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Another Look at the Cross-section of Expected Stock Returns

S. P. KOTHARI, JAY SHANKEN, and RICHARD G. SLOAN*

ABSTRACT

Our examination of the cross-section of expected returns reveals economically and statistically significant compensation (about 6 to 9 percent per annum) for beta risk when betas are estimated from time-series regressions of annual portfolio returns on the annual return on the equally weighted market index. The relation between book-to-market equity and returns is weaker and less consistent than that in Fama and French (1992). We conjecture that past book-to-market results using COMPUSTAT data are affected by a selection bias and provide indirect evidence.

AN EXTENSIVE BODY OF empirical research over the past 10 to 15 years has provided evidence contradicting the prediction of the Sharpe (1964), Lintner (1965), and Black (1972) capital asset pricing model (CAPM) that the cross-section of expected returns is linear in beta. This research documents that deviations from the linear CAPM risk-return trade-off are related to, among other variables, firm size (e.g., Banz (1981)), earnings yield (e.g., Basu (1977, 1983)), leverage (e.g., Bhandari (1988)), and the ratio of a firm's book value of equity to its market value (e.g., Stattman (1980), Rosenberg, Reid, and Lanstein (1985), and Chan, Hamao, and Lakonishok (1991)). After carefully reexamining this research, a recent article by Fama and French (FF; 1992) draws two main conclusions about the cross-section of average stock returns. First, there is only a weak positive relation between average return and beta over the period 1941 to 1990, and virtually no relation over the shorter period 1963 to 1990. Second, firm size and book-to-market equity (B/M) do a good

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job of capturing the cross-sectional variation in average returns over the 1963 to 1990 period.

This article reexamines whether beta explains cross-sectional variation in average returns over the post-1940 period as well as the longer post-1926 period, and whether B/M captures cross-sectional variation in average returns over a longer 1947 to 1987 period using a somewhat different data set. We draw the following conclusions:

(1) Given the low power of the tests for a positive market risk premium, the FF evidence provides little basis for rejecting the null hypothesis of a nontrivial 6 percent per annum risk premium over the post-1940 period.
(2) When annual returns are employed in the estimation of beta, there is substantial ex post compensation for beta risk over the 1941 to 1990 period and even more over the 1927 to 1990 period. This result is robust to various ways of forming portfolios.
(3) It is likely that the FF results are influenced by a combination of survivorship bias in the COMPUSTAT database affecting the high B/M stocks' performance and period-specific performance of both low B/M, past "winner" stocks, and high B/M, past "loser" stocks.
(4) Using an alternative data source, Standard & Poor's (S&P) industry-level data from 1947 to 1987, we find that B/M is at best weakly related to average stock return. Since 1963, the relation is statistically significant using the 500 largest COMPUSTAT firms each year, but the estimated effect is about 40 percent lower than that obtained using all COMPUSTAT firms.

When we examine the average return-beta relation using annual rather than monthly data, estimates of the annual compensation for beta risk over the 1927 to 1990 period range from 8.9 to 11.7 percent for the equally weighted index and 6.2 to 8.9 percent for the value-weighted index, depending on how we form portfolios. In particular, even when we rank portfolios first on size and then on beta, as in FF, the estimated risk premia are 10.1 percent (equally weighted) and 7.3 percent (value-weighted). While all estimates are significantly positive at the 10 percent level using one-sided tests, far greater statistical significance is observed (t-statistics greater than 3) when relating *monthly* expected returns to the annual betas.

Consistent with evidence in FF and elsewhere in the literature, estimated risk premia for the 1941 to 1990 subperiod are smaller, and there is virtually no relation between beta and average return over the relatively short post-1962 period. In contrast, though, our estimates for post-1940 remain economically substantial and statistically significant as well. Although the post-1940 results are included for comparison with FF, we know of no compelling reason for emphasizing this period (or the post-1962 subperiod) over the longer 1927 to 1990 period. The significant results for a variety of portfolio groupings when betas are computed from annual data extend similar findings by Handa, Kothari, and Wasley (1989) for size portfolios.[1] However, the alternative grouping procedures used here provide stronger evidence that size, as well as beta, is needed to account for the cross-section of expected returns.

Section II examines the relation between B/M and stock returns and explores the possibility of selection biases. We suggest that the returns on the high B/M portfolios formed using the COMPUSTAT data may be spuriously inflated for at least two reasons. First, several years of the surviving firms' historical data were included when COMPUSTAT added firms to the database. Second, even in recent years, there are many firms with stock returns on the Center for Research in Securities Prices (CRSP) tapes, but financial data missing on COMPUSTAT. Evidence suggests that the frequency of such firms' experiencing financial distress is relatively high.

To explore the survivorship-bias problem in the COMPUSTAT data, we separately analyze data for firms on CRSP, firms on COMPUSTAT, and those on CRSP but not on COMPUSTAT (hereafter, the CRSP − COMPUSTAT sample). The CRSP sample does not suffer from a survivorship bias problem. Therefore, if the COMPUSTAT sample exhibits survivorship bias, we expect the CRSP − COMPUSTAT sample to include a preponderance of failing stocks. Consistent with the survivorship-bias concern, the returns for small firms on COMPUSTAT are 9 to 10 percentage points higher than those for CRSP − COMPUSTAT small firms.

