The Effect of Portfolio Weighting on Investment Performance Evaluation: The Case of Actively Managed Mutual Funds

Stanley B. Block and Dan W. French*

Abstract

Among the factors influencing investment performance measurement is the weight dedicated to each security. This paper develops metrics for measuring the extent of equal weighting and value weighting of a portfolio. A sample of 506 actively managed mutual funds shows that funds tend to be equally weighted to a greater degree than they are value weighted, implying that investment performance based solely on a single value-weighted benchmark may not adequately identify excess performance. We propose a two-factor model utilizing both a value-weighted and an equally weighted index and show that the model provides a better fit than the single-index model. (*JEL G1*)

Introduction

Over the decades there has been much debate about the ability of mutual funds to outperform the market when performance is measured with Jensen's (1969) alpha. Early research by Friend, Brown, Herman, and Vickers (1962), Sharpe (1966), and Jensen (1968) indicated that mutual fund managers not only have difficulty beating the market but frequently perform at a level inferior to the market. Although some later studies such as Alexander and Stover (1980), Kon (1983), Chang and Lewellen (1984), and Ippolito (1993) have found results more favorable to funds, the average fund still appears to show no above-normal performance. For example, Volkman (1999) found that while the average fund had no ability to select undervalued stocks and a negative ability to time the market, a few individual funds did display a persistent ability to select undervalued investments. Malkiel (1995) found that survivorship bias is more important than previously realized and concluded that funds have in aggregate underperformed benchmark portfolios even before considering fund expenses. Carhart (1997) controlled for common factors influencing

*Stanley B. Block, M. J. Neeley School of Business, Texas Christian University, Fort Worth, TX 76129, S.Block@tcu.edu; Dan W. French, Department of Finance, College of Business Administration and Economics, New Mexico State University, Las Cruces, NM 88003, finance@danfrench.com.

returns and found that they generally explained persistence in performance. Carhart's only unexplained persistence existed in significant underperformance of the worst funds.

A strong debate continues over the methodology of measuring and comparing returns. As early as 1970, Friend, Blume, and Crockett warned about using a benchmark that effectively tricks the alpha calculation by over (under) weighting small-firm returns. During the same time period, Carlson (1977) further warned about drawing conclusions that were specific to the time period, type of fund, or choice of benchmark. Later research by Chang and Lewellen (1985), Admati, Bhattacharya, Pfleiderer, and Ross (1986), Lehman and Modest (1987), and Daniel, Grinblatt, Titman, and Werners (1997) stresses the importance of factors such as benchmark selection, survivability, portfolio composition, and non-CAPM return-generating factors when measuring fund performance.

There is another factor important to the performance evaluation issue, the weighting of individual securities within the portfolio. The weight that a portfolio manager assigns to a given security in a portfolio can make a contribution to return that is just as important as the security selection and investment timing decisions. Because stock indexes, such as the S&P 500 Index, that are commonly used for performance evaluation are often value weighted (market-cap weighted), their use as benchmarks for evaluating non-value-weighted portfolios may fail to adequately identify fund performance. Strongin, Petsch, and Sharenow (2000) show that an actively managed portfolio's performance is determined *not* by the success of its managers' security analysis but rather by high concentration of risk in a value-weighted benchmark.

To what extent do portfolio managers tend to equally weight or value-weight their portfolios, and how do their weighting choices affect investment performance evaluation? The intent of this paper is to address these issues. In the next section, we briefly summarize some important work in investment performance evaluation based on the capital asset pricing model. In the third section, we examine two popular mechanical schemes for portfolio weighting: equal weighting and value weighting. The fourth section presents the derivation of metrics to measure the extent to which a portfolio is tilted toward equal or value weighting and then, using a sample of actively managed mutual funds, applies these metrics to show how fund managers typically weight their portfolios. In the fifth section, we analyze weighting's effect on investment performance evaluation by computing various measures of investment performance for the mutual fund sample. The paper concludes with a summary.

Measuring Fund Performance

While a number of methods exist for risk-adjusting returns in order to evaluate the performance of a portfolio, probably the most widely used are based on Jensen's (1969) alpha. Jensen used the capital asset pricing model security market line (SML) framework for adjusting returns. The SML states that equilibrium expected returns are a function of a security or portfolio's systematic risk measured against the market portfolio as follows:

$$E(R) = Rf + \beta \cdot [E(Rm) - Rf] \quad (1)$$

where $E(R)$ is the expected return on a portfolio, Rf is the riskless return, $E(Rm)$ is the expected return on the market portfolio of assets, and β is the systematic risk of the portfolio. Jensen recast the relationship from expected returns to realized returns, subtracted Rf from both sides, and presented the following:

$$R_i - Rf_i = \alpha + \beta \cdot (Rm_i - Rf_i) + \varepsilon_i \quad (2)$$

where α, β, and ε_i are estimated using least-squares regression for n observed holding periods (i =

1 ... *n*). Of these, α represents the risk-adjusted performance of the portfolio, and β is an estimate of the risk of the portfolio. The ε_i is a random error term for holding period *i*. In a market in equilibrium, the SML implies a zero alpha (α) for all securities and portfolios, but when securities are mispriced, superior investment performance ($\alpha > 0$) or inferior performance ($\alpha < 0$) may occur. Jensen (1968) used this model to evaluate the performance of 115 mutual funds during the 1945-1964 time period and found the mean alpha to be -0.011 per year. Thirty-nine funds did exhibit a positive alpha, but only one fund provided an alpha that was positive and significant at the 0.05 level. These results led Jensen in this pioneer work to conclude that mutual funds do not provide their shareholders with superior investment performance.

