^2},
\end{aligned}$$

or computing the dispersions using equal weights instead of using value weights. We conducted our analysis using these specifications as well as different mixes of these specifications (not reported in order to save space). Our main results remain the same.

3.2 Quantifying Style Dispersions

Panel A of Table I reports summary statistics on the style dispersions. Size dispersion demonstrates significant cross-sectional variation. Specifically, it has an average level of 0.626, and ranges between 0.039 and 1.295. Value and momentum dispersions do not as much as size dispersion.

Panel B of Table I reports the correlation structure of the style dispersions and other fund characteristics. Funds with different style dispersions may have substantially different investment styles. For example, the correlation between size dispersion and size score is -0.530, suggesting that funds with high size dispersion tend to overweight small-cap stocks.

The correlation between size dispersions and Kacperczyk et al.'s (2005) industry concentration measure (ICI) is low, 0.227. This suggests that in practice, fund managers seldom deviate along the size dimension (captured by size dispersion) and the industry dimension (captured by ICI) at the same time. For example, consider a large-cap fund manager that shifts the portfolio weight from large-cap manufacturing firms to mid-cap or small-cap manufacturing firms. This rebalancing increases size dispersion but does not change the ICI.

The correlations between size dispersion and Cremers and Petajisto's (2009) Active Share is relatively high, 0.622. The reason for this is that both size dispersion and Active Share capture the fact that fund managers deviate from the core size style. To see this, consider a large-cap fund manager with the S&P 500 as the benchmark index. If she buys mid-cap or small-cap stocks, then both size dispersion and Active Share increase. However and importantly, a significant component of size dispersion is independent of Active Share.

The reason for this is that size dispersion also captures the distance of a fund's deviation from the core size style, whereas Active Share does not. Specifically, buying small-cap stocks represents a greater deviation from the core size style than buying mid-cap stocks, and increases size dispersion to a greater extent. Active Share recognizes buying mid-cap stocks and buying small-cap stocks as deviations from the benchmark index, but does not distinguish between them further. We will show in Section 5 that it is the distance of deviation, not the mere fact of deviation, from the core size style that contributes to superior fund performance (measured by the Carhart abnormal return).

We examine the stability of the style dispersions by running an AR(1) regression for each style dispersion at a quarterly frequency. The slope coefficients are respectively 0.963, 0.813, and 0.707; the R^2s are respectively 0.931, 0.664, and 0.505. These results suggest that the style dispersions, especially size dispersion, are fairly stable.

4 Style Dispersions and Fund Performance

In this section, we investigate the relations between the style dispersions and fund performance using portfolio and regression approaches.

4.1 Portfolio Evidence

We conduct the following portfolio analysis for each of size, value, and momentum dispersions. Take size dispersion as an example. At the beginning of each quarter, we sort all mutual funds in our sample into 10 portfolios based on the lagged size dispersion. We then compute the three monthly returns for each decile in the quarter by weighting all the funds in the decile equally. This gives us a time series of monthly returns for each decile.

Our analysis in Section 3 suggests that funds with different style dispersions can have different investment styles. To control for these style differences, we use five risk- and style-adjusted performance measures for each decile. The first performance measure is excess return of the decile over the market portfolio. The next four measures are the intercepts from a time-series regression based on the one-factor model of CAPM, the three-factor model of Fama and French (1993), the four-factor model of Carhart (1997), and the five-factor model of Pástor and Stambaugh (2003). The general form of these models is given by

$$\begin{aligned} R_{pt} - R_{Ft} &= \alpha_p + \beta_{p\mathrm{M}}(R_{Mt} - R_{Ft}) + \beta_{p\mathrm{SMB}}\mathrm{SMB}_t + \beta_{p\mathrm{HML}}\mathrm{HML}_t \\ &\quad + \beta_{p\mathrm{MOM}}\mathrm{MOM}_t + \beta_{p\mathrm{LIQ}}\mathrm{LIQ}_t + \epsilon_{pt}, \end{aligned}$$

where the dependent variable is the portfolio return minus the risk-free rate, and the independent variables are the returns of the five zero-investment factor portfolios. $R_{Mt} - R_{Ft}$ is the excess return of the market portfolio over the risk-free rate; SMB_t is the return difference between small and large capitalization stocks; HML_t is the return difference between high and low book-to-market stocks; MOM_t is the return difference between stocks with high and low past returns; and LIQ_t is the return difference between low and high liquidity stocks.[9] CAPM uses the first factor. Fama and French use the first three factors. Carhart uses the first four factors. Pástor and Stambaugh use all five factors. The intercept is referred to as the abnormal return.

In the main tests, we use the returns before subtracting expenses. These returns describe fund managers' investment ability, which we are primarily interested in. We also conduct our portfolio analysis using the returns after subtracting expenses (reported in

[9] The size, value, and momentum factor returns are taken from Kenneth French's website, http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html. The liquidity factor is obtained through WRDS.

Appendix A, Table A.I). Our main results are the same.

[**Insert Table II here.**]

Panel A of Table II reports the five risk- and style-adjusted performance measures for the deciles based on size dispersion. Column 1 shows that the difference in excess returns between the funds with the highest and lowest size dispersions (respectively, deciles 10 and 1) equals 38.9 basis points (bps) per month, which is statistically significant at the 1% level. Column 2 uses CAPM to control for market risk. The difference in abnormal returns between deciles 10 and 1 equals 29.9 bps per month, which is statistically significant at the 1% level. Column 3 uses the Fama-French three-factor model to further control for size and value. The difference in abnormal returns between deciles 10 and 1 equals 22.7 bps per month, which is statistically significant at the 1% level. Column 4 uses the Carhart four-factor model to further control for momentum. The difference in abnormal returns between deciles 10 and 1 drops to 16.9 bps per month, which is still statistically significant at the 1% level. Column 5 uses the Pástor-Stambaugh five-factor model to further control for liquidity. There is little change in the magnitude and significance of the difference in abnormal returns between deciles 10 and 1.

In short, funds with high size dispersion outperform funds with low size dispersion. As a matter of fact, decile 10 funds have positive and significant Carhart abnormal return, suggesting that fund managers with the highest size dispersion indeed possess superior investment ability. We find no such evidence for decile 1 funds.

Panels B and C of Table II report the five risk- and style-adjusted performance measures for the deciles based on value and momentum dispersions, respectively. We find no significant evidence that after using, e.g., the Carhart four-factor model to control for risk and style differences, value and momentum dispersions are related to fund performance.

4.2 Multivariate Regression Evidence

In this section, we conduct our analysis using multivariate regressions. We use the Carhart abnormal return as the only performance measure because our previous portfolio analysis suggests that the Carhart four-factor model controls for risk and style differences properly and sufficiently. Using other risk- and style-adjusted performance measures does not change our results.

The regression approach is different from the portfolio approach in two major ways. First, a multivariate regression framework simultaneously controls for other fund characteristics that can be related to fund performance. Second, the regressions account for possible time variations in the factor loadings of individual funds, using the recent data to estimate the four-factor model and determine the subsequent abnormal returns.[10]

We use the Fama-MacBeth (1973) cross-sectional regression that adjusts for heteroscedasticity and serial correlation of standard errors using Newey-West (1987) lags of order three. The Fama-MacBeth regression approach is appropriate for correcting for the time effect. We also conduct our analysis using the panel regression (reported in Appendix A, Table A.II). Our main results are the same.

