NBER WORKING PAPER SERIES

CHARACTERISTICS OF MUTUAL FUND PORTFOLIOS: WHERE ARE THE VALUE FUNDS?

Martin Lettau
Sydney C. Ludvigson
Paulo Manoel

Working Paper 25381
http://www.nber.org/papers/w25381

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
December 2018

We thank seminar participants at UC Berkeley and UC Irvine for helpful comments. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

At least one co-author has disclosed a financial relationship of potential relevance for this research. Further information is available online at http://www.nber.org/papers/w25381.ack

Characteristics of Mutual Fund Portfolios: Where Are the Value Funds?
Martin Lettau, Sydney C. Ludvigson, and Paulo Manoel
NBER Working Paper No. 25381
December 2018
JEL No. G11,G12,G2

ABSTRACT

This paper provides a comprehensive analysis of portfolios of active mutual funds, ETFs and hedge funds through the lens of risk (anomaly) factors. We show that that these funds do not systematically tilt their portfolios towards profitable factors, such as high book-to-market (BM) ratios, high momentum, small size, high profitability and low investment growth. Strikingly, there are virtually no high-BM funds in our sample while there are many low-BM "growth" funds. Portfolios of "growth" funds are concentrated in low BM-stocks but "value" funds hold stocks across the entire BM spectrum In fact, most "value" funds hold a higher proportion of their portfolios in low-BM ("growth") stocks than in high-BM ("value") stocks. While there are some micro/small/mid-cap funds, the vast majority of mutual funds hold very large stocks. But the distributions of mutual fund momentum, profitability and investment growth are concentrated around market average with little variation across funds. The characteristics distributions of ETFs and hedge funds do not differ significantly from the those of mutual funds. We conclude that the characteristics of mutual fund portfolios raises a number of questions about why funds do not exploit well-known return premia and how their portfolio choices affects asset prices in equilibrium.

Martin Lettau
Haas School of Business
University of California, Berkeley
545 Student Services Bldg. #1900
Berkeley, CA 94720-1900
and CEPR
and also NBER
lettau@haas.berkeley.edu

Sydney C. Ludvigson
Department of Economics
New York University
19 W. 4th Street, 6th Floor
New York, NY 10002
and NBER
sydney.ludvigson@nyu.edu

Paulo Manoel
University of California at Berkeley
545 S Student Services Building, #1900
Berkeley, CA 94720
paulombfm@berkeley.edu

1. Introduction

Since the seminal study by Jensen (1968) the focus of most of the literature on active mutual funds has been on the question about their performance and the related issue about whether fund managers have skill or not. Some recent examples include Fama and French (2010), Berk and van Binsbergen (2015), Cremers and Petajisto (2009), Pástor, Stambaugh, and Taylor (2015), Kacperczyk, Nieuwerburgh, and Veldkamp (2014), and many more. The composition and characteristics of mutual funds portfolios have largely been ignored.[1] For example, the performance literature focuses on the distribution of Jensen's α's across funds but pays less attention to the distributions of β's of risk factors.

The goal of this paper is to provide a comprehensive analysis of the cross-section of portfolios of active mutual funds through the lens of risk (anomaly) factors.[2] Following Fama and French (1992), the asset pricing literature has identified an ever-growing list of characteristics that are associated with return premia (see Harvey, Liu, and Zhu (2016) for a recent overview). According to the three "classic" size, value and momentum anomalies, small stocks, value stocks, and high momentum stocks earn return premia relative to large, growth and low momentum stocks. To what extent do active fund managers exploit these factor premia? If there are limits to arbitrage, do active funds contribute to the existence of these anomalies or do they overweight underpriced stocks? And, more broadly, what set of strategies is available to retail investors via active funds? The literature on mutual funds typically takes the universe of funds as given. However, the set of funds in existence is an endogenous object subject to demand and supply. What are the market forces that determine the set of funds that are available to investors?[3] This paper takes a first step in answering these questions by establishing a comprehensive set of stylized facts about the characteristics of portfolios of mutual funds, ETFs and, to a limited degree, hedge funds.

We find that mutual funds do not systematically exploit return premia of well-known risk/anomaly factors. In fact, for some factors mutual funds target the low-return leg of long/short factor portfolios rather than the high-return leg. This bias is especially strong for book-to-market (BM) ratios. The BM premium is one of the most well-known and robust stylized facts in the asset pricing literature. Yet, the BM ratio of mutual funds, ETFs and hedge funds is tilted towards low BM values rather than high BM ratios. While there are over 1,000 mutual funds with consistently low BM ratios, there are virtually no high-BM funds in our sample. When we analyze fund portfolios in more detail, we find that even funds with an explicit "value" objective hold a larger share of low BM stocks than high-BM stocks in their portfolios. This bias is present in other value/growth measure, such as the earnings-to-price and dividend-to-price ratios as well as the Morningstar value/growth index. While there are over 100 "value" ETFs in our sample, very few have consistently high BM-ratios. Instead, ETFs mostly track indices that are based on the Morningstar value/growth index that is based not only on price-multiples but also on growth rates of fundamentals. Yet, portfolio sorts based on the Morningstar index produce a small

[1] One recent exception is Pastor, Stambaugh, and Taylor (2017) who study the relationship between liquidity and fund characteristics, in particular the optimal choice of stocks of different size.

[2] There is an ongoing debate whether the factors are due to risk premia or behavioral biases. We remain agnostic about the underlying source of factor premia.

[3] Berk and Green (2004) study how demand and supply affect flows performance across funds but they take the set of funds that are available to investors as given.

and insignificant return spread. We conclude that universe of active mutual funds and ETFs does not include high-BM investments. The BM distribution of our limited sample of hedge funds is close to that of mutual funds. We also finds that the majority of mutual funds hold predominantly very large stocks. The fund-level distributions of other factor characteristics that are associated with return premia, such as momentum, profitability and investment growth are centered around the CRSP-VW index and exhibit little variation across funds. This suggests that funds do not systematically target these characteristics. The body of the paper focuses on the presentation of empirical findings. We return to the implications of the results in the conclusion.

Our analysis focus primarily on holdings of mutual funds instead of factor exposures estimated from regressions of fund returns on factor portfolios. There are several reasons why holdings give a more accurate description of mutual fund strategies than factor loadings. First, factor loadings are estimated and thus subject to estimation error while holdings data is directly observable. Second, loadings might vary over time and estimates with historical data might not reflect high-frequency changes in fund portfolios. Third, regression loadings are more difficult to interpret than characteristics computed from portfolio holdings, as we will show below.

We use data on fund holdings to construct characteristics of active mutual funds in each quarter that a fund is listed. The paper focuses on the "classic" size, value and momentum characteristics, while the appendix includes results on a variety of other characteristics (e.g., investment and profitability). Fund-level characteristics are constructed by appropriately value-weighting the stocks in fund portfolios, e.g., the book-to-market ratio (BM) of a mutual fund is the portfolio-weighted average of the BM ratios of all stocks in the fund's portfolio. Following Daniel, Grinblatt, Titman, and Wermers (1997), we use quintile scores based on NYSE breakpoints, so that a stock in quintile j has a score of j.[4] The fund score is the value-weighted score of all stocks in its portfolio. Hence, a fund that only invests in stocks in the lowest BM quintile has a BM score of "1" and a fund that only invests in stocks in the highest BM quintile has a BM score of "5". A score of "3" corresponds to a fund that focuses on stocks in the middle BM quintile. In addition to BM, we also compute an alternative measure of value/growth following the methodology of the widely-used Morningstar index.[5]

We then study the distributions of mutual fund characteristics in several ways. We analyze the average univariate distributions of size, value/growth, and momentum as well as joint distribution and time-variation in the distribution. We use two methods to frame fund characteristics. First, we use the components of the Fama-French factors as natural "pseudo-fund" benchmarks. In other words, we treat the "S" and "B" components of SMB, "H" and "L" components of HML, and "U" and "D" of MOM as if there were mutual funds and compute their characteristics in the same way as we do for actual mutual funds. Hence we can investigate to what extent mutual fund portfolios compare to the Fama-French portfolios that have served as benchmarks in the academic literature. Second, we compare the characteristics distribution of mutual funds to that of individual stocks.

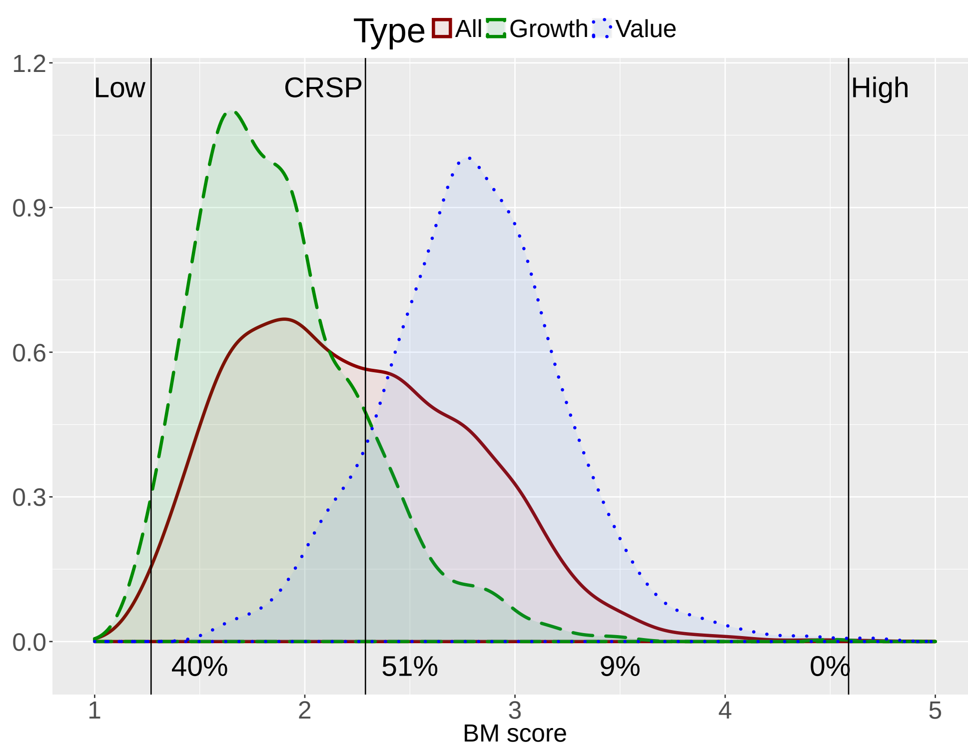
We find that, except for a relatively small number of small-cap and mid-cap funds, mutual funds overwhelmingly hold very large stocks, similar in magnitudes to the CRSP-VW index and "B" in SMB. The

[4] Our results are robust to alternative characteristic measures. The online appendix includes a variety of robustness checks.

[5] The Morningstar index (MS) is an average of price-to-fundamental ratios and growth rates of fundamentals, see section 2 for details.

distribution of book-to-market ratios of mutual funds, shown in Figure 1, is more surprising. The figure, described in more detail below, shows the histogram of BM scores for all funds (solid black), "growth" funds (dashed green) and "value" funds (dotted blue).[6] The BM ratio of funds is based on quintile scores where "1" and "5" corresponds to the extreme low and high BM quintiles, respectively. The vertical lines show the BM ratio of the CRSP-VW index and the "L" and "H" components of HML. Hence, funds that mimic "L" or "H" would have a BM scores of 1.27 and 4.6, respectively, while the overall market has a BM score of 2.3. The figure shows that the distribution of mutual funds is heavily tilted towards low BM values. 40% of all mutual funds have a BM score between 1 and 2 and a further 51% between 2 and 3. On the other hand, 9% of funds have a moderately high BM score between 3 and 4, but only 7 out of 2,657 funds in our sample have a BM score above 4. In this sense, high BM "value" funds are missing from the US equity market. To put this differently, an investor can easily find "growth" mutual funds that are similar to the "L" portfolio, but it is virtually impossible to use mutual funds to mimic the "value" portfolio "H". In contrast to the BM distribution of mutual funds, the BM distribution of individual S&P 500 stocks is much more spread out. 46% of S&P 500 stocks have a BM score above 3 and 18% above 4.

Figure 1: Distribution of Book-to-Market Ratios of Mutual Funds



Notes: See Figure 3.

Figure 1 also shows that even "value" funds are not necessarily high BM funds. The dotted blue histogram shows that the bulk of "value" funds have BM scores between 2 and 3.5. In contrast, the majority of "growth" funds have low BM scores between 1 and 2. Moreover, the BM distribution of hedge funds and ETFs is similar to that of mutual funds (with the caveat that our sample of hedge funds is

[6] We classify mutual funds as "value" or "growth" based on the fund name or on CRSP/Lipper/Wiesenberger style codes, as explained in more detail below.

very limited and not representative). These findings are robust to different measures of "value" and different methodologies for constructing BM rankings.

In contrast to the asymmetric distribution of BM, the distributions of other characteristics are more symmetric and clustered around scores of 3. For example, the mean mutual fund has a momentum score of 3.28, a profitability score of 3.17 and investment score of 3.08. In each case, few funds have scores below 2 and above 4. This suggests that funds do not systematically exploit high momentum, high profitability or high investment strategies. We estimate the relationship of mutual portfolio holdings and characteristics more formally using a Probit-model. The estimation results confirm the patterns in the histograms. One interesting finding is that stocks with higher Morningstar indices are more likely to be held by mutual funds than stocks with high book-to-market ratios.

Next, we study portfolio compositions in more detail and compute the portfolio weights by quintiles for each mutual fund. The average fund holds 40% of its portfolio in stocks with BM scores between 1 and 2 and only 6% in stocks in the highest BM quintile. Not surprisingly, the portfolios of "growth" funds are even more tilted towards low BM stocks. For example, 95% of all "growth" funds hold over a quarter of their portfolios in low-BM stock. But we find that "value" funds hold a larger portion of their portfolio in stocks in the lowest BM quintile (24%) than in stocks in the highest BM quintile (13%). More than half of all "value" funds hold a larger share of low-BM stocks than high-BM stocks, and only 7% hold more than 25% of their portfolio in high-BM stocks. Evidently, "value" funds are not high-BM assets and do not tilt their portfolios towards high-BM value stocks.

We also study the joint distribution of characteristics as well as the time-variation of fund characteristic scores. For instance, we find that unconditionally, there is no link between the BM and MOM scores of mutual funds but momentum of low-BM funds varies significantly over time while momentum of higher BM funds is more stable.

How do portfolio holdings compare to factor loadings, β's, of mutual funds? On first glance, loadings yield a very different picture. For each 15-year window in our sample, we estimate the 4-factor model for all mutual funds that are listed in that subsample window. The median of mutual fund SMB β's distribution is (slightly positive) while the median HML β hovers around zero. Hence, at first glance, these betas suggest that the median mutual funds is slightly tilted towards small and BM-neutral stocks. How can this be reconciled with the results based on fund holdings that mutual funds hold very large and low BM stocks? It turns out that the β distributions are misleading without proper framing. We estimate the SMB and HML β's of the S, B, H and L portfolios from which SMB and HML are constructed. We show that β's estimated in univariate regressions depend on the relative volatilities of the components of the long/short portfolio. The β of the more volatile component is larger (in absolute) value than that of the less volatile component. In multivariate regressions, the magnitudes of β's depend on the covariance structure of all portfolios that make up the long/short factors and are not necessarily centered around zero. In our sample, $\beta_{\text{H,HML}} = 0.72$ and $\beta_{\text{L,HML}} = -0.28$. Hence, an asset with an HML beta of -0.25 is comparable to "L" while an asset with an HML beta of +0.25 is comparable to the "BM-neutral" portfolio (H+L)/2. Once the distribution of mutual fund betas is framed in the context of HML betas of H and L, the bias of mutual funds towards low-BM ratios is confirmed. While there are many funds with HML betas close to L, there are (virtually) no funds with HML betas that are as high H.

While studying mutual fund performance is not the primary goal of this paper, it is worthwhile to ask how mutual fund characteristics relate to their returns. When we compute the average return of stocks by characteristic quintiles, the familiar pattern emerges: Small stocks with high BM and MOM have higher returns than large stocks with low BM and MOM. We also find that the return spread across Morningstar quintiles is much smaller than that of BM quintiles, implying that one of the most popular measures of "value/growth" is not associated with a significant return premium. For all characteristics, the spread across quintiles is much smaller for mutual funds than for stocks. For example, the BM return spread for stocks is 2.82% per quarter while it is only 0.78% for mutual funds. Mutual fund returns across size, momentum and Morningstar quintiles show no pattern at all. Hence, there is no size, value and momentum effect in mutual funds returns and investors in mutual funds are not rewarded for factor premia that exist for individual stocks. These results are confirmed in Fama-MacBeth regressions.

The rest of the paper proceeds as follows. Section 2 describes the sample and data construction. Results about the characteristics distributions of mutual funds, ETFs and hedge funds are presented in section 3. Section 4 compares the characteristics distributions derived regression factor loading to those of portfolio holdings. Sections 5 and 6 provide additional details of mutual funds portfolios. Results about the link between mutual fund characteristics and returns are reported in section 7. Section 8 concludes.

2. Data Construction

The mutual fund and ETF holdings data are from CRSP/Thompson-Reuters. Our sample is 1980Q1 to 2016Q2 and uses standard screens. We group active mutual funds into three categories based on their stated investment objective: "Growth", "value" and "other". We analyze ETFs separately. Unlike mutual funds, hedge funds are not required to report their portfolio holdings to the SEC. However, every institutional investment manager, including hedge funds, with at least $100 million in equity assets under management has to disclose their aggregate equity holdings using form 13F. Since only aggregate holdings are reported, it is not possible to obtain holdings data for individual funds for the majority of hedge funds. Instead, we manually identify 13F filings of 114 hedge funds with only a single fund under management.[7] For this subset of hedge funds, the 13F filings of portfolio holdings correspond to individual funds and are thus comparable to the holdings data of individual mutual funds. Given that we can only identify portfolio holdings of hedge funds with only a single individual fund, our HF sample is very limited, not representative and biased towards small hedge funds.

Table 1 reports descriptive statistics of the sample. Our sample of active mutual funds consists of 2,638 funds, of which 574 are "value" funds and 1,130 are "growth" funds.[8] Furthermore, the sample includes 955 ETFs and 114 hedge funds. The number of active mutual funds has grown from 185 in 1980Q1 to 1,424 in 2016Q2 with a peak of 1,946 in 2008Q3. The number of "growth" and "value" funds has risen from 96 and 7 in 1980Q1 to 564 and 350 in 201Q2, respectively. The median fund size is $149 mil. over the sample but the size distribution is heavily right-skewed. In 2016Q2, the net asset value of 320 funds exceeded $1 bil. and 30 funds exceeded $10 bil.