One shortcoming of Jensen's approach is the use of only one benchmark index, the market portfolio, as the overall return-generating factor in the market. Other researchers have successfully developed and tested models with additional or alternative common factors. Fama and French (1992) found that two empirical variables (size and book-to-market equity) do a very good job of explaining the cross-section of observed returns for stocks. Accordingly, in a follow-up study, they (Fama and French 1993) proceeded to incorporate these elements in a three-factor model of performance evaluation summarized as follows:

$$R_i - Rf_i = \alpha + \beta \cdot (Ra_i - Rf_i) + \varsigma \cdot S_i + \eta \cdot H_i + \gamma_i \tag{3}$$

where Ra_i is the return on a value-weighted aggregate market proxy, S is the return on a factor-mimicking value-weighted portfolio representing size, and H is the return on a factor-mimicking value-weighted portfolio for book to market equity. For mutual funds, Carhart (1997) identified an additional item, the momentum in common stock returns, and his model is

$$R_i - Rf_i = \alpha + \beta (Ra_i - Rf_i) + H \cdot S_i + 0 \cdot H_i + B \cdot P_i + \gamma_i \tag{4}$$

where P is a factor-mimicking value-weighted portfolio for the one-year momentum in common stock returns. When measuring the performance of a sample of mutual funds, Carhart found that the three-factor model (equation 3) yielded average pricing errors less than the SML model (equation 2), and the four-factor model (equation 4) improved on the three-factor model. Carhart concluded that the four-factor model explains the apparent performance persistence for some mutual funds identified in prior studies.

The purpose of this paper is to study the impact of portfolio weighting on performance evaluation. Accordingly, our model is a two-factor model that separates the portion of portfolio return attributable to non-value weighting and allows us to measure its importance. An advantage of our approach is that it requires only one principal variable, the market portfolio (proxied by an index), but two variants of that variable (a value-weighted version and an equally weighted version). Our approach should not be a substitute for other multi-factor models; it should augment them. In a general evaluation of the performance of portfolios, it would likely be desirable to extend our two-factor model to incorporate factors from Fama and French, Carhart, other researchers, or as yet undiscovered factors important in the return-generating process.

Large Firms versus Small Firms, Value Weighting versus Equal Weighting

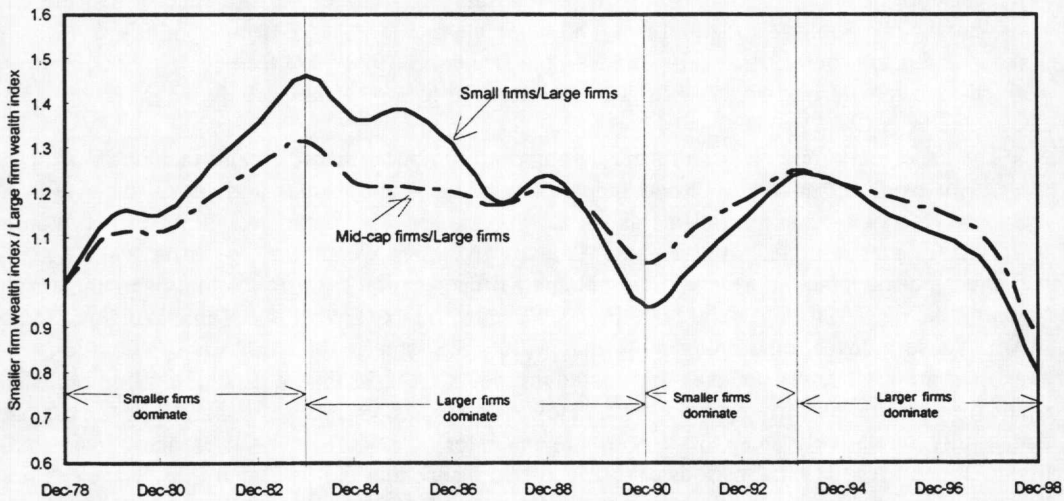
The Standard & Poor's Composite Index (S&P 500) is a widely used measure of the general stock market, and investors often use it as a benchmark when evaluating investment performance. However, the S&P 500 contains a sample of only 500 of the stocks in the U.S. equity market. While these 500 stocks are of the largest corporations in the country and represent a substantial majority of the total market, the index does not consider the performance of thousands of other smaller companies in the economy. To the extent that small-firm returns match those of larger companies, the S&P 500 Index would be a good benchmark for measuring portfolio performance. Elton, Gruber, Das, and Hlavka (1993) examine the impact of the existence of non-S&P 500 Index stocks in fund portfolios on fund performance. They document that small-firm indexes underperformed the S&P 500 over the 1945-1964 period by exhibiting negative alphas and outperformed the S&P 500 from 1965 to 1984 by showing positive alphas. They then develop a three-factor model to compute alphas as a metric for fund performance. The model uses the following variables as benchmarks: the return on the S&P 500 Index, the return on a small-stock index with the effect of the S&P 500 return removed, and the return on a passive bond portfolio with the effects of both the S&P 500 and small stocks removed. When this three-factor model is used to evaluate investment performance of funds during the 1965-1984 period, in which the small-firm effect (Banz 1981; Reinganum 1981) was evident, most of the positive alphas that funds apparently exhibited changed to negative.