4.2.1 Controlling for Various Fund Characteristics

Table III reports the regression results of the Carhart abnormal return on the style dispersions and other fund characteristics. We run the regressions at a quarterly frequency, because the style dispersions and other holding-based measures are mostly quarterly. At the beginning of each quarter, we use two years of past monthly returns to estimate the coefficients of the Carhart four-factor model. We subtract the expected return from the

[10]Ferson and Schadt (1996) point out that common variation in risk levels and risk premia can cause time-varying factor loadings of fund portfolios in an unconditional factor model.

realized fund return to determine the three monthly abnormal returns of a fund in this quarter. We use as the dependent variable the average of the three monthly abnormal returns. All explanatory variables are lagged by one quarter, except for expense ratio and turnover ratio, which are lagged by one year. We take the natural logarithms of fund TNA and age because both variables are skewed to the right.

[Insert Table III here.]

Panel A of Table III considers the entire sample period of 1980 to 2009. Consistent with our previous portfolio analysis, we find evidence of a positive and significant relation between size dispersion and the Carhart abnormal return. For example, Column 1 suggests that after controlling for often-used fund characteristics, a 0.287 increase in size dispersion, which corresponds to a one standard deviation increase in size dispersion, increases the abnormal monthly return in the subsequent quarter by $(21.6 \times 0.287 =)$ 6.20 bps. This result is statistically significant at the 1% level. Columns 2 to 4 show that value and momentum dispersions can predict the Carhart abnormal return, but their predictive power is not robust after including size dispersion as an explanatory variable.

Besides using the Carhart abnormal return as the dependent variable to control for risk and style differences, we explicitly control for fund style using size, value, and momentum scores as explanatory variables. We find evidence consistent with Chan et al. (2002) that growth funds (low value score) outperform.[11] We find persistent evidence consistent with previous mutual fund research that funds with good past performance (high 1-year fund return) continue to perform well.[12]

[11] Alternatively, we tried to control for the fund style fixed effect. Our results remain the same.

[12] Early studies of the persistence of mutual fund performance include, e.g., Grinblatt and Titman (1992), Hendricks et al. (1993), Brown and Goetzmann (1995). Carhart (1997) surveys these studies. Recent developments along this line of research include Bollen and Busse (2005), Cohen et al. (2005), Kosowski et al. (2006), etc.

Panel B of Table III includes a dummy variable, indicating top ten fund families with the largest family TNAs or the largest number of investment objectives, as an additional explanatory variable in the regression. We use the period of 2000 to 2009 because the fund family information in the CRSP mutual fund database, the management company code, is available for this period. The purpose of including this dummy variable is to examine whether the documented positive relation between size dispersion and the Carhart abnormal return is due to a (large) fund-family spillover effect. Intuitively, fund managers in a large fund family can share investment ideas or obtain advice from the research department of the family, and hence can successfully invest outside the core size style. We find, however, that the interaction term between the (top 10 family) dummy and size dispersion is not significant. Therefore, the documented positive relation between size dispersion and the Carhart abnormal return is not due to the (large) fund-family spillover effect.

We considered various other controls (not reported to save space). For example, we controlled for the calendar (year-end) effect by running the regression with the first quarter of each year excluded in our sample. The relation between size dispersion and the Carhart abnormal return remains positive and significant. We also considered the style drift measure examined by Brown et al. (2009) and Wermers (2012). This style drift measure captures the migration of core fund styles over time (see Figure 1, the panel of investment style history, though the style of this particular fund has no migration) and is given by $|\bar{s}_t - \bar{s}_{t-1}|$, $|\bar{v}_t - \bar{v}_{t-1}|$, and $|\bar{m}_t - \bar{m}_{t-1}|$ using our notations. We have two findings. First, the correlations between style dispersions and style drift measures are low, suggesting that they describe distinct fund characteristics. Second, after controlling for the style drift measures, the relation between size dispersion and the Carhart abnormal return remains positive and significant.

4.2.2 Controlling for Idiosyncratic Risk and Survivorship

As fund managers invest outside the core fund style, they may be exposed to greater idiosyncratic risk. To account for the different amounts of unique risk across our sample of funds, we use the modified appraisal ratio of Treynor and Black (1973) as a performance measure. The appraisal ratio is computed by dividing the abnormal return by idiosyncratic risk.

Brown et al. (1995) show that survivorship bias is positively related to fund return variance. Thus, the higher the return volatility, the greater the difference between the ex post observed mean and the ex ante expected return. Using the abnormal return scaled by idiosyncratic risk as our performance measure mitigates such survivorship problems.

[Insert Table IV here.]

Table IV reports the regression results of the appraisal ratio on the lagged style dispersions and other fund characteristics. We run the regressions at a quarterly frequency. At the beginning of each quarter, we use two years of past monthly returns to estimate the coefficients of the Carhart four-factor model. We estimate the idiosyncratic risk using the standard deviation of the residuals. We subtract the expected return from the realized fund return to determine the three monthly abnormal returns of a fund in this quarter. We use as the dependent variable the average of the three monthly abnormal returns scaled by the estimated idiosyncratic risk.

We find evidence of a positive and significant relation between size dispersion and the appraisal ratio. For example, Column 1 suggests that a 0.287 increase in size dispersion, which corresponds to a one standard deviation increase in size dispersion, increases the appraisal ratio in the subsequent quarter by $(0.171 \times 0.287 =)$ 0.05. This result is statistically significant at the 1% level. Column 4 shows that size dispersion is still significant in predicting the appraisal ratio after being put in a horse race with value and momentum dispersions.

Thus, the results suggest that the relation between size dispersion and fund performance is not driven by the amount of idiosyncratic risk, which is related to survival conditions.

5 The Source of Fund Performance

In this section, we examine the source of the superior fund performance associated with high size dispersion.

5.1 Decomposing Size Dispersion into "Deviation-Only" and "Distance-Only" Measures

We decompose size dispersion into two parts: a "deviation-only" measure capturing how likely a fund manager invests outside of the core fund style, and a "distance-only" measure capturing how far the fund manager invests outside. We use Cremers and Petajisto's (2009) Active Share to proxy the deviation-only measure because according to its computation (see Eq. 2), Active Share captures how likely a fund manager deviates, but not how far she deviates, from the benchmark index holdings. We run the following regression for each fund at a quarterly frequency:

$$\text{Size dispersion}_t = a + b \cdot \text{Active Share}_t + \epsilon_t,$$

and use the estimated residual term, $\hat{\epsilon}_t$, as the distance-only measure.

[Insert Table V here.]

Table V reports the results from regressing the Carhart abnormal return on the distance-only measure, the deviation-only measure (Active Share), and other fund characteristics. We use the period of 1990 to 2006 because the data on Active Share are available only for this period. Column 2 shows that the relation between the distance-only measure and the Carhart abnormal return is positive and significant (at the 1% level). Column 3 shows that the deviation-only measure (Active Share) is not related to the Carhart abnormal return. These results remain the same when both the distance-only measure and and the deviation-only measure are included as explanatory varibles at the same time (see Column 4).

In sum, our evidence is consistent with that fund managers who merely invest outside of the core size style do not necessarily produce superior fund performance; fund managers who invest *far* outside do.