[7] To identify hedge funds in the 13F filings we follow Agarwal, Fos, and Jiang (2013) and Agarwal, Jiang, Tang, and Yang (2013).

[8] The CRSP/Thompson-Reuter database includes multiple flags for mutual fund styles. However, style codes often change without obvious reasons and are contradictory across providers. We therefore infer the "value" and "growth" from the fund name, see **??** for more details. The results are very similar when we use style flags from CRSP/Thompson-Reuter.

The average age of mutual funds is 11.5 years and “growth” funds are slightly older on average than “value” funds. Not surprisingly, ETFs are on average younger than mutual funds. The number of stocks in mutual fund portfolios varies substantially across funds. The median number of stocks is 54 with a minimum of 10 and a maximum of 1,813. ETFs hold on average 99 stocks in their portfolios. Consistent with the literature on mutual fund performance, returns of mutual funds are on average lower than those of the S&P 500 index; however, the median ETFs has a higher return than the S&P index. Median 4-factor alphas are negative, including those of ETFs.

Mutual fund characteristics

Next, we construct characteristics of mutual funds, ETFs and hedge funds. The paper includes results for size (market equity, ME), the book-to-market ratio (BM), momentum (MOM) characteristics as well as the Morningstar value/growth index (MS, defined later in this section). Results for other characteristics, including other price multiples, ROE and asset growth, are reported in the online appendix. We consider a number of different methods.

The benchmark case follows Daniel, Grinblatt, Titman, and Wermers (1997): In each quarter t we sort all stocks into five quintiles based on characteristic C using NYSE breakpoints. Stock i in quintile j is assigned a characteristic score of $C_{i,t} = j, j \in \{1, 2, \ldots, 5\}$. The characteristic score of fund m in quarter t, $C_{m,t}$, is computed as the portfolio-weighted average of the characteristic scores of the stocks in the fund’s portfolio:

$$C_{m,t} = \sum_{i \in S_t} w_{m,i,t} \, C_{i,t},$$

where S_t is the set of stocks listed in quarter t and $w_{m,i,t}$ is the weight of stock i in the portfolio of fund m in quarter t.

This procedure has several advantages. First, it is robust to stocks with extreme values of $C_{i,t}$. Second, scores have the same units and are comparable across characteristics. On the other hand, quintile scores depend on the breakpoints. We follow the standard procedure and use NYSE breakpoints. Note that the total market capitalization of the stock quintiles varies across quintiles and, therefore, the value-weighted market portfolio does not necessarily have a characteristic score equal to the midpoint of 3 but will be biased towards the quintiles with larger market caps. For example, the top size quintile accounts for about 73% of the total market cap while the bottom quintile accounts for only 3%. Hence, the size quintile score of the value-weighted CRSP index will be strongly tilted towards the fifth quintile. In contrast, the low BM quintiles account for a larger share of the total market cap that the high BM quintiles. Thus the BM score of the CRSP-VW index is below the midpoint of 3.[9]

As an alternative measure, we compute “market-adjusted” characteristics. For example, in each quarter we compute the “market-adjusted” BM ratio for each stock i as

$$\widetilde{\mathrm{BM}}_{i,t} = \frac{\mathrm{BM}_{i,t}}{\mathrm{BM}_{\mathrm{MKT},t}},$$

where $\mathrm{BM}_{\mathrm{MKT},t}$ is the book-to-market ratio of the CRSP-VW index. The market-adjusted BM ratio of a

[9]We also consider the case where breakpoints are chosen so that the market cap in each quintile is identical. Results are reported in the online appendix.

mutual fund is the portfolio-weighted average adjusted BM-ratios of the stocks in its portfolio. For momentum, we compute the difference of momentum of each stock and momentum of the CRSP-VW portfolio:

$$\widetilde{\text{MOM}}_{i,t} = \text{MOM}_{i,t} - \text{MOM}_{\text{MKT},t}.$$

This method has the advantage of not relying on breakpoints. Moreover, the market-adjusted characteristics of the value-weighted CRSP portfolio are equal to one for $\widetilde{\text{BM}}_{\text{MKT}}$ and zero for $\widetilde{\text{MOM}}_{\text{MKT}}$ by construction. On the other hand, adjusted characteristics can be sensitive to outliers. For example, the distribution of stock-level $\widetilde{\text{MOM}}_i$ is right-skewed. The minimum $\widetilde{\text{MOM}}_i$ is 0.04, the median is 1.35, and the maximum is 14.47. Hence the mutual fund level $\widetilde{\text{MOM}}_m$ constructed as the portfolio-weighted average of the stock-level $\widetilde{\text{MOM}}_i$ can be dependent on whether the mutual fund holds one of the few outlier stocks with very high $\widetilde{\text{MOM}}_i$. Another drawback is that the units differ across characteristics making a comparison difficult. Most of the results reported in the paper are based on characteristics scores. The online appendix includes results for adjusted characteristics and quintile score based on different breakpoints. Our main results are not affected by the methodology of how mutual funds characteristics are constructed.

While the book-to-market ratio has become the standard metric for value/growth in academic research, there are many alternative measures. One popular measure is the Morningstar value/growth index that is used in Morningstar's "style box".[10] The MS value/growth index is defined as the difference of a multiples (MULT) index and a growth (GR) index. Both components are scaled from 0 to 100 so that the MS index ranges from -100 to 100:

$$\text{MULT} = \frac{1}{2}\frac{E(\text{Earn})}{P} + \frac{1}{2}\,\text{avg}\left(\frac{B}{P}, \frac{S}{P}, \frac{CF}{P}, \frac{D}{P}\right)$$

$$\text{GR} = \frac{1}{2}\Delta E(\text{LT Earn}) + \frac{1}{2}\,\text{avg}\left(\Delta\text{Earn}, \Delta S, \Delta CF, \Delta B\right)$$

$$\text{MS}[-100, 100] = \text{scaled MULT}[0, 100] - \text{scaled GR}[0, 100],$$

where $E(\text{Earn})$ are the expected earnings, $E(\text{LT Earn})$ are expected long-term earnings and P, B, S, CF, D are price, book value, sales, cash flow, and dividend, respectively. MS has two components: *(i)* an average of multiples (MULT) and, *(ii)* an average of expected long-term earnings growth $E(LT\Delta E)$ and growth of current earnings, sales cash flow and book value (GR). Note that the terms with *expected* earnings have a larger weight in MULT and GR than the terms with current fundamentals. The index is constructed so that high MS scores correspond to "value" and low MS scores correspond to "growth" in line with the BM ratio.[11] We construct the MS index for each stock in each quarter, form quintiles and compute the MS score for mutual funds as the portfolio-weighted average of MS scores of the stocks in the fund's portfolio. More details are given in the Appendix.

We also compute the characteristics of the components of the Fama-French portfolios, SMB, HML, and MOM, as benchmarks. For example, HML is defined as HML = 1/2 (SH+BH) - 1/2 (SL+BL), where

[10] http://corporate.morningstar.com/US/documents/MethodologyDocuments/FactSheets/MorningstarStyleBox_FactSheet_.pdf

[11] The Morningstar index used in the style box is defined as scaled $\text{GR}[0, 100]$ − scaled $\text{MULT}[0, 100]$. We adjust the definition so that low/high MS values have the same value/growth interpretation as low/high BM scores.

SL is the small/low-BM portfolio, BL is the big/low-BM portfolio, etc. The component portfolios of HML are based on the intersection of two size and three BM-sorted portfolios (with NYSE breakpoints). We treat each of the component portfolios, SL, BH, ..., as a "passive mutual fund" and construct its characteristics following the same methodology described above for mutual funds. Lastly, we compute the characteristics of the CRSP-VW portfolio as a proxy for the market portfolio.

As an illustration, Figure 2 plots the characteristics of one of the oldest and largest mutual funds, "The Investment Company of America Fund" (ticker AIVSX), over time. Panel A shows the characteristic scores while the market-adjusted characteristics are plotted in Panel B. Adjusted MS is divided by 10 to make the scales comparable. ME scores are close to the maximum of five indicating that the fund only invests in the very largest stocks. The BM score ranges from 1.5 to 2.6 while the MS score exhibits an upward trend and is higher than the BM score throughout the sample. BM and MS are both value/growth measures, but they can differ substantially. Recall that MS is a combination of price multiples and growth rates of fundamentals. The plot suggests that the fund targets firms that have high fundamental growth rates rather than firms with high BM ratios. MOM scores vary more over the sample than ME, BM and MS scores. This is not surprising since the persistence of momentum on the stock level is lower than that of the other characteristics and will be the case for most mutual funds.

Market-adjusted characteristics show similar patterns. Recall that the adjusted ME, MS and MOM characteristics of the CRSP-VW portfolio are zero and one for adjusted BM. However, the scales are not comparable since different characteristics have different "units". The plot shows that adjusted ME and MS are (mostly) positive suggesting that the fund invests in very large stocks that have higher MS values than the market. In contrast, adjusted BM is close to one apart from the first 10 years of the sample. Finally, adjusted MOM hovers around zero.

3. Mutual Fund Portfolios

Passive benchmarks

Before analyzing characteristics of mutual funds, we start with the characteristics of the CRSP-VW index and the components of the Fama-French SMB, HML and MOM factors as benchmarks for mutual fund characteristics. Table 2 reports the average scores as well as average adjusted characteristics of the CRSP-VW index, the components of HML (SL, BL, SH, BH) and the components of MOM (SD, SD, SU, BU).[12] Consider first the characteristic scores of the "market" CRSP-VW index. The average value-weighted size (ME) score is 4.50 while the average book-to-market (BM) score is 2.31. The average Morningstar (MS) score is slightly higher than the average BM score. The average momentum (MOM) score is 3.44. The reason these value-weighted averages are are not equal to the midpoint of 3 is that the total market capitalizations in each quintile are different. As mentioned above, the market cap in the fifth size quintile is much larger than that of the first quintile. Hence, the average ME score of the value-weighted CRSP index is higher than 3. For the same reason, the BM and MS scores are below the midpoint of 3 while the MOM score is above 3. In contrast, the "adjusted" characteristics of the CRSP-VW index are either 1 or 0, by construction.

[12] S/B are small/big, L/H are low/high book-to-market and D/U are low/high momentum portfolios. See Ken French's website http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html for more details.

Next, consider the passive Fama-French portfolio components. The four “small” portfolios have ME scores between 1.86 and 2.07, while the “big” portfolios range between 4.6 and 4.8. This pattern is similar for the other characteristics. The “low BM” portfolios have a BM score of 1.28 and 1.25, respectively, and the scores of the “high BM” portfolios are 4.63 and 4.56. Note that the BM, MS and MOM scores of “small” and “high” portfolios are similar, the BM score of “small/high BM” is 4.63 while the score of the “big/high BM” portfolios is 4.56. Hence, portfolios with high BM scores can be constructed not just from small and potentially illiquid stocks but also from large liquid stocks. Given this similarity, we follow Fama and French and aggregate the “small” and “high” portfolios into a single portfolios, e.g. “small/high BM” and “big/high BM” are combined into “high BM”, etc. These portfolios correspond to the components of the SMB, HML and MOM factors.

Portfolio Characteristics of Mutual Funds

Next, we study the univariate distributions of mutual fund characteristics. Results for multivariate distributions are presented in section 6. The histograms of mutual funds scores of size (ME), book-to-market (BM), Morningstar (MS) and momentum (MOM) are shown in Figure 3. Each panel shows the histogram for all funds (solid black) in the sample as well as “growth” (dashed green) and “value” (dotted blue) funds. The numbers at the bottom of each histogram represent the percentage of all funds with characteristic scores between 1 and 2, 2 and 3, etc., respectively. The vertical lines show the scores of the CRSP-VW index and the passive Fama-French benchmarks. The percentiles of the distributions are reported in Table 3.

The ME histogram in Panel A shows that the size score of 79% of all funds is above 3 implying that most mutual funds invest in very large stocks. The histogram shows that 19% of funds have an ME score between 2 and 3. The vertical lines indicate the characteristics scores of the CRSP-VW index as well as scores of the “small” and “big” portfolios S and B (see Table 2). The size score of 33% of all mutual funds is higher than the size score of the H portfolios. In contrast, only 2% of all active mutual funds have a size score comparable that of the “small” S portfolio. Thus, the stocks that make up the composition of the “S” component of SMB are significantly smaller than the stocks held by all but 2% of mutual funds, and it is thus virtually impossible to replicate a portfolio similar to “S” by investing in mutual funds. Clearly, most mutual funds do not exploit the small stock premium. The figure also shows the size distribution of “growth” and “value” funds. The ME distribution is similar for “growth” and “value” funds, although growth funds have somewhat larger ME scores than “value” funds. Pastor, Stambaugh, and Taylor (2017) argue that mutual funds tilt towards large stocks because small-stocks a more expensive to trade. In equilibrium, funds optimally choose the tradeoff of trading costs versus potentially higher returns of small stock. Large funds have higher trading costs and therefore hold large stocks.

The BM histogram in Panel B is identical to that in Figure 1. As already described in the introduction, the BM distribution is heavily skewed towards low BM scores as 91% of all funds have a BM score below 3, and virtually no funds have a BM score that exceeds 4. The histogram also shows that many funds have a BM score that is close to that of the “Low BM” portfolio but no funds with a BM score that is similar to that of the “High BM” portfolio. Only 7 of the 2,657 funds in the sample are in fact high-BM funds with a score above 4, while 1,063 funds have a BM score below 2. While it is not surprising that the distribution of "growth" funds is more skewed towards low BM scores, it is noteworthy that the BM score of the majority of "value" funds is below 3. The means of BM scores, shown in Table 3, are 2.23 for all funds, 1.89 for "growth" funds and 2.74 for "value" funds. Thus, "value" funds with high BM scores are largely missing. This fact is not driven by the lack of large and liquid stocks in the top quintile. Recall from Table 2 that the "big/high BM" portfolio is made up entirely of large stocks but has a BM score of 4.56.

One possible explanation is that the BM ratio does not capture the notion of "value" as viewed by fund managers and investors. To explore this possibility further, we compute the Morningstar value/growth index (MS) that underlies the well-known Morningstar style box. As explained in section 2, the Morningstar index is an average of price multiples and growth rates of firm fundamentals. The histogram of MS scores in Panel C shows that the distribution is somewhat shifted to the right compared to the BM distribution but still skewed towards low MS scores. 33% of mutual funds have an MS score below 2 while only the MS score of only 1% is above 4.

Finally, Panel D shows the momentum (MOM) histogram. The vast majority of mutual funds have a MOM score between 3 and 4 and are thus somewhat tilted towards higher momentum stocks. However, only 4% of funds have a MOM score above 4 indicating that few funds focus on momentum as a primary strategy. We will see below that the momentum tilt is due to the fact that most funds hold low BM stocks that on average have higher MOM scores than high BM stocks. Moreover, we will also show that there is more time variation in the momentum scores of individual funds than in the size and growth/value scores. Hence the distribution of fund averages is less informative for momentum than for the other more persistent characteristics.

Since mutual funds hold mostly large stocks, it is instructive to compare the characteristics distribution of mutual fund portfolios to that of individual large stocks. Figure 4 plots the ME, BM, MS and MOM histograms of individual stocks (dashed black) along with the histograms for mutual funds. We include stocks that were a constituent of the S&P 500 index for at least eight quarters during the sample period. The size distribution in Panel A shows that ME scores of mutual funds are on average higher than those of S&P 500 stocks confirming the previously mentioned result that mutual funds hold mostly very large stocks. Panel B plots the BM score distribution. The BM scores of S&P 500 stocks is more spread out than those of funds. While there are few funds with a BM score above 3, 39% of stocks have BM scores that exceed 3. The average BM score of stocks is 2.62, which is significantly higher than the mean for mutual funds of 2.23 (Table 3). Fund managers choose portfolios that are more tilted towards low book-to-market values than the set of stocks that are available to them. Moreover, since there are many large liquid stocks with high BM scores, there is no obvious constraint that might preclude managers from constructing high BM funds. The distribution of Morningstar scores in Panel C shows that fund portfolios have lower MS scores than those of stocks confirming that fund managers choose portfolios that are tilted towards growth than the market overall. Panel D shows that the momentum distribution of mutual funds is slightly shifted to the right relative to that of individual stocks.

Next, we take a closer look at the mutual funds with the lowest and highest BM scores. Table 4 shows the 10 funds with the highest BM score and the 10 funds with the lowest score. The scores of the "H" component of HML are included for comparison. In our sample of 2,657 funds, only seven funds have a BM score above 4, and only one fund exceeds the BM score of "H". Only four of the 10 funds have an AUM above $1 bil. Interestingly, three of the four large funds are Dimensional Fund Advisor (DFA) funds that, according to their prospectuses, specifically target stock with high price multiples but, in contrast to the Morningstar notion of "value", do not take fundamental growth into account.[13] Note, however, that the BM scores of the DFA funds are significantly below that of the "H" portfolio. The bottom panel shows the 10 funds with the lowest BM scores. Note that their BM scores are all below that of the low BM benchmark portfolio.

How do mutual fund portfolios compare to those of hedge funds and Exchange Traded Funds (ETFs)? Figure 5 shows the BM and MS histograms of ETFs and our limited samples of (mostly small) hedge funds. Panels A and B show the BM and MS distribution of hedge funds. Means and percentiles are reported in the bottom left panel of Table 3. The BM distribution of hedge funds is very similar to that of mutual funds with almost identical means of 2.29 and 2.23, respectively, as well as comparable percentiles. While 40% of HFs have a BM score lower than 2, there are no HFs with a BM score above 4. The MS distribution is shifted more towards low MS than the mutual fund distribution.

The BM distribution of ETFs shown in Panel C is shifted towards low BM scores but slightly less so than the distribution of mutual funds. 26% of ETFs have a BM score above 3, compared with 9% of mutual funds, but the BM score of only 3% is above 4, and no ETF approaches the BM score of the "H" portfolio. However, the ETF MS distribution in Panel B differs significantly from that of the distribution of mutual funds shown in Figure 3. The distribution of all ETFs is centered around the midpoint of 3 and spread out symmetrically. In other words, there are (almost) as many high MS ETFs as there are low MS ETFs. Furthermore, MS scores of "value" ETFs are much higher than those of "value" mutual funds and, unlike mutual funds, there are many ETFs with an MS score between 4 and 5.