In thinking about size and B/M effects, it is important to remember that these variables have emerged as the winners in a sequential process of examining and eliminating many other variables. These include the variables explicitly analyzed by FF, taken from past studies, as well as other ex post insignificant variables that never made it into the literature. Under these circumstances, classical measures of statistical significance will likely overstate the true economic significance of the variables that provide the best fit (see Lo and MacKinlay (1990b) for an interesting analysis of related issues). This is of particular concern for the B/M ratio which, unlike size, has only been examined over the relatively short 1963 to 1990 period for which data are available in machine-readable form on the COMPUSTAT tapes.[2]

Related to this concern about "data-snooping," there is good reason to doubt that findings of a positive relation between B/M and stock returns in recent decades would be robust to longer periods. The low B/M portfolios include relatively large market-capitalization "winner" stocks that have experienced above-average stock-price performance prior to their ranking on the B/M

[1] Annual betas have also been used by Jagannathan and Wang (1995) in examining the relation between average return and beta, and by Ball and Kothari (1989), Chopra, Lakonishok, and Ritter (1992), and Ball, Kothari, and Shanken (1995) in evaluating the apparent profitability of the contrarian investment strategy (see e.g., DeBondt and Thaler (1985, 1987)). In particular, Ball, Kothari, and Shanken (1995) show that there are no significant abnormal returns for a June-end initiated strategy after adjusting for beta risk.

[2] Davis (1994) is an exception that came to our attention in the final stages of this work. See footnote 13.

ratio. Although we cannot directly study the behavior of low B/M stocks before 1963, we can examine the performance of winners (see the stock-market overreaction literature including DeBondt and Thaler (1985, 1987), Chan (1988), Ball and Kothari (1989), Chopra, Lakonishok, and Ritter (1992), and Ball, Kothari, and Shanken (1995)). Winners outperformed the market prior to 1963, but underperformed over the post-1962 period. Therefore, the negative performance of low B/M stocks since 1963 may be a period-specific phenomenon. Similar remarks apply to the high B/M "loser" stocks.

Given these considerations, we believe it is useful to explore an alternative data set over a longer time period. Using industry data from the *S&P Analyst's Handbook*, we find no evidence of a monotonic relation between B/M and average return over the period 1947 to 1987 or, surprisingly, the FF post-1962 period. Our failure to find a significant positive relation is not due simply to the use of value-weighted *industry-level* data. For example, variation in the B/M ratios of the S&P industry portfolios is comparable to that of the FF B/M portfolios employing COMPUSTAT data. Moreover, the positive relation between B/M and average return is obtained even using value-weighted industry portfolios from COMPUSTAT data.

Overall, we conjecture that the B/M results are influenced by a combination of survivorship bias affecting the high B/M stocks' performance and period-specific performance of both low and high B/M, past winner and loser stocks. We recognize, however, that there are valid economic arguments for ratios like B/M and dividend or earnings yield to be positively related to expected return beyond beta (see Ball (1978) and Sharathchandra and Thompson (1993)). Indeed, when we restrict our attention to the largest 500 COMPUSTAT firms, for which survivorship biases should be relatively minor, the t-statistic on B/M is close to two. Consistent with biases in the larger COMPUSTAT universe, however, the coefficient on B/M is reduced by 40 percent. Therefore, we are not suggesting that all B/M findings are attributable to selection biases but, rather, that the current empirical case for this ratio is weaker than the previous literature would suggest.[3]

Section I provides results of testing the CAPM risk-return relation employing betas estimated using annual returns. Section II examines the effect of COMPUSTAT selection biases on the relation between B/M and stock returns. This section also explores the period-specific nature of both low and high B/M, past winner and loser stocks. Section III offers conclusions and implications for other research.

I. Beta Results

This section begins with a brief review of the FF finding that a flat relation between average return and beta over the 1941 to 1990 period cannot be rejected. We then briefly outline the rationale for employing annual returns

[3] Work in progress indicates that B/M tracks significant *time-series* variation in expected market returns.

in the estimation of beta and reexamine the return-beta relation over the post-1926 and post-1940 periods. Results are presented for cross-sectional regressions of average monthly returns on annual betas. In these regressions, portfolios are formed using a variety of aggregation procedures, including the FF approach of ranking stocks first on size and then on beta. Regardless of the portfolio-formation procedure and choice of index (i.e., equally- or value-weighted), the coefficient on beta is economically significant and, with few exceptions, the estimates are more than three standard errors above zero for the post-1940 as well as the post-1926 period.

Before proceeding, we offer a few observations on the choice of an appropriate proxy for the market portfolio. The CAPM implies that the value-weighted portfolio of *all* assets should be mean-variance efficient. It is sometimes suggested, therefore, that the value-weighted *stock* index is preferred as a market proxy over the equally weighted index. This is by no means obvious, however. If we limit our attention to the equity universe, the CAPM implies that the portfolio of stocks that has maximum correlation with the true market portfolio is efficient (see Breeden, Gibbons, and Litzenberger (1989) and related analysis by Kandel and Stambaugh (1987) and Shanken (1987)). Whether the value- or equally weighted index is a better proxy for this benchmark portfolio depends largely on whether the returns on assets other than stocks are more closely related to small- or large-firm stock returns. This is an interesting empirical question, but its examination is beyond the scope of this article. As a practical matter, though, we find that while the level of the market risk premium is lower for the lower volatility value-weighted index, inferences about the risk premium are not at all sensitive to the index employed.