5.2 A Diagnostic Analysis Using Holding-Based Performance Measures

In this section, we use the two holding-based performance measures proposed by DGTW (1997) to conduct our analysis. The first measure is the "Characteristic Selectivity" measure (CS), which describes fund managers' stock selection ability. The second measure is the "Characteristic Timing" measure (CT), which describes fund managers' style timing ability.

$$
\begin{aligned}
\mathrm{CS}_t &= \sum_j w_{j,t-1}\Big[R_{jt} - \mathrm{BR}_t(j,t-1)\Big], \\
\mathrm{CT}_t &= \sum_j \Big[w_{j,t-1}\mathrm{BR}_t(j,t-1) - w_{j,t-13}\mathrm{BR}_t(j,t-13)\Big],
\end{aligned}
$$

where R_{jt} is the return on stock j during month t; $\mathrm{BR}_t(j,t-k)$ is the return on the benchmark portfolio during month t to which stock j was allocated during month $t-k$ according to its size, book-to-market, and momentum characteristics;[13] and $w_{j,t-k}$ is the value weight of stock j at the end of month $t-k$ in the mutual fund.

5.2.1 Portfolio Holding-Based Performance Measures

At the beginning of each quarter, we sort all mutual funds in our sample into 10 portfolios based on the lagged size dispersion. We then compute the three monthly CS and CT measures for each decile in the quarter by weighting all the funds in the decile equally. This procedure gives us time series of monthly CS and CT for each decile.

[Insert Table VI here.]

Table VI reports the CS and CT for the deciles based on size dispersion. Column 1 shows that funds with high size dispersion exhibit higher stock selection measure CS than funds with low size dispersion. For example, the CS measure of decile 10 is 27.1 bps per month higher than that of decile 1. This result is statistically significant at the 5% level. Column 2 finds no significant evidence that decile 10 has higher style timing measure CT than decile 1.

In sum, fund managers with high size dispersion exhibit better stock selection ability, but no better style timing ability. In what follows, we examine whether these fund managers are better than other fund managers when picking stocks near the core size style, far from the core size style, or both.

---

[13]DGTW (1997) and Wermers (2000, 2004) describe the computation of these benchmark returns in detail. The DGTW benchmark returns were taken from Russ Wermers' website, http://www.smith.umd.edu/faculty/rwermers/ftpsite/Dgtw/coverpage.htm.

5.2.2 Stock Selection Ability Near (Far from) the Core Size Style

At the beginning of each quarter, we form 10 portfolios based on the lagged size dispersion. For each fund in a decile, we sort its stockholdings (j) into two portfolios according to the distance from the core size style, $|s_{jt} - \bar{s}_t|$. We refer to these two portfolios as "near" and "far" portfolios, and compute their CS measures. We compute the three monthly CS for the decile "near" and "far" portfolios in the quarter by weighting all the funds in the decile equally. This gives us time series of CS for the decile "near" and "far" portfolios.

[Insert Table VII here.]

Table VII reports the CS for the "near" and "far" portfolios in each decile based on size dispersion. Columns 1 to 3 divide the "near" and "far" portfolios for each fund according to the median distance of all the stockholdings in each decile. Column 1 shows that near the core size style, fund managers with high size dispersion exhibit slightly better stock selection ability than fund managers with low size dispersion. Specifically, the difference in CS between the "near" portfolios of deciles 10 and 1 is 24.6 bps per month, which is statistically significant at the 10% level. Column 2 shows that far from the core size style, the stock selection ability of fund managers with high size dispersion is significantly better. Specifically, the difference in CS between the "far" portfolios of deciles 10 and 1 is 30.8 bps per month, which is statistically significant at the 5% level. Column 3 shows that for each decile, the performance of the "near" portfolio is not significantly different from that of the "far" portfolio; therefore, fund managers' investments near and far from the core size style are an equilibrium outcome.

Columns 4 to 6 divide the "near" and "far" portfolios according to the 75th percentile distance of all the stockholdings in each decile. The evidence becomes even more significant than our analysis in Columns 1 to 3.

In sum, while in general fund managers with high size dispersion exhibit better stock selection ability than fund managers with low size dispersion, near the core size style their stock selection ability is only slightly better. Only far from the core size style, their stock selection ability is significantly better.

6 Conclusions

Fund style dispersions are important fund characteristics describing how widely fund investments are distributed around the core fund style along the dimensions of size, book-to-market, etc. However, the mutual fund literature has little to say about the style dispersions and their relations to fund performance. In this article, we make an initial attempt to estimate the style dispersions. We then examine the relations between the style dispersions and performance.

We have two major findings. First, high style dispersion along the dimension of size, not value or momentum, is associated with superior fund performance (measured by the Carhart abnormal return). This finding supports the view that fund managers with high investment ability take advantage of opportunities to invest outside the core size style, producing superior fund performance. Second, the Carhart abnormal return is significantly positively related to the distance of deviation, not the mere fact of deviation, from the core size style. This finding supports the view that fund managers who merely invest outside of the core size style do not necessarily produce superior fund performance; only the fund managers who invest *far* outside do.

Overall, our findings suggests that investment style dispersions are an important fund characteristics indicating fund manager investment ability and fund performance.

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Figure 1: A Snapshot of Fidelity Contrafund's stockholdings

This figure provides a snapshot taken by Morningstar of Fidelity Contrafund's (managed by William Danoff) stockholdings as of September 30, 2012.
(Source: Morningstar website,
http://portfolios.morningstar.com/fund/summary?t=FCNTX&region=USA&culture=en-us).