The reason for this difference is that many "value" ETFs track indices that are constructed using a similar methodology as that of the Morningstar index, i.e., indices that are based on multiples as well as growth rates of firm fundamentals. For example, the largest "value" ETF (iShares Russell 1000 Value ETF) tracks the Russell 100 Value Index that follows the Morningstar classification closely, as stated in its documentation: "FTSE Russell uses three variables in the determination of growth and value. For value, book-to-price (B/P) ratio is used, while for growth, two variables—I/B/E/S forecast medium-term growth (2-year) and sales per share historical growth (5-year) are used".[14] The notion of "value" in fund management differs from that in the academic literature, which has focused on pure price multiples as measures of "value". The evidence of the "value puzzle" in the academic literature is based on sorts on variables such as the book-to-market, earnings-to-price, sales-to-price, etc., but does not include information of fundamental growth rates. We will show in section 7 that return spreads based on portfolios sorted according to the Morningstar index are significantly smaller than that for portfolios constructed from book-to-market sorts. The reason is that the GR component of the MS index produces no return premium and the premium of the MULT component is smaller than that for BM. In other words, the widely used value/growth MS index is not associated with a "value premium".

Next, we perform a number of robustness checks that are reported in Figure 6. Results for additional robustness checks are reported in the online appendix. We consider the earnings-to-price ratio (EP) as

[13] The prospectuses of the DFA funds state: "Securities are considered value stocks primarily because a company's shares have a low price in relation to their book value." (https://us.dimensional.com/funds)

[14] *Russell U.S. Equity Indexes v3.1*, available at https://www.ftse.com/products/downloads/Russell-US-indexes.pdf?467.

an alternative "value" measure (Panel A), plot the histogram of fund/quarter observation instead of fund averages (Panel B), consider the "adjusted BM" measure instead of BM scores (Panel C), the AUM-weighted histogram (Panel D), the distribution of a larger set of mutual funds that includes index and sector funds (Panel E), and the BM distribution at four different points in time (Panel F). The distribution of EP scores is slightly shifted towards higher scores compared to the BM distribution, but there are virtually no funds with an EP score above 4. The histogram with fund/quarter observation is similar to the histogram with fund-average observations. Unlike the BM scores, the "adjusted BM" ratio does not depend on breakpoints and is scaled to the overall market has a value of one but is more sensitive to outliers. The "adjusted BM" ratios of "H" and "L" are 3.1 and 0.6, respectively, implying that the BM ratio of the "H" portfolio is about three times as high as that of the CRSP-VW index while the BM ratio of the "L" portfolio is 40% lower than that of the CRSP-VW index. The "adjusted BM" histogram confirms the pattern found for BM scores. Few funds have an "adjusted BM" ratio above 2 and there are no funds that have a ratio that is as high as that of "H". Panel D shows the histogram when funds are weighted according to their AUM. The only significant difference compared to the equally-weighted histogram is the higher mass for BM scores around 4, which is due to the large DFA value funds shown in Table 4. Our benchmark sample of mutual funds excluded index and sector funds. In Panel E, we plot the BM distribution for the sample that including index and sector funds. The distribution is almost identical to that for the benchmark sample. Finally, we study the BM distribution across time. Panel F shows the BM histograms of mutual funds in the fourth quarters of 1985, 1995, 2005, and 2015.

Appendix B reports distributions of additional characteristics, including profitability, investment growth as well as all individual components of the Morningstar index.

To assess more formally how stock characteristics affect mutual fund portfolios, we estimate the following Probit model:

$$P(y_{i,j,t}) = \Phi(\mathbf{X}'_{i,t}\,\boldsymbol{\beta}), \tag{1}$$

where $y_{i,t}$ is an indicator variable that is 1 if stock i is held by mutual fund j in quarter t and zero otherwise, $\mathbf{X}_{i,t}$ is a vector of ME, MOM, BM and MS characteristics of stock i in period t and Φ is the cumulative distribution function of the standard normal distribution. We estimate the model for all funds, "growth" funds and "value" funds. Results are reported in Table 5. The regression with all mutual funds shows that larger stocks with higher momentum are more likely to be included in mutual funds portfolios but higher BM and MS scores decrease the probability to be included in a fund portfolio. All scores are measured on the same $[1, 5]$ interval, so the magnitudes of the point estimates are comparable. The ME coefficient is by far the largest showing that mutual funds mostly invest in very large stocks. All characteristics coefficients are statistically significant.

If the Probit model is estimated for only "growth" funds, the MS coefficient becomes larger. It is larger by a factor of 5 than in the estimation of all funds and also larger than the BM coefficient. For "value" funds the MS coefficient is positive and significant while the BM coefficient is insignificant. These estimates are consistent with the distributions of mutual fund characteristics shown above. These results suggest that in the mutual fund industry the Morningstar index is more widely used as a measure of "value" than the book-to-market ratio.

Time-series variation of mutual fund characteristics

So far, we focused on time-series averages by fund. Next, we investigate the variations of fund characteristics over time. For each mutual fund, we compute the time-series standard deviation of ME, BEME, MS and MOM characteristics. The mean standard deviations across all mutual funds are as follows: $\overline{\sigma}_{\text{ME}} = 0.23, \overline{\sigma}_{\text{BM}} = 0.29, \overline{\sigma}_{\text{MS}} = 0.32, \overline{\sigma}_{\text{MOM}} = 0.42$. ME scores vary the least over time followed by BM and MS. Fund-level momentum has a significantly higher standard deviation than size, book-to-market, and Morningstar characteristics. On the stock level, momentum is less persistent than the other characteristics. If a mutual fund invests in stocks without using information on momentum, momentum in the mutual level will also be less persistent than the other characteristics. However, if a fund consistently targets either high or low momentum stocks, then fund momentum is more persistent than the momentum stocks in its portfolios. In our sample, the distribution of momentum persistence on the mutual fund level is very similar to that on the stock-level suggesting that mutual funds do not target either high or low momentum stocks.

As an illustration of the time series behavior of different characteristics, we plot the characteristics of the largest mutual fund in our sample as well as those for the largest "value fund" in Figure 7. The figure also shows plots for the characteristics of passive benchmark portfolios. The figures shows that ME and BM are stable for some funds but vary for others. The time-series variation of these characteristics tends to be on a lower frequency as funds shift their investment objectives. In contrast, the variation in fund-level MOM is of higher frequency. This variation is "passive" in the sense that it is due to changes in momentum of the stocks in a fund portfolio rather than due to portfolio reallocations. As a consequence, a fund can be high-momentum in one quarter and low-momentum in a different quarter.

4. Loadings vs. Holdings

In the literature on mutual fund performance, the magnitudes of regression factor loadings (i.e., betas) are less relevant since the factors serve only as controls for diversifiable risk. For our purposes, the question is whether loadings estimated from time series regressions of fund returns on factors such as SMB, HML, and MOM are informative indicators of fund strategies. Next, we argue that While factor loadings are appropriate as a measure of exposure to diversifiable risk, they are not necessarily reliable indicators of the underlying investment strategy of an active mutual fund.

First, risk exposures are estimated using historical data and are thus subject to estimation error. Historical data might also not reflect the current portfolio of an active fund. This is especially true for firm characteristics that change over time, such as momentum. Unless a fund deliberately hedges momentum, the momentum of a fund's portfolio changes as the momentum of the stocks in its portfolio changes over time. In contrast, measuring fund characteristics directly from portfolio holdings yields an accurate assessment of the fund's portfolio at each point in time.

Second, the interpretation of the magnitudes of estimated loadings in factor regressions are not straightforward and can easily be misinterpreted. Consider the univariate setting with two portfolios, P and Q, that are based on sorts on some characteristic. Let $\text{PMQ}_t = \text{P}_t - \text{Q}_t$ be the corresponding long/short portfolios and consider the regressions of P_t and Q_t on PMQ_t:

$$Y_t = \alpha_{\mathrm{Y}} + \beta_{\mathrm{Y,PMQ}}\,\mathrm{PMQ}_t + e_{\mathrm{Y},t}, Y \in \{\mathrm{P}, \mathrm{Q}\}.$$

Since $\mathrm{PMQ}_t = \mathrm{P}_t - \mathrm{Q}_t$, the P and Q betas have the property

$$\beta_{\mathrm{P,PMQ}} - \beta_{\mathrm{Q,PMQ}} = 1.$$

However, the magnitudes of the two betas depend on the variance-covariance structure of $[\mathrm{P}_t, \mathrm{Q}_t]$:

$$\beta_{\mathrm{Y,PMQ}} = \rho_{\mathrm{Y,PMQ}}\ \frac{\sigma_{\mathrm{Y}}}{\sigma_{\mathrm{PMQ}}}$$

$$|\beta_{\mathrm{P,PMQ}}| > |\beta_{\mathrm{Q,PMQ}}| \iff \sigma_{\mathrm{P}} > \sigma_{\mathrm{Q}}.$$

The last line follows from the fact that $\mathrm{Cov}(\mathrm{P}_t, \mathrm{P}_t - \mathrm{Q}_t) = \mathrm{Var}(\mathrm{P}_t) - \mathrm{Cov}(\mathrm{P}_t, \mathrm{Q}_t), \mathrm{Cov}(\mathrm{Q}_t, \mathrm{P}_t - \mathrm{Q}_t) = \mathrm{Var}(\mathrm{P}_t) - \mathrm{Cov}(\mathrm{P}_t, \mathrm{Q}_t)$. Hence, betas are not necessarily symmetric around 0 and the more volatile portfolio has a larger (in absolute value) beta with respect to the long/short portfolio. The $\mathrm{P}_t - \mathrm{Q}_t$ beta of the "neutral" portfolio $(\mathrm{P}_t + \mathrm{Q}_t)/2$ is positive if $\sigma_{\mathrm{P}} > \sigma_{\mathrm{Q}}$ and negative otherwise. In other words, the magnitudes of betas are more informative about the volatility of the portfolios that make up the long/short portfolios than as a measure of how tilted a portfolio is towards the underlying characteristic.

The dependence of regression loadings on the volatility of the long/short portfolios is borne out in the data. In our sample, univariate HML betas are not centered around zero since $\sigma_{\mathrm{L}} > \sigma_{\mathrm{H}}$ and thus $|\beta_{\mathrm{L,HML}}| > |\beta_{\mathrm{H,HML}}|$. The estimated univariate betas are $\beta_{\mathrm{L,HML}} = -0.75, \beta_{\mathrm{H,HML}} = 0.25$. The HML beta of the "BM-neutral portfolio" (H+L)/2 is -0.25. In contrast, the HML beta of a "growth-tilted" portfolio of 0.75H+0.25L is 0. Hence, a comparison of HML loadings of two portfolios based only on the magnitudes of their HML betas is misleading. Say, the HML betas of two portfolios are -0.2 and 0.2, respectively. The portfolio with an HML beta of 0.2 is much closer to "H" than the portfolio with an HML beta of -0.2 is to "L".

This pattern is even more pronounced for the SMB β's of "S" and "B": $\beta_{\mathrm{S,SMB}} = 1.60, \beta_{\mathrm{B,SMB}} = 0.60$. The *positive* sign of $\beta_{\mathrm{B,SMB}}$ is counterintuitive since SMB=S−B but is due to the fact that "S" is much more volatile than "B" and Cov(B,S) > Var(B). Hence, the SMB beta of any linear combination of "S" and "B" with non-negative weights is strictly positive. Thus univariate SMB betas of large stocks, or mutual funds that hold large stocks, are positive. By themselves, beta coefficients in regressions on long/short factors are generally not informative. Instead, betas need to be interpreted relative to the range spanned by the betas of the components of the long/short factors.

In multivariate regression, the patterns of betas are more complicated and depend on the joint variance-covariance structure of the left- and right-hand side variables. Consider the 4-factor model

$$Y_t = \alpha_{\mathrm{Y}} + \beta_{\mathrm{Y,MKT}}\,\mathrm{MKT}_t + \beta_{\mathrm{Y,SMB}}\,\mathrm{SMB}_t + \beta_{\mathrm{Y,HML}}\,\mathrm{HML}_t + \beta_{\mathrm{Y,MOM}}\,\mathrm{MOM}_t + e_{\mathrm{Y},t},$$

where $Y \in \{\text{S, B, H, L, U, D}\}$. As in the univariate case, the betas have the property

$$\begin{aligned} \text{SMB} = \text{S} - \text{B} &\implies \beta_{\text{S,SMB}} - \beta_{\text{B,SMB}} = 1, \\ \text{HML} = \text{H} - \text{L} &\implies \beta_{\text{H,HML}} - \beta_{\text{L,HML}} = 1, \\ \text{MOM} = \text{U} - \text{D} &\implies \beta_{\text{U,MOM}} - \beta_{\text{D,MOM}} = 1. \end{aligned}$$

However, the estimates of the individual β's depend on the variance-covariance of $Z_t = [\text{MKT}_t, \text{S}_t, \text{B}_t, , \text{H}_t, \text{L}_t, \text{U}_t, \text{D}_t]'$. As with univariate betas, it is not necessarily the case that the coefficients are symmetric in the sense that $\beta_{\text{S,SMB}} = -\beta_{\text{B,SMB}}, \beta_{\text{H,HML}} = -\beta_{\text{L,HML}}, \beta_{\text{U,MOM}} = -\beta_{\text{D,MOM}}$.

In general, the relative magnitudes and signs can take any value. The betas of the six component portfolios of SMB, HML and MOM in 4-factor regressions are shown in Table 6. The SMB loading of "S" is 0.90, while the loading for "B" is −0.10 and thus much smaller in absolute value. The same pattern is true for the HML loadings of "H" and "L": $\beta_{\text{H,HML}} = 0.72$ and $\beta_{\text{L,HML}} = -0.28$, while $\beta_{\text{U,MOM}} = 0.34$ and $\beta_{\text{D,MOM}} = -0.66$. While the signs of the betas are intuitive in the sense that betas of "long" portfolios S, H and U are positive and betas of "short" portfolios B, L and D are negative, the betas are not symmetric around zero.

The effect of this asymmetry is visible in the magnitudes of SMB and HML loadings of 25 ME-BM sorted portfolios shown in Table 7. The SMB betas of all portfolios constructed from size quintiles 1 to 4 are positive and only the five portfolios with the smallest stocks have a negative SMB beta. The magnitudes of the SMB betas are only interpretable in comparison to the "S" and "B" betas of 0.9 and -0.10 (Table 6). [15] The pattern of HML betas is similar. Only the portfolios with the lowest BM quintile have negative HML betas. As in the case of SMB betas, HML betas need to be interpreted in conjunction with "H" and "L" betas. Otherwise, asset betas can lead to incorrect inference. Consider for example the "neutral" portfolio formed from stocks in the third ME and BM quintiles. The SMB beta of this portfolio is 0.51, and the HML beta is 0.42 suggesting, incorrectly, that this portfolio is tilted towards large, high BM stocks. However, the betas are close to the midpoints of the "S" and "B" SMB betas and the "H" and "L" HML betas, which is an indication that this portfolio is indeed BM-neutral and ME-neutral.

Consider two mutual funds with $\beta_{1,\text{HML}} = 0.25$ and $\beta_{2,\text{HML}} = -0.25$, respectively. Since the HML betas are equal in absolute value, it might seem that both funds are comparable in terms of their respective value and growth strategies. However, the HML beta of fund 2 is close to the HML beta of "L" of −0.27 while the HML beta of fund 1 is much smaller than the HML beta of "H" of 0.73. Hence, the proper interpretation is that fund 1 is a "moderate" value fund while fund 2 is an "extreme" growth fund.

The third issue with factor exposures estimates is that they are varying over time. Figure 8 shows this time-variation of factor betas for the passive benchmarks as well as the distribution of mutual fund SMB and HML betas. The solid lines in Panel A show "S" and "B" SMB 4-factor betas in 10-year rolling samples. In addition to the "S" and "B" loadings, the figure also shows betas of an ME-neutral portfolio of SB=(S+B)/2. Panel B shows the "H", "L" and HL=(H+L)/2 betas. The shaded areas are 95% confidence bands. SMB betas vary slightly over the sample ranging from −0.14 to −0.04 for "S" and 0.87 to 1.01 for "B". The time-variation of HML betas are more pronounced. Panel B shows that $\beta_{\text{H,HML}}$ and $\beta_{\text{L,HML}}$ are

[15] The betas of the 25 ME-BM portfolios can be larger in absolute value than the "S", "B", "H" and "L" betas since the they are based on quintiles while "S", "B", "H" and "L" are constructed from two ME quantiles and BM terciles.

both higher towards the end of the sample than in early in the sample. The variation is economically and statistically significant. The estimates for $\beta_{\mathrm{H,HML}}$ range from 0.57 in 1991Q3 to 0.76 in 2012Q2 and from -0.41 in 1991Q4 to -0.21 in 2007Q2 for $\beta_{\mathrm{L,HML}}$. Hence a mutual fund with a β_{HML} of 0.5 is an extreme-value fund similar to "H" in the 1980s but only a moderate-value fund in the 2000s. Similarly, a mutual fund with a β_{HML} of -0.2 is an extreme-growth fund in the 2000s but only a moderate-growth fund in the 1980s.

Next, we estimate 4-factor betas of mutual funds in rolling 10-year regressions. Each estimation window includes all funds with at least 75% available data. Figure 9 shows violin plots of the distribution of mutual fund HML and SMB loadings for 10-year windows ending in the second quarters of 1988, 1995, 2002, 2009, and 2016. The figures also show the median and inter-quartile range of each distribution. The solid lines are betas of "S", "B", "H" and "L". The SMB-beta distribution in the top panel is stable over time, which is intuitive since the majority of mutual funds holds almost exclusively large stocks throughout the sample. The median of the distribution varies between 0.04 in 2009 to 0.17 in 1988.

The majority of mutual funds have *positive* SMB betas, from 55% in 2009 to 78% in 1988. Without proper context, this would incorrectly indicate that most mutual funds hold small stocks. SMB-betas of very few mutual funds are as high as the "S" SMB-beta; but many funds have an SMB-beta that is comparable to that of the "B" portfolio. The upper interquartile range is close to the SMB-beta of the ME-neutral SB=(S+B)/2 portfolio and lower interquartile range is close to that of the "B" beta. Hence, properly interpreted, the SMB-beta distribution confirms the pattern found in portfolio holdings that most mutual funds invest in large stocks.

The HML beta distributions are shown in Panel B. First, notice that there is time-variation in the mutual fund HML-β distribution. The distribution shifts up in the middle of the sample compared to the beginning and end of the sample. The median in 1988 is -0.08, 0.14 in 2002 and -0.07 in 2016. Thus mutual fund HML-betas follow a similar pattern as the HML-betas of the passive "H", "HL" and "L" portfolios shown in Figure 8. The medians of the distributions are around 0 and would, as in the case of SMB-betas, incorrectly indicate that funds are on average BM-neutral. However, there are virtually no mutual funds with an HML-beta close to the "H" HML-beta while most funds have an HML beta that is lower than the beta of the BM-neutral HL=(H+L)/2 portfolio. For example, in 2016 93% of all mutual funds had an HML beta that was lower than the HL beta confirming that very few mutual funds are high-BM funds, whether the degree of "value" is measured based on portfolio holdings or regression loadings.