A. Review of Fama and French (1992)

FF present several cross-sectional regression estimates of the risk premium associated with beta. All risk premia are based on betas estimated using monthly returns. A value-weighted market index is employed, although they state (p. 431) that estimating betas using the equally-weighted market index produces "inferences on the role of β in average returns like those reported below." When stocks are grouped on firm size alone (Table AI), their coefficient on beta for the 1941 to 1990 period is a hefty 1.45 percent per month, more than 3 standard errors above zero. However, when stocks are ranked first on size and then on beta to form 100 portfolios, the estimate is only 0.24 percent with a standard error of 0.23 percent for the same period (Table AIII). Thus, they conclude (p. 458) that "...allowing for variation in β that is unrelated to size flattens the relation between average return and β, to the point where it is indistinguishable from no relation at all."

We emphasize that, although the hypothesis that the true coefficient is zero cannot always be rejected, a range of economically significant positive values cannot be rejected either, given the large standard error. In other words, the power of the tests is very low (also see Chan and Lakonishok

(1993)). For example, the t-statistic for a null hypothesis of 50 basis points per month (6 percent per annum) would only be $(0.24 - 0.50)/0.23 = -1.13$, as compared to the t-statistic of 1.07 for the null hypothesis of zero. Alternatively, focusing on the likelihood function, since each parameter value (i.e., zero risk premium and a risk premium of 50 basis points per month) is roughly the same distance from the point estimate obtained by FF, the hypotheses are about equally likely. In a Bayesian framework, the odds for or against a 6 percent risk premium per annum, as compared to no risk premium, would thus be close to one's prior odds.[4] Insofar as the insights of modern portfolio theory are compelling a priori, these prior odds would place more weight on 6 percent, and there would be little reason to modify this weight in light of the FF evidence.

B. Return-Measurement Interval and Beta

Previous research has generally examined the risk-return relation using monthly return data (e.g., Fama and MacBeth (1973), Black, Jensen, and Scholes (1972), and FF). There are at least three reasons for reexamining the risk-return relation using longer measurement-interval returns. First, the CAPM does not provide explicit guidance on the choice of horizon in assessing whether beta explains cross-sectional variation in average returns. Since the choice of monthly returns is largely a consequence of data availability, it is of interest to explore the robustness of results to an alternative horizon. Inferences from cross-sectional regressions of average returns on beta can be sensitive to the return-measurement interval used to estimate betas because true betas themselves vary systematically and nonlinearly with the length of the interval used to measure returns (see, for example, Levhari and Levy (1977) and Handa, Kothari, and Wasley (1989)).

Second, beta estimates are biased due to trading frictions and non-synchronous trading (e.g., Ball (1977), Scholes and Williams (1977), and Cohen *et al.* (1983)), or other phenomena inducing systematic cross-temporal covariances in short-interval returns (e.g., Lo and MacKinlay (1990a) and Mech (1993)). These biases are mitigated by using longer interval return observations. An alternative approach to reduce biases in beta estimates, adopted by FF, is to estimate beta as the sum of the slopes in the regression of a portfolio's monthly return on the current and prior month's market return (Dimson (1979) and Fowler and Rorke (1983)).

Third, although it is not fully understood, there appears to be a significant seasonal component to monthly returns (see, for example, Rozeff and Kinney (1976) and Keim (1983)).[5] Using annual returns is one way, although not necessarily the best, of sidestepping the statistical complications that arise from seasonality in returns.

[4] In general, the posterior odds ratio equals the product of the prior odds ratio and the likelihood ratio when considering two simple hypotheses. More complicated analyses with composite hypotheses are, of course, possible.

[5] This goes beyond the well-known seasonal in mean returns. Shanken (1990) provides evidence of shifting variances and betas in January.

Empirically, Handa, Kothari, and Wasley (1989) have shown that the betas of small firms increase and those of large firms decrease with the return-measurement interval, substantially reducing the size effect when annual returns are employed. Moreover, the annual estimates of beta are strongly statistically correlated with both monthly and annual average returns. They document this only for size portfolios, however. Thus, their evidence is not inconsistent with that of FF. As discussed earlier, FF find support for beta using size portfolios but not alternatives such as ranking on beta alone, or first on size and then on beta. The important question that remains, therefore, is whether annual betas will continue to produce significant results when alternative portfolio grouping procedures are used. We explore this issue below.[6]

C. Relation between Average Return, Beta, and Firm Size Using Annual Betas

We present cross-sectional regression results based on annual betas for a variety of portfolio aggregation procedures: (i) grouping on beta alone; (ii) grouping on size alone; (iii) taking intersections of independent beta or size groupings; (iv) ranking first on beta and then on size within each beta group; and (v) ranking first on size and then on beta as in FF. When portfolios are formed on beta or size alone, 20 equally weighted portfolios are formed every year. For the remaining three grouping procedures, we form 100 (= 10 × 10) portfolios. Size is measured as the natural logarithm of market value of equity in millions of dollars on June 30 of each calendar year. Annual returns are measured from July 1 to June 30 of the following year, consistent with FF. Use of July of calendar year t as the first month of the annual return-measurement interval makes it very likely that book values are publicly available for most firms of all fiscal-year ends that are assigned calendar year $t - 1$ by COMPUSTAT, and thus there is very little hindsight bias (see Alford, Jones, and Zmijewski (1994)). Using the July-to-June period also mitigates biases in measured returns due to the turn-of-the-year seasonality in bid prices (see Lakonishok and Smidt (1984), Keim (1989), Bhardwaj and Brooks (1992), and Ball, Kothari, and Shanken (1995)).