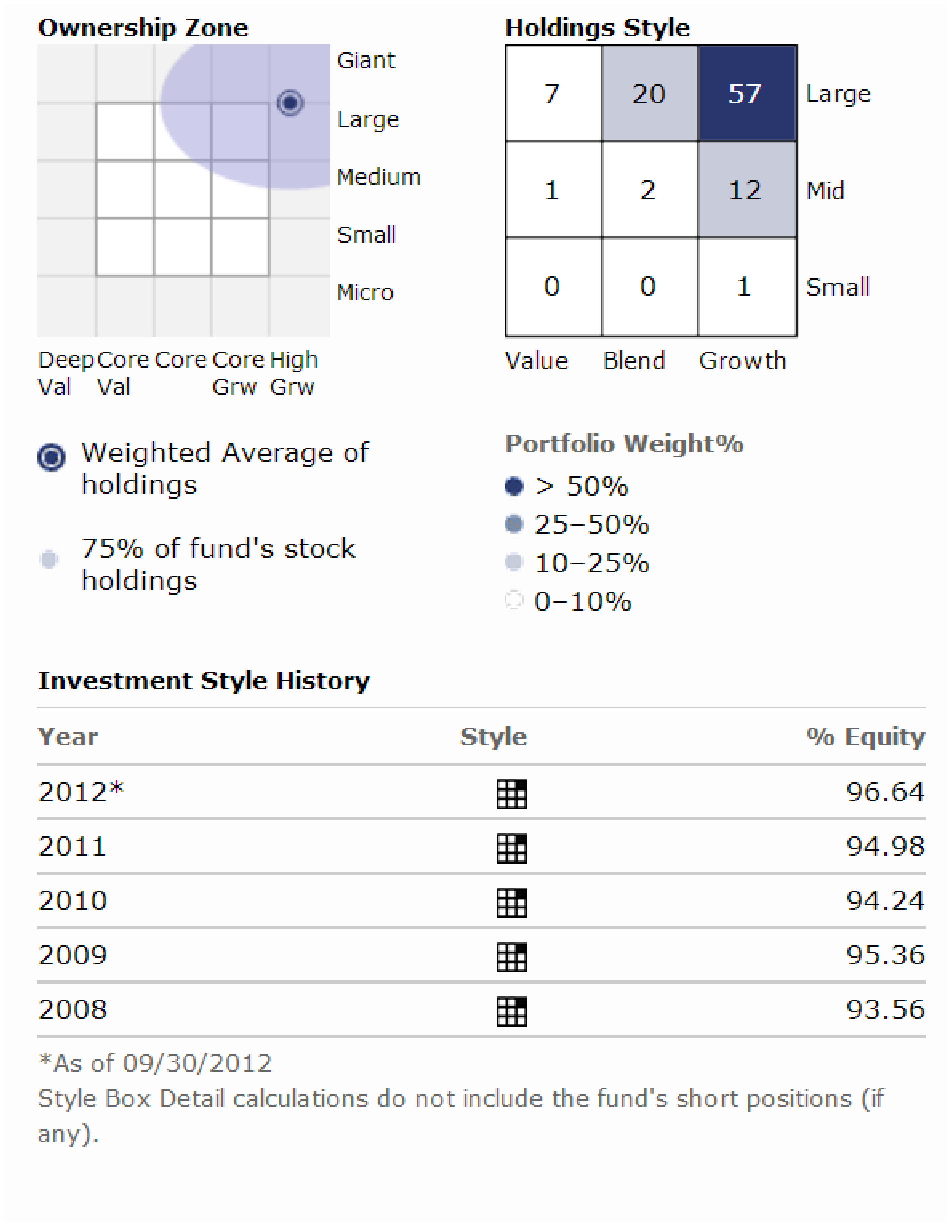

Table I: Summary Statistics

This table reports the summary statistics for the sample of actively managed open-end U.S. domestic equity mutual funds for the period of 1980 to 2009. The sample includes 2,555 distinct funds and 82,512 fund-quarter observations. Panel A reports the time-series average of cross-sectional summary statistics. Panel B reports the time-series average of the cross-sectional pairwise correlation. All continuous variables are winsorized at the 1% and 99% levels.

Panel A: Fund Characteristics

Variables	Mean	Median	Minimum	Maximum	Standard Deviation
TNA (in millions)	681.2	189.8	9.5	11191.5	1489.3
Fund Age	17.7	13.3	1.6	72.1	14.6
Expense Ratio	0.011	0.011	0.000	0.024	0.004
Turnover Ratio	0.942	0.720	0.048	5.116	0.830
New Money Growth (NMG)	0.023	-0.003	-0.380	0.836	0.153
Industry Concentration Index (ICI)	0.096	0.053	0.004	0.714	0.133
Active Share	0.797	0.823	0.319	0.987	0.143
Size Score	3.992	4.323	1.106	4.979	0.911
Value Score	2.665	2.668	1.290	4.180	0.518
Mom Score	3.265	3.245	1.743	4.739	0.524
Size Dispersion	0.626	0.638	0.039	1.295	0.287
Value Dispersion	1.101	1.116	0.669	1.452	0.155
Mom Dispersion	1.117	1.135	0.544	1.496	0.173

Panel B: Correlation Structure

	Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1)	Size Dispersion	1.000												
(2)	Value Dispersion	0.087	1.000											
(3)	Mom Dispersion	0.054	0.175	1.000										
(4)	TNA	-0.185	0.009	0.055	1.000									
(5)	Fund Age	-0.201	0.033	0.027	0.318	1.000								
(6)	Expense Ratio	0.224	-0.020	-0.040	-0.220	-0.229	1.000							
(7)	Turnover Ratio	0.190	0.101	-0.011	-0.122	-0.121	0.250	1.000						
(8)	NMG	0.049	0.004	-0.029	-0.019	-0.148	0.039	0.045	1.000					
(9)	ICI	0.227	-0.142	-0.199	-0.075	-0.078	0.180	0.115	0.023	1.000				
(10)	Active Share	0.622	0.013	-0.034	-0.174	-0.141	0.253	0.101	0.027	0.408	1.000			
(11)	Size Score	-0.530	0.039	0.000	0.187	0.281	-0.227	-0.099	-0.076	-0.118	-0.654	1.000		
(12)	Value Score	-0.090	0.352	0.116	0.090	0.032	-0.095	-0.095	0.007	-0.079	-0.059	0.214	1.000	
(13)	Mom Score	0.171	-0.052	-0.283	-0.072	-0.062	0.138	0.254	0.065	0.057	0.174	-0.272	-0.438	1.000

Table II: Before-Expense Returns of Portfolios Based on Style Dispersions

This table reports the five risk- and style-adjusted returns (before-expense) of decile portfolios based on the size, value, and momentum dispersions, respectively, for the period of 1980 to 2009. We form 10 portfolios at the beginning of each quarter based on each lagged style dispersion. The equally-weighted decile returns are expressed at a monthly frequency. We use excess return over the market, and abnormal returns of CAPM, the Fama-French three-factor model, the Carhart four-factor model, and the Pástor-Stambaugh five-factor model. The t-statistics are given in parentheses. The table also reports the differences in these returns, along with their t-statistics, between the top and the bottom deciles and between the top and the bottom halves. The significance levels are denoted by *, **, and ***, and indicate whether the results are statistically different from zero at the 10%, 5%, and 1% significance levels.

Panel A: Before-Expense Monthly Returns of Portfolios Based on Size Dispersion ($\times$100)

	Excess Return	CAPM	Fama-French	Carhart	Pástor-Stambaugh
	(1)	(2)	(3)	(4)	(5)
1 (Low Size Disp.)	-0.067	-0.024	0.020	0.039	0.043
	(-1.63)	(-0.63)	(0.66)	(1.32)	(1.43)
2	-0.028	-0.006	0.027	0.048	0.058*
	(-0.76)	(-0.15)	(0.81)	(1.43)	(1.70)
3	-0.036	-0.020	-0.006	-0.010	0.001
	(-1.09)	(-0.63)	(-0.20)	(-0.30)	(0.02)
4	0.019	0.036	0.028	0.030	0.056
	(0.44)	(0.84)	(0.65)	(0.68)	(1.25)
5	0.048	0.038	0.020	0.013	0.027
	(0.96)	(0.75)	(0.44)	(0.29)	(0.58)
6	0.108	0.084	0.065	0.035	0.035
	(1.64)	(1.28)	(1.22)	(0.65)	(0.64)
7	0.162**	0.120	0.099*	0.066	0.075
	(2.01)	(1.51)	(1.82)	(1.20)	(1.35)
8	0.235***	0.181**	0.163***	0.111**	0.124**
	(2.66)	(2.10)	(2.90)	(1.99)	(2.21)
9	0.234**	0.183**	0.146***	0.104**	0.118**
	(2.57)	(2.05)	(2.81)	(2.00)	(2.24)
10 (High Size Disp.)	0.322***	0.275***	0.247***	0.208***	0.226***
	(3.69)	(3.21)	(4.82)	(4.06)	(4.38)
Decile 10-Decile 1	0.389***	0.299***	0.227***	0.169***	0.183***
	(3.39)	(2.73)	(3.71)	(2.78)	(2.99)
2nd half-1st half	0.225***	0.164**	0.126***	0.080**	0.079**
	(2.86)	(2.18)	(3.30)	(2.16)	(2.09)

Table II (Continued)

Panel B: Before-Expense Monthly Returns of Portfolios Based on Value Dispersion (×100)

