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The Effects of Rebalancing on Size and Book-to-Market Ratio Portfolio Returns

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After adjusting for transaction costs and different rebalancing periods, portfolios of securities selected on the basis of the issuing firm's book-to-market-equity (BE/ME) ratio and size can produce returns superior to those of the the market. Specifically, after adjusting for 1.0 percent transaction costs and annual rebalancing, investors would have outperformed the market by 4.82 percent over the 1963–88 period if they had invested in securities from firms with high BE/MEs and small size. The optimal rebalancing period for long positions in these securities is two years, and the optimal period for portfolios that use the proceeds from short positions in firms with low BE/MEs and large size to purchase firms with high BE/MEs and small size is four years.

Fama and French demonstrated that, during the 1963–89 period, beta was not an important explanatory variable for expected nominal stock returns but a firm's size and book-to-market value of equity ratio were important.[1] Their work raises several interesting questions. Do portfolios of securities chosen on the basis of firm size and BE/ME outperform the market? Do they outperform the market after adjusting for transaction costs? How do alternative rebalancing periods affect portfolio returns? How well diversified are such portfolios?

We investigated these questions and found that, over our 26-year sample period, portfolios formed with securities that were issued by small firms with high BE/MEs outperformed the market portfolio for rebalancing periods of one, four, and ten years, even after adjusting for transaction costs of up to 2 percent for each purchase or sale decision. These portfolios also outperformed portfolios that included securities issued by relatively large firms with relatively low BE/MEs. The Fama–French optimal portfolios, which comprise securities issued by small firms with high BE/MEs, generally provided the highest absolute returns among 25 size- and BE/ME-based portfolios constructed from all NYSE-, Amex- and Nasdaq-traded securities. Nonoptimal portfolios, which comprise securities issued by large firms with low BE/MEs, generally provided the smallest returns for all rebalancing periods.

We also found that the greatest spread in returns between optimal portfolios and nonoptimal portfolios was maximized at 13.54 percent when the rebalancing period was four years. In addition, the highest return to the optimal portfolio was achieved by rebalancing every two years, and the least negative return for the nonoptimal portfolio was obtained by rebalancing every year.

We found further that the optimal portfolios were well diversified, as measured by the number of securities included in each, the number of distinct three-digit SIC codes represented in each, or the correlation between each portfolio's returns and the market's returns.

We also confirmed prior findings that for any given size category, average annual portfolio returns increase as the BE/ME increases and, for any given BE/ME category, average returns decrease as size increases. Thus, size and BE/ME do affect stock returns, and the BE/ME effect appears to have the dominant impact.

Together, our results illustrate and confirm an important relation between BE/ME and common equity returns. The BE/ME effect was significant for different holding periods and transaction costs levels, thus indicating that during our sample period, a trading strategy based on BE/ME and size could have been profitable.

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Although BE/ME is related to common equity return, the economic fundamentals driving the BE/ME effect are not clearly understood. Fama and French suggested that BE/ME could be a measure of financial distress and that higher returns to higher BE/ME firms incorporate a financial distress risk premium;[2] they also illustrated that high BE/MEs are correlated with low profitability, which implies a correlation between BE/ME and financial distress.[3] Peevey, Senchack, and Woodruff provided evidence, however, that BE/ME does not proxy for financial distress.[4] Harris and Marston focused on the empirical links among BE/ME, beta, and growth and concluded that "[BE/ME] not growth appears to be the factor driving return performance."[5] They also found that when analysts' growth estimates are held constant, the relation between beta and BE/ME is positive. Thus, although consensus about the economic fundamentals driving the BE/ME effect is lacking, a significant relation does exist between BE/ME and common equity returns.

A few cautionary notes should be mentioned. First, although there are few alternatives to using past time-series data, the data may not have been completely stationary over the sample period, and thus the average returns reported here may not be good estimates of expected return. Second, the results possibly could have been driven by the fact that the BE/ME effect represents a form of market inefficiency that, having been documented, could be dissipating as investors bid up the price of high-BE/ME securities. Only better developed theory as to why the BE/ME should be able to explain past average returns and longer data samples will help resolve this issue.[6] As mentioned previously, some logical reasons explain why the BE/ME might affect expected returns, but theory lags behind empirical work on this issue. Last, the effect might be a statistical anomaly of the time period, and thus studies that focus on this effect may be guilty of data "snooping" or "mining."[7] As will be discussed later, a large part of the difference in relative performance between high BE/ME–small size and low BE/ME–large size occurred between 1981 and 1988. Differences began to appear in the portfolio returns in 1970, however, indicating that the BE/ME effect may have been important for a longer period of time. Only a longer data sample will resolve this issue.