In summary, magnitudes of SMB and HML loadings are difficult to interpret and vary over time. Estimated portfolio or mutual fund betas should be compared to betas of the individual portfolios that are used to construct long/short factors.

Finally, we compare the distribution of mutual fund loadings to that of hedge funds in Figure 10. The distributions of HML and MOM betas of hedge funds are very similar to those of mutual funds while hedge funds have on average slightly higher SMB-betas. However, the hedge fund and mutual funds distributions of market betas are fundamentally different. Most mutual funds have a market beta between 0.5 and 1.5 with a mean close to 0. Market betas if hedge funds are on average lower. The mean market beta is close to 0.6, and about 40% of hedge funds have a market beta of less than 0.5. Since mutual funds are restricted to only hold long positions, it is not surprising that their market betas are around one. Hedge funds can take short positions and thus create portfolios with lower market betas. However, the histograms show that hedge funds exposures to factors other than the market do not differ significantly from those of mutual funds.

5. Portfolio Composition by Quintiles

So far, we have focused on average portfolio characteristics of mutual funds. Next, we analyze portfolio compositions in more detail. Specifically, for each fund, we compute the average portfolios shares in each of the characteristic quintiles over the lifetime of the fund. Table 8 reports average portfolio shares in the five BM quintiles for the CRSP-VW index and mutual funds, hedge funds and ETFs, as well as for the five largest "value" and "growth" funds in our sample. Figure 11 shows the histograms of portfolio shares in BM quintiles across mutual funds, hedge funds and ETFs.

Since the total market capitalization is higher in the lower BM quintiles than in the higher BM quintiles, the average portfolio share of the CRSP-VW index declines from quintiles one to five. The average BM-quintile portfolios shares across all funds, shown in the second row of Panel A, are very close to the shares of the CRSP-VW index. The portfolios of growth funds are heavily concentrated in extreme low BM stocks. The average portfolio share of stocks in quintile one is 53% and 22% in quintile two. Only 12% of portfolios of "growth" funds are invested in higher BM stocks. However, the pattern for "value" funds is very different. The average share of stocks in the lowest BM quintiles of value fund portfolios is 22%, and an additional 23% are invested in stocks in the second BM quintile. On the other hand, only 14% are held in high BM stocks. In other words, on average value funds hold a higher fraction of their portfolios in low BM "growth" stocks than in high BM "value" stocks. Figure 11 shows the distribution of portfolio shares across mutual funds (in black). Very few mutual funds hold more than 30% or their portfolios in quintiles 4 and 5 stocks. This pattern is particularly stark for "value" funds. Only 41 of 574 "value" funds hold more than 25% of their portfolio in BM quintile-5 stocks (in comparison, 1,082 out of 1,130 "growth" funds hold more than 25% of their portfolio in quintile-1 stocks). In contrast, 209 "value" funds hold more than 25% of their portfolio in quintile-1 stock and 309 "value" funds hold a larger share of their portfolio in quintile-1 than in quintile-5 stocks. In other words, "value" mutual funds hold significantly more "low-BM growth" stocks than "high-BM value" stocks.

Panel A of Table 8 also shows the average BM-quintile portfolios shares of hedge funds and ETFs. The quintile shares in BM hedge fund and ETF portfolios look remarkably similar to those of mutual funds. The histograms in Figure 11 show that not only the mean of the shares distributions across BM quintiles are similar for mutual funds, hedge funds, and ETFs but also the overall shape.

Panel B reports the portfolio shares across BM quintiles for the five largest value funds. Four of the five largest value funds hold the highest portfolio share in stocks in the lowest BM quintile. Their portfolio shares decline (mostly) monotonically and the lowest portfolio shares are in stocks in the highest BM quintile (with one exception). The largest "value" fund, the "T. Rowe Price Equity Income" fund (with assets of $21.6 bil. as of July 2018), holds 29% of its portfolio in stocks in the lowest BM quintile and only 13% in stocks in the highest BM quintile. Using the BM as a measure of "value", as is done in most of the academic literature, this fund would be labeled as a "growth" fund rather than a "value" fund. The portfolios of the second to fourth largest "value" funds have similar patterns. The notable exception is the fifth largest "value" fund, the "DFA US Large Cap Value" fund. This fund holds very small fractions of stocks in the lowest two BM quintiles and holds on average 70% in stocks in the two highest BM quintiles. In contrast, portfolios of "growth" funds are more concentrated in low BM stocks. Panel C shows the average portfolio weights for the five largest "growth" funds in our sample. These funds hold at least 65% of their portfolios in BM1 and BM2 stocks and the portfolio shares are declining in BM.

6. Joint Distribution of Mutual Fund Characteristics

So far, we have focused on the univariate characteristics distributions. Next, we will study the joint distribution of average BM and MOM scores of mutual funds; additional results are reported in the online appendix. Figure 12 shows the 2-dimensional scatter plot with BM scores on the x-axis and MOM scores on the y-axis. The plots also show the scores of the CRSP-VW and S&P 500 indices as well as the components of Fama-French portfolios ("S", "B" for small/big, "H", "L" for high/low BM, "U", "D" for high/low MOM).

Panel A shows the BM/MOM distribution for individual stocks. Each dot represents the average BM and MOM characteristics for an individual stock. Smaller/larger dots correspond to smaller/larger stocks. Average MOM scores for most stocks are between 2.75 and 3.75 while average BM score are more spread out. The scatter plot also shows no strong link between BM and MOM scores for stocks. Panel B shows the same plot for mutual funds with different mutual funds types indicated by different colors. The BM/MOM distribution of mutual funds is different from that of stocks in a number of ways. First, it is more clustered around BM scores between 1.2 and 3 and MOM scores between 3 and 4, as already indicated by the univariate BM and MOM histograms. Second, there is a negative correlation between a fund's BM and MOM scores. Funds with low BM scores have higher MOM scores than those with higher BM scores. Hence "growth" funds (in green) have on average a higher MOM score than "value" funds (in blue). The figure shows that there are no funds with a portfolio that is tilted towards high BM *and* high MOM.

Panel C shows the BM/MOM distribution for fund/quarter observations instead of time series averages. Compared to the fund/averages observations shown in Panel B, the fund/quarter MOM scores are more spread out. The bulk of the observations are the BM scores are between 1 and 3. About 60% of all fund/quarter observations have a BM score between 1 and 3 and a MOM score between 3 and 4. It is instructive to compare the mutual fund distribution of S&P 500 stocks. Since stocks are assigned integer scores between 1 and 5 in each quarter, we add some random noise around the integer values to show the distribution. The stock/quarter distribution is superimposed in red. Since the breakpoints in the constructions of portfolios are reset each year, the distribution of stocks is almost uniform. Hence the BM/MOM scores of portfolios of mutual funds are more concentrated than scores of individual (large) stocks. Panel D shows the BM/MOM distribution for hedge funds and ETFs. Both distributions are very similar to the distribution of mutual funds.

The scatter plots in Figure 12 show the joint BM/MOM distribution over the entire sample but there is significant time variation in the joint distribution. Figure 13 plots the joint distributions in 1999Q1 and 2001Q2. In 1999Q1 mutual funds with low BM scores have high MOM scores. This pattern is reversed in 2001Q2 when low BM funds have lower than average MOM scores. During the stock market boom, growth stocks were on average also high momentum stocks; hence portfolios of "growth" funds, holding primarily low BM stocks, were also high momentum. Momentum of low BM stocks was low after the market correction in 2000, hence "growth" funds were low momentum. Since portfolios of "value" funds are invested in low, mid and high BM stocks in similar proportions, this comovement of BM and MOM scores are much less pronounced. This pattern holds throughout the sample. The time series standard deviation of MOM scores for low BM funds is twice as high as that of higher BM funds.

7. Characteristics and Return

Finally, we investigate how characteristics are related to returns. Table 9 reports returns of stocks in Panel A and mutual funds in Panel B across characteristic quintiles. In addition to ME, BM, MS, and MOM we also report results for the two components of the MS index: Fundamental growth rates (GR) and multiples (MULT). The returns across size, book-to-market and momentum have the familiar patterns of the size, value and momentum premia. The Morningstar value index MS produces a significantly smaller return spread than the book-to-market ratio. The reason is that both MS components yield relatively small return spreads. There is no consistent return pattern across GR quintiles, and the index of multiples produces a smaller return spread than the book-to-market ratio by itself. The corresponding results for mutual funds are reported in Panel B. The mutual fund returns are after fees and overall lower than those of individual stocks but have lower volatility. Sharpe-ratios of stock and mutual fund returns are comparable.

While the well-studied characteristic premia are present in stock returns, they are much smaller on the mutual fund level. There are no consistent return patterns across ME, MOM, MS, MULT and GR quintiles. Only the book-to-market effect is present in mutual funds returns, but its magnitude is smaller than that for stocks. The BM quintile-5 to quintile-1 spread for stocks is 2.82%, and 0.78% for mutual funds, respectively. Hence, investors in mutual funds are not rewarded for return premia associated with characteristics that are present in individual stock returns.

Next, study the characteristics-return link more formally using Fama-MacBeth regressions. In each quarter t we estimate the regression

$$R_{i,t+1} - R_{f,t+1} = \boldsymbol{\beta}_t' \mathbf{X}_{i,t} + e_{i,t+1}, \tag{2}$$

where $R_{i,t+1} - R_{f,t+1}$ is the excess return of asset i in quarter $t+1$ and $\mathbf{X}_{i,t}$ is a vector of characteristics of asset i at time t. Then, we time-average the betas and report $\overline{\boldsymbol{\beta}} = \sum_t \boldsymbol{\beta}_t$ in Table 10. We estimate the model for individual stocks and mutual funds. The results for the sample of individual stocks in the top panel shows the familiar patterns. Stocks that are small size have high momentum and high "value" are associated with higher returns. The size effect is statistically insignificant while the momentum coefficient is significant. The BM coefficient is twice as large as the MS coefficient and strongly significant while the significance of the MS estimate is only marginal. This suggests that on the stock level the book-to-market ratios are more powerful return predictor than the Morningstar index, consistent with the results in Table 9.

The results for the sample of mutual funds, shown in Panel B, differ from those for individual stocks in important aspects. The ME coefficients are slightly more negative than those for the stock sample while the MOM point estimates are almost identical. The BM and MS coefficients, however, are slightly negative and insignificant. This in sharp contrast to the estimates for individual stocks. The "value" premium is present in individual stocks returns but not in returns of mutual funds, which is also consistent with the results in Table 9.

8. Conclusion

This paper provides a comprehensive analysis of characteristics of mutual fund portfolios. Some facts stand out. First, the BM distribution of mutual funds is strongly skewed towards low BM ratios. While there are many funds that have a BM ratio comparable to that of the "L" portfolio in HML, there very no funds with a BM ratio close to "H". Moreover, the skew towards low BM values is more pronounced for mutual funds than for individual (large) stocks. Second, "growth" funds hold almost exclusively low BM stocks in their portfolios. In contrast, portfolios of "value" funds include stocks across the entire BM distribution. In fact, on average mutual funds hold a higher share of stocks with low BM ratios that stocks with high BM ratios. The BM distributions of ETFs and hedge funds are similar to that of mutual funds. Third, mutual funds are on average almost momentum-neutral. While momentum of "growth" funds varies over time, in contrast to momentum of "value" funds, there are very few mutual funds with consistently high momentum. Fourth, size, book-to-market and momentum return spreads are smaller for mutual funds than for individual stocks and insignificant in Fama-MacBeth regressions.

These stylized facts raise a number of questions about active mutual funds:

1. Why is the distribution of mutual fund portfolios so strongly tilted towards low book-to-market ratios and why are there virtually no high BM funds at all even though high BM stocks are associated with higher returns than low BM stocks?

2. Why do funds that label themselves as "value" funds hold more low BM stocks than high BM stocks while "growth" funds hold almost exclusively low BM stocks?

3. Why are portfolios of active mutual funds not more tilted towards characteristics that are associated with high returns, i.e. small, high BM and high momentum stocks?

4. Why don't mutual funds combine multiple strategies (e.g., high BM - high momentum) that have been shown to be more profitable than univariate strategies (Asness, Moskowitz, and Pedersen (2013)).

5. Why do mutual funds and ETFs follow strategies that emulate the Morningstar value/growth definition even though it has no return premium?

Our results have also broader implications for equity markets. Aside from the issue of delisting of funds and the implied survivorship bias, the literature takes the set of mutual funds as given and there is little research about why new funds are created. In other words, what economic forces determine the set of funds and strategies that we observe? Is the mutual fund market driven by investor's demand for certain strategies or by the supply of profitable strategies? Are there so many "growth" funds because investor's demand for "growth" stocks and the absence of high-BM funds is due to low demand? How can the stylized facts presented in this paper be reconciled with the evidence that capital flows react strongly to past performance? Since returns of high-BM stocks are on average higher than returns of low BM stocks, capital should flow from low-BM funds into high-BM mutual funds over the sample and the number of high-BM funds should increase relative to the number of low-BM funds. Yet, there is no evidence support this conjecture.

Portfolios of active mutual funds account for about 13% of total market cap (as of 2016) and their portfolio allocations are likely to have an effect on equilibrium prices. Whether factor premia are permanent or diminishing over time due to higher demand for underpriced stocks is still an open question. Our results suggest that active mutual funds do not systematically hold the stocks with characteristics associated with high returns and thus are unlikely to contribute to any shrinking of factor premia during the sample period. Our sample of mutual funds and ETFs is exhaustive but we only observe portfolio holdings of a very small subset of small hedge funds, so we cannot rule out that (larger) hedge funds tilt their portfolios towards profitable characteristics.

References

Agarwal, Vikas, Vyacheslav Fos, and Wei Jiang, 2013, Inferring Reporting-Related Biases in Hedge Fund Databases from Hedge Fund Equity Holdings, *Management Science* 59, 1271–1289.

Agarwal, Vikas, Wei Jiang, Yuehua Tang, and Baozhong Yang, 2013, Uncovering hedge fund skill from the portfolio holdings they hide, *Journal of Finance* 68, 739–783.

Asness, Clifford S, Tobias J Moskowitz, and Lasse Heje Pedersen, 2013, Value and Momentum Everywhere, *The Journal of Finance* 68, 929–985.

Berk, Jonathan B., and Jules H. van Binsbergen, 2015, Measuring skill in the mutual fund industry, *Journal of Financial Economics* 118, 1–20.

Berk, J.B. Jonathan B., and Richard C. Green, 2004, Mutual fund flows and performance in rational markets, *Journal of Political Economy* 112, 1269–1295.

Cremers, Martijn, and Antti Petajisto, 2009, How Active Is Your Fund Manager A New Measure That Predicts Performance, *Review of Financial Studies* 22, 3329–3365.

Daniel, Kent, Mark Grinblatt, Sheridan Titman, and Russ Wermers, 1997, Measuring Mutual Fund Performance with Characteristic-Based Benchmarks, *The Journal of Finance* 52, 1035–1058.

Fama, Eugene F., and Kenneth R. French, 1992, The Cross-Section of Expected Stock Returns, *The Journal of Finance* 47, 427–465.

Fama, Eugene F., and Kenneth R. French, 2010, Luck versus Skill in the cross-section of mutual fund returns, *Journal of Finance* 65, 1915–1947.

Harvey, Campbell R., Yan Liu, and Heqing Zhu, 2016, … and the Cross-Section of Expected Returns, *Review of Financial Studies* 29, 5–68.

Jensen, Michael C., 1968, The performance of mutual funds in the period 1945-1964, *Journal of Finance* 23, 389–416.

Kacperczyk, Marcin, Stijn V. Nieuwerburgh, and Laura Veldkamp, 2014, Time-varying fund manager skill, *Journal of Finance* 69, 1455–1484.

Pastor, Lubos, Robert Stambaugh, and Lucian Taylor, 2017, Fund Tradeoffs, *NBER working paper No. 23670*.

Pástor, Lubos, Robert F. Stambaugh, and Lucien A. Taylor, 2015, Scale and skill in active management, *Journal of Financial Economics* 116, 23–45.

Wermers, Russ, 2000, Mutual Fund Performance: An Empirical Decomposition into Stock-Picking Talent, Style, Transactions Costs, and Expenses, *The Journal of Finance* 55, 1655–1695.

Appendix A. Data and Fund Selection

Mutual Funds and ETFs

Our sample of mutual funds and ETFs builds upon several databases. Net assets (TNA), investment objective codes, realized returns, expense ratios, turnover, starting dates and other fund characteristics comes from the Center for Research in Security Prices (CRSP) Survivorship Bias Free Mutual Fund Database. We collapse funds with different share classes investing in the same portfolio into single fund-observations.[16]

Holdings data comes from two different sources. First, we take data on portfolios weights from CRSP, merging it with funds characteristics by portfolio codes (CRSP_PORTNO) and calendar dates. CRSP provides the most comprehensive data about mutual funds ETFs holdings in terms of number of portfolios, with the downside that it is available only since 2002. In order to cover a time period as large as possible, we also use data from the Thomson Reuters Mutual Fund Holdings (formerly CDA/Spectrum S12). Thomson Reuters tables contain data from funds holdings since 1980, when the U.S. Securities and Exchange Commission (SEC) made the disclosure of mutual funds portfolios mandatory. We merge the CRSP database with the Thomson Reuters holdings using the MFLINKS table developed by Wermers (2000) and available on WRDS.

After merging all relevant tables, we apply standard filters to exclude undesirable observations. First, we remove all funds not classified as U.S. domestic equity funds.[17] Since self-reported classifications can be misleading, We also exclude observations of funds investing on average less than 70% of their total assets in U.S. stocks.

Hedge Funds

We use two different samples of hedge funds in this paper. The first sample comes from the Hedge Funds Research (HFR), with information about performance, strategy, net assets (TNA), fees and other fund characteristics. We include only US-based funds investing 50% or more of their assets in US stocks, obtaining a table with 973 hedge funds.

The HFR data do not include portfolios holdings. We address this limitation by building a second hand-collected sample of hedge funds from the 13F filings of institutional institutional investors managing more than $100 million in value. After restricting this universe to institutional investors that (i) are hedge funds, and (ii) manage a single fund, we obtained quarterly holdings of 114 hedge funds.