	Excess Return	CAPM	Fama-French	Carhart	Pástor-Stambaugh
	(1)	(2)	(3)	(4)	(5)
1 (Low Value Disp.)	0.035	-0.055	0.084	0.076	0.103
	(0.33)	(-0.55)	(1.28)	(1.13)	(1.53)
2	0.020	-0.005	0.045	0.030	0.046
	(0.36)	(-0.10)	(1.11)	(0.72)	(1.11)
3	0.065	0.052	0.068	0.048	0.068
	(1.32)	(1.06)	(1.63)	(1.14)	(1.59)
4	0.100**	0.110***	0.091**	0.085**	0.096**
	(2.39)	(2.62)	(2.46)	(2.25)	(2.51)
5	0.081*	0.095**	0.053	0.041	0.053
	(1.93)	(2.26)	(1.45)	(1.08)	(1.40)
6	0.108**	0.116***	0.082**	0.064	0.075*
	(2.54)	(2.74)	(2.08)	(1.60)	(1.86)
7	0.123**	0.128***	0.087**	0.073	0.077*
	(2.56)	(2.63)	(1.97)	(1.63)	(1.69)
8	0.079	0.078	0.037	0.029	0.034
	(1.52)	(1.49)	(0.81)	(0.61)	(0.72)
9	0.165***	0.153***	0.108**	0.082*	0.091*
	(3.00)	(2.77)	(2.26)	(1.71)	(1.85)
10 (High Value Disp.)	0.215***	0.187***	0.146***	0.112**	0.116**
	(3.27)	(2.87)	(2.67)	(2.02)	(2.06)
Decile 10-Decile 1	0.180*	0.242**	0.063	0.036	0.013
	(1.81)	(2.50)	(0.79)	(0.45)	(0.16)
2nd half-1st half	0.078**	0.093**	0.024	0.016	0.005
	(1.97)	(2.37)	(0.71)	(0.47)	(0.16)

Table II (Continued)

Panel C: Before-Expense Monthly Returns of Portfolios Based on Momentum Dispersion (×100)

	Excess Return (1)	CAPM (2)	Fama-French (3)	Carhart (4)	Pástor-Stambaugh (5)
1 (Low Mom Disp.)	0.075	-0.002	0.153	0.054	0.052
	(0.57)	(-0.01)	(1.64)	(0.58)	(0.56)
2	0.070	0.030	0.105*	0.037	0.045
	(0.91)	(0.39)	(1.90)	(0.68)	(0.83)
3	0.086	0.080	0.094**	0.041	0.046
	(1.64)	(1.50)	(2.11)	(0.94)	(1.05)
4	0.090**	0.101**	0.074**	0.052	0.058
	(2.26)	(2.51)	(2.05)	(1.43)	(1.57)
5	0.055	0.070*	0.034	0.028	0.040
	(1.35)	(1.74)	(0.91)	(0.72)	(1.02)
6	0.072	0.086*	0.043	0.047	0.063
	(1.54)	(1.84)	(0.96)	(1.02)	(1.34)
7	0.140***	0.150***	0.093*	0.106**	0.120**
	(2.61)	(2.78)	(1.81)	(2.03)	(2.27)
8	0.136**	0.133**	0.080	0.089	0.106*
	(2.39)	(2.31)	(1.47)	(1.59)	(1.89)
9	0.096	0.089	0.033	0.059	0.074
	(1.57)	(1.44)	(0.59)	(1.04)	(1.29)
10 (High Mom Disp.)	0.170**	0.123	0.093	0.129*	0.155**
	(2.22)	(1.65)	(1.44)	(1.96)	(2.34)
Decile 10-Decile 1	0.095	0.125	-0.060	0.075	0.103
	(0.68)	(0.89)	(-0.47)	(0.60)	(0.82)
2nd half-1st half	0.047	0.060	-0.023	0.044	0.055
	(0.74)	(0.93)	(-0.40)	(0.77)	(0.96)

Table III: Fama-MacBeth Regression Evidence: Controlling for Other Fund Characteristics

This table reports the regression results of the Carhart abnormal return (before-expense) on the style dispersions and other fund characteristics. The regressions are run at a quarterly frequency. The dependent variable, the Carhart abnormal return, measures the average monthly abnormal performance in a quarter using the four-factor model of Carhart (1997) based on 24 months of lagged data. All explanatory variables are lagged by one quarter, except for expense ratio and turnover ratio, which are lagged by one year. Panel A uses the entire sample period of 1980 to 2009; Panel B uses the sample period of 2000 to 2009 because fund family information from the CRSP database is available for this period. We use the Fama-MacBeth cross-sectional regression that adjusts for heteroscedasticity and serial correlation of standard errors using Newey-West (1987) lags of order three. The *t*-statistics are given in parentheses. The significance levels are denoted by *, **, and ***, and indicate whether the results are statistically different from zero at the 10%, 5%, and 1% significance levels.

Panel A: Dependent Variable: Before-Expense Average Monthly Carhart Abnormal Return in a Quarter ($\times 100$), 1980-2009

	(1)	(2)	(3)	(4)
Size Dispersion	0.216***			0.200***
	(4.56)			(4.44)
Value Dispersion		0.187***		0.125*
		(2.70)		(1.92)
Mom Dispersion			0.118**	0.057
			(2.04)	(1.01)
ln(TNA)	-0.083***	-0.103***	-0.098***	-0.092***
	(-2.63)	(-3.15)	(-2.84)	(-2.68)
$(\ln(\text{TNA}))^2$	0.007**	0.008***	0.008**	0.008**
	(2.58)	(2.94)	(2.61)	(2.61)
ln(Fund Age)	-0.002	-0.005	-0.002	-0.006
	(-0.24)	(-0.55)	(-0.26)	(-0.68)
Expense Ratio	0.531	-0.354	-0.607	-0.133
	(0.22)	(-0.14)	(-0.24)	(-0.05)
Turnover Ratio	0.007	0.008	0.012	0.001
	(0.41)	(0.48)	(0.72)	(0.04)
1-Yr Fund Return	0.991***	1.040***	1.071***	1.044***
	(3.32)	(3.41)	(3.57)	(3.47)
NMG	0.185*	0.189**	0.200**	0.192**
	(1.94)	(2.00)	(2.04)	(2.05)
ICI	-0.021	0.080	0.044	0.008
	(-0.15)	(0.56)	(0.30)	(0.06)
Size Score	0.029	-0.005	-0.005	0.029
	(1.39)	(-0.25)	(-0.24)	(1.28)
Value Score	-0.082**	-0.101**	-0.078*	-0.096**
	(-2.02)	(-2.45)	(-1.86)	(-2.32)
Mom Score	-0.019	-0.023	-0.011	-0.015
	(-0.39)	(-0.47)	(-0.24)	(-0.31)

No. of Observations: 71,872

Table III (Continued)

Panel B: Dependent Variable: Before-Expense Average Monthly Carhart Abnormal Return in a Quarter (×100), 2000-2009