The betas used to form portfolios are estimated using at least two and, when available, five years of past monthly return data regressed on the CRSP equally weighted index. Any New York Stock Exchange (NYSE) and American Stock Exchange (AMEX) firm with a beta estimate available as of July 1 of a calendar year is included in the analysis. The annual time series of postranking July-to-June returns on the beta-size-ranked "mutual funds" are then used to reestimate full-period postranking betas for use in the cross-sectional regressions, as in FF and many earlier studies going back to Black, Jensen, and Scholes (1972). All returns data taken from the CRSP

[6] Jegadeesh (1992) makes a point similar to that of FF using monthly as well as annual return data. However, his results appear to be driven by a portfolio formation procedure that yields relatively little dispersion in beta, while maximizing dispersion in size. Thus, his failure to document a positively sloped average return-beta relation may be due to a combination of low power and the errors-in-variables problem. This impression is strengthened by our results below.

tape are included. This mitigates the survivorship-bias problem affecting average returns on the portfolios. Postranking betas are estimated for each portfolio by regressing portfolio returns on an equally- or value-weighted market average of annual returns on all the stocks included in a given year.

C.1. Descriptive Statistics on Beta, Firm size, and Average Return

Table I reports the ranking betas, postranking betas estimated using the equally and value-weighted market indices, natural logarithm of portfolio firm size, and average annual return over the postranking year for the 20 beta-ranked portfolios for the entire period from 1927 to 1990 and for the post-1940 period. Consistent with the findings in previous research, ranking stocks on past beta also generates considerable spread in both equally- and value-weighted index postranking betas. Over the entire period, the postranking period equally-weighted betas range from 0.44 for Portfolio 1 to 1.51 for Portfolio 19. A similar dispersion is observed in the post-1940 betas. The value-weighted index betas range from 0.73 for Portfolio 1 to 2.24 for Portfolio 19. As expected, the portfolios' value-weighted betas are larger than the respective equally-weighted betas because the value-weighted index is dominated by relatively low volatility, large market-capitalization stocks. The greater spread in the value-weighted betas, together with the fact that the two sets of betas are almost perfectly correlated (correlation exceeds 0.99), explains the lower level of the value-weighted risk premia and the robustness of inferences to the choice of market index alluded to earlier.

As in earlier studies, firm size is inversely related to beta. The portfolios' postranking returns are increasing in beta, consistent with a positive risk-return trade-off. Over the entire period, the lowest average return of 12.4 percent is earned by Portfolio 1 with the lowest postranking beta, whereas the highest return of 21.9 percent is earned by Portfolio 17 that has the second highest postranking beta of 1.41. Thus, the spread in average returns across the 20 portfolios is about 9 percent, while the spread is a little over 1 for the equally-weighted betas and 1.51 for the value-weighted betas. Similar remarks apply to the portfolio betas and average returns over the post-1940 period. Detailed information for the remaining portfolio-grouping procedures is available on request.

C.2. Cross-sectional Regression Results with Annual Betas

We have looked at cross-sectional regressions of both monthly and annual returns on the annual betas. The monthly regression (annualized) estimates are generally comparable to, but a bit smaller than, the annual regression estimates. The (annualized) monthly standard errors are much smaller, however, and so we focus on these results.[7] This also facilitates comparison

[7] A formal test of the efficiency of the market index over an annual horizon would, of course, consider the linearity of expected return in annual betas. This hypothesis is rejected by the finding (not reported) of a significant risk-adjusted size effect. Insofar as the annual beta estimates are viewed as better estimates of the true monthly betas, our monthly results could be interpreted as tests of efficiency over the monthly horizon. See Roll and Ross (1994) and Kandel and Stambaugh (1995) for analyses of the relation between cross-sectional studies and tests of mean-variance efficiency.

with earlier studies that use monthly returns as the dependent variable. The considerable increase in statistical significance achieved in the monthly regressions is likewise observed for the mean market return. The average monthly return on the equally-weighted index is 1.30 percent (t-statistic 4.55) for the 1927 to 1990 period and 1.28 percent (t-statistic 5.76) for the 1941 to 1990 subperiod. The corresponding numbers for the annual measurement interval are 17.9 percent (t-statistic 3.08) and 17.2 percent (t-statistic 4.38).

Each month, we estimate the following cross-sectional regression of portfolio returns on beta, size, or beta and size:

$$R_{pt} = \gamma_{0t} + \gamma_{1t}\beta_p + \gamma_{2t}\mathrm{Size}_{pt-1} + \varepsilon_{pt} \tag{1}$$

where R_{pt} is the equally-weighted buy-and-hold return on portfolio p for month t; β_p is the full-period postranking beta of portfolio p;[8] $Size_{pt-1}$ is the natural log of the average market capitalization on June 30 of year t of the stocks in portfolio p; γ_{0t}, γ_{1t}, and γ_{2t} are regression parameters; and ε_{pt} is the regression error. We obtain similar results for value-weighted portfolio returns.

The cross-sectional regression results using the equally-weighted index betas are presented in Table II for the five different portfolio aggregation procedures.[9] Results based on the value-weighted index betas are similar and available on request. The average estimated coefficients and associated t-statistics are reported in Panel A of Table II for the period 1927 to 1990, and Panel B for the 1941 to 1990 subperiod. The tenor of the results is unaffected when we make Newey-West adjustments for serial correlation in the time series of estimated coefficients. The t-statistics under the γ_0 estimates test for the difference between the intercept and the average risk-free rate of return. The risk-free T-bill rates are taken from Ibbotson and Sinquefield (1989). The average adjusted R^2s of the annual cross-sectional regressions reflect correlation between the independent variables and both the expected and surprise components of returns, and are reported only as descriptive statistics.