Thus, small-size–high-BE/ME portfolios constructed in the future are not guaranteed to achieve the same levels of performance as those constructed in the past, nor do our results suggest that investors should abandon the concept of beta. Black provided three theoretical reasons why mismeasuring the market portfolio, a fact of life in applying the capital asset pricing model (CAPM), might result in a flat line relating expected return to beta; he also discussed how investment strategies can and should be based upon beta if this line is indeed truly flat, as Fama and French contend.[8] Nonetheless, our results indicate that investors would have significantly outperformed the market if they had selected small-size–high-BE/ME securities for their portfolios during this period.

DATA AND METHODOLOGY

Our sample selection procedure was similar to that used by Fama and French.[9] Specifically, our sample included all firms listed on the NYSE, Amex, and Nasdaq that appear on the daily stock return files of the Center for Research in Security Prices (CRSP) and the Compustat annual industrial files of accounting data. To correspond to Fama and French, the Compustat data used in this study cover the period from 1962 to 1989.

We matched the accounting data for all fiscal year-ends in calendar year $t - 1$ with the returns for July of year t to June of year $t + 1$. This matching procedure ensures that the accounting data are known prior to the following year's stock returns. The market value of the firm's equity at the end of December of year $t - 1$ was used to calculate its book-to-market ratio for t, and the market value of equity for June of year t was used to measure its size. A firm was included in the sample for year t if CRSP data were available for the June year t stock price and for monthly returns for at least 24 months before July of year t. The firm must, in addition, have had Compustat data available for the total book value of assets for its fiscal year ending in any year of calendar year $t - 1$.

We estimated each security's beta using at least 24 monthly returns prior to July of year t. If available, we used up to 60 months of returns. The CRSP value-weighted index of NYSE, Amex, and (after 1972) Nasdaq securities was the proxy for the market portfolio. The beta estimates were the sum of the coefficients of the market model regression of a portfolio's current return on the current and prior month's market return. As Fama and French noted, this method of estimating betas is intended to adjust for nonsynchronous trading biases.

In order to examine the returns of various size–BE/ME portfolios, all NYSE, Amex, and Nasdaq securities with the requisite CRSP and Compustat data were assigned to one of five BE/ME quintiles and each BE/ME quintile was further subdivided into size quintiles.[10] This procedure generated 25 portfolios each June, based first on BE/ME and then on size. The equal-weighted monthly security returns for the proceeding 12 months, from July through June, were calculated and assigned to each portfolio. In calculating the portfolio return, we subtracted transaction costs of either 0.0 percent, 0.5 percent, 1.0 percent, or 2.0 percent of the security's value for those securities that had to be sold or purchased to rebalance each of the 25 portfolios at the beginning of each rebalancing period. If, for example, 10 securities were sold and 15 securities were purchased in order to rebalance the small-size–high-BE/ME portfolio, then we subtracted the appropriate transaction costs from the return of the 25 securities. If a security was neither sold nor purchased, then no transaction costs were applied.

The average portfolio return was found by calculating

$$AVGRET_{bst} = \frac{\sum_{n=1}^{N_{bst}} RET_{nt}}{N_{bst}},$$

where

$AVGRET_{bst}$ = the average return for portfolio b,s in year t

b = one of five book-to-market quintiles

s = one of five size quintiles

N_{bst} = the number of securities in portfolio b,s

RET_{nt} = the annual return net of transaction costs for each individual security

We calculated the equal-weighted return on the market for each year using

$$R_{mt} = \frac{\sum_{n=1}^{N_{tot}} RET_{nt}}{N_{tot}},$$

where

R_{mt} = the average return on all NYSE-, Amex- and Nasdaq-listed securities included in the sample

N_{tot} = the total number of securities in the sample in year t

All other variables are defined as before.

To compute the market-adjusted return (MAR) for each portfolio, we used

$$MAR_{bst} = AVGRET_{bst} - R_{mt},$$

where MAR_{bst} is the market- and transaction-costs-adjusted return for portfolio b,s in year t, and all other variables are defined as above.

The average portfolio beta was found with

$$\beta_{bst} = \frac{\sum_{n=1}^{N_{bs}} \beta_{nt}}{N_{bst}},$$

where β_{bst} is the average beta for portfolio b,s in year t and all other variables are defined as before.

We measured the degree of portfolio diversification in three different ways. We calculated the number of securities included in each portfolio, the number of unique three-digit SIC codes that those securities represented, and the correlation of each portfolio's returns with the returns provided by all NYSE-, Amex-, and Nasdaq-traded securities in the sample. The greater the number of securities or unique SIC codes, or the higher the correlations, the greater is the assumed level of portfolio diversification.

THE EMPIRICAL RESULTS

In this section, we provide risk and diversification attributes of portfolios composed of securities selected on the basis of firm size and BE/ME and rebalanced at intervals of one, four, and ten years. In addition, we present the average market- and transaction-costs-adjusted rates of return that investment advisors would have received from each of the portfolios.[11]

The first section of Table 1 presents average betas for size and BE/ME portfolios that were rebalanced annually. Two characteristics of the portfolio betas are immediately evident. First, the average beta for all but one of the portfolios is greater than 1. As noted previously, we followed Fama and French and estimated betas by summing the coefficients of the market model regression of a portfolio's current return on the current and prior month's market return. These "sum-betas" adjust for nonsynchronous trading biases and also generate betas greater than 1.[12] The weighted-average beta in Fama and French, for example, was 1.324 and in this paper, 1.344. We expected this beta to be closer to 1 because our sample included a significant proportion of the firms listed on the NYSE, Amex, and Nasdaq exchanges and thus should have approached the market's beta of 1.