	(1)	(2)	(3)	(4)
Size Dispersion	0.141*	0.133**	0.150**	0.142**
	(2.00)	(2.02)	(2.17)	(2.20)
Top 10 Family (based on Family TNA)	-0.004	-0.004		
	(-0.18)	(-0.14)		
Top 10 Family (based on Family TNA)×Size Dispersion	0.093	0.093		
	(1.28)	(1.20)		
Top 10 Family (based No. of Inv. Obj.)			-0.001	-0.001
			(-0.04)	(-0.03)
Top 10 Family (based on No. of Inv. Obj.)×Size Dispersion			0.043	0.039
			(0.68)	(0.62)
Value Dispersion		0.089		0.088
		(0.77)		(0.77)
Mom Dispersion		0.102		0.103
		(1.35)		(1.38)
ln(TNA)	0.007	0.007	0.006	0.006
	(0.27)	(0.28)	(0.22)	(0.25)
$(\ln(\text{TNA}))^2$	-0.001	-0.001	-0.000	-0.000
	(-0.29)	(-0.36)	(-0.18)	(-0.27)
ln(Fund Age)	0.007	0.007	0.006	0.007
	(0.70)	(0.71)	(0.65)	(0.67)
Expense Ratio	2.226	2.028	1.925	1.711
	(0.87)	(0.81)	(0.77)	(0.70)
Turnover Ratio	-0.012	-0.013	-0.011	-0.013
	(-0.87)	(-1.06)	(-0.84)	(-1.04)
1-Yr Fund Return	0.668	0.675	0.673	0.681
	(1.16)	(1.19)	(1.16)	(1.19)
NMG	0.131	0.127	0.136	0.133
	(1.48)	(1.46)	(1.52)	(1.52)
ICI	0.212	0.247	0.225	0.262*
	(1.39)	(1.65)	(1.47)	(1.74)
Size Score	0.048	0.044	0.050	0.046
	(1.36)	(1.28)	(1.41)	(1.34)
Value Score	-0.061	-0.066	-0.063	-0.068
	(-0.86)	(-0.93)	(-0.89)	(-0.96)
Mom Score	-0.078	-0.074	-0.079	-0.075
	(-0.71)	(-0.67)	(-0.71)	(-0.67)

No. of Observations: 50,801

Table IV: Fama-MacBeth Regression Evidence: Controlling for Idiosyncratic Risk and Survivorship Using the Appraisal Ratio

This table reports the regression results of the appraisal ratio (before-expense) on the style dispersions and other fund characteristics for the period of 1980 to 2009. The regressions are run at a quarterly frequency. The dependent variable, the appraisal ratio, measures the average monthly abnormal performance in a quarter scaled by idiosyncratic volatility estimated using the four-factor model of Carhart (1997) based on 24 months of lagged data. All explanatory variables are lagged by one quarter, except for expense ratio and turnover ratio, which are lagged by one year. We use the Fama-MacBeth cross-sectional regression that adjusts for heteroscedasticity and serial correlation of standard errors using Newey-West (1987) lags of order three. The t-statistics are given in parentheses. The significance levels are denoted by *, **, and ***, and indicate whether the results are statistically different from zero at the 10%, 5%, and 1% significance levels.

Dependent Variable: Before-Expense Average Monthly Appraisal Ratio in a Quarter

	(1)	(2)	(3)	(4)
Size Dispersion	0.171***			0.160***
	(4.47)			(4.39)
Value Dispersion		0.152***		0.111**
		(2.85)		(2.21)
Mom Dispersion			0.050	0.001
			(1.15)	(0.01)
ln(TNA)	-0.025	-0.043**	-0.038*	-0.033
	(-1.18)	(-2.11)	(-1.71)	(-1.48)
$(\ln(\text{TNA}))^2$	0.002	0.003	0.003	0.003
	(1.04)	(1.65)	(1.29)	(1.33)
ln(Fund Age)	0.004	0.002	0.003	0.001
	(0.47)	(0.25)	(0.42)	(0.11)
Expense Ratio	2.183	1.364	1.130	1.479
	(1.10)	(0.65)	(0.53)	(0.74)
Turnover Ratio	-0.007	-0.006	-0.002	-0.011
	(-0.58)	(-0.51)	(-0.22)	(-1.08)
1-Yr Fund Return	0.748***	0.769***	0.805***	0.778***
	(3.67)	(3.67)	(3.88)	(3.75)
NMG	0.115**	0.119**	0.125**	0.121**
	(2.03)	(2.06)	(2.19)	(2.13)
ICI	-0.097	-0.012	-0.054	-0.086
	(-1.34)	(-0.17)	(-0.74)	(-1.26)
Size Score	0.026*	-0.002	-0.002	0.025
	(1.79)	(-0.13)	(-0.16)	(1.64)
Value Score	-0.063**	-0.077**	-0.061*	-0.077**
	(-1.99)	(-2.24)	(-1.85)	(-2.24)
Mom Score	-0.011	-0.015	-0.011	-0.016
	(-0.37)	(-0.46)	(-0.34)	(-0.49)

No. of Observations: 71,872

Table V: Fama-MacBeth Regression Evidence: Decomposing Size Dispersion into "Deviation-Only" and "Distance-Only" Measures

This table reports the regression results of the Carhart abnormal return (before-expense) on size dispersion and its deviation-only and distance-only components for the period of 1990 to 2006, due to availability of the Active Share (proxy of the distance-only measure) data. The regressions are run at a quarterly frequency. The dependent variable, the Carhart abnormal return, measures the average monthly abnormal performance in a quarter using the four-factor model of Carhart (1997) based on 24 months of lagged data. All explanatory variables are lagged by one quarter, except for expense ratio and turnover ratio, which are lagged by one year. We use the Fama-MacBeth cross-sectional regression that adjusts for heteroscedasticity and serial correlation of standard errors using Newey-West (1987) lags of order three. The t-statistics are given in parentheses. The significance levels are denoted by *, **, and ***, and indicate whether the results are statistically different from zero at the 10%, 5%, and 1% significance levels.

Table V (Continued)

Dependent Variable: Before-Expense Average Monthly Carhart Abnormal Return in a Quarter ($\times$100), 1990-2006				
	(1)	(2)	(3)	(4)
Size Dispersion	0.186***			
	(2.88)			
Distance-Only		0.248***		0.290***
		(3.39)		(3.41)
Deviation-Only (Active Share)			0.214	0.242
			(1.32)	(1.41)
Value Dispersion	0.039	0.105	0.110	0.098
	(0.44)	(1.11)	(1.20)	(1.10)
Mom Dispersion	0.121*	0.101	0.097	0.093
	(1.68)	(1.27)	(1.21)	(1.19)
ln(TNA)	-0.043	-0.049	-0.050	-0.047
	(-1.62)	(-1.62)	(-1.51)	(-1.42)
$(\ln(TNA))^2$	0.004	0.003	0.003	0.003
	(1.53)	(1.22)	(1.25)	(1.17)
ln(Fund Age)	-0.010	0.002	-0.001	0.002
	(-1.20)	(0.17)	(-0.13)	(0.22)
Expense Ratio	0.498	-1.456	-1.799	-1.793
	(0.30)	(-0.64)	(-0.85)	(-0.87)
Turnover Ratio	-0.005	-0.013	-0.012	-0.012
	(-0.30)	(-0.73)	(-0.66)	(-0.65)
1-Yr Fund Return	1.195***	1.226***	1.231***	1.218***
	(4.06)	(4.50)	(4.53)	(4.44)
NMG	-0.014	0.050	0.040	0.042
	(-0.16)	(0.55)	(0.47)	(0.50)
ICI	0.176	0.136	0.014	0.003
	(1.36)	(0.47)	(0.05)	(0.01)
Size Score	-0.007	-0.030	-0.017	-0.009
	(-0.30)	(-1.42)	(-0.65)	(-0.36)
Value Score	-0.027	-0.023	-0.023	-0.022
	(-0.60)	(-0.54)	(-0.57)	(-0.53)
Mom Score	-0.094*	-0.104	-0.094	-0.094
	(-1.75)	(-1.46)	(-1.37)	(-1.41)
No. of Observations: 33,759				

Table VI: Holding-Based Performance Measures of Portfolios Based on Size Dispersion

This table reports the two holding-based performance measures proposed by DGTW (1997), the "Characteristic Selectivity" measure CS and the "Characteristic Timing" measure CT, for decile portfolios based on size dispersion for the period of 1980 to 2009. We form 10 portfolios at the beginning of each quarter based on the lagged size dispersion. The equally-weighted decile CS and CT measures are expressed at a monthly frequency. The t-statistics are given in parentheses. The table also reports the differences in the performance measures, along with their t-statistics, between the top and the bottom deciles and between the top and the bottom halves. The significance levels are denoted by *, **, and ***, and indicate whether the results are statistically different from zero at the 10%, 5%, and 1% significance levels.