Looking at the results for beta alone in Panel A, the highest risk premium, 1.02 percent (per month), is indeed obtained using size portfolios, whereas the lowest estimate, 0.54 percent, is derived by sorting solely on past beta. Although somewhat surprising at first glance, the relatively weaker results based on beta sorting begin to make sense when we note that the spread in post-ranking beta is greater when portfolios are formed on size (1.07 using beta-sorted portfolios as compared to 1.35 using size-sorted portfolios). Rankings that involve size appear to capture current information about firms that

[8] We also use postranking period beta estimates from the 1927 to 1990 period in the post-1940 cross-sectional regressions. Using postranking betas from the post-1940 period yields similar results. The point estimates of the risk premium are generally slightly greater using the post-1940 period betas. Results are also similar when we use betas estimated with just the year of the given cross-sectional regression excluded.

[9] Portfolio rankings for 1927 are based on 18-month estimates of beta from January 1926 through June 1927.

Table I

Preranking and Postranking Betas, Firm Size, and Average Returns on 20 Beta-ranked Portfolios over the Periods 1927 to 1990 and 1941 to 1990.

In Panel A, portfolios are formed each year on June 30 from 1927 to 1989 by ranking all stocks for which a beta estimate, preranking beta, can be obtained using the Center for Research in Securities Prices (CRSP) monthly return data on New York Stock Exchange and American Stock Exchange stocks. The preranking beta for an individual stock is estimated by regressing 24 to 60 monthly portfolio returns ending in June of each year on the CRSP equally-weighted portfolio. Each year 20 equally weighted portfolios are constructed. Portfolio 1 in each year consists of the smallest 5 percent preranking beta stocks, whereas Portfolio 20 consists of the largest 5 percent preranking beta stocks. Portfolios are rebalanced every year. An annual, equally-weighted buy-and-hold return on each portfolio over the period July 1 of year t to June 30 of year $t + 1$ is calculated. If a firm did not survive the 12-month July-to-June period, then the return until the delisting month plus any liquidating dividend as reported on the CRSP tape are used as the return for that stock for the year. A time series of 64 postranking-year returns for each portfolio from year 1927 to 1990 is constructed. Postranking beta for each portfolio is the slope coefficient from a time-series regression of annual postranking returns on an equally weighted market portfolio consisting of the 20 preranking-beta portfolios. Size is the natural logarithm of the average market value of equity in millions of dollars on June 30 of each year, of the stocks in a portfolio. The simple average of size over the 64 years is reported in the table as Ln(Size). The postranking return for each portfolio is a simple average of the time series of 64 annual returns from 1927 to 1990. The above procedures are repeated for the 1941 to 1990 period in Panel B.

		Postranking Beta			
Portfolio	Preranking Beta	Eq. Wt.	V. Wt.	Ln(Size)	Postranking Return
		Panel A. 1927 to 1990			
1	0.20	0.44	0.73	5.45	12.4
2	0.38	0.59	0.96	5.75	13.4
3	0.48	0.75	1.17	5.72	15.0
4	0.56	0.68	1.09	5.69	15.3
5	0.63	0.72	1.15	5.59	15.3
6	0.70	0.75	1.20	5.31	16.1
7	0.76	0.80	1.28	5.26	17.1
8	0.81	1.05	1.62	5.15	18.3
9	0.87	0.82	1.30	5.10	16.9
10	0.93	0.91	1.43	4.92	18.0
11	0.99	0.97	1.51	4.82	18.1
12	1.04	1.14	1.72	4.72	19.0
13	1.10	1.19	1.82	4.49	20.9
14	1.17	1.10	1.70	4.47	18.4
15	1.24	1.39	2.09	4.30	21.6
16	1.32	1.28	1.92	4.12	20.4
17	1.42	1.41	2.12	3.93	21.9
18	1.54	1.30	1.96	3.80	20.4
19	1.71	1.51	2.24	3.55	20.7
20	2.17	1.19	1.81	3.27	18.1

Table I—*Continued*

Portfolio	Preranking Beta	Postranking Beta Eq. Wt.	Postranking Beta V. Wt.	Ln(Size)	Postranking Return
		Panel B. 1941 to 1990			
1	0.20	0.48	0.71	5.86	13.0
2	0.38	0.54	0.80	6.08	13.8
3	0.48	0.61	0.88	6.06	14.7
4	0.56	0.68	0.99	6.02	16.0
5	0.63	0.76	1.05	5.91	15.9
6	0.70	0.80	1.11	5.62	15.4
7	0.76	0.81	1.15	5.58	17.5
8	0.81	0.89	1.24	5.47	16.7
9	0.87	0.92	1.25	5.37	17.4
10	0.93	1.01	1.36	5.24	17.8
11	0.99	1.01	1.36	5.17	17.2
12	1.04	0.99	1.31	5.00	17.1
13	1.10	1.11	1.47	4.83	19.2
14	1.17	1.08	1.47	4.79	17.6
15	1.24	1.22	1.61	4.63	18.4
16	1.32	1.25	1.63	4.46	19.1
17	1.42	1.46	1.86	4.26	19.6
18	1.54	1.33	1.72	4.19	18.5
19	1.71	1.47	1.86	3.95	19.4
20	2.17	1.58	1.97	3.63	18.5

is missed by the "stale" (and noisy) historical betas used in forming beta-ranked portfolios. The important point, however, is that regardless of the portfolio formation procedure, the point estimates of risk premia are substantial in magnitude and fairly consistent across grouping methods. The t-statistic for the beta rankings is close to 2, while all others exceed 3.[10]

Panel B of Table II presents similar results for the 1941 to 1990 period. The risk-premium estimates range from 0.36 percent using the beta-size independently ranked portfolios to 0.76 percent employing the size-ranked portfolios. Thus, the estimated risk premia for the post-1940 subperiod are quite a bit lower, but still economically important in magnitude. Again, all but one t-statistic exceeds 3, in part reflecting the lower volatility of the 1941 to 1990 period. Even the size-then-beta rankings of FF produce a substantial risk premium of 0.5 percent (t-statistic 3.12) for this period. As in earlier studies, the γ_0 estimates are positive and often reliably greater than the average risk-free rate, which was 3.7 percent for the full period and 4.4 percent for the post-1940 period.