Morningstar Index

We reconstruct the Morningstar value/growth index (MS) for each stock in each quarter and then aggregate to the fund level. The MS index is defined as the difference of a multiples (MULT) and a growth (GR) index, which are, by its turn, defined as a combination of ten different scores, each one a percentile between 1 and 100. MULR is a a weighted average of the percentiles (calculated using

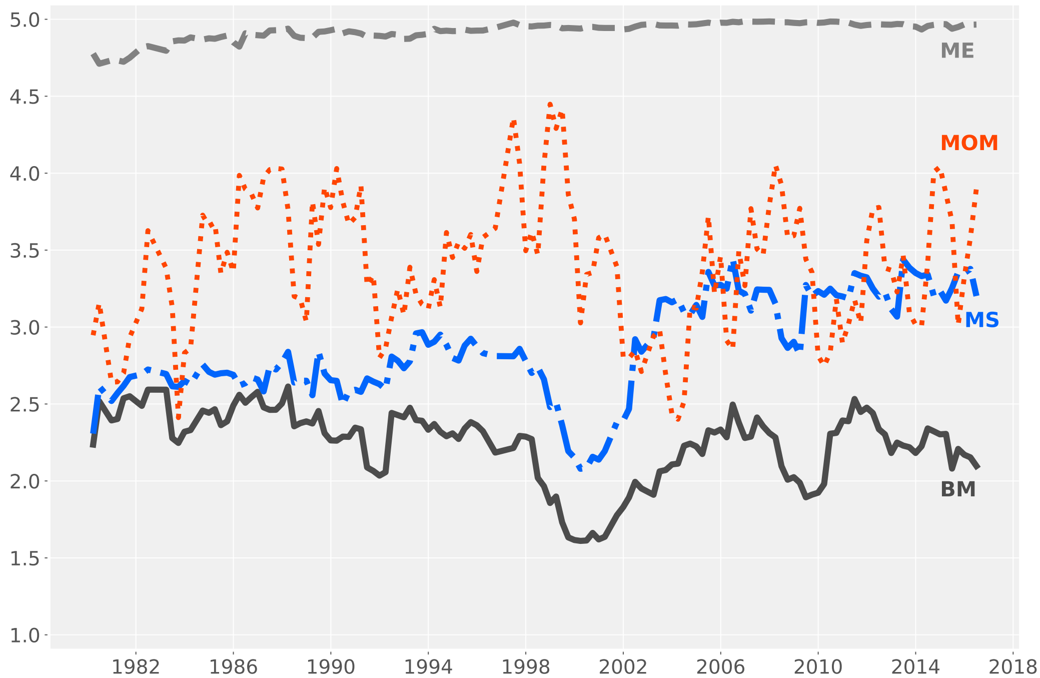
[16]The aggregated observation have TNA equal to the sum of the TNAs of different classes. Qualitative characteristics of the aggregated observation equals to the average of the characteristic among individual observations, weighted by their total assets. Qualitative characteristics of the aggregated observation equals to the characteristic of the oldest share.

[17]We say that an observation is a domestic equity mutual funds if its CRSP investment objective code starts with “ED”.

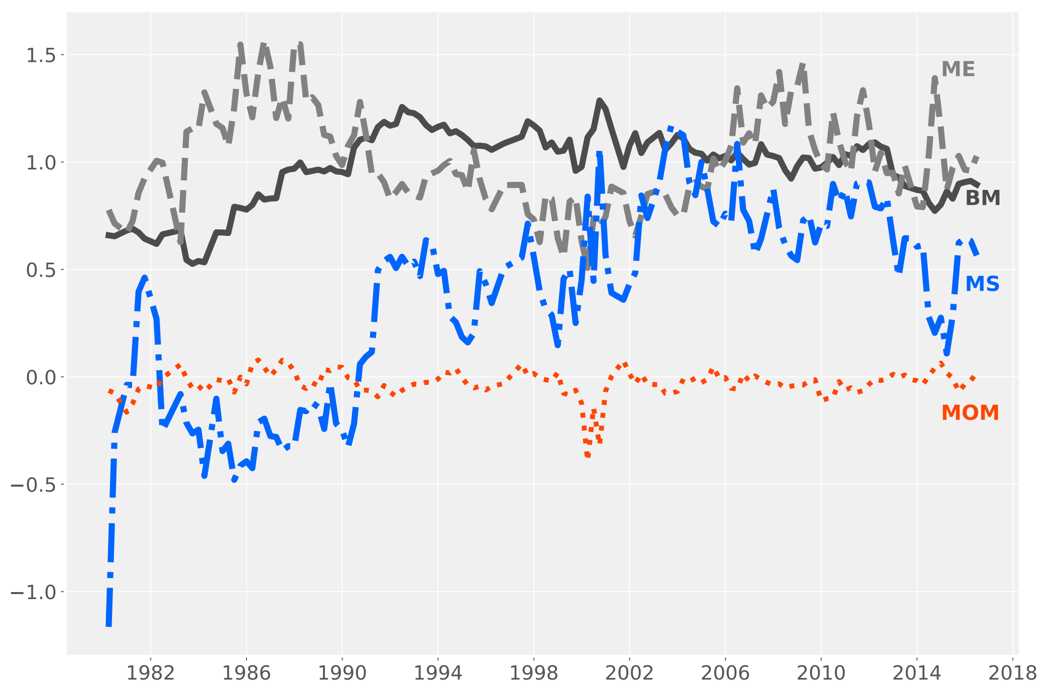
all stocks) of: earnings-to-market (50%), book-to-market (12.5%), sales-to-market (12.5%), cash flow-to-market (12.5%), and dividend yield (12.5%). GR is a a weighted average of the percentiles of: long term projected earnings growth growth from I/B/E/S (50%), year-over-year lagged earnings growth (12.5%), lagged sales growth (12.5%), lagged cash flow growth (12.5%), and lagged book value growth (12.5%). If not available, the projected earnings growth was replaced by the percentile of the lagged earnings growth in this calculation. The resulting Morningstar, calculated as the difference between MULT and GR, ranges from -100 to 100.

Figure 2: Characteristics of "The Investment Company of America Fund" (AIVSX)

Panel A: Characteristics scores

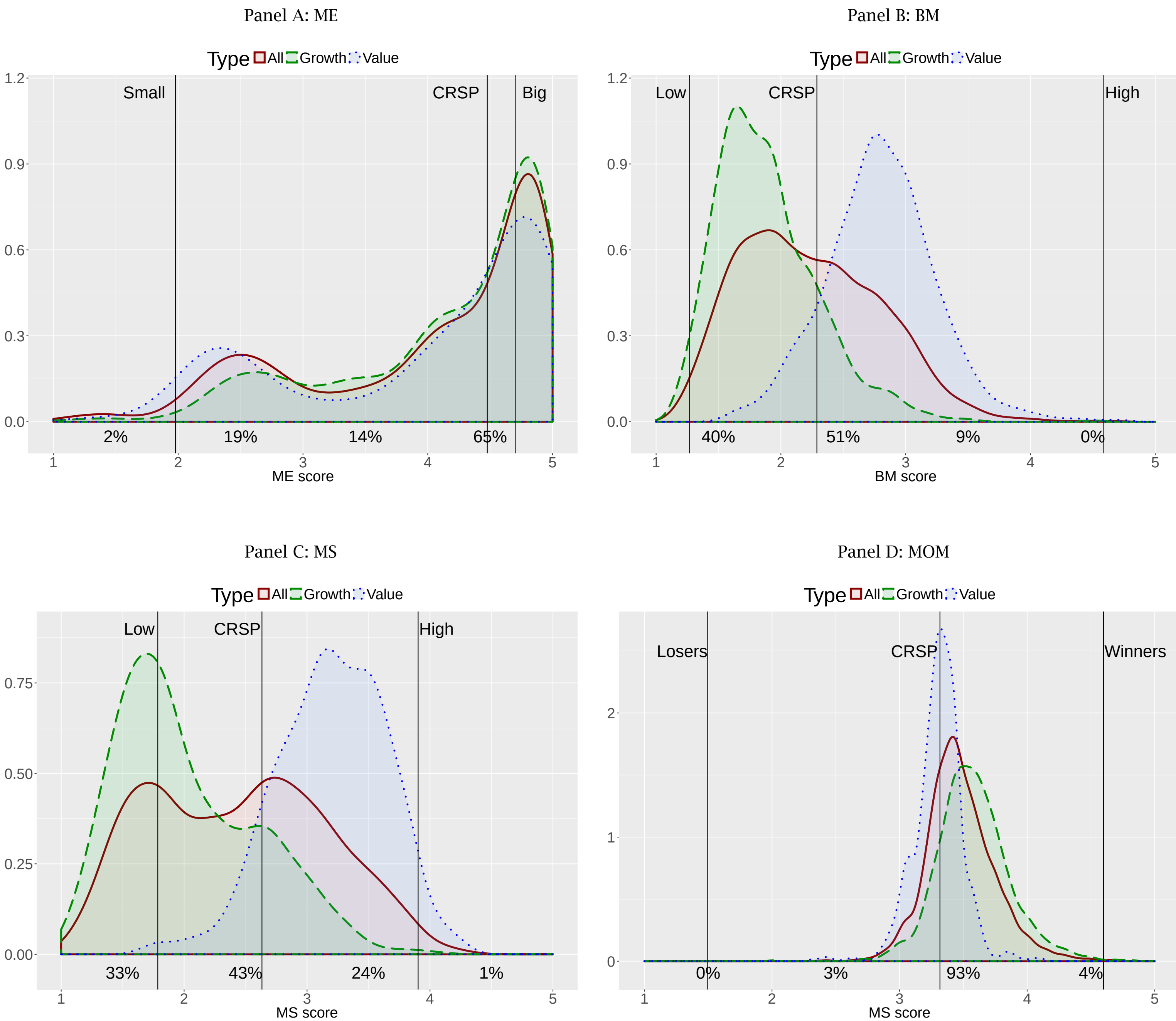


Panel B: Market-adjusted characteristics



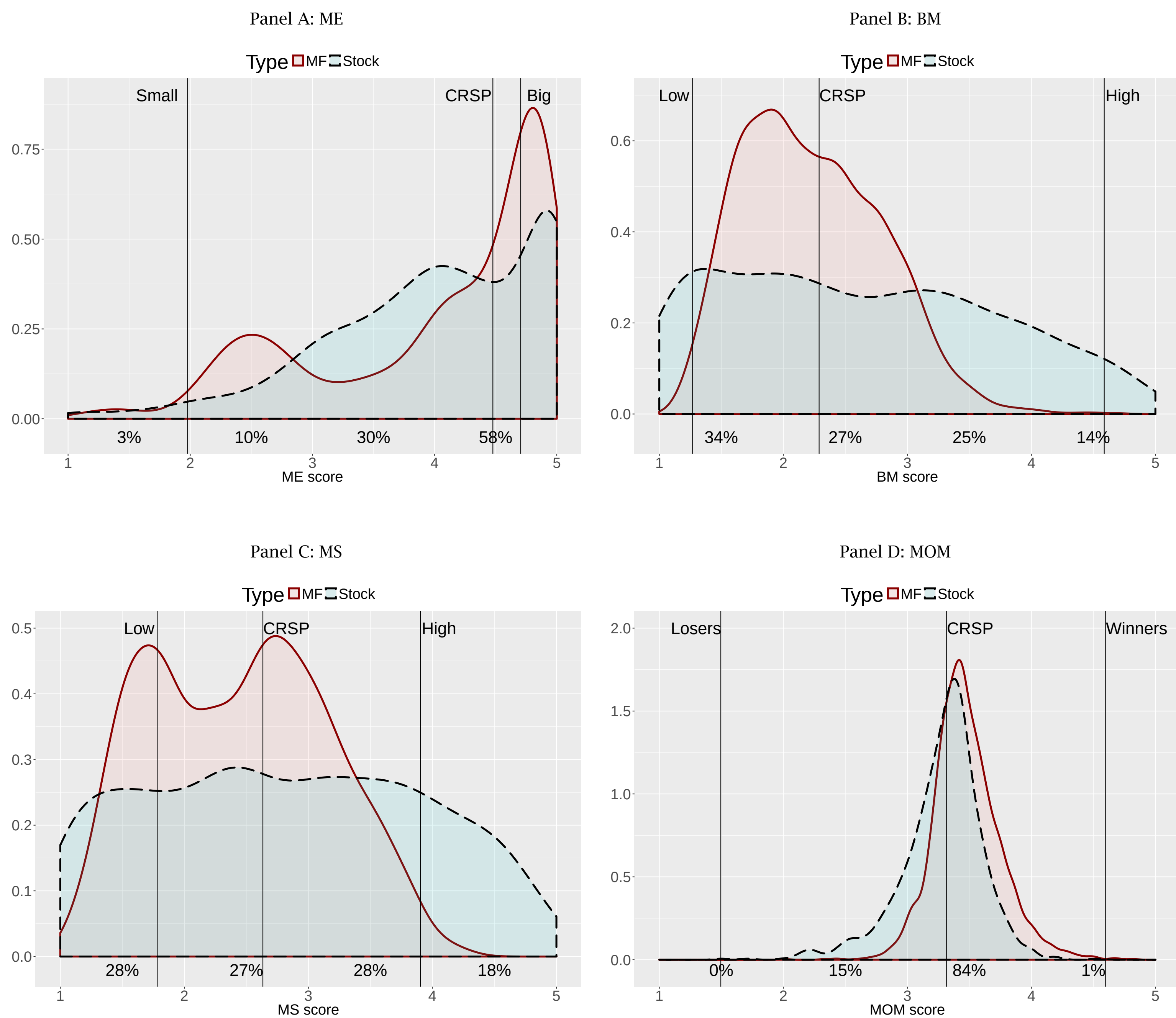
Note: This shows the time series of ME, BM, MS and MOM characteristics of the "The Investment Company of America Fund" (AIVSX) mutual fund. Panel A shows the characteristic scores. The market-adjusted characteristics are plotted in Panel B. Adjusted MS is divided by 10.

Figure 3: Characteristics of Mutual Funds



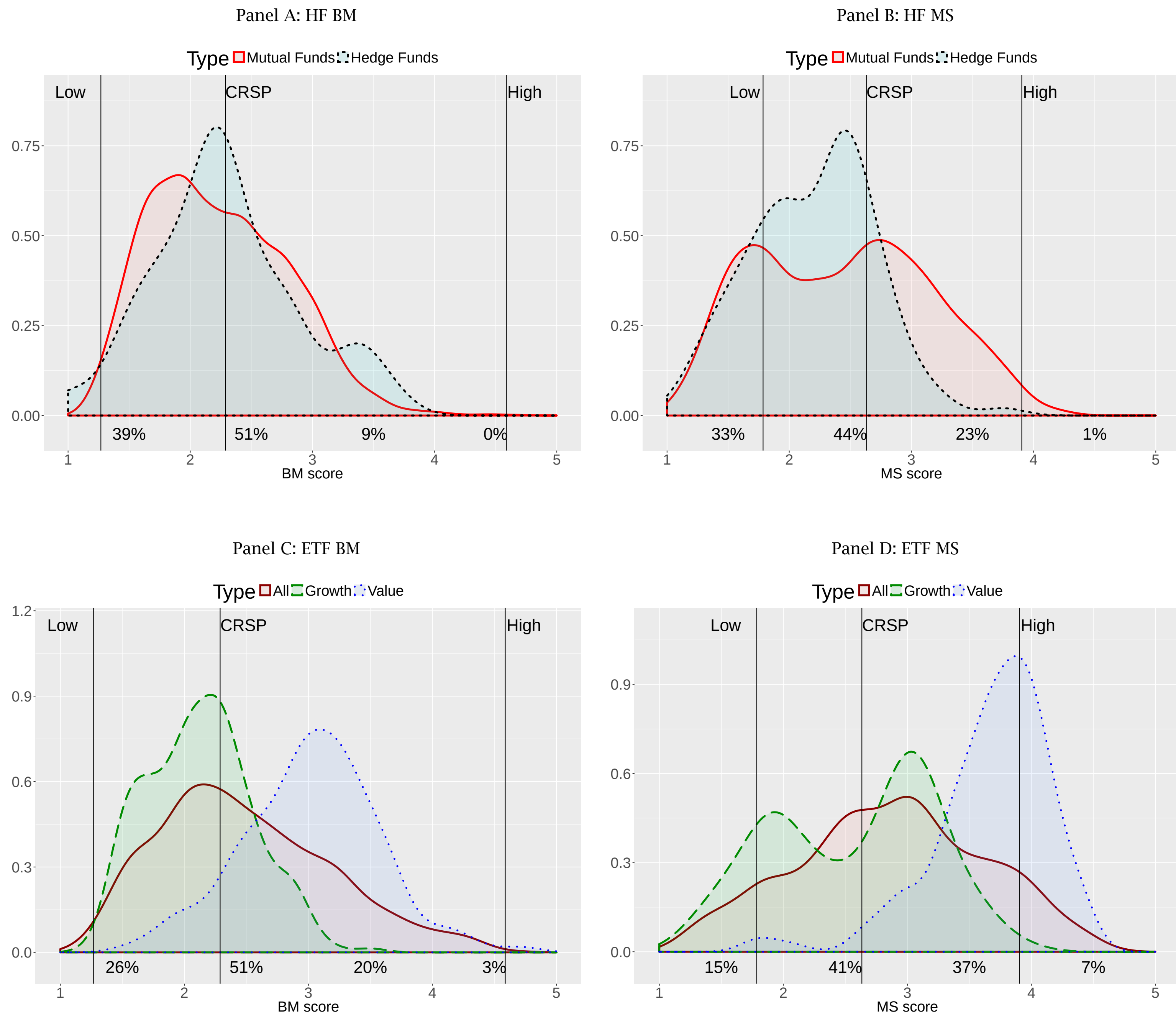
Note: This plot shows the histograms of the distribution of average size (ME), book-to-market (BM), Morningstar index (MS) and momentum (MOM) characteristics of mutual funds over the periods that the fund is in the sample. In each quarter, the fund characteristics are computed as the value-weighted averages of scores of holdings of the fund. The scores are computed using Fama-French quintile breakpoints. An index of '1' indicates firms in the lowest B/M quintile and firms with a score of '5' are in the highest B/M quintile. The solid black line is the histogram of all mutual funds, the dashed green line is for 'growth' funds fund and the dashed blue line is for 'value' funds. The vertical lines indicate the average score of the CRSP-VW index and the corresponding "high" and "low" portfolios of Fama-French long/short portfolios. The sample is from 1980Q1 to 2016Q2.

Figure 4: Histograms - Characteristics of Mutual Funds and Stocks



Note: This plot shows the histograms of the distribution of average size (ME), book-to-market (BM), Morningstar index (MS) and momentum (MOM) characteristics of mutual funds over the periods that the fund is in the sample as well as the histogram of average characteristics for individual S&P500 stocks. In each quarter, the fund characteristics are computed as the value-weighted averages of scores of holdings of the fund. The scores are computed using Fama-French quintile breakpoints. An index of '1' indicates firms in the lowest B/M quintile and firms with a score of '5' are in the highest B/M quintile. The solid black line is the histogram stocks and the dashed line is for mutual funds. The vertical lines indicate the average score of the CRSP-VW index and the corresponding "high" and "low" portfolios of Fama-French long/short portfolios. The sample is from 1980Q1 to 2016Q2.