Table 1. Portfolio Characteristics by Firm Size and BE/ME Quintiles

Firm-Size Quintile	BE/ME Quintile: Lowest	II	III	IV	Highest
Portfolio betas					
Smallest	1.75	1.59	1.53	1.46	1.42
II	1.75	1.58	1.45	1.36	1.38
III	1.61	1.46	1.33	1.26	1.36
IV	1.41	1.31	1.20	1.13	1.28
Largest	1.16	1.08	1.03	0.99	1.10
Portfolio standard deviation					
Smallest	0.3952	0.4000	0.3278	0.3358	0.3411
II	0.3156	0.2974	0.2993	0.2869	0.3385
III	0.3141	0.2694	0.2781	0.2472	0.2992
IV	0.2521	0.2562	0.2339	0.2212	0.2462
Largest	0.2252	0.2052	0.1967	0.1837	0.2023
Correlation with the market					
Smallest	0.9385	0.9626	0.9423	0.9309	0.9025
II	0.9277	0.9770	0.9871	0.9853	0.9390
III	0.9468	0.9634	0.9606	0.9822	0.9580
IV	0.9151	0.9574	0.9585	0.9267	0.9723
Largest	0.8358	0.8651	0.8899	0.8721	0.9044
Average number of securities per portfolio					
Smallest	103.38	103.42	103.35	103.42	103.38
II	103.27	103.27	103.27	103.27	103.27
III	103.35	103.38	103.38	103.38	103.35
IV	103.27	103.27	103.27	103.27	103.27
Largest	103.38	103.42	103.35	103.42	103.38
Average number of three-digit SIC codes per portfolio					
Smallest	55.23	59.08	62.69	64.42	63.58
II	55.35	60.15	66.50	66.27	65.19
III	58.92	63.42	62.96	61.69	62.85
IV	58.46	62.69	59.58	52.46	56.54
Largest	50.58	55.89	49.27	42.73	44.69

Note: Portfolios are selected and held for one year.

Second, within each size quintile, the betas generally decline monotonically as BE/ME increases, and within each BE/ME quintile, the betas decline as size increases. These results, also noted in Fama and French, imply that in accordance with the CAPM, returns should increase, *ceteris paribus*, as BE/ME declines and as size declines.

The second section of Table 1 presents the standard deviation of returns for the portfolios and provides additional insight into their risk characteristics. The pattern of standard deviations is similar to that for betas. In general, within each size quintile, the standard deviation of portfolio returns declines as the BE/ME increases. In addition, within each BE/ME quintile, the standard deviation declines as size increases. If standard deviation were the appropriate risk measure, the returns should decrease, *ceteris paribus*, as BE/ME increases and as size increases.

The remaining sections of Table 1 present alternative diversification measures for 25 size–BE/ME portfolios that are rebalanced annually. The third section lists the correlation between each portfolio's return with an index composed of all NYSE-, Amex- and Nasdaq-traded securities included in our sample.[13] Larger correlation coefficients may imply greater diversification because they indicate that a portfolio's returns closely track the well-diversified market portfolio. The average correlation between the 25 size–BE/ME portfolios and the market is 0.9360, with a range from 0.8358 to 0.9871. All but four of the correlation values are greater than 0.9000. No pattern is evident in the distribution of correlation coefficients across portfolios, although the largest size portfolios have correlations that appear to be somewhat smaller than those for other portfolios. In addition, the largest size–smallest BE/ME portfolio is associated with the smallest correlation, and the smallest size–largest BE/ME portfolio, with a correlation of 0.9025, is below the mean. These correlations provide evidence that the returns from these portfolios are closely associated with the market's returns and that the portfolios are reasonably well diversified.

The fourth section of Table 1, which presents the average annual number of securities included in each portfolio at the beginning of each year, indicates that the number of securities in each of the 25 portfolios is approximately the same. Every year, each portfolio was rebalanced and an equal number of securities was assigned to the portfolios. This procedure placed approximately the same number of securities in each portfolio across time. For rebalancing periods greater than one year, the average number of securities in each portfolio is not equal. When securities delist, the average annual number of firms included in a portfolio declines. If the firms in the portfolios delist at different rates, then the average annual number of securities in the portfolios will differ.

The results in the fourth section of the table indicate that, on average, the number of securities from small firms with high BE/MEs is sufficient to create a well-diversified portfolio. The number of securities from which portfolios could be constructed, furthermore, increased over the sample period. During the first nine years of the sample, the returns from Nasdaq securities were not available from CRSP and thus were not included in the sample. In 1963, each portfolio averaged 36 firms; in 1988, when Nasdaq firms were included in the sample, each portfolio averaged 130 securities. The number of securities, therefore, should not be a major constraint to selecting a well-diversified portfolio.