Monthly Holding-Based Performance Measures of Portfolios Based on Size Dispersion ($\times 100$)

	CS (1)	CT (2)
1 (Low Size Disp.)	0.078	-0.044
	(0.29)	(-1.38)
2	0.081	-0.038
	(0.30)	(-1.46)
3	0.087	-0.045
	(0.31)	(-1.55)
4	0.081	-0.007
	(0.28)	(-0.29)
5	0.088	0.012
	(0.29)	(0.56)
6	0.127	-0.012
	(0.41)	(-0.54)
7	0.195	-0.007
	(0.60)	(-0.30)
8	0.192	-0.016
	(0.60)	(-0.58)
9	0.252	-0.030
	(0.78)	(-1.30)
10 (High Size Disp.)	0.349	0.008
	(1.10)	(0.32)
Decile 10-Decile 1	0.271**	0.051
	(2.23)	(1.50)
2nd half-1st half	0.140*	0.013
	(1.68)	(0.69)

Table VII: "Characteristic Selectivity" (CS) Measures of Portfolios Based on Size Dispersion: A Diagnostic Analysis

This table reports the "Characteristic Selectivity" measure CS for the "near" and "far" portfolios in each decile based on size dispersion for the period of 1980 to 2009. We form 10 portfolios at the beginning of each quarter based on the lagged size dispersion. For each fund in a decile, we divide its stockholdings into "near" and "far" portfolios based on the distance from the fund's core size style, and compute their CS measures. The equally-weighted decile CS measures are expressed at a monthly frequency. The t-statistics are given in parentheses. The table also reports the differences in the CS measures, along with their t-statistics, between the top and the bottom deciles, between the top and the bottom halves, and between "near" and "far" portfolios. The significance levels are denoted by *, **, and ***, and indicate whether the results are statistically different from zero at the 10%, 5%, and 1% significance levels.

Monthly "Characteristic Selectivity" (CS) Measures of Portfolios Based on Size Dispersion (×100)

	Portfolios according to Median Distance of Decile Stockholdings			Portfolios according to 75th percentile Distance of Decile Stockholdings		
	"Near" (1)	"Far" (2)	Diff. (3)=(2)-(1)	"Near" (4)	"Far" (5)	Diff. (6)=(5)-(4)
1 (Low Size Disp.)	0.070	0.063	-0.007	0.087	0.061	-0.026
	(0.26)	(0.22)	(-0.08)	(0.33)	(0.20)	(-0.21)
2	0.072	0.132	0.060	0.082	0.138	0.056
	(0.27)	(0.44)	(0.64)	(0.30)	(0.42)	(0.43)
3	0.063	0.124	0.061	0.085	0.087	0.001
	(0.23)	(0.39)	(0.59)	(0.31)	(0.25)	(0.01)
4	0.102	0.093	-0.009	0.095	0.073	-0.022
	(0.36)	(0.30)	(-0.13)	(0.34)	(0.21)	(-0.19)
5	0.050	0.171	0.121*	0.054	0.257	0.203*
	(0.17)	(0.53)	(1.71)	(0.18)	(0.76)	(1.93)
6	0.096	0.158	0.062	0.120	0.237	0.117
	(0.31)	(0.48)	(0.99)	(0.39)	(0.68)	(1.06)
7	0.163	0.296	0.133*	0.164	0.332	0.167*
	(0.50)	(0.88)	(1.93)	(0.52)	(0.92)	(1.76)
8	0.181	0.205	0.024	0.171	0.246	0.075
	(0.56)	(0.62)	(0.36)	(0.54)	(0.68)	(0.68)
9	0.228	0.286	0.058	0.245	0.373	0.128
	(0.70)	(0.86)	(0.76)	(0.77)	(1.05)	(1.25)
10 (High Size Disp.)	0.316	0.371	0.055	0.322	0.477	0.155
	(0.98)	(1.11)	(0.67)	(1.02)	(1.33)	(1.35)
Decile 10-Decile 1	0.246*	0.308**		0.234*	0.416**	
	(1.87)	(2.23)		(1.89)	(2.40)	
2nd half-1st half	0.129	0.144*		0.124	0.203**	
	(1.42)	(1.72)		(1.45)	(2.01)	

Appendix A

Table A.I: After-Expense Returns of Portfolios Based on Style Dispersions

This table reports the five risk- and style-adjusted returns (after-expense) of decile portfolios based on the size, value, and momentum dispersions, respectively, for the period of 1980 to 2009. We form 10 portfolios at the beginning of each quarter based on each lagged style dispersion. The equally-weighted decile returns are expressed at a monthly frequency. We use excess return over the market, and abnormal returns of CAPM, the Fama-French three-factor model, the Carhart four-factor model, and the Pástor-Stambaugh five-factor model. The t-statistics are given in parentheses. The table also reports the differences in these returns, along with their t-statistics, between the top and the bottom deciles and between the top and the bottom halves. The significance levels are denoted by *, **, and ***, and indicate whether the results are statistically different from zero at the 10%, 5%, and 1% significance levels.

Panel A: After-Expense Monthly Returns of Portfolios Based on Size Dispersion (×100)

	Excess Return (1)	CAPM (2)	Fama-French (3)	Carhart (4)	Pástor-Stambaugh (5)
1 (Low Size Disp.)	-0.153***	-0.109***	-0.066**	-0.046	-0.043
	(-3.71)	(-2.93)	(-2.23)	(-1.55)	(-1.40)
2	-0.108***	-0.086**	-0.053	-0.032	-0.023
	(-2.91)	(-2.36)	(-1.59)	(-0.95)	(-0.66)
3	-0.122***	-0.107***	-0.093***	-0.096***	-0.086***
	(-3.74)	(-3.30)	(-2.90)	(-2.94)	(-2.60)
4	-0.070	-0.053	-0.060	-0.058	-0.033
	(-1.62)	(-1.24)	(-1.39)	(-1.31)	(-0.74)
5	-0.043	-0.053	-0.071	-0.078*	-0.064
	(-0.87)	(-1.07)	(-1.57)	(-1.68)	(-1.37)
6	0.016	-0.008	-0.027	-0.056	-0.057
	(0.25)	(-0.12)	(-0.50)	(-1.05)	(-1.04)
7	0.066	0.024	0.003	-0.030	-0.021
	(0.82)	(0.31)	(0.05)	(-0.55)	(-0.38)
8	0.137	0.083	0.065	0.013	0.027
	(1.55)	(0.96)	(1.16)	(0.23)	(0.47)
9	0.131	0.080	0.043	0.001	0.015
	(1.44)	(0.90)	(0.83)	(0.02)	(0.28)
10 (High Size Disp.)	0.209**	0.162*	0.134***	0.095*	0.114**
	(2.39)	(1.89)	(2.61)	(1.85)	(2.19)
Decile 10-Decile 1	0.361***	0.272**	0.200***	0.142**	0.156**
	(3.15)	(2.48)	(3.26)	(2.33)	(2.54)
2nd half-1st half	0.211***	0.150**	0.112***	0.067*	0.065*
	(2.69)	(2.00)	(2.94)	(1.79)	(1.72)