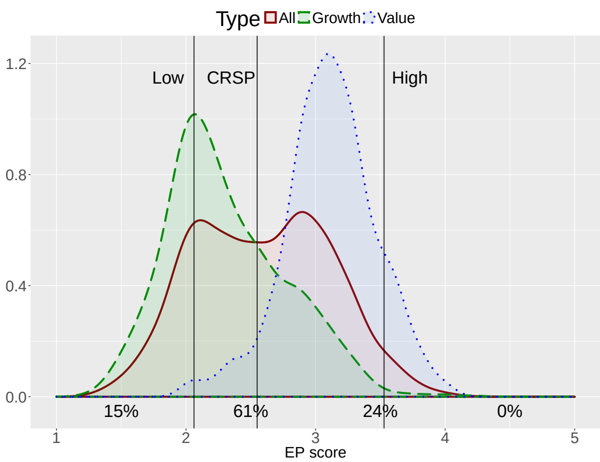
Figure 5: Histograms - Characteristics of Hedge Funds and ETFs



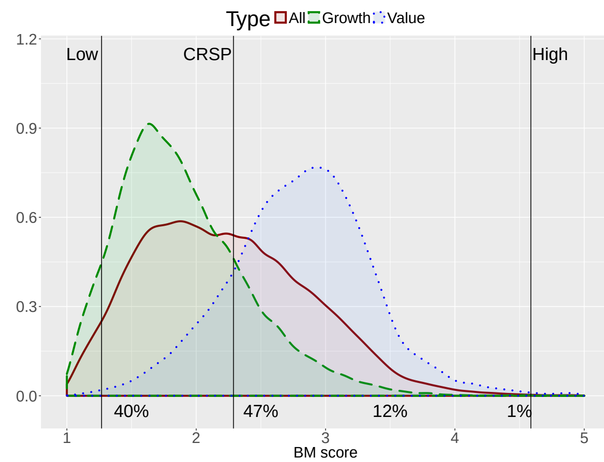
Note: This plot shows the histograms of the distribution of average book-to-market (BM) and Morningstar index (MS) characteristics of ETFs and hedge funds. In each quarter, the fund characteristics are computed as the value-weighted averages of scores of holdings of the fund. The scores are computed using Fama-French quintile break-points. An index of '1' indicates firms in the lowest B/M quintile and firms with a score of '5' are in the highest B/M quintile. Panels A and B are ETF histograms (for all, 'value' and 'growth' ETFs) and Panels C and D are HF histograms (dashed lines and solid lines for mutual funds). The vertical lines indicate the average score of the CRSP-VW index and the corresponding "high" and "low" portfolios of Fama-French long/short portfolios. The sample is from 1980Q1 to 2016Q2.

Figure 6: Characteristics of Mutual Funds – Robustness

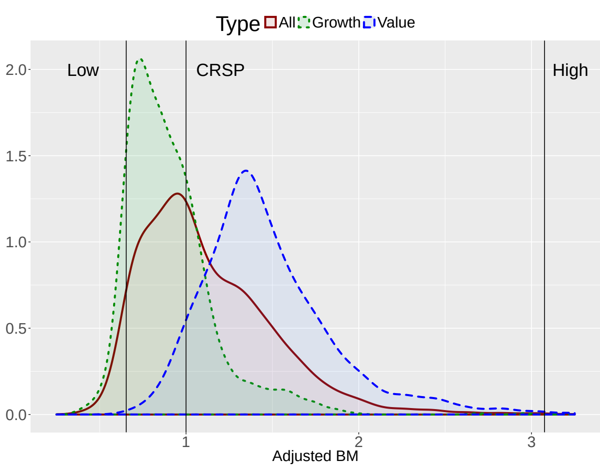
Panel A: EP



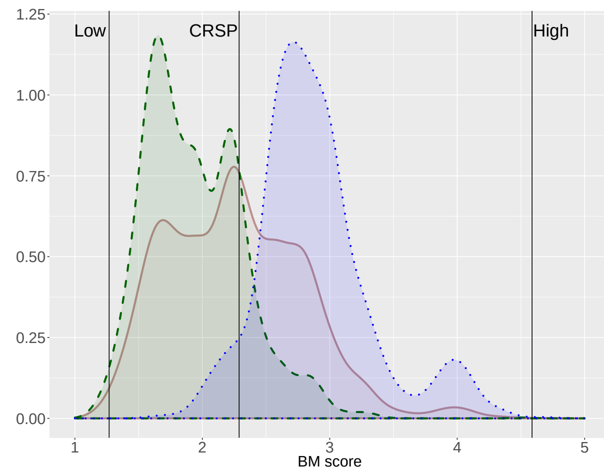
Panel B: Fund/Date Obs.



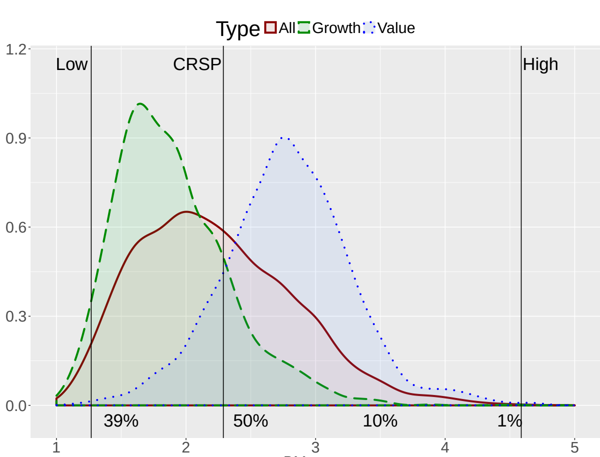
Panel C: Adjusted BM



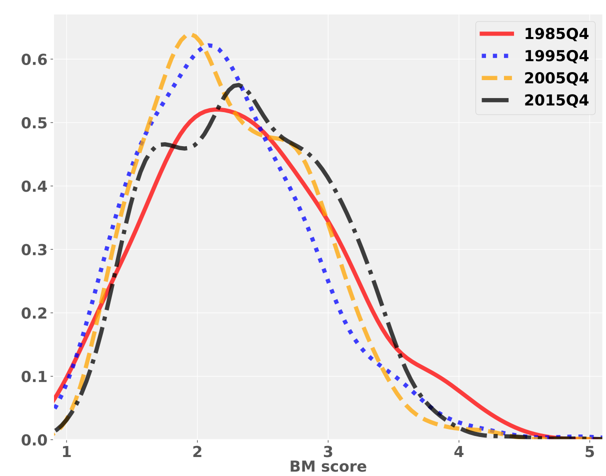
Panel D: AUM-weighted



Panel E: Incl. index and sector MFs

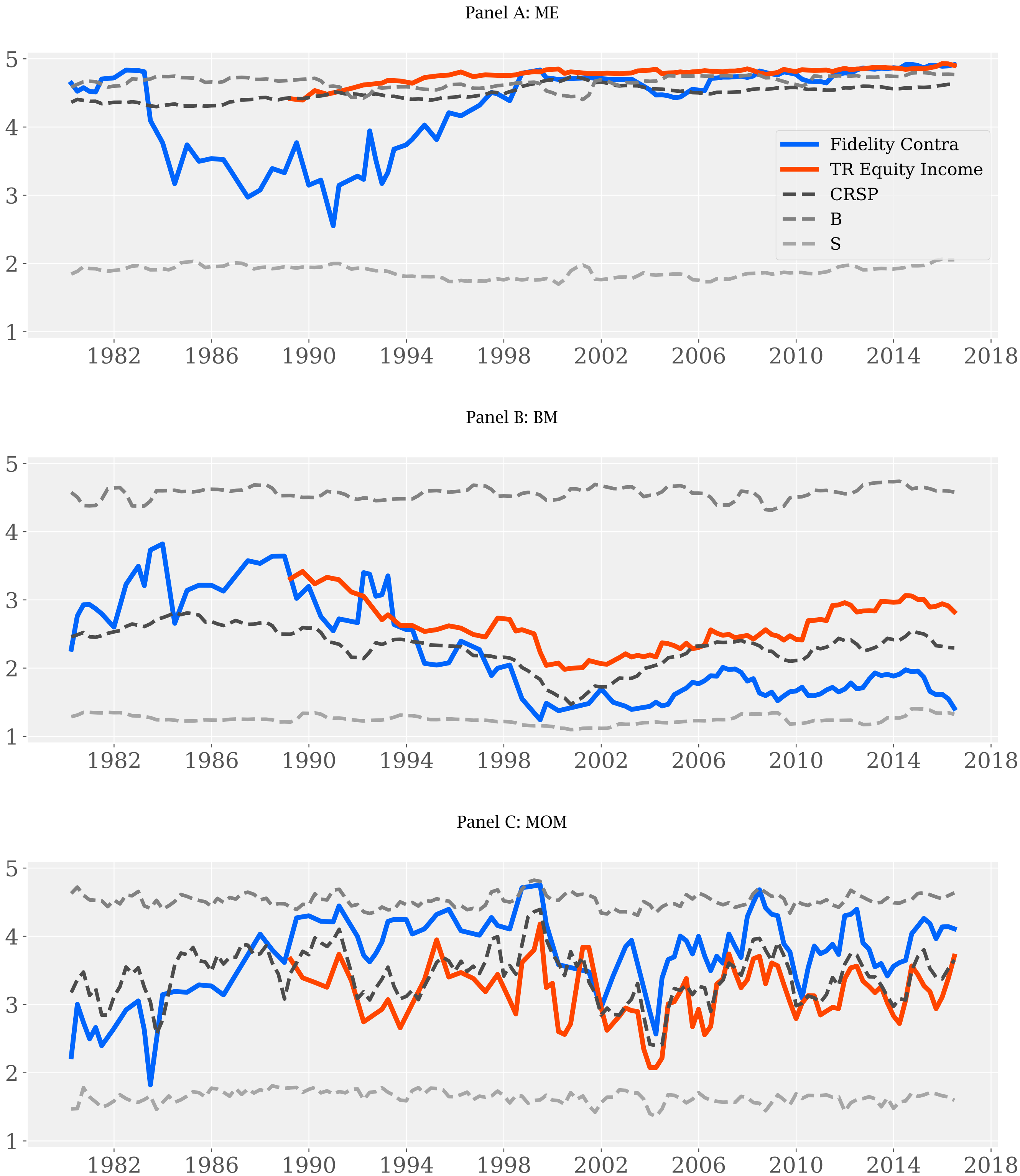


Panel F: Subsamples



Note: This plot shows the histograms of the characteristic distributions of the earnings/price (EP) ratio, fund/date BM, the adjusted BM ratio, AUM-weighted BM, BM for all mutual funds, including index and sector funds, and the BM in four quarters. The sample is from 1980Q1 to 2016Q2.

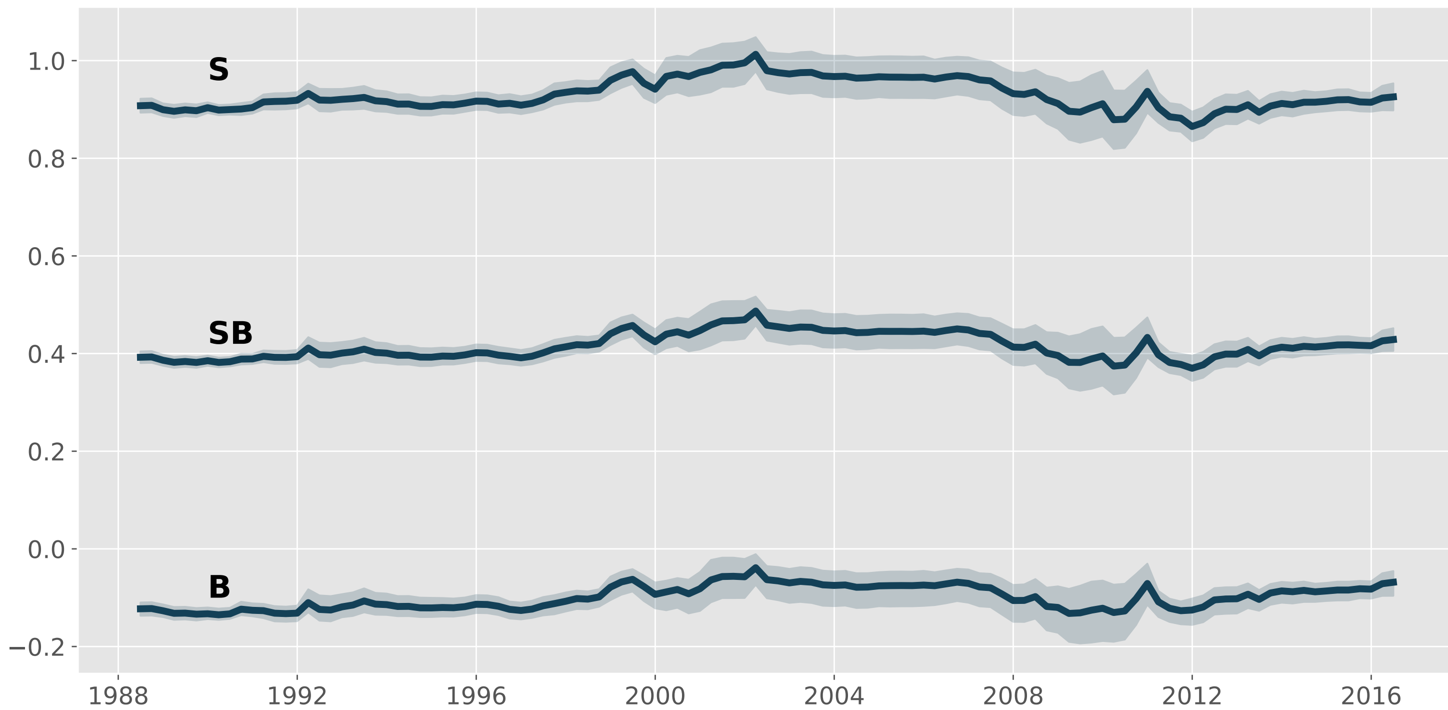
Figure 7: Time-series of Characteristics of two large Mutual Funds



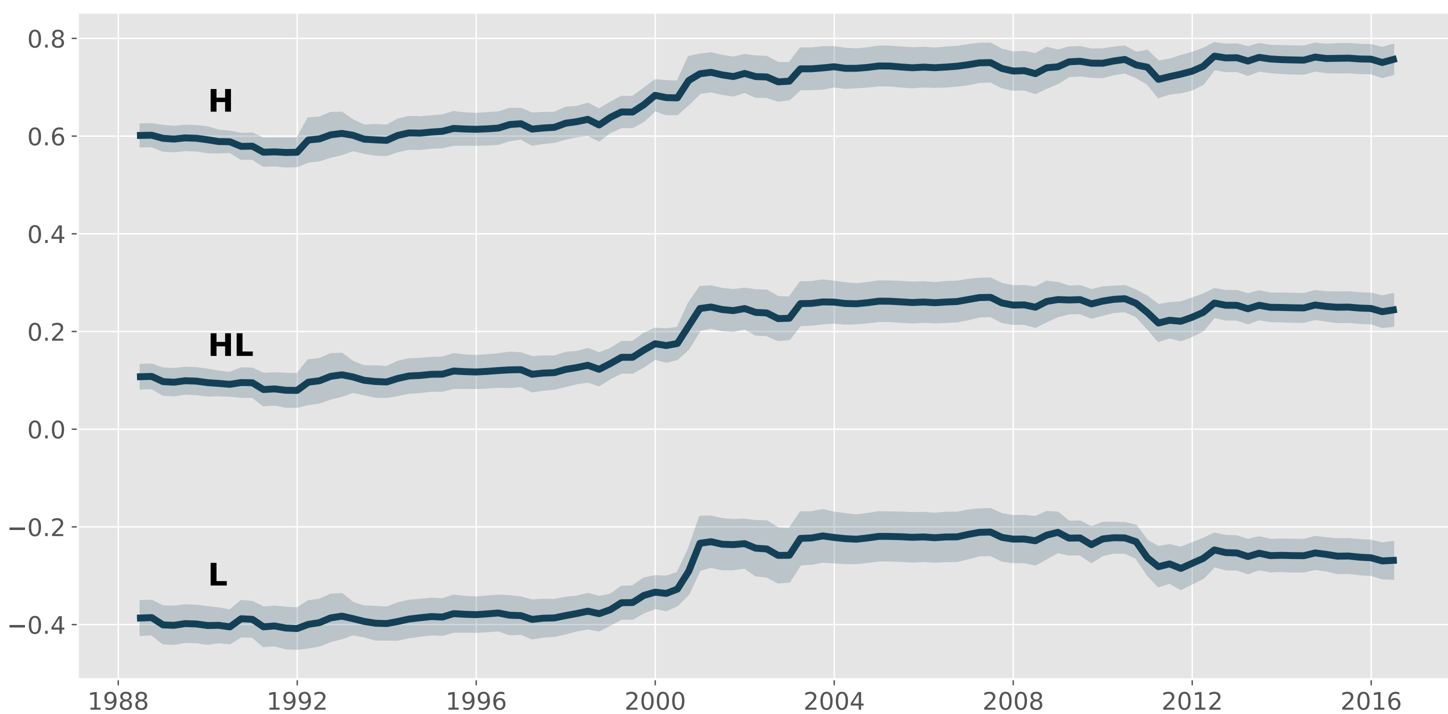
Note: This plot shows time-series of size (ME), book-to-market (BM) and momentum (MOM) characteristics of the the largest mutual fund in our sample (Fidelity Contrafund), the largest value fund (Fidelity Equity Income Fund), the CRSP−VW index and the Fama-French long/short portfolios. The sample is from 1980Q1 to 2016Q1.