The fifth section of Table 1 presents the average number of distinct three-digit SIC codes represented by firms within each portfolio. Averages of 58.45 distinct three-digit SIC codes were represented in each portfolio, with a minimum of 42.73 and a maximum of 66.50. In the smallest two size quintiles, more distinct SIC codes were represented in the highest BE/ME portfolios. In the largest two size quintiles, however, more SIC codes were represented in the smallest BE/ME portfolios. Despite this pattern, the number of SIC codes, on average, appears to be sufficiently large to construct portfolios that are diversified across industries.

In summary, Table 1 indicates that within a given size quintile, two measures of risk—beta and standard deviation—decrease when BE/ME increases; within a given BE/ME quintile, the risk measures decrease when firm size increases. In addition, the portfolios appear to be well diversified, as confirmed by our three simple measures of diversification.

Table 2 displays different market- and transaction-cost-adjusted returns to the 25 size and BE/ME portfolios that were rebalanced annually. The results in the top section indicate that, for any given size category, the average annual portfolio returns generally increase as the BE/ME increases. The returns increase for portfolios in the smallest size category, for example, from 14.48 percent for the lowest BE/ME to 21.73 percent for the highest. Although the returns increase as BE/ME increases, the first section of Table 1 indicates that average portfolio betas tend to decrease. Thus, controlling for size, returns increase as beta risk declines, which is consistent with the findings of Fama and French.

For purposes of exposition, we defined optimal portfolios as those that comprise securities issued by the smallest firms with the highest BE/MEs. Investment advisors who had selected optimal portfolios would have received an average return of 21.73 percent per annum, which is the third highest return for any of the portfolios. We defined nonoptimal portfolios as those that comprise securities in the largest size and smallest BE/ME categories. Managers who had selected nonoptimal portfolios would have received, on average, 11.52 percent per annum, which is the fourth smallest return any of the portfolios provided and is 10.21 percentage points below the returns to the optimal portfolio. The smallest return of any of the 25 portfolios is 9.45 percent.

The average portfolio returns generally decrease for any given BE/ME category as the size of firms included in the portfolios increases. For example, for the middle-BE/ME category, BE/ME Quintile III, the average return for the smallest firm-size portfolio is 17.53 percent, 5.01 percentage points greater than the 12.52 percent return for the largest firm-size portfolio.

The remainder of Table 2 presents new information on the market- and transaction-cost-adjusted portfolio returns. The market-adjusted portfolio returns, shown in the second section of the table, indicate, as might be expected, that smaller firms with higher BE/MEs outperformed the market during the sample period and that larger firms with lower BE/MEs underperformed the market. The optimal portfolio, for example,

Table 2. Annual Portfolio Returns under Various Assumptions by Firm Size and BE/ME Quintiles

Firm-Size Quintile	BE/ME Quintile: Lowest	II	III	IV	Highest
Total					
Smallest	0.1448	0.1946	0.1753	0.2332	0.2173
II	0.0945	0.1485	0.1705	0.1931	0.2326
III	0.1035	0.1349	0.1784	0.1746	0.1951
V	0.1030	0.1454	0.1490	0.1603	0.1736
Largest	0.1152	0.1201	0.1252	0.1365	0.1767
Market-adjusted					
Smallest	–0.0151	0.0347	0.0153	0.0732**	0.0574**
II	–0.0655*	–0.0115	0.0105	0.0332**	0.0727**
III	–0.0564*	–0.0250	0.0184	0.0146	0.0351
IV	–0.0569*	–0.0145	–0.0109	0.0003	0.0137
Largest	–0.0447*	–0.0398	–0.0347	–0.0235	0.0167
Market- and 0.5 percent transaction-cost-adjusted					
Smallest	–0.0209	0.0276	0.0081	0.0661*	0.0528*
II	–0.0716**	–0.0184	0.0035	0.0262*	0.0669*
III	–0.0621**	–0.0315*	0.0116	0.0082	0.0291
IV	–0.0617**	–0.0202	–0.0171	–0.0059	0.0079
Largest	–0.0476*	–0.0446	–0.0401	–0.0285	0.0123
Market- and 1 percent transaction-cost-adjusted					
Smallest	–0.0267	0.0205	0.0008	0.0590*	0.0482*
II	–0.0777**	–0.0253	–0.0036	0.0193	0.0611*
III	–0.0678**	–0.0379*	0.0048	0.0017	0.0232
IV	–0.0666**	–0.0259	–0.0233	–0.0122	0.0022
Largest	–0.0505*	–0.0494	–0.0455	–0.0336	0.0078
Market- and 2 percent transaction-cost-adjusted					
Smallest	–0.0383	0.0064	–0.0138	0.0449	0.0389*
II	–0.0900**	–0.0391**	–0.0177	0.0055	0.0495*
III	–0.0792**	–0.0508**	–0.0088	–0.0113	0.0112
IV	–0.0762**	–0.0373*	–0.0358*	–0.0247	–0.0093
Largest	–0.0563*	–0.0590*	–0.0563*	–0.0437	–0.0012