Consistent with the results in previous research, when size alone is included in the cross-sectional regression (1), the γ_2 coefficient on size is

[10] Chan and Lakonishok (1993) and Jagannathan and Wang (1995) also report a reliably positive coefficient on beta over comparable time periods.

Table II

Cross-sectional Regressions of Monthly Returns on Beta and Firm Size: Equally-weighted Market Index

Time-series averages of estimated coefficients from the following monthly cross-sectional regressions from 1927 to 1990 (Panel A) and from 1941 to 1990 (Panel B), associated t-statistics, and adjusted R^2s are reported (with and without Size being included in the regressions).

$$R_{pt} = \gamma_{0t} + \gamma_{1t}\beta_p + \gamma_{2t}Size_{pt-1} + \varepsilon_{pt}$$

where R_{pt} is the buy-and-hold return on portfolio p for one month during the year beginning from July 1 of year t to June 30 of year $t+1$; β_p is the full-period postranking beta of portfolio p and is the slope coefficient from a time-series regression of annual buy-and-hold postranking portfolio returns on the returns on an equally-weighted portfolio of all the beta-size portfolios; $Size_{pt-1}$ is the natural log of the average market capitalization in millions of dollars on June 30 of year t of the stocks in portfolio p; γ_{0t}, γ_{1t}, and γ_{2t} are regression parameters; and ε_{pt} is the regression error. Portfolios are formed in five different ways: (i) 20 portfolios by grouping on beta alone; (ii) 20 portfolios by grouping on size alone; (iii) taking intersections of 10 independent beta or size groupings to obtain 100 portfolios; (iv) ranking stocks first on beta into 10 portfolios and then on size within each beta group into 10 portfolios; and (v) ranking stocks first on size into 10 portfolios and then on beta within each size group into 10 portfolios. When ranking on beta, the beta for an individual stock is estimated by regressing 24 to 60 monthly portfolio returns ending in June of each year on the CRSP equally-weighted portfolio. The t-statistic below the average γ_0 value is for the difference between the average γ_0 and the average risk-free rate of return over the 1927 to 1990 or 1941 to 1990 period. The t-statistics below γ_1 and γ_2 are for their average values from zero.

Portfolios	γ_0 t-statistic	γ_1 t-statistic	γ_2 t-statistic	Adj. R^2
	Panel A. 1927 to 1990			
20, beta ranked	0.76	0.54		0.32
	3.25	1.94		
	1.76		−0.16	0.27
	2.48		−2.03	
	1.68	0.09	−0.14	0.35
	3.82	0.41	−2.57	
20, size ranked	0.30	1.02		0.32
	−0.18	3.91		
	1.73		−0.18	0.33
	3.70		−3.50	
	−0.05	1.15	0.03	0.40
	−0.85	4.61	0.76	
100, beta and	0.63	0.66		0.07
size ranked	1.67	3.65		
independently	1.72		−0.17	0.09
	3.92		−3.71	
	1.21	0.40	−0.11	0.12
	3.74	2.63	−2.83	
100, first beta,	0.57	0.73		0.12
then size ranked	1.43	3.49		
	1.73		−0.18	0.12
	3.70		−3.48	
	1.12	0.45	−0.10	0.16
	3.43	2.83	−2.65	

Table I—*Continued*

Portfolios	γ_0 t-statistic	γ_1 t-statistic	γ_2 t-statistic	Adj. R^2
		Panel A. 1927 to 1990		
100, first size,	0.58	0.71		0.12
then beta ranked	1.54	3.39		
	1.72		−0.18	0.12
	3.66		−3.43	
	1.14	0.43	−0.10	0.16
	3.78	2.58	−2.87	
		Panel B. 1941 to 1990		
20, beta ranked	0.95	0.36		0.33
	4.69	1.63		
	1.61		−0.10	0.28
	2.31		−1.49	
	1.70	−0.03	−0.10	0.36
	3.49	−0.18	−2.00	
20, size ranked	0.54	0.76		0.32
	0.82	3.69		
	1.73		−0.14	0.34
	4.03		−3.28	
	0.32	0.85	0.02	0.44
	−0.15	4.35	0.56	
100, beta and	0.87	0.42		0.07
size ranked	2.95	3.33		
independently	1.70		−0.13	0.10
	4.29		−3.40	
	1.43	0.20	−0.10	0.13
	4.63	2.12	−2.89	
100, first beta,	0.82	0.49		0.12
then size ranked	2.76	3.07		
	1.73		−0.14	0.13
	3.99		−3.22	
	1.35	0.26	−0.09	0.17
	4.35	2.20	−2.78	
100, first size	0.81	0.49		0.12
then beta ranked	2.75	3.12		
	1.71		−0.13	0.13
	3.96		−3.17	
	1.32	0.27	−0.09	0.17
	4.39	2.38	−2.77	