Figure 8: Loadings in Rolling 4-Factor Regressions

Panel A: SMB-β



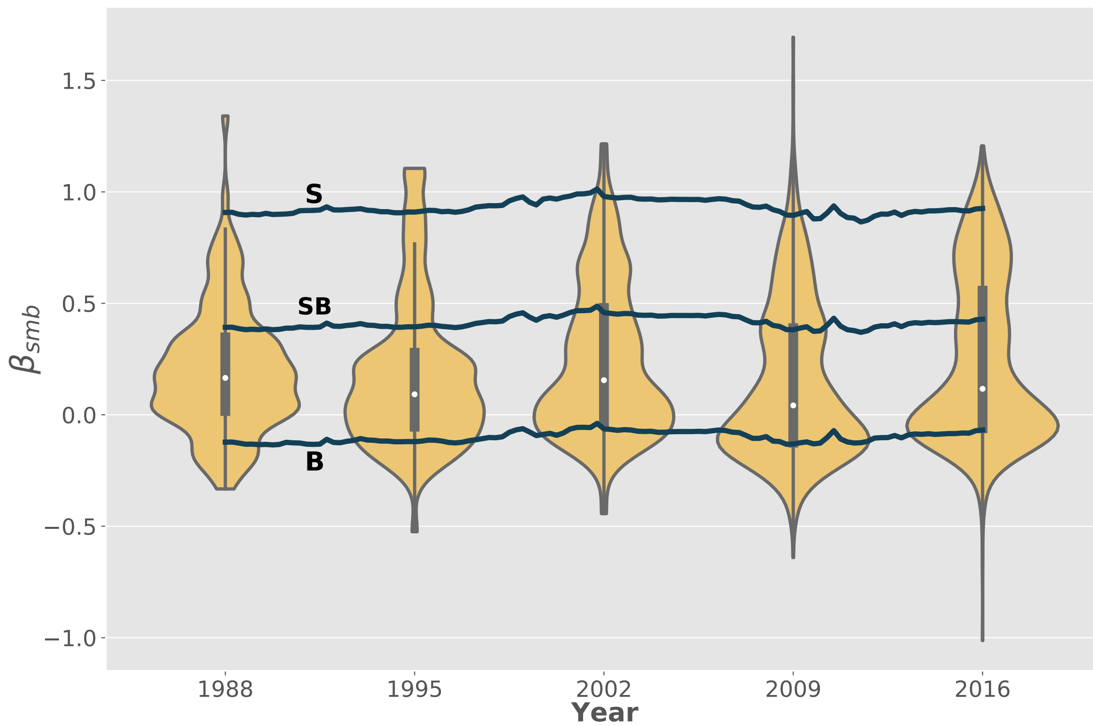
Panel B: HML-β



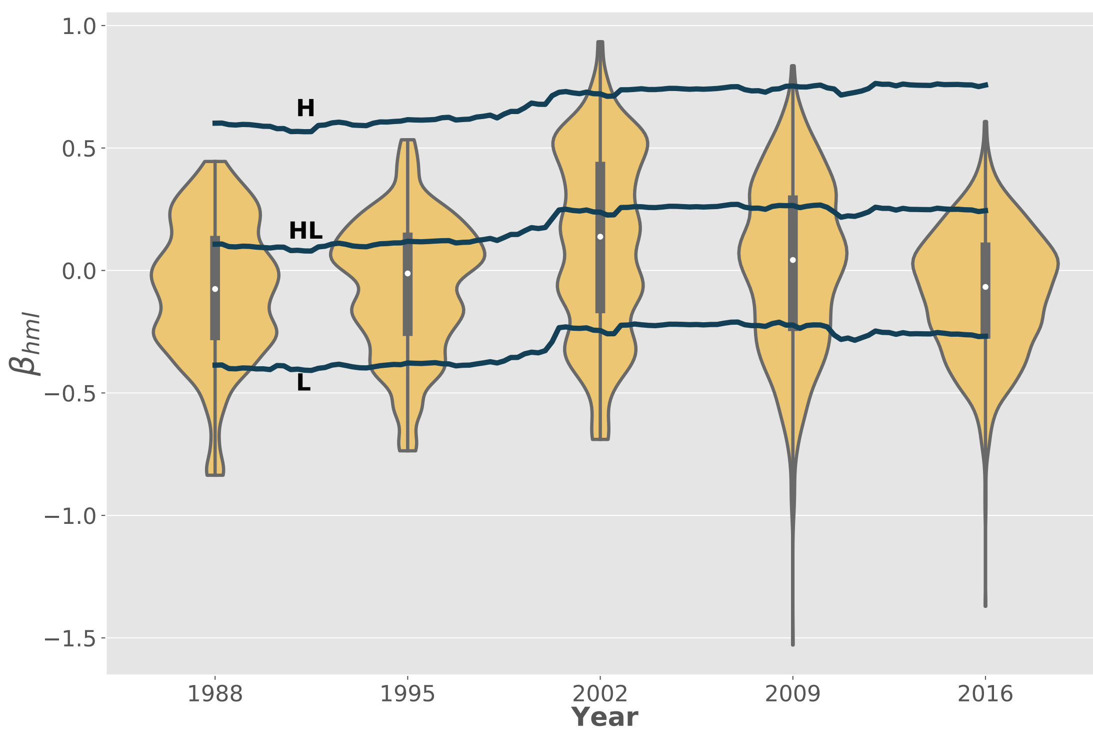
Note: This figure shows loadings in rolling window regressions of fund excess returns on the market excess return (MKT), SMB and HML. The windows size is 60 quarters.

Figure 9: HML and SMB Loadings in Rolling 4-Factor Regressions

Panel A: SMB-β

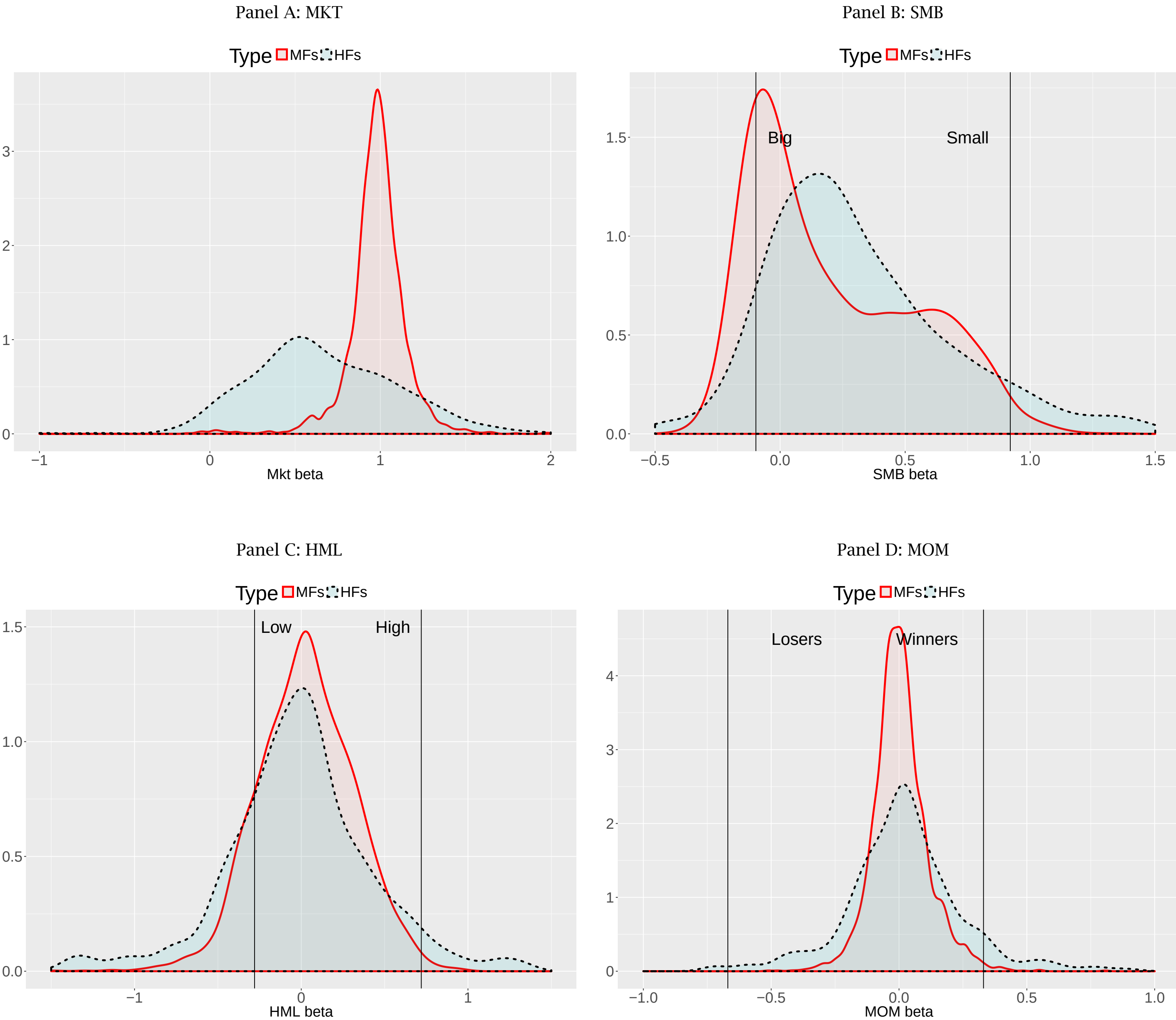


Panel B: HML-β



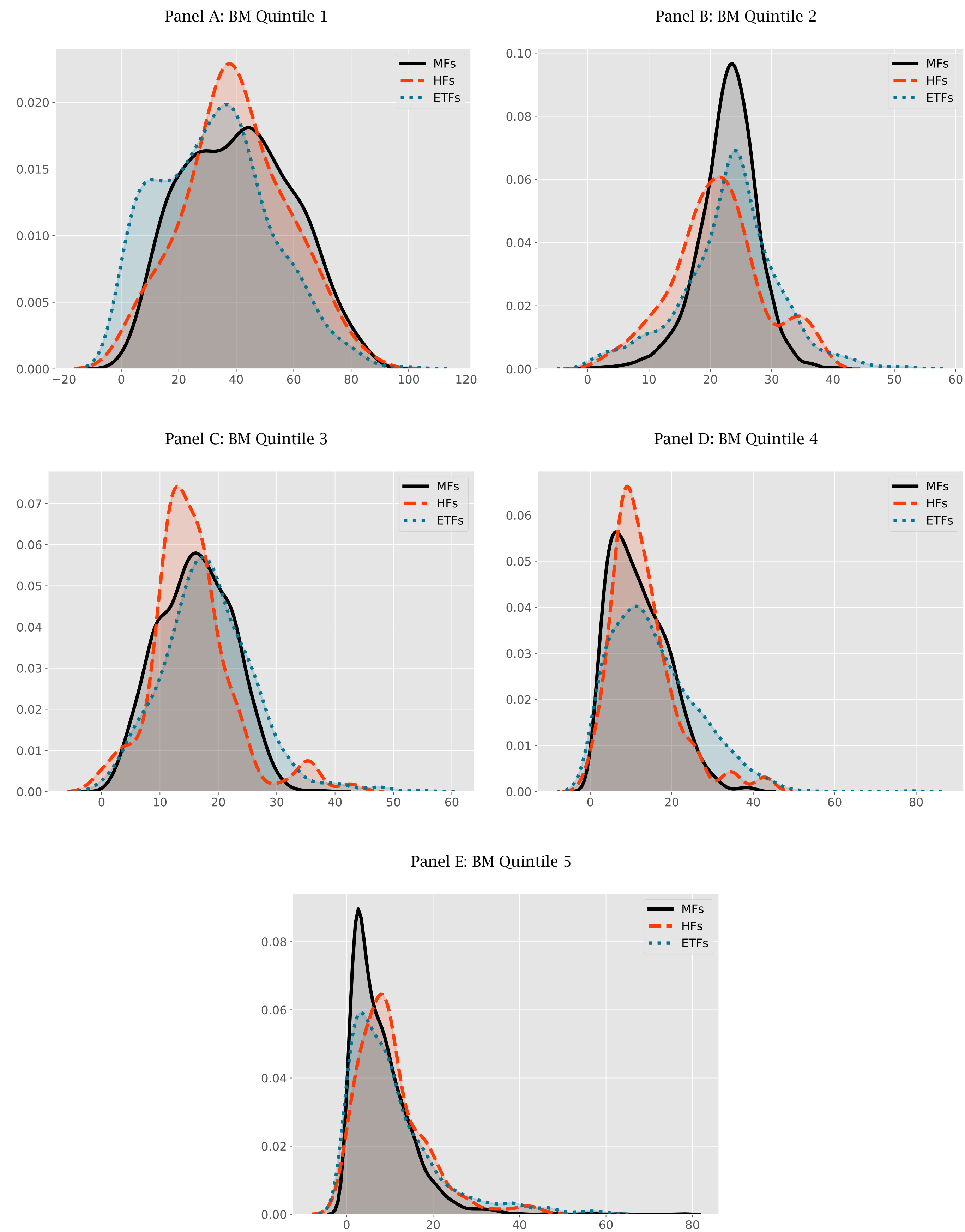
Note: This figure shows box plots of HML and SMB loadings in rolling window regressions of fund excess returns on the market excess return (MKT), SMB and HML. The windows size is 60 quarters. The years on the x-axis indicate the end-year of a window. The box plots show deciles as well as the median for all mutual funds that are included in a window. The lines indicate the rolling β estimates for "H","L", "S" and "B"

Figure 10: Histograms - Loadings of Mutuals Funds and Hedge Funds



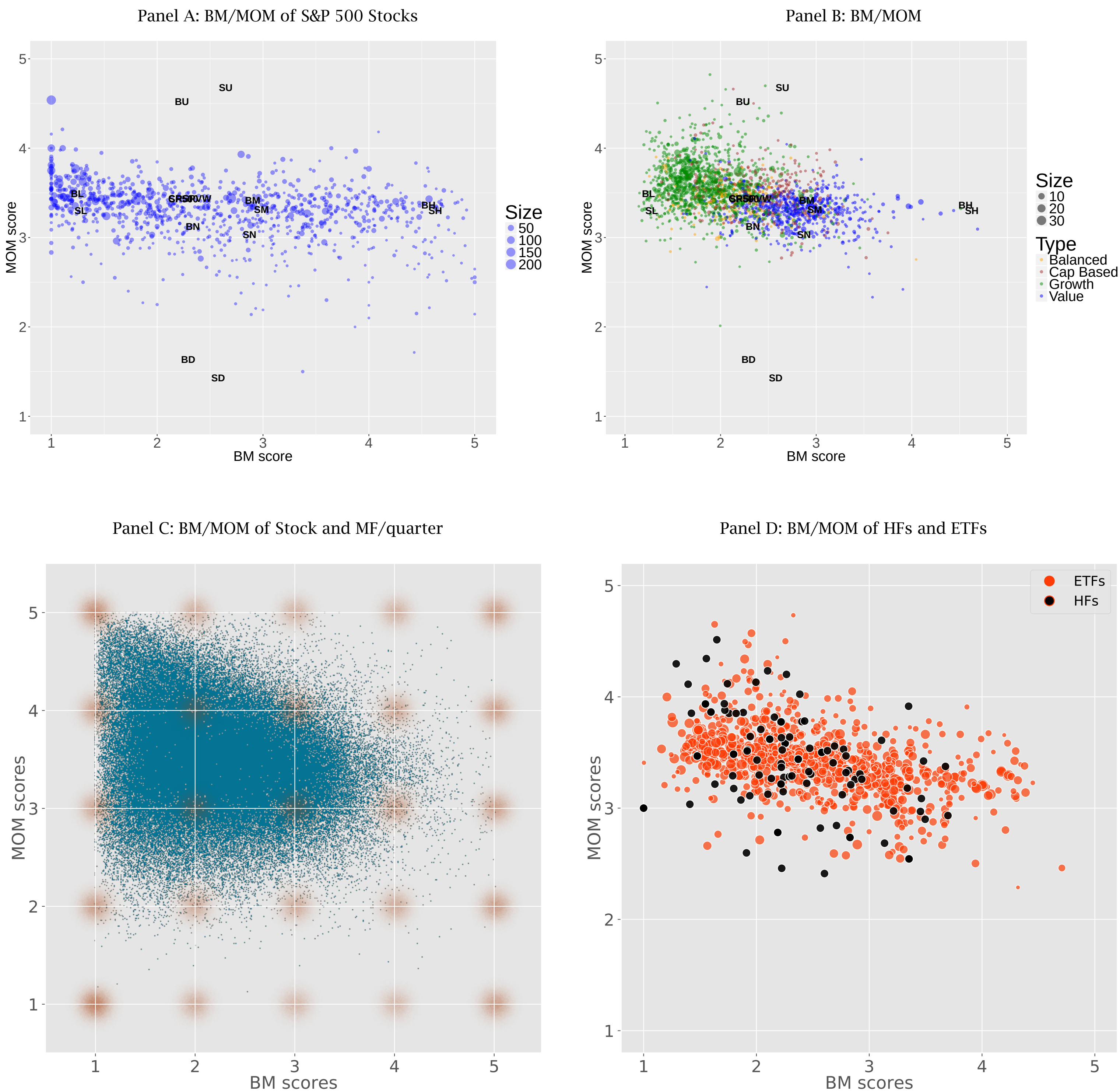
Note: This plot shows the histograms of β's of mutual funds and hedge funds in 3-factor regressions of fund excess returns on the market excess returns, SMB, HML and MOM. Hedge funds returns are from Hedge Fund Research (HFR). The vertical lines indicate β's of the components of SMB, HML and MOM The sample is from 1980Q1 to 2016Q2.

Figure 11: BM-Quintile Portfolio Shares of Mutual Funds, Hedge Funds and ETFs



Note: The figure shows the distributions of portfolio shares in BM quintiles 1 to 5 for mutual funds, hedge funds and ETFs.