Note: Portfolios are selected and held for one year.
*Statistically significant at the 5 percent level.
**Statistically significant at the 1 percent level.

earned 5.74 percentage points more per annum, on average, than the market index; the nonoptimal portfolio underperformed the market by 4.47 percentage points.[14] The returns that differ from zero are those of the four largest size portfolios in the lowest BE/ME quintile, which are negative and significant; those of the two highest BE/ME portfolios in the smallest two size quintiles are positive and significant.

The remaining sections of Table 2 present the returns to portfolios that are rebalanced each year and are adjusted for transaction costs of 0.5, 1.0, and 2.0 percent and for the returns on the market. A review of the third through fifth sections indicates that the returns to the highest BE/ME–smallest size portfolios are significantly higher than the returns to the market portfolio, even after adjusting for transaction costs.[15] The returns to this portfolio, adjusted for 2.0 percent transaction costs, for example, are 3.89 percentage points higher than the market return; if transaction costs are 0.5 percent, then the returns are 5.28 percentage points higher. In contrast, the lowest BE/ME–largest size portfolio underperforms the market regardless of the level of transaction costs assumed.

The BE/ME effect appears to dominate the size effect. At every level of transaction costs presented in Table 2, 4 of the 5 portfolios (a total of 16, given the four levels of transaction costs) in the lowest BE/ME quintile underperform the market. In contrast, two of the five portfolios (a total of eight) in the highest BE/ME quintile outperform the market at all levels of transaction costs. Conversely, in the largest size quintile, across all transaction costs levels, only six portfolios, of which three are at the 2 percent level of transaction costs, significantly underperform the market. In the smallest size quintiles across all transaction cost levels, however, the highest and second highest BE/ME portfolios outperform the market, except at the 2 percent level of transaction costs, at which only the highest BE/ME portfolio outperforms the market. Thus, even for transaction costs of 2 percent, the optimal portfolio returns are significantly larger than those to the nonoptimal portfolio. We find, in fact, that transaction costs would have to be approximately 30 percent before the return differences in these two portfolios approach zero.[16]

In summary, the returns to the highest BE/ME–smallest size portfolio outperform the market even with transaction costs of up to 2.0 percent. In addition, the BE/ME effect appears to be stronger than the size effect. Lastly, the highest BE/ME–smallest size portfolio outperforms the market at transaction cost levels up to 2.0 percent.

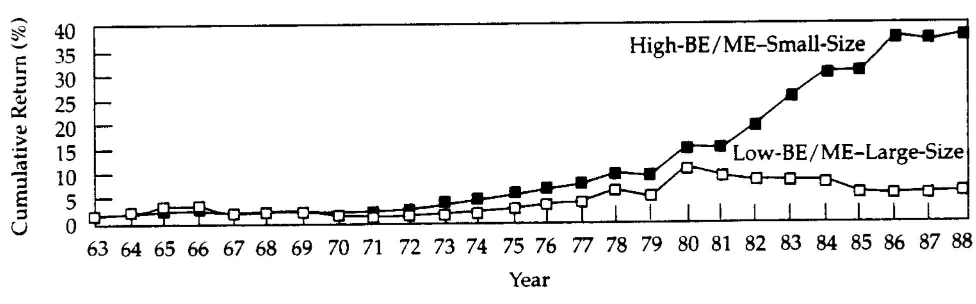
Figure 1 plots the cumulative returns for the high-BE/ME–small-size and the low-BE/ME–large-size portfolios with 1.0 percent transaction costs and annual rebalancing.[17] Investing $100 in the high-BE/ME and small-size portfolio would have yielded about $3,800 by the end of 1988, and a similar investment in the low-BE/ME–large-size portfolio would have resulted in a payoff of only $600 at the end of the period.

the returns to each portfolio. The fundamental characteristics of the firms issuing the securities continually change, however. As the rebalancing period increases, the probability increases that a security, if rebalanced, would be classified into another portfolio. This misclassification, or drift, in securities may reduce returns of portfolios based on BE/ME or size. We investigated the impact of longer rebalancing periods in Figures 2 through 4. Figure 2 graphs the market- and 1 percent transaction-cost-adjusted returns for the size- and BE/ME-based portfolios (the fourth section of Table 2), and Figures 3 and 4 provide information similar to Figure 1 except that the portfolios were rebalanced every four and ten years. The first set of portfolios formed for the four-year rebalancing period, for example, was selected in 1963 and held until 1967; the second set was formed in 1964 and held until 1968. The returns, therefore, are rolling averages of the portfolio returns.