One important conclusion from the Elton, Gruber, Das, and Hlavka study is that small-firm returns are important to consider when evaluating performance of an equity mutual fund. While the small-firm effect dominated in the 1970s and early '80s, the bias has moved in the other direction in more recent years. Figure 1 shows the relative performance of small firms to large firms from 1979 to 1998. The graphed line is an index computed as follows:

$$\textit{Firm size performance index} = \frac{\textit{small firm wealth index}}{\textit{large firm wealth index}} \tag{5}$$

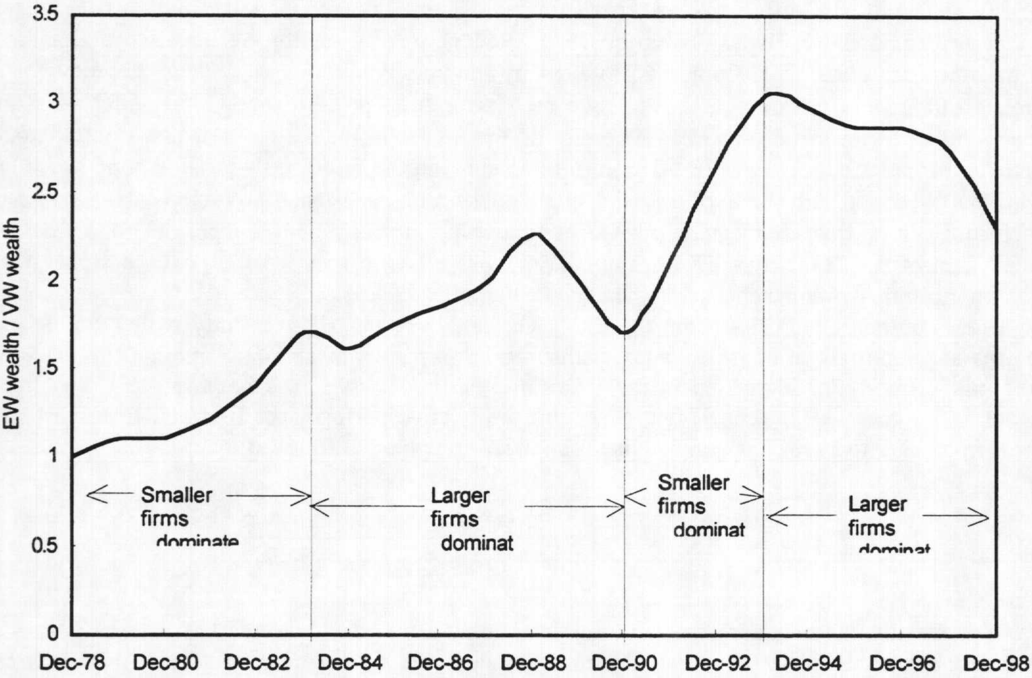
The wealth indexes represent the total accumulated wealth of the market index, dividends included, December 31, 1978 = 100. The market index used for large firms is the Wilshire Large Cap 750 Index. The market index for smaller firms is the Wilshire Small Cap 1750 Index, and the

FIGURE 1. ACCUMULATED WEALTH IN SMALL-FIRM INDEXES DIVIDED BY ACCUMULATED WEALTH OF THE LARGE-FIRM INDEX, 1979 TO 1998



Notes: The small-firm index is the Wilshire Small Cap 750 Index, the mid-cap index is the Wilshire Mid Cap 500 Index, and the large-firm index is the Wilshire Large Cap 1750 Index.

FIGURE 2. ACCUMULATED WEALTH IN THE WILSHIRE 5000 EQUAL-WEIGHTED INDEX DIVIDED BY ACCUMULATED WEALTH IN THE WILSHIRE 5000 VALUE-WEIGHTED INDEX, 1979 TO 1998



relationship between the two is shown as the solid line. The broken line shows the relationship between the Wilshire Mid Cap 500 Index and the Large Cap Index. The discussion now relates principally to the solid line. The slope of the line indicates relative performance. When the line rises, small firms outperform large firms, and when the line falls, large firms dominate. As Figure 1 shows, there are four distinct sub-periods in the December 1978-1998 time period. Smaller firms performed better during the 12-78 to 12-83 and 12-90 to 12-93 sub-periods, while larger firms dominated from 12-83 to 12-90 and 12-93 to 12-98.