Table A.I (Continued)

Panel B: After-Expense Monthly Returns of Portfolios Based on Value Dispersion (×100)

	Excess Return (1)	CAPM (2)	Fama-French (3)	Carhart (4)	Pástor-Stambaugh (5)
1 (Low Value Disp.)	-0.068	-0.157	-0.019	-0.027	0.001
	(-0.64)	(-1.57)	(-0.28)	(-0.40)	(0.01)
2	-0.076	-0.102*	-0.051	-0.067	-0.050
	(-1.33)	(-1.80)	(-1.26)	(-1.62)	(-1.21)
3	-0.026	-0.039	-0.024	-0.043	-0.024
	(-0.53)	(-0.78)	(-0.56)	(-1.02)	(-0.56)
4	0.011	0.021	0.002	-0.004	0.007
	(0.25)	(0.49)	(0.05)	(-0.11)	(0.18)
5	-0.008	0.006	-0.036	-0.049	-0.036
	(-0.18)	(0.14)	(-0.97)	(-1.29)	(-0.95)
6	0.019	0.028	-0.007	-0.025	-0.014
	(0.44)	(0.65)	(-0.17)	(-0.62)	(-0.33)
7	0.033	0.038	-0.003	-0.016	-0.013
	(0.69)	(0.79)	(-0.06)	(-0.37)	(-0.28)
8	-0.014	-0.015	-0.055	-0.064	-0.058
	(-0.27)	(-0.28)	(-1.20)	(-1.36)	(-1.22)
9	0.071	0.059	0.014	-0.011	-0.003
	(1.30)	(1.07)	(0.30)	(-0.24)	(-0.06)
10 (High Value Disp.)	0.114*	0.087	0.046	0.012	0.016
	(1.75)	(1.34)	(0.84)	(0.21)	(0.28)
Decile 10-Decile 1	0.182*	0.244**	0.065	0.038	0.015
	(1.83)	(2.52)	(0.82)	(0.47)	(0.18)
2nd half-1st half	0.078**	0.094**	0.025	0.017	0.006
	(1.98)	(2.39)	(0.73)	(0.49)	(0.17)

Table A.I (Continued)

Panel C: After-Expense Monthly Returns of Portfolios Based on Momentum Dispersion ($\times 100$)

	Excess Return (1)	CAPM (2)	Fama-French (3)	Carhart (4)	Pástor-Stambaugh (5)
1 (Low Mom Disp.)	-0.028	-0.105	0.050	-0.050	-0.051
	(-0.21)	(-0.81)	(0.54)	(-0.54)	(-0.55)
2	-0.027	-0.067	0.008	-0.060	-0.052
	(-0.35)	(-0.89)	(0.14)	(-1.13)	(-0.96)
3	-0.006	-0.012	0.001	-0.052	-0.046
	(-0.11)	(-0.23)	(0.03)	(-1.20)	(-1.06)
4	-0.000	0.010	-0.017	-0.039	-0.033
	(-0.00)	(0.26)	(-0.46)	(-1.07)	(-0.89)
5	-0.034	-0.018	-0.054	-0.061	-0.049
	(-0.83)	(-0.45)	(-1.44)	(-1.59)	(-1.26)
6	-0.016	-0.002	-0.045	-0.041	-0.025
	(-0.34)	(-0.05)	(-0.99)	(-0.88)	(-0.54)
7	0.050	0.060	0.002	0.015	0.030
	(0.93)	(1.11)	(0.05)	(0.29)	(0.56)
8	0.047	0.044	-0.009	-0.000	0.018
	(0.82)	(0.76)	(-0.16)	(-0.00)	(0.32)
9	0.002	-0.005	-0.061	-0.035	-0.020
	(0.04)	(-0.08)	(-1.08)	(-0.61)	(-0.34)
10 (High Mom Disp.)	0.069	0.022	-0.008	0.028	0.054
	(0.91)	(0.30)	(-0.12)	(0.42)	(0.81)
Decile 10-Decile 1	0.097	0.127	-0.058	0.077	0.105
	(0.69)	(0.90)	(-0.46)	(0.62)	(0.83)
2nd half-1st half	0.049	0.062	-0.021	0.046	0.057
	(0.77)	(0.96)	(-0.37)	(0.80)	(1.00)

Table A.II: Panel Regression Evidence: Controlling for Other Fund Characteristics

This table reports the regression results of the Carhart abnormal return (before-expense) on the style dispersions and other fund characteristics for the period of 1980 to 2009. The regressions are run at a quarterly frequency. The dependent variable, the Carhart abnormal return, measures the average monthly abnormal performance in a quarter using the four-factor model of Carhart (1997) based on 24 months of lagged data. All explanatory variables are lagged by one quarter, except for expense ratio and turnover ratio, which are lagged by one year. We use the panel regression that includes the time fixed effects. Standard errors are adjusted for heteroscedasticity and clustered at the time level. The t-statistics are given in parentheses. The significance levels are denoted by *, **, and ***, and indicate whether the results are statistically different from zero at the 10%, 5%, and 1% significance levels.

Dependent Variable: Before-Expense Average Monthly Carhart Abnormal Return in a Quarter ($\times$100), 1980-2009

	(1)	(2)	(3)	(4)
Size Dispersion	0.211***			0.174***
	(3.07)			(2.75)
Value Dispersion		0.204*		0.114
		(1.87)		(1.20)
Mom Dispersion			0.307**	0.257*
			(2.07)	(1.80)
ln(TNA)	-0.017	-0.022	-0.022	-0.021
	(-0.70)	(-0.90)	(-0.90)	(-0.86)
$(\ln(TNA))^2$	0.001	0.001	0.001	0.001
	(0.43)	(0.52)	(0.47)	(0.50)
ln(Fund Age)	0.001	0.003	0.004	0.000
	(0.10)	(0.25)	(0.35)	(0.03)
Expense Ratio	0.217	0.892	0.856	0.108
	(0.12)	(0.45)	(0.43)	(0.06)
Turnover Ratio	-0.002	-0.000	-0.002	-0.007
	(-0.13)	(-0.02)	(-0.12)	(-0.52)
1-Yr Fund Return	0.565	0.587	0.622*	0.590
	(1.46)	(1.53)	(1.67)	(1.56)
NMG	-0.110	-0.103	-0.107	-0.107
	(-0.67)	(-0.63)	(-0.66)	(-0.65)
ICI	0.235**	0.338***	0.374***	0.302***
	(2.15)	(2.94)	(3.20)	(2.65)
Size Score	0.020	-0.015	-0.009	0.019
	(0.86)	(-0.71)	(-0.44)	(0.82)
Value Score	-0.069	-0.087	-0.057	-0.081
	(-1.06)	(-1.39)	(-0.87)	(-1.31)
Mom Score	-0.152*	-0.157*	-0.120	-0.130
	(-1.88)	(-1.93)	(-1.48)	(-1.60)

No. of Observations: 71,872