The general patterns evident in Figure 1 and the fourth section of Table 2 are similar to those in Figures 3 and 4; the optimal portfolios have higher returns than their nonoptimal counterparts. Furthermore, the market- and 1 percent transaction-cost-adjusted returns for the optimal portfolios based on four- and ten-year rebalancing periods are statistically greater than zero at the 5 percent level, and the corresponding returns for the nonoptimal portfolios, based on the same rebalancing periods, are statistically less than zero at the 5 percent level of significance.

Although not reported here, the levels of the

Figure 1. Cumulative Returns for High-BE/ME–Small-Size and for Low-BM/BE–Large-Size Portfolios



Note: Returns are net of 1 percent transaction costs, cumulated from 1963 through 1988, and calculated assuming annual portfolio rebalancing.

Tables 1 and 2 present data for portfolios that were rebalanced every year. If the rebalancing period is longer than one year, then transaction costs for each portfolio decline, which will increase

summary attributes of these portfolios differed somewhat across rebalancing periods.[18] For example, betas for high-BE/ME-quintile portfolios tend to increase with lengthening of the rebalancing

Figure 2. Market- and 1 Percent Transaction-Cost-Adjusted Returns for Size and BE/ME Quintile Portfolios Held for One Year

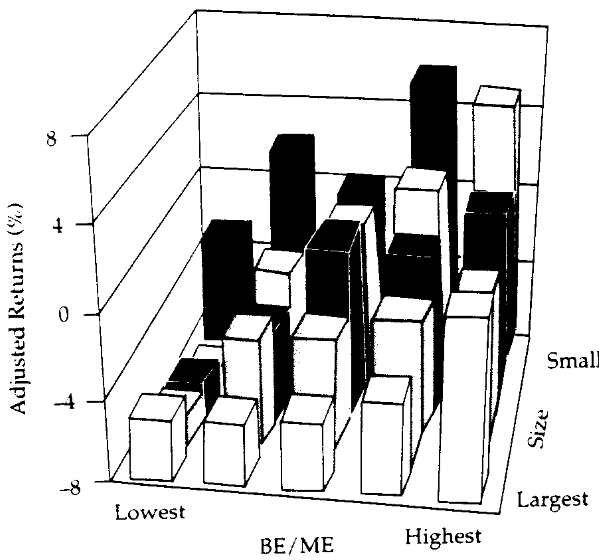
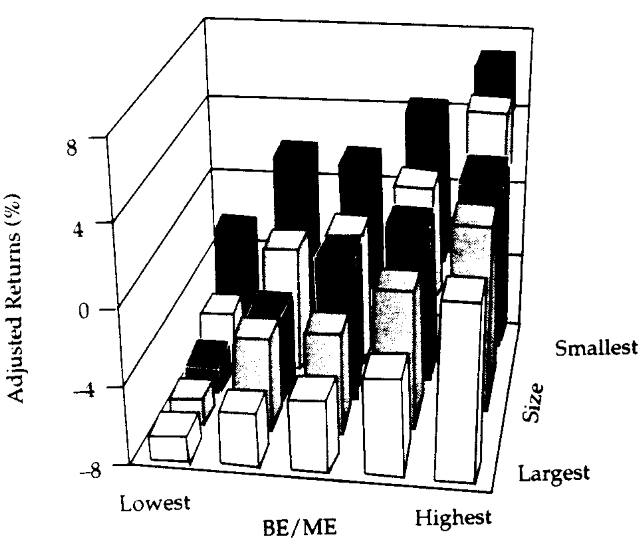
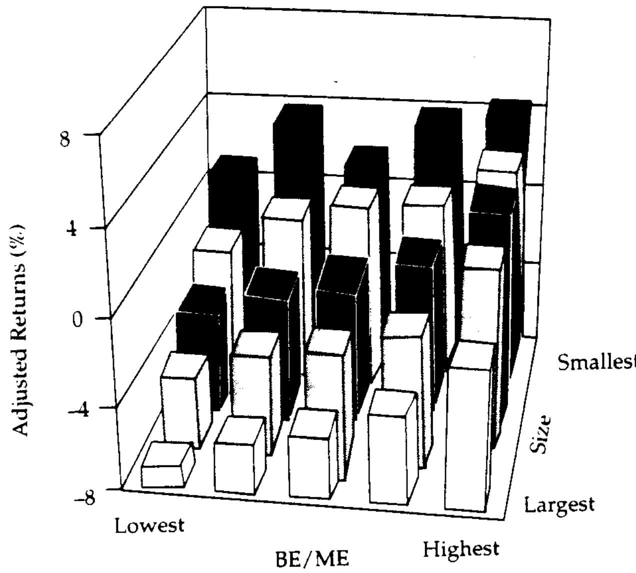


Figure 3. Market- and 1 Percent Transaction-Cost-Adjusted Returns for Size and BE/ME Quintile Portfolios Held for Four Years



period, and the betas for the smallest BE/ME portfolios tend to decrease. Furthermore, average holding period standard deviations of returns tend to decline as the rebalancing period lengthens. Although the levels decline, a general monotonic decline in standard deviations occurs within BE/ME quintiles as size increases.