The benchmark index chosen for measuring portfolio performance should include firms of all sizes. However, the use of a broad index that includes both small and large firms fails to adequately serve as a single all-inclusive benchmark because of the weighting effect. Value-weighted (market capitalization-weighted) indexes give more weight to large firms while equally weighted indexes place more emphasis on small-firms. Figure 2 illustrates this phenomenon by graphing the ratio of the Wilshire 5000 Equal-Weighted Index (EW) to the Value-Weighted Index (VW). These indexes, containing more than 7,000 U.S. stocks for which daily quotations are available, are total return indexes that include dividends. As in Figure 1, a rising line indicates small firms are outperforming large firms. However, since both indexes contain large and small firms, only a relatively steep slope is a sure indicator of performance differences. In general, Figure 2 identifies the same periods of relative performance that Figure 1 identifies. The exception is the 12-83 to 12-90 sub-period, which contains some conflicting signals.

The small-firm versus large-firm issue is therefore intertwined with the weighting issue. Complicating the matter is the observation that mutual funds neither value-weight nor do they equally weight their portfolios. Discussions with portfolio managers indicate that they often tend to allocate a set percentage of their portfolio to each new purchase. A purchase of a large-cap stock is not likely to receive a proportionately greater dollar amount than the purchase of a medium or small-cap stock. (Exceptions, of course, are the index funds, which do value-weight in an attempt to track the index.) Perhaps the normal unit for purchase is $100,000 or $200,000 and that amount is applied uniformly throughout. While initial allocations may increase or decrease due to performance, there are normally limits on how large a percentage an asset may represent of a portfolio. Even a large-cap fund will likely contain some closer-to-equally weighted components and therefore should not be evaluated based solely on a large-firm or value-weighted index. Thus, it is possible that the S&P 500 Index has beaten 92 percent of the mutual funds in performance over the last decade and a half (as reported by Morningstar 1998), not because of information-gathering expenses or poor investment decisions, but partially because of style of management, which normally calls for equal allocation of capital among new purchases.

Portfolio Weighting

If mutual fund managers do tend to tilt their portfolios toward equal weighting, then the relevance of using a value-weighted index such as the S&P 500 as a performance benchmark might be suboptimal. Just how much mutual fund managers actually slant their portfolios toward equal or value weighting is a question to be answered empirically. This section of the paper proposes metrics for gauging the amount of value or equal weighting in a portfolio and applies them to a sample of actively managed mutual fund portfolios.

Measuring Portfolio Weighting

The observed weight w_i of an individual security S_i as a portion of a portfolio of size N is

$$w_i = S_i / \sum_{i=1}^{N} S_i \tag{6}$$

If a portfolio is perfectly value-weighted, each weight vw_i of a security with total market value V_i is

$$vw_i = V_i / \sum_{i=1}^{N} V_i \tag{7}$$

For any portfolio, the total deviation dv of observed portfolio weights from the hypothetically perfect value weights is

$$dv = \sum_{i=1}^{N} \left| w_i - vw_i \right| \tag{8}$$

The maximum possible total deviation for a portfolio of given securities would occur when virtually all of the funds are invested in the security with the smallest market value and minuscule amounts in each of the other securities. At the limit, letting the weight of the minimum market value security V_{min} be 1 and the weights of all others be 0 in equation (8), the maximum possible total deviation dv_{max} is

$$dv_{\max} = \left[1 - \frac{V_{\min}}{\sum_{i=1}^{N} V_i} \right] + \frac{\left[\sum_{i=1}^{N} V_i \right] - V_{\min}}{\sum_{i=1}^{N} V_i} \tag{9}$$

which simplifies to

$$dv_{\max} = 1 + \frac{\left[\sum_{i=1}^{N} V_i\right] - 2 \cdot V_{\min}}{\sum_{i=1}^{N} V_i} \tag{10}$$

The measure dv_{max} represents the greatest possible total absolute deviation of the observed weights of securities in a portfolio from their values if the portfolio were perfectly value-weighted. The value of dv_{max} depends on both the number of securities in the portfolio and their market values. In the limit, dv_{max} approaches 2 as N increases and as V_{min} decreases.

Let the measure of value-weightedness of a portfolio be the total observed portfolio deviation from the value-weighted ideal (equation 7) as a portion of the maximum possible deviation, expressed as a difference from 1. The value-weighted measure M_{vw} is therefore

$$M_{vw} = 1 - \frac{dv}{dv_{\max}} \tag{11}$$

A portfolio that is perfectly value-weighted will have a value of 1 for M_{vw}. The less a portfolio is oriented toward value weighting, the lower will be the value of M_{vw}, which has a theoretical lower limit of 0.