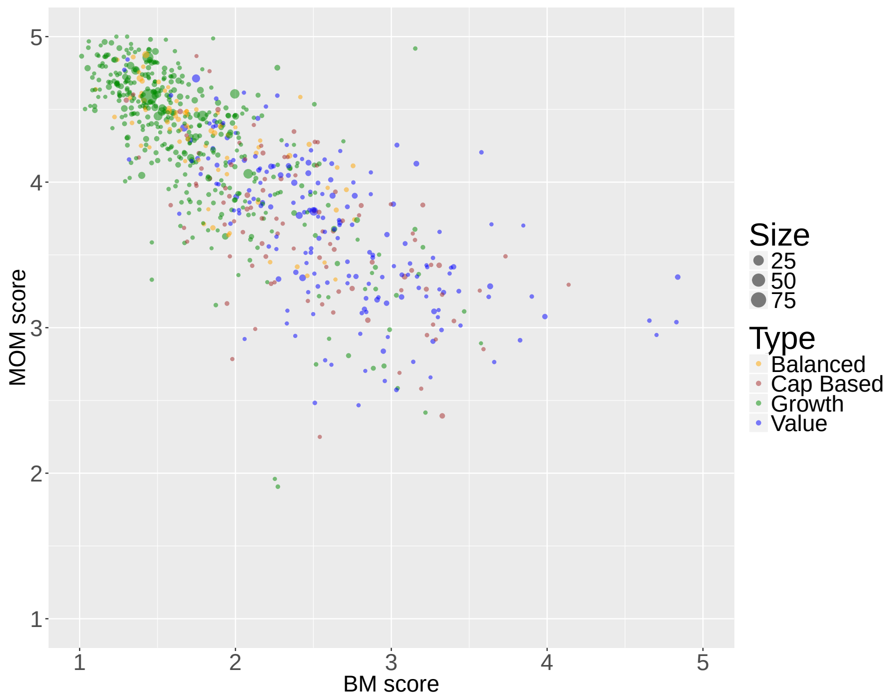
Figure 12: Joint Characteristics Distributions



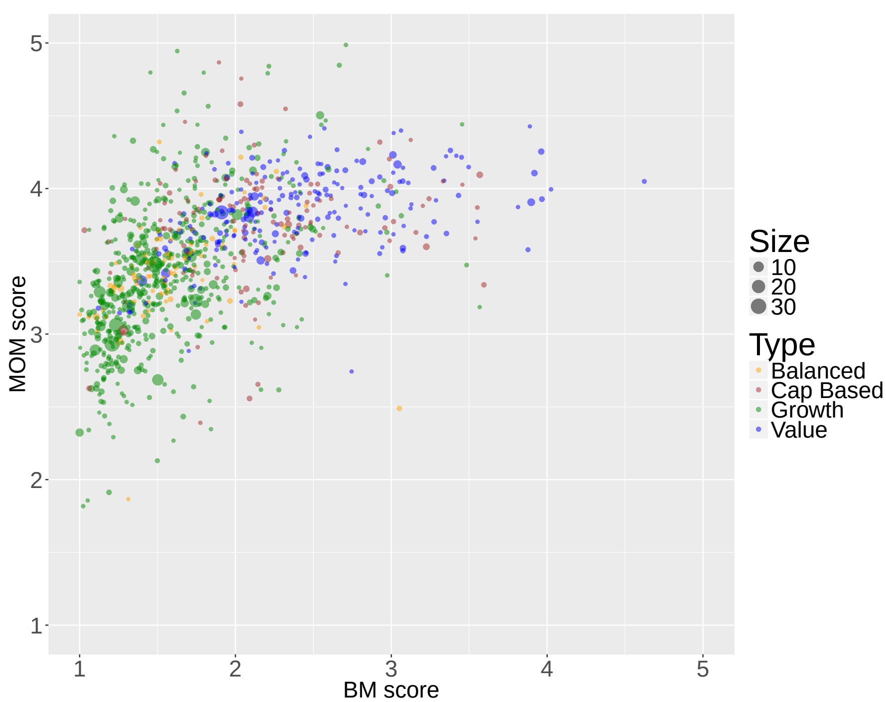
Note: This figure shows scatter plots of characteristics. Panels A and B show the BM/MOM and MS/MOM distributions of mutual funds, respectively. Panels C and D show the BM/MOM distributions of ETFs and hedge funds (Panel C) and stocks (Panel D). The sample is from 1980Q1 to 2016Q2.

Figure 13: Joint Characteristics Distributions: 1999Q1 and 2001Q2

Panel A: 1999Q1



Panel B: 2001Q2



Note: This figure shows scatterplots of the BM/MOM distribution of mutual funds in 1999Q1 and 2001Q2.

Table 1: Descriptive Statistics of Mutual Funds and Hedge Funds

	Mutual Funds				ETFs	HFs
	All	Value	Growth	Other		
Number of funds	2,638	574	1,130	934	955	114
AUM 12/2014 ($ bil.)	2,143	416	927	799	1,124	53
Median size ($ mil.)	149	145	150	150	167	NA
Median age (years)	11.58	9.88	11.83	12.56	5.42	NA
Median no. of stocks	54	56	51	56	99	64
Median Return over S&P 500 (% p.a.)	-0.70	-0.41	-0.74	-0.81	0.76	NA
Median 4-Factor α (% p.a)	-0.35	-0.04	-0.45	-0.41	-0.36	NA

Note: Descriptive statistics of mutual funds, ETFs and hedge funds.

Table 2: Characteristics of Passive Benchmark Portfolios

	CRSP-VW	BM				MOM			
		SL	BL	SH	BH	SD	BD	SU	BU
ME score	4.50	2.07	4.80	1.88	4.66	1.86	4.60	2.02	4.73
BM score	2.31	1.28	1.25	4.63	4.56	2.58	2.29	2.65	2.23
MS score	2.74	1.53	2.00	3.61	4.08	2.33	2.75	2.29	2.53
MOM score	3.44	3.30	3.49	3.30	3.36	1.43	1.64	4.68	4.52
Adjusted ME	1.00	0.02	1.29	0.01	0.65	0.01	0.69	0.02	1.04
Adjusted BM	1.00	0.66	0.62	3.31	2.98	1.46	1.12	1.54	1.04
Adjusted MS	0.00	−28.31	−14.95	18.48	26.23	−9.31	−0.69	−9.83	−5.44
Adjusted MOM	0.00	0.08	0.01	0.03	−0.04	−0.48	−0.41	0.53	0.30

Note: This table shows average characteristic scores and adjusted characteristics of the CRSP-VW index and passive Fame-French portfolios. “SL” is the small/low-BM portfolio, “BL” is the big/low-BM portfolio, etc.

Table 3: Characteristics of Mutual Funds and Hedge Funds

	Stocks					All Funds				
	mean	10th	25th	75th	90th	10th	25th	75th	90th	
ME score	4.01	3.47	4.80	5.00	0.31	4.02	2.42	3.38	4.81	4.91
BM score	2.62	1.69	3.46	4.17	0.69	2.23	1.55	1.78	2.63	2.99
MS score	2.82	1.89	3.71	4.36	0.82	2.44	1.51	1.82	2.98	3.42
MOM score	3.28	3.13	3.47	3.62	1.12	3.48	3.19	3.31	3.63	3.83

	Value Funds					Growth Funds				
	mean	10th	25th	75th	90th	mean	10th	25th	75th	90th
ME score	3.99	3.06	4.83	4.91	0.18	4.15	2.72	3.76	4.82	4.91
BM score	2.80	2.52	3.06	3.32	0.29	1.89	1.43	1.59	2.11	2.42
MS score	3.20	2.89	3.54	3.76	0.29	2.02	1.38	1.59	2.42	2.87
MOM score	3.30	3.21	3.41	3.50	0.38	3.58	3.26	3.41	3.74	3.93

	Hedge Funds					All 13F Institutions				
	mean	10th	25th	75th	90th	mean	10th	25th	75th	90th
ME score	3.64	3.15	4.35	4.65	0.35	4.11	2.69	3.73	4.78	4.90
BM score	2.29	1.91	2.62	3.19	0.34	2.25	1.57	1.85	2.55	3.06
MS score	2.19	1.82	2.52	2.78	0.35	2.42	1.54	2.01	2.82	3.24
MOM score	3.42	3.18	3.64	3.94	0.48	3.43	2.98	3.25	3.64	3.89

Note: The table reports the percentiles of the distributions of average characteristic scores for our sample of individual stocks, mutual funds, hedge funds and all 13F institutions.

Table 4: Characteristics of highest/lowest BM Mutual Funds

Fund	BM	MS	MOM	ME	AUM ($ mil.)
		10 Highest BM Funds			
High BM portfolio "H"	4.59	3.90	3.30	3.25	NA
Aegis Value Fund	4.69	3.56	3.09	1.36	276
Mellon Capital S&P SMid 60	4.51	3.89	3.33	2.69	400
Franklin MicroCap Value Fund	4.44	3.45	3.30	1.11	285
Franklin Balance Sheet Investment Fund	4.30	3.77	3.27	2.89	1887
First Trust Dow Target Dividend	4.12	4.23	3.20	3.73	20
DFA US Small Cap Value Portfolio	4.10	3.23	3.40	1.88	5925
Ancora Special Opportunity Fund	4.05	3.05	2.75	1.94	7
DFA US Targeted Value Portfolio	3.99	3.74	3.39	4.74	306
SA US Value Fund	3.99	3.33	3.34	2.51	1849
DFA US Large Cap Value Portfolio	3.96	3.77	3.35	4.68	6307
		10 Lowest BM Funds			
Low BM portfolio "L"	1.27	1.79	3.30	3.44	NA
AmSouth Capital Growth Fund	1.14	1.44	3.35	4.93	19
Excelsior Optimum Growth Fund	1.15	1.31	3.50	4.96	16
Armada Tax Managed Equity Fund	1.18	1.78	3.19	5.00	190
Jensen Quality Growth Fund	1.18	2.10	3.31	4.78	1374
Pioneer Papp Strategic Growth Fund	1.20	1.49	3.40	4.73	129
IAI Emerging Growth Fund	1.20	1.02	4.04	3.14	260
Bender Growth Fund	1.20	1.04	3.38	4.24	15
JPMorgan Equity Growth Fund	1.20	1.50	3.62	4.93	120
American Performance Growth Equity Fund	1.21	1.74	3.49	4.94	94
JNL/S&P Competitive Advantage Fund	1.21	2.34	3.32	4.70	1161

Note: THis table reports characteristics scores of the the 10 mutual funds with the highest BM scores as well as the scores of the 10 funds with the lowest BM scores.

Table 5: Probit Regressions

	All	Growth	Value
ME score	0.263***	0.382***	0.250***
	(0.014)	(0.020)	(0.016)
MOM score	0.084***	0.116***	0.032***
	(0.011)	(0.016)	(0.010)
BM score	-0.028**	-0.066***	0.022
	(0.011)	(0.014)	(0.016)
MS score	-0.024**	-0.135***	0.096***
	(0.011)	(0.015)	(0.012)
Observations	1,095,648	478,668	211,536
No. stocks	1356	1356	1356
No. funds	808	353	156
Pseudo R2	0.0616	0.130	0.0489

Note: This table shows result for the Probit model

$$P(y_{i,j,t}) = \Phi(\mathbf{X}'_{i,t}\,\boldsymbol{\beta}),$$

where $y_{i,t}$ is an indicator variable that is 1 if stock i is held by mutual fund j in quarter t and zero otherwise. $\mathbf{X}_{i,t}$ is a vector of ME, MOM, BM and MS characteristics of stock i in period t.

Table 6: 4-Factor Regressions of Passive Benchmark Portfolios

	S	B	H	L	U	D
α	0.01	0.01	0.01	0.01	0.01	0.01
MKT	1.01	1.01	1.04	1.04	1.05	1.05
SMB	**0.90**	**-0.10**	0.41	0.41	0.51	0.51
HML	0.26	0.26	**0.72**	**-0.28**	0.05	0.05
UMD	0.00	0.00	-0.01	-0.01	**0.34**	**-0.66**

Note: The tables reports coefficients of the regression

$$X_t = \alpha_X + \beta_{X,MKT}\,\mathrm{MKT}_t + \beta_{X,SMB}\,\mathrm{SMB}_t + \beta_{X,HML}\,\mathrm{HML}_t + \beta_{X,MOM}\,\mathrm{MOM}_t + e_{X,t},$$

where $X \in \{S, B, H, L, U, D\}$. The sample is from 1980Q1 to 2016Q2.

Table 7: Loadings of 25 ME-BM sorted Portfolios

	BM1	BM2	BM3	BM4	BM5
			SMB Betas		
ME1	1.37	1.30	1.13	1.13	1.15
ME2	0.90	0.91	0.74	0.72	0.86
ME3	0.65	0.62	0.51	0.45	0.57
ME4	0.47	0.33	0.31	0.21	0.27
ME5	-0.29	-0.15	-0.23	-0.23	-0.23
			HML Betas		
ME1	-0.41	0.02	0.26	0.49	0.70
ME2	-0.45	0.06	0.41	0.61	0.82
ME3	-0.45	0.16	0.42	0.60	0.79
ME4	-0.42	0.21	0.42	0.50	0.72
ME5	-0.33	0.12	0.31	0.64	0.62

Note: The tables reports SMB and HML coefficients of the regression

$$R_{i,t} = \alpha_{\mathrm{X}} + \beta_{\mathrm{X,MKT}}\,\mathrm{MKT}_t + \beta_{\mathrm{X,SMB}}\,\mathrm{SMB}_t + \beta_{\mathrm{X,HML}}\,\mathrm{HML}_t + \beta_{\mathrm{X,MOM}}\,\mathrm{MOM}_t + e_{\mathrm{X},t},$$

for 25 size/BM double-sorted portfolios. The sample is from 1980Q1 to 2016Q2..

Table 8: Portfolio Composition of Mutual Funds by Quintiles

	BM1	BM2	BM3	BM4	BM5
Panel A: Funds					
CRSP-VW	39.01%	21.86%	16.93%	13.49%	8.70%
All MFs	40.96%	22.88%	16.13%	12.05%	7.97%
Growth MFs	53.10%	22.11%	12.39%	7.71%	4.70%
Value MFs	22.11%	23.02%	21.70%	19.20%	13.97%
HFs	39.98%	21.23%	15.53%	12.89%	10.37%
ETFs	32.31%	23.23%	18.18%	15.74%	10.55%
Panel B: 5 Largest Value Funds					
T Rowe Price Equity Income Fund	29.29%	23.56%	19.28%	14.59%	13.28%
Fidelity Equity-Income Fund	19.89%	22.66%	20.49%	22.36%	14.60%
T Rowe Price Value Fund	24.97%	24.43%	20.29%	14.34%	15.96%
Fidelity Value Fund	18.10%	25.93%	23.06%	19.61%	13.29%
DFA US Large Cap Value	0.84%	4.26%	25.42%	37.98%	31.50%
Panel C: 5 Largest Growth Funds					
Fidelity Contrafund	45.30%	19.31%	16.35%	12.16%	6.88%
Growth Fund of America	50.71%	23.49%	12.41%	8.38%	5.01%
Fidelity Magellan Fund	42.39%	22.87%	15.29%	11.08%	8.37%
Fidelity Growth Company Fund	64.34%	18.09%	9.26%	5.52%	2.79%
Fidelity Blue Chip Growth Fund	63.28%	20.82%	8.17%	4.74%	2.98%

Note: This table shows the average portfolio shares in the five BM quintiles.

Table 9: Returns of Stocks and Mutual Funds

Quintile	ME	BM	MS	MULT	GR	MOM
			Panel A: Stocks			
1	4.06	2.38	3.25	3.64	3.71	2.89
2	3.54	3.64	3.96	3.98	4.20	3.56
3	3.63	4.00	4.04	3.52	4.30	3.94
4	3.64	4.25	4.35	3.34	4.04	4.22
5	3.17	5.20	4.32	4.61	3.27	4.55
$5-1$	-0.88	2.82	1.07	0.97	-0.43	1.66
			Panel B: Mutual Funds			
$[1,2]$	2.37	2.17	2.23	2.20	2.37	1.88
$(2,3]$	2.75	2.38	2.39	2.41	2.21	2.09
$(3,4]$	2.84	2.48	2.32	2.30	2.42	2.63
$(4,5]$	2.11	2.95	2.17	2.24	2.24	1.12
$(4,5]-(1,2]$	-0.25	0.78	-0.05	0.04	-0.13	-0.76

Note: The table reports the mean returns by quintile (stocks) and quintile ranges (mutual funds).

Table 10: Fama-MacBeth Regressions

ME	MOM	BM	MS
Panel A: Stocks			
-0.26	0.39	0.54	
[-1.65]	[2.44]	[5.01]	
-0.37	0.40		0.27
[-2.36]	[2.58]		[1.98]
Panel B: Mutual Funds			
-0.45	0.39	-0.02	
[-3.11]	[1.39]	[-0.14]	
-0.43	0.39		-0.05
[-3.20]	[1.53]		[-0.28]

Note: Fama-MacBeth regressions of returns of individual stocks and mutual funds on characteristic scores. The regression coefficients are in percent per month. t-statistics are in brackets.

Appendix B. Tables

Table B.1: Distribution of Mutual Fund and Stock Characteristics

Characteristic	Mutual Funds				Stocks			
	[1-2]	[2-3]	[3-4]	[4-5]	[1-2]	[2-3]	[3-4]	[4-5]
ME	2%	19%	14%	65%	3%	11%	30%	57%
BM	40%	51%	9%	0%	34%	28%	24%	14%
MS	33%	43%	24%	1%	28%	27%	27%	18%
MOM	0%	3%	93%	4%	0%	15%	82%	3%
OP	0%	27%	72%	1%	13%	23%	31%	19%
INV	0%	13%	84%	4%	5%	40%	43%	11%
MULT	33%	47%	20%	0%	33%	28%	23%	16%
GR	0%	29%	50%	21%	12%	38%	29%	21%
EP	15%	61%	24%	0%	27%	34%	27%	13%
CFP	20%	58%	22%	0%	25%	35%	25%	15%
DP	18%	42%	36%	4%	28%	21%	30%	21%
SP	37%	58%	5%	0%	34%	27%	23%	16%
GRB	0%	17%	83%	1%	6%	42%	44%	8%
GRE	0%	14%	85%	0%	2%	43%	51%	4%
GRLTE	1%	37%	45%	17%	16%	35%	28%	22%
GRS	0%	19%	79%	2%	5%	43%	42%	10%
GRCF	0%	9%	91%	0%	3%	40%	53%	4%

Note: This table reports the distributions of mutual funds and stocks for individual characteristics. The percentages correspond to the shares of funds and stocks that have characteristic scores between 1 and 2, 2 and 3, 3 and 4, and 4 and 5, respectively. ME is size (market capitalization), BM is the book-to-market ration, MS is the Morningstar index, OP is operating profitability, INV is investment growth, MULT and GR is the multiples and growth components of the Morningstar index, EP, CFP, DP and SP are the earnings, cash flow, dividend and sale to price rations, respectively, and GRB, GRE, GRLTE, GRS, and GRCF are the growth rates of the book value, earnings, long-term earnings, sales, and cash flows, respectively.

Table B.2: Distribution of Mutual Fund and Stock Characteristics:
Size-weighted

Characteristic	Mutual Funds				Stocks			
	[1-2]	[2-3]	[3-4]	[4-5]	[1-2]	[2-3]	[3-4]	[4-5]
ME	2%	10%	9%	79%	0%	1%	9%	90%
BM	35%	57%	7%	1%	52%	23%	18%	7%
MS	30%	42%	28%	0%	38%	26%	26%	10%
MOM	0%	1%	97%	2%	0%	6%	90%	4%
OP	0%	15%	84%	1%	9%	15%	34%	27%
INV	0%	19%	78%	2%	2%	34%	46%	19%
MULT	30%	49%	21%	0%	49%	23%	17%	11%
GR	1%	37%	47%	15%	12%	33%	31%	24%
EP	11%	67%	23%	0%	42%	34%	14%	10%
CFP	15%	58%	26%	0%	37%	31%	20%	12%
DP	11%	42%	39%	8%	23%	21%	30%	26%
SP	34%	61%	5%	0%	53%	26%	14%	7%
GRB	0%	25%	75%	0%	3%	42%	46%	9%
GRE	2%	44%	42%	12%	15%	33%	28%	24%
GRLTE	0%	21%	79%	0%	1%	38%	56%	5%
GRS	0%	27%	72%	1%	2%	42%	44%	12%
GRCF	0%	17%	83%	0%	1%	34%	63%	2%

Note: See Table B.1 but distributions are AUM-weighted for mutual funds and market cap-weighted for stocks.