Figure 4. Market- and 1 Percent Transaction-Cost-Adjusted Returns for Size and BE/ME Quintile Portfolios Held for Ten Years



The average correlations are comparable across rebalancing periods, although they decline somewhat as the rebalancing period lengthens. The correlations for the lowest BE/ME and largest size portfolios are significantly smaller (0.4284 and 0.4652) for the four- and ten-year rebalancing periods than for the one-year rebalancing period (0.8358). For no other portfolios do the correlations differ as greatly.

The average numbers of securities and average numbers of distinct SIC codes contained in each of the portfolios decline as the rebalancing period increases. Fewer securities were included in the CRSP and Compustat databases during the early part of the sample period, and the number of securities increased significantly during the sample period. The longer the rebalancing period the fewer the average number of securities and SIC codes represented in each portfolio, because longer rebalancing periods require that the portfolios be formed earlier in the sample period, when the data set contained fewer firms.

Of the three different rebalancing periods, the returns to selecting portfolios on the basis of their size and BE/ME are greatest for the four-year rebalancing period. The spreads between optimal and nonoptimal portfolio market-adjusted returns at the 1 percent transaction cost level, for example, increase from 9.87 percent to 13.54 percent between the one-year and four-year rebalancing periods before falling to 11.53 percent for the ten-year rebalancing period. This pattern in spreads, increasing between the one- and four-year rebalancing periods and then decreasing for the ten-year rebalancing period, is consistent across the different levels of transaction costs.

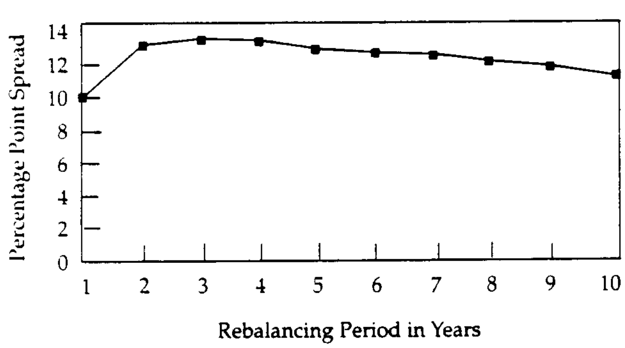
We examined the market-adjusted returns for different rebalancing periods and found that the greatest spread between the optimal and nonoptimal portfolio is generated by four-year rebalancing. This spread is the return an investment manager would receive if he or she shorted the nonoptimal portfolio and purchased the optimal portfolio. Figure 5 presents the spread between the optimal and nonoptimal portfolios for rebalancing periods from one to ten years. The spread increases significantly between the first and second years, reaches a maximum at four years, and then tapers off gradually after four years. The individual yearly differences from Year 2 through Year 10 (e.g., Year 2 compared with Year 3, etc.) do not differ significantly from zero, however. The four-year rebalancing spread does differ significantly from the spreads for one-year and seven-year rebalancing periods.

Table 3. Spread between Optimal and Nonoptimal Portfolios by Rebalancing Period

Rebalancing Period	High BE/ME, Small Size	Low BE/ME, Large Size	Spread
1	0.0528	–0.0476	0.1004
2	0.0714	–0.0601	0.1315
3	0.0705	–0.0645	0.1351
4	0.0693	–0.06 61	0.1354
5	0.0632	–0.0662	0.1294
6	0.0599	–0.0681	0.1280
7	0.0584	–0.0676	0.1260
8	0.0535	–0.0685	0.1219
9	0.0490	–0.0705	0.1194
10	0.0442	–0.0711	0.1153

Note: Returns are net of 1 percent transaction costs.

Figure 5. Spread between the Optimal and Nonoptimal Portfolios by Rebalancing Period



Note: Returns are net of 1 percent transaction costs.

A closer look at Figure 5 and Table 3 reveals that the highest market-adjusted return to the optimal portfolio is achieved by rebalancing every two years and that the returns to the optimal portfolio decline monotonically from Year 2 through Year 10. The highest return to the nonoptimal portfolio is obtained by rebalancing every year, and the return to this portfolio also declines monotonically (except for seven-year rebalancing periods) from Year 1 through Year 10.[19]

For investors interested in shorting nonoptimal portfolios and purchasing optimal portfolios, if the rebalancing period is shorter than four years, then transaction costs more than offset the gains from reducing the misclassification of securities. If the rebalancing period is longer than four years, then the lost returns from misclassification of securities is greater than the transaction costs necessary to rebalance the portfolios. The optimal portfolio provides the highest returns if rebalanced every two years.

CONCLUSION

Fama and French argued that beta provided little information about the cross-section of common stock returns during the 1963–88 period. Instead, firm size and the BE/ME were important determinants of common stock returns. The relation between stock returns and BE/ME implies that as the book value of the firm's equity increases relative to its market value, the returns to the firm's equity increase.