Applying the same procedure to equally weighted portfolios yields the following:

$$de = \sum_{i=1}^{N} \left| w_i - 1/N \right| \tag{12}$$

$$de_{\max} = 1 + \frac{N-2}{N} \tag{13}$$

$$M_{ew} = 1 - \frac{de}{de_{\max}} \tag{14}$$

A value of 1 for M_{ew} indicates a portfolio that is perfectly equally weighted. M_{ew} and M_{vw} are not complementary; that is, the existence of equal weighting in a portfolio does not preclude value weighting. For example, a portfolio that contains an equal amount of securities, each with equal market value, would have a value for both M_{ew} and M_{vw} of 1. Unfortunately, it is not possible to compute one measure that indicates value weighting on one extreme and equal weighting on the other. Indeed, equal weighting and value weighting are only two among many possible weighting methods. For example, a portfolio manager might choose to use the Elton, Gruber, and Padberg (1978) technique for weighting portfolios based on estimated expected returns and correlations of the securities in the portfolio.

Observed Mutual Fund Weighting

This section presents computation of the portfolio weighting measures in equations (11) and (14) using the composition of a sample of mutual fund portfolios. The sample of mutual funds is from the Morningstar Principia Pro Plus database. We extracted all open-end investment companies that met the following criteria: the fund's portfolio was composed only of common stocks; the fund was not an index fund; monthly returns were available from 1989 to 1998; and the fund's year-end 1998 portfolio was available. This yielded a sample of 506 different funds. We then matched each stock in each portfolio with that stock's total market value as of December 31, 1998, from the database of the Center for Research in Security Prices. Finally, we computed the degree of value-weightedness (M_{vw}, equation 11) and the degree of equal-weightedness (M_{ew}, equation 14) for all 506 mutual funds.

Summary statistics describing the fund portfolios and summary measures of M_{vw} and M_{ew} appear in Table 1. The median fund's portfolio contains 68 stocks with a total value of $542 million. The mean equally weighted measure (M_{ew}) of 0.726 is significantly greater than the mean value-weighted measure (M_{vw}) of 0.568 at the 0.01 level. The median M_{ew} is also significantly greater than the median M_{vw}. These statistics provide ample evidence that mutual fund portfolios in general are considerably tilted toward equal weighting. Of the 506 funds, only 71 (14 percent) exhibit a value for M_{vw} greater than its M_{ew} value.

TABLE 1. SUMMARY STATISTICS AND PORTFOLIO WEIGHTING MEASURES FOR 506 MUTUAL FUND PORTFOLIOS

	Number of stocks in portfolio	Total value of portfolio	M_{vw}	M_{ew}	Test Statistic $M_{vw} = M_{ew}$
Median	68.0	$ 542,240,619	0.575	0.745	17.72**
Mean	87.4	2,105,322,710	0.568	0.726	22.57**
Standard deviation	70.9	4,731,108,213	0.118	0.110	1.16

Notes: Statistics computed using investment portfolios of 506 equity mutual funds on December 31, 1998. The test statistic for the median is the normal approximation Z for the medians test. The test statistic for the means is the paired-t. The test statistic for the standard deviation is the F statistic. **Significant at the 0.01 level.

Morningstar classifies mutual funds using two different criteria sets. The first set of criteria is based on the average size of companies held in the fund portfolio, and the categories are small-cap, mid-cap, and large-cap. Morningstar's second criteria set is based on the fund's investment style: value, blend, or growth. Table 2 summarizes these categories and gives a brief description of each.

To further examine the tendency of mutual funds to weight their portfolios, we computed the two weightedness measures for all of the Morningstar categories. Table 3 presents these results. Addressing the number of funds that falls into each category, it is not surprising that most funds (290, or 57 percent) fall into the large-cap class. The blend style is most popular overall, but within the small-cap and mid-cap categories, the growth style predominates. Focusing on the weightedness measures, the consistency of M_{ew} among all of the categories is obvious. Its range is only from 0.69 to 0.74 with most of the values being 0.72 or 0.73. Mutual fund managers

TABLE 2. MUTUAL FUND CATEGORIES

Category Name	Portfolio Concentrates On
Size categories	
Small-cap	smaller companies generally with a market value of about $1 billion or less
Mid-cap	firms of all sizes but tending toward those with market values between $1 billion and $8 billion
Large-cap	larger companies
Style categories	
Value	stocks that are underpriced in the current market
Blend	stocks with mixed characteristics from both the value and growth sectors
Growth	stocks expected to grow faster than the overall market

Notes: Definitions represent categories of mutual funds classified by size of companies in the fund portfolio and by fund investing style, paraphrased from Morningstar Principia Pro Plus.