generally reliably negative. Alternative grouping procedures have relatively little effect on the size coefficient. Not surprisingly, given the strong correlation between size and beta, the significance of beta and size is reduced over the 1927 to 1990 and 1941 to 1990 periods when both are included as independent variables in the cross-sectional regressions. As in Handa, Kothari, and Wasley (1989), beta continues to dominate size for size-ranked portfolios. Most t-statistics still exceed 2 in magnitude, however, for both beta and size.[11,12] Note that since beta is measured with error and is fixed over the full period, size could in part be proxying for variation in the true beta that is missed by the estimate. In any event, the main point to take away from Table II is that there is indeed evidence of a positive simple relation between beta and average monthly return for a variety of asset portfolios. Risk premium estimates (not reported) from cross-sectional regressions of annual returns on beta are typically somewhat greater than 12 times the monthly estimates, and all are significant at the 10 percent level in one-sided tests. These results are available on request.

In assessing the economic significance of the size effect, it is important to remember that the implied deviations from the "beta-only" model are *not* equal to the multiple regression γ_2 times (log) size. Rather, these deviations equal γ_2 times the residuals from an auxiliary cross-sectional regression of size on beta and a constant. Since beta and size are strongly negatively correlated, these residuals are relatively small. As a result, the estimated deviations never exceed 3 percent and average less than 1 percent across all of our portfolios, whose average returns range from 8.1 to 38.2 percent per annum. Alternatively, the cross-sectional correlations between the expected returns predicted by the beta-only and beta-size models range from 0.96 to 1.00 for the five grouping procedures. These measures indicate that the *incremental* contribution of size, while not unimportant, is not large either.

D. Summary

FF regress monthly returns on betas estimated using monthly returns. They fail to reject the null hypothesis of zero risk premium. Following previous research documenting the sensitivity of Fama-MacBeth regression results to return-measurement interval employed for estimating betas, we report results using annual betas. Results based on annual betas for a variety of portfolio aggregation procedures reveal economically and statistically significant compensation for beta risk. These findings are robust to: full post-1927 period or 1941 to 1990 subperiod analysis; the use of equally- and value-

[11] As demonstrated in Shanken (1992), provided that the true coefficient on beta in nonzero, "t-statistics" for the null hypothesis of no size effect are biased upward due to measurement error in the betas. T-statistics for the null hypothesis of no risk-premium remain asymptotically valid, however.

[12] Some differences in experimental design between our study and Handa, Kothari, and Wasley (1989) should be noted. The time period examined in Handa, Kothari, and Wasley (1989) is 1941 to 1982; they reestimate beta every year using data over the past 15 years and they use January-to-December returns.

weighted index betas; the use of equally- and value-weighted portfolios; and forming portfolios by ranking on beta or size alone, or independently ranking on beta and size, or ranking on beta then size, or size then beta.

II. Selection Biases and Book-to-Market

This section begins by replicating some of the FF analysis using B/M equity. The main objective is to demonstrate that although we use slightly different variable definitions and sample selection procedures, there is still a near-monotonic relation between B/M and average returns over the 1963 to 1989 period using COMPUSTAT data. We then explore the possibility of selection biases affecting the B/M results. This is done using the COMPUSTAT data and S&P industry-level data.

A. B/M Equity and Average Returns: COMPUSTAT Data

To provide some continuity with the FF (1992, 1993) studies, we begin this subsection by presenting results for 13 equally weighted B/M portfolios. Each year, from 1963 to 1989, all NYSE-AMEX firms with returns on the CRSP monthly tapes and COMPUSTAT book value of equity data are ranked on the ratio of book equity to the market value of equity. As in FF, returns are measured beginning on July 1 to ensure that the accounting data for the previous fiscal year are publicly available for most of the firms. Book equity is measured at the end of a firm's fiscal year. Market equity in the denominator of the B/M ratio is also measured at the end of the fiscal year, although similar results are obtained using the prior December-end market equity. We neither include firms from the CRSP National Association of Securities Dealers Automated Quotation system (NASDAQ) tape, nor exclude financial firms. FF exclude financial firms since they also examine leverage variables, which might have different interpretations for financial and nonfinancial firms.

Companies with negative values of book equity are grouped together in Portfolio −1. Portfolios 1A and 1B contain firms in the lowest and next-lowest 5 percent of the (positive) B/M rankings, while Portfolios 10B and 10A consist of the highest and next-highest 5 percent. Of course, the set of firms in any given portfolio can change from year to year. Table III presents, for each portfolio, the mean and standard deviation of B/M equity and return, average market capitalization, as well as Jensen alphas, betas, and adjusted R^2s of excess-return time-series regressions of annual buy-and-hold portfolio returns on the equally-weighted market index.

The average B/M ratios in Table III range from 0.18 to 2.80 for the positive B/M portfolios, similar to the range in FF (Table IV, Panel A). Market capitalization is inversely related to B/M, but even the highest B/M portfolio's average size, $155 million, corresponds to that of the median NYSE-AMEX firm over the post-1962 period. As in FF, average return increases monotonically with B/M, except for the negative B/M portfolio, which has

Table III

Average Return, Size, Alpha, Beta, and Adjusted R^2 from Excess-return Time-series Regressions for Portfolios Constructed by Ranking COMPUSTAT Stocks on Book-to-Market Equity; 1963 to 1989