Our study provides additional support for Fama and French's results but also incorporates the effects of transaction costs and rebalancing periods. Specifically, optimal portfolios, which comprise securities issued by small firms with high BE/MEs, provided higher returns from 1963 through 1988 than nonoptimal portfolios, which comprise securities issued by large firms with low BE/MEs, for rebalancing periods of one, four, and ten years. The Fama–French optimal portfolios provided the highest absolute returns of the 25 portfolios constructed from all NYSE-, Amex- and Nasdaq-traded securities, and nonoptimal portfolios provided the smallest, or nearly the smallest, returns for all rebalancing periods.

Our results also indicate that the greatest benefits from purchasing optimal portfolios (high BE/ME–small size) and shorting nonoptimal portfolios (low BE/ME–large size) are generated by rebalancing portfolios every four years. The spread between the returns from these two portfolios was 10.04 percent for one-year rebalancing periods, 13.54 percent for four-year periods, and 11.53 percent for ten-year periods. The highest return to the optimal portfolio is achieved by rebalancing every two years, and the least negative return for the nonoptimal portfolio is obtained by rebalancing every year.

Portfolio managers may be able to increase their returns and reduce risk as measured by beta and by standard deviation. During the 1963–88 period, portfolios that were composed of the securities of small firms with low BE/MEs, for example, could have been rebalanced to include small-firm–high-BE/ME securities. If a portfolio had been rebalanced every four years, the market-adjusted returns would have increased from –1.37 percent to 7.80 percent and the average portfolio beta would have dropped from 1.76 to 1.45.

In summary, even after accounting for transaction costs and differing rebalancing periods, BE/ME appears to be an important explanatory factor of expected returns. The economic rationale for the BE/ME effect, however, is an issue for research and debate.[20]

FOOTNOTES

1. See Eugene Fama and Kenneth French, "The Cross-Section of Expected Stock Returns," *The Journal of Finance*, vol. 47, no. 2 (June 1992):427–65; "The Economic Fundamentals of Size and Book-to-Market Equity," working paper, University of Chicago, 1992; and "Common Risk Factors in the Returns on Stocks and Bonds," *Journal of Financial Economics*, vol. 33, no. 1 (February 1993):3–56.
2. Fama and French, "The Cross-Section of Expected Stock Returns."
3. Fama and French, "The Economic Fundamentals of Size and Book-to-Market Equity."
4. Robert M. Peevey, A.J. Senchack, Jr., and Catherine S. Woodruff, "Firm Size, Book-to-Market, and Financial Distress: Their Effect on Equity Returns," working paper, University of Texas–Austin, 1993.
5. Robert S. Harris and Felicia Marston, "Value versus Growth Stocks: Book-to-Market, Growth, and Beta," *Financial Analysts Journal*, vol. 50, no. 5 (September/October 1994):14.
6. See Fischer Black, "Estimating Expected Return," *Financial Analysts Journal*, vol. 49, no. 5 (September/October 1993): 36–38.
7. Andrew W. Lo and A. Craig MacKinlay, "Data-Snooping Biases in Tests of Financial Asset Pricing Models," *The Review of Financial Studies*, vol. 3, no. 3 (Fall 1990):431–67.
8. Black, "Estimating Expected Return."
9. Fama and French, "The Cross-Section of Expected Stock Returns."
10. As in Fama and French ("The Cross-Section of Expected Stock Returns"), the breakpoints for these divisions were determined using only NYSE securities.
11. Some of the results—for example, those presented in the first two sections of Table 1—are similar to those in Fama and French ("The Cross-Section of Expected Stock Returns"). We included them to confirm that our data sample produces results that are consistent with their study.
12. The results presented in this paper are unchanged if simple market model beta estimates are used instead of the sum betas.
13. The results are relatively unchanged if we restrict the index to securities traded only on the NYSE, Amex, or Nasdaq.
14. We also calculated the market- and risk-adjusted returns by subtracting each portfolio's beta multiplied by the market return from the portfolio's total net return. The resulting pattern of returns is qualitatively the same as that for the market-adjusted returns.
15. We assume that investing in the market portfolio generates no transactions costs, which biases against finding positive abnormal returns.
16. Harris and Marston, in "Value versus Growth Stocks," reported that firms with BE/MEs in the top 30 percent of their sample outperformed the CRSP value-weighted index by 3 percent. They do not, however, control for size or transaction costs, and their sample period covers only seven years, 1982 through 1989, because of limitations on the availability of Institutional Broker's Estimate System (IBES) data.

17. Graphs with different levels of transaction costs and rebalancing periods were similar.
18. Tables detailing the summary attributes of the portfolios rebalanced every four and ten years are available from the authors upon request.
19. The returns continue to decline more or less monotonically for rebalancing periods longer than ten years.
20. We thank Jennifer Conrad and Marc Zenner for helpful comments. Address correspondance to Kenneth W. Wiles at DGI, Post Office Box 1006, Salisbury, NC 28144.