TABLE 3. MEAN PORTFOLIO WEIGHTING MEASURES FOR 506 MUTUAL FUNDS BY FUND CATEGORY

Size Categories		Style Categories: Value	Blend	Growth	Total	Kruskal-Wallis test statistic
Small-cap	M_{vw}	0.53	0.57	0.60	0.57	1.14
	M_{ew}	0.73	0.69	0.73	0.72	1.65
	N	23	16	28	67	
Mid-cap	M_{vw}	0.49	0.47	0.56	0.52	15.88^{**}
	M_{ew}	0.71	0.74	0.73	0.73	2.65
	N	40	47	62	149	
Large-cap	M_{vw}	0.57	0.60	0.61	0.59	9.19^{**}
	M_{ew}	0.73	0.72	0.71	0.72	2.17
	N	102	120	68	290	
Total	M_{vw}	0.55	0.57	0.59	0.57	13.26^{**}
	M_{ew}	0.73	0.73	0.72	0.73	0.18
	N	165	183	158	506	
Kruskal-Wallis test statistic	M_{vw}	16.70^{*}	31.77^{**}	3.88	34.74^{**}	
	M_{ew}	2.65	3.38	2.34	1.81	

Notes: Statistics computed using investment portfolios of 506 equity mutual funds on December 31, 1998. **Significant at the 0.01 level.

appear to be remarkably consistent in their proclivity to manage their portfolios with a bent toward equal weighting. With respect to value weighting, there is somewhat more variation among the fund categories, ranging from 0.47 to 0.61. To test the weightedness measures for differences within categories, we computed the chi-square approximation statistic of the Kruskal-Wallis test. These test statistics, shown in Table 3, indicate that there is no difference in the equal-weightedness (M_{ew}) among any of the fund categories, but there is a significant difference in the value-weightedness (M_{vw}) of funds in the mid-cap and large-cap size categories and in the value and blend style categories. Mutual fund portfolio managers are therefore much more consistent in constructing and maintaining equal weights in their portfolios than value weights.

We should note that these observations result from year-end fund portfolios, which might be subject to manipulation or "window dressing" by fund managers trying to tidy up their end-of-year financial statements. For example, Brown, Harlow, and Starks (1996) show that depending upon the fund managers' compensation package and fund performance during the first half of the year, managers tend to change fund volatility during the latter part of the year.

Portfolio Performance Evaluation Accounting for Both Value and Equal Weighting

The previous section has shown that mutual funds managers tend to construct portfolios with a significant amount of equal weighting. The impact of this tendency on performance evaluation is likely to be that the choice of a value- or equal-weighted index is an important determinant of estimated performance measures, especially considering Strongin, Petsch, and Sharenow's (2000) observation that undue risk-concentration in large-cap benchmarks has a strong influence on measured performance. They suggest that "Both portfolio managers and investors would be better off if the benchmarks were redesigned to promote the success of active portfolio managers…" (2000, p. 24). While benchmark redesign provides a worthy avenue for improving performance measurement, the fact remains that investors continue to use widely available indexes such as the S&P 500 when assessing performance. In light of this observation, we propose that a simple method that uses two benchmarks, an equal-weighted and a value-weighted index, will provide better investment performance evaluation compared to employing a single index alone. Using the sample of mutual fund returns, we provide evidence to support this proposal.

Measuring Portfolio Performance

For a base-line measure of the performance of the mutual funds in our sample, we estimate alpha using the single-index model. We estimate equation (2) using two different indexes that are distinct versions of the same market portfolio; a value-weighted market index and an equally weighted index. This allows us to identify the single index that excels for performance evaluation and to compare it to our two-index approach.

It is likely that a two-index model, using both the value and the equally weighted indexes, would provide results superior to the single-index model using either of the indexes. Such an approach would capture both the equally weighted and the value-weighted nature of the portfolio. Adapting the single-index model to employ two market indexes that are considerably correlated (as are a value and an equally weighted index composed of the same underlying securities) requires the removal of the influence of one index (the value-weighted index) on the other (the equally weighted index) as represented by the following:

$$R_i - Rf_i = \alpha + \beta \cdot (Rvw_i - Rf_i) + \gamma \cdot \overline{Rew_i} + \varepsilon_i \tag{15}$$

where Rvw_i is the return on the value-weighted index and $\overline{Rew_i}$ represents the return on the equally weighted market index with the influence of the value-weighted index removed. We investigate two different techniques for adjusting the equally weighted index to remove the effects of the value-weighted index.

The first technique for adjusting the equally weighted returns is similar to that used by Elton, Gruber, Das, and Hlavka. They remove the returns common to both large and small firms from the small-firm index by orthogonolizing the return vector of the small-firm index returns to the large firm index returns. In the present paper, we accomplish the same goal by orthogonolizing the return vector of the equally weighted index to the value-weighted index. The orthogonolized equally weighted returns become the values for $\overline{Rew_i}$ to be used in (12). This is the "orthogonolized model."

The second method of adjusting the equally weighted returns is a simple one. The adjusted equally weighted returns are equal to the difference between the equally and value-weighted returns:

$$\overline{Rew_i} = Rew_i - Rvw_i \tag{16}$$

This is the "simple model."

Each form of the model has its advantages and disadvantages. The principal advantage of the orthogonolized model is that the estimate of β will be the same as the β estimate from the single-index model equation (2), and it can be interpreted as the systematic risk of the fund in the context of a value-weighted index. However, when using the simple model, the two estimates will differ, and neither represents a single estimate of the risk of the fund. The advantage of the simple model is its simplicity and the possibility that some information in individual observations is lost in the orthogonolizing process.

Results

To compute the performance measures using regression for the models described in the previous section, we used monthly returns on the same 506 funds used to compute the measures of weightedness in the second section. Monthly returns on the Wilshire 5000 VW and EW indexes from 1989 through 1998 served as market returns for the study. We ran the single-index model using the VW index and using the EW index, employing monthly T-bill returns as the risk-free rate. To orthogonolize the EW index returns for the two-index model, we ran a regression of the EW returns on the VW returns. The results are as follows:

$$Rew_i = -.000398 + 0.971592 \cdot Rvw_i \qquad R^2 = 0.604$$

The value of R^2 shows that the variation in the VW index explains about 60 percent of the variation in the EW index. Importantly, this leaves the other 40 percent of the variation unexplained by value weighting and therefore attributable to equal weighting, which leaves the possibility that equal weighting can explain a significant portion of mutual fund returns. The vector of adjusted returns on the equally weighted index for the orthogonal model was set equal to the intercept plus the residual for each data point from the above regression. The adjusted equally weighted returns for the simple two-index model were equal to the EW index return minus the VW index return.

Table 4 presents these results. It provides mean model parameter estimates and R^2s for each of the models. In addition, the table shows the number of funds for each model that produced significantly negative and significantly positive estimates.

TABLE 4. PERFORMANCE EVALUATION MEASURES FOR 506 MUTUAL FUNDS

	α			β			γ			Adj.
Model	Mean	S -	S +	Mean	S -	S +	Mean	S -	S +	R^2
Single-index models										
Value-weighted	-0.0008 (0.93)	13	6	0.952** (19.52)	0	506				0.741
Equally weighted	0.0018 (1.15)	7	23	0.677** (12.87)	0	506				0.567
Two-index models										
orthogonolized	-0.0009 (1.02)	36	6	0.952** (20.58)	0	506	0.208** (3.33)	7	280	0.774
simple	-0.0009 (1.02)	36	6	0.958** (20.67)	0	506	0.208** (3.33)	7	280	0.774

Notes: All were calculated using monthly returns on 506 mutual funds from 1987 to 1998. The single-index models are equation (2) using either the Wilshire 5000 Value-Weighted Index or the Wilshire 5000 Equal-Weighted Index. The two-index models are equation (16). The orthogonalized model adjusts the equally weighted index returns by orthogonalizing them to the value-weighted index returns. The simple model adjusts the equally weighted index returns by subtracting the value-weighted index return. S - is the number of negative estimates significant at the 5 percent level. S + is the number of positive estimates significant at 5 percent level. **Significant at the 0.01 level.

Using adjusted R^2 as a measure of "success" and comparing the two single-index models in Table 4, it is clear that using the value-weighted index yields a better fit (value-weighted R^2 is 0.741 versus the equally weighted R^2 of 0.567). At first glance, this may appear surprising given the predominance of equal weighting in the fund sample. However, the R^2s of the individual stocks in the portfolio, particularly the larger firms, determine the portfolio's R^2 to a greater degree than does weighting. Therefore, because large-cap firms tend to have higher R^2s than do small-cap firms, it is understandable that the value-weighted single-index model provides a higher R^2 than does the single-index model using the equally weighted index. Examining α, the performance metric, shows that the value-weighted model yielded 13 funds that significantly underperformed and six that outperformed the market at the two-tailed 5 percent level. The equally weighted model produced seven underperformers and 23 overperformers. The greater number of overperformers using the equally weighted index is not surprising given the observation in the first section that large firms generally beat smaller firms over the sample period.

Comparing the single-index and the two-index models in Table 4, the two-index models provide additional explanatory power based on the observed higher R^2s of the two-index models (0.774 versus 0.741 for the value-weighted and 0.567 for the equally weighted model), showing that they do a much better job of evaluating fund performance considering all sources of return. The mean γ estimate was significant at the 0.01 level, and well over half (280) of the funds exhibited a significantly positive γ. Also important is the observation that the number of funds showing significantly negative returns increased to 36 while the number of overperformers remained at 6. (These six overperformers were the same funds identified as overperformers in the value-weighted model, and all of the 13 underperformers in the value-weighted model appeared in the 36 underperformers of the two-index models.) In addition, note that both of the two-index models performed equally well. There appears to be no advantage associated with the extra estimation steps required to compute the orthogonal model. Therefore, considering both equally and value-weighted returns in the estimation of CAPM-based performance measures appears to be superior to using only a value or equally weighted index.

Summary

When evaluating the performance of equity mutual funds, it can be important to use multiple indexes in order to consider the effects of both small and large firms on portfolio performance. For example, using an index such as the S&P 500 does not fully capture the "market" because of the omission of many smaller firms from the index. In addition, the S&P 500, like most other popularly used market indexes, is a value-weighted index. This paper proposes that using a value-weighted index to measure portfolio performance may not give a complete picture of investment performance because portfolios may not be value-weighted.

We propose two metrics that measure the degree to which a portfolio leans toward value weighting or equal weighting. Using a sample of 506 mutual funds, we compute these metrics and find that there is a marked tendency of fund managers to equally weight their portfolios. This tendency toward equal weighting seems to be fairly consistent across fund size types (small-cap, mid-cap, and large-cap) and fund investing styles (value, blend, and growth), but fund portfolio value-weightedness appears to vary significantly among the different size types and styles.

To account for the equal-weightedness displayed by many mutual funds, we propose the use of a two-index model when computing fund performance metrics (CAPM αs) that includes both a value-weighted and an equally weighted index. Estimation of fund αs using monthly returns of the sample of 506 mutual funds and the Wilshire 5000 Value-Weighted and Equal-Weighted indexes showed that the two-index models exhibit higher explanatory power than using a single index, and they identify a larger set of funds that underperform the market but the same set of overperforming firms. Our conclusion is that consideration of both equally weighted and value-weighted index returns is important when evaluating the investment performance of equity mutual funds because of the tendency of fund managers to construct portfolios with a significant amount of equal weighting.

References

Admati, Anat, Sudipto Bhattacharya, Paul Pfleiderer, and Stephen Ross. 1986. "On Timing and Selectivity." *Journal of Finance* 41: 715-731.

Alexander, Gordon, and R. Stover. 1980. "Consistency of Mutual Fund Performance during Varying Market Conditions." *Journal of Economics and Business* 32: 219-266.

Banz, Rolf W. 1980. "The Relationship Between Return and Market Value of Common Stock." *Journal of Financial Economics* 9: 3-18.

Brown, Keith C., W. Van Harlow, and Laura T. Starks. 1996. "Of Tournaments and Temptations: an Analysis of Managerial Incentives in the Mutual Fund Industry." *Journal of Finance* 51: 85-110.

Carhart, Mark M. 1997. "On Persistence in Mutual Fund Performance." *Journal of Finance* 52: 57-82.

Carlson, R. 1997. "Aggregate Performance of Mutual Funds, 1948-1967." *Journal of Financial and Quantitative Analysis* 5: 1-32.

Chang, Eric, and Wilbur Lewellen. 1984. "Market Timing and Fund Investment Performance." *Journal of Business* 57: 57-72.

Chang, Eric C., and Wilbur G. Lewellen. 1985. "An Arbitrage Pricing Approach to Evaluating Mutual Fund Performance." *Journal of Financial Research* 8: 15-30.

Daniel, Kent, Marc Grinblatt, Sheridan Titman, and Russ Wermers. 1997. "Measuring Mutual Fund Performance with Characteristic-Based Benchmarks." *Journal of Finance* 52: 1035-1057.

Elton, Edwin J., Martin J. Gruber, and Manfred W. Padberg. 1978. "Optimal Portfolios from Simple Ranking Devices." In *Security Selection and Active Portfolio Management*, edited by Peter L. Bernstein. New York: Institutional Investor, 219-232.

Elton, Edwin J., Martin J. Gruber, Sanjiv Das, and Mathew Hlavka. 1993. "Efficiency with Costly Information: A Reinterpretation of Evidence from Portfolio Managers." *Review of Financial Studies* 6: 1-22.

Fama, Eugene F., and Kenneth R. French. 1992. "The Cross Section of Stock Returns." *Journal of Finance* 46: 427-463.

Fama, Eugene F., and Kenneth R. French. 1993. "Common Risk Factors in the Returns on Stocks and Bonds." *Journal of Financial Economics* 3: 3-56.

Friend, Irwin, Marshall Blume, and J. Crockett. 1970. *Mutual Funds and Other Institutional Investors*. New York: McGraw-Hill.

Friend, Irwin, F. E. Brown, Edward S. Herman, and Douglas Vickers. 1962. *A Study of Mutual Funds*. Washington, D.C.: U.S. Securities and Exchange Commission.

Ippolito, Richard A. 1993. "On Studies of Mutual Fund Performance, 1962-1991." *Financial Analysts Journal* 49: 42-50.

Jensen, Michael C. 1968. "The Performance of Mutual Funds in the Period 1945-1954." *Journal of Finance* 42: 389-416.

Jensen, Michael C. 1969. "Risk, the Pricing of Capital Assets, and the Evaluation of Investment Portfolios." *Journal of Business* 42: 167-247.

Kon, Stanley. 1983. "The Market Timing Performance of Mutual Fund Managers." *Journal of Business* 56: 323-347.

Lehmann, Bruce, and David Modest. 1987. "Mutual Fund Performance Evaluation: a Comparison of Benchmarks and Benchmark Comparisons." *Journal of Finance* 42: 233-265.

Malkiel, Burton G. 1995. "Returns from Investing in Equity Mutual Funds." *Journal of Finance* 50: 549-572.

Morningstar. 1998 and 1999. *Principia Pro Plus*. (*www.morningstar.com*)

Reinganum, Marc R. 1981. "Misspecification of Capital Asset Pricing: Empirical Anomalies Based on Earnings' Yields and Market Values." *Journal of Finance* 9: 19-46.

Sharpe, William F. 1966. "Mutual Fund Performance." *Journal of Business* 39: 119-138.

Volkman, David A. 1999. "Market Volatility and Perverse Timing Performance of Mutual Fund Managers." *Journal of Financial Research* 22: 449-470.