Each year, from 1963 to 1989, all New York Stock Exchange and American Stock Exchange firms with returns on the CRSP monthly tapes and book value of equity data on COMPUSTAT are ranked on the ratio of book equity to the market value of equity (B/M). The market equity in the denominator of the B/M ratio is measured at the end of the fiscal year. Companies with negative values of book equity are grouped together in Portfolio 0. Portfolios 1A and 1B contain firms in the lowest and next lowest 5 percent of the B/M rankings, while Portfolios 10B and 10A consist of the highest and next highest 5 percent. The composition of each portfolio changes from year to year. Equally-weighted buy-and-hold annual returns on the portfolios are calculated from July 1 of year t to June 30 of year $t + 1$ when the B/M equity is calculated using data at the end of fiscal year $t - 1$. If a firm is delisted over the 12-month period beginning on July 1, then return until the delisting month plus any liquidating dividend reported on the CRSP tape are used as the return on that stock for the year. To calculate the past return, first the average annual return over a 5-year period ending in June of year t for each security is calculated (if returns over the past 5 years are not available, then average annual return is calculated using a minimum of the past 2 years' returns). Then, for each year t and for each portfolio, an equally-weighted portfolio average past return is calculated. Finally, portfolio returns are averaged across the years to obtain the past return as reported below. Average size is market capitalization in millions of dollars on December 31 of year t of the stocks in each portfolio, averaged over the years 1963 to 1989. Alpha, Beta, and Adjusted R^2 are from time-series regressions of annual buy-and-hold portfolio returns, in excess of the risk-free rate, on the excess returns on the equally-weighted market index from 1963 to 1989.

Portfolio	Book-to-Market Std. Dvn.	Return Std. Dvn.	Past Return	Avg. Size	Alpha t-Statistic	Beta t-Statistic	Adj. R^2
−1	−1.39	0.29	0.07	69	0.102	1.47	61.0
	1.43	0.51			1.52	6.21	
1A	0.18	0.10	0.29	1328	−0.060	1.05	86.0
	0.06	0.30			−2.62	12.70	
1B	0.30	0.11	0.28	1159	−0.047	0.99	91.2
	0.10	0.28			−2.83	16.47	

Table III—*Continued*

Portfolio	Book-to-Market Std. Dvn.	Return Std. Dvn.	Past Return	Avg. Size	Alpha t-Statistic	Beta t-statistic	Adj. R^2
2	0.41	0.12	0.25	852	−0.033	0.93	92.7
	0.15	0.26			−2.28	18.18	
3	0.54	0.13	0.22	987	−0.027	1.00	91.0
	0.21	0.28			−1.54	16.28	
4	0.66	0.14	0.20	664	−0.016	0.94	93.9
	0.25	0.26			−1.25	20.04	
5	0.77	0.15	0.18	719	−0.009	1.02	94.3
	0.30	0.28			−0.64	20.93	
6	0.89	0.16	0.16	695	0.005	0.93	96.5
	0.34	0.25			0.52	26.78	
7	1.03	0.18	0.16	550	0.019	0.99	96.2
	0.40	0.27			1.72	25.49	
8	1.21	0.18	0.14	435	0.032	0.85	94.4
	0.47	0.24			2.77	20.97	
9	1.49	0.20	0.12	283	0.039	0.96	94.8
	0.60	0.26			3.21	21.72	
10A	1.87	0.22	0.10	195	0.051	1.13	89.5
	0.77	0.32			2.40	14.89	
10B	2.80	0.23	0.07	155	0.051	1.22	84.7
	1.20	0.35			1.80	12.05	

Table IV

Average Return, Beta, and Size of 12 Market-value-ranked Portfolios: CRSP, COMPUSTAT, and CRSP − COMPUSTAT Samples from 1963 to 1989

The CRSP, COMPUSTAT, and CRSP − COMPUSTAT samples consist of 63,581 firm-year observations on CRSP, 46,021 on COMPUSTAT, and 17,568 that appear on CRSP, but not COMPUSTAT, from 1963 to 1989. The number of firms in the COMPUSTAT sample ranges from 352 in 1963 to between 1900 and 2200 during 1971 to 1989. The number of firms in the CRSP − COMPUSTAT sample ranges from 1694 in 1963 to between 500 and 300 from 1971 to 1989. The CRSP sample represents the sum of the COMPUSTAT and CRSP − COMPUSTAT samples. Average portfolio market values, means and standard deviations of return, and market betas for 12 portfolios formed on size rankings of individual securities are reported below. The rankings are done separately in each year for the CRSP, COMPUSTAT, and CRSP − COMPUSTAT samples. Portfolios 1A and 1B represent the smallest 5 percent and next smallest 5 percent market capitalization stocks. Similarly, Portfolios 10B and 10A represent the largest 5 percent and next largest 5 percent stocks. Portfolios are equally-weighted. Betas are estimated by regressing the time series of annual buy-and-hold portfolio returns from 1963 to 1989 on the equally-weighted market return.

		Return		
Portfolio	Size	Avg.	Std. Dvn.	Beta
		Panel A. CRSP		
1A	3.5	0.22	0.44	1.51
1B	7.2	0.20	0.38	1.36
2	13.0	0.17	0.34	1.23
3	23.8	0.17	0.32	1.17
4	39.3	0.17	0.29	1.07
5	62.9	0.15	0.27	1.01
6	104.3	0.16	0.27	1.02
7	182.9	0.16	0.25	0.92
8	339.1	0.14	0.23	0.84
9	715.8	0.14	0.21	0.73
10A	1445.1	0.12	0.19	0.64
10B	6435.0	0.11	0.17	0.50
		Panel B. COMPUSTAT		
1A	5.8	0.23	0.42	1.44
1B	11.5	0.22	0.39	1.40
2	19.8	0.18	0.33	1.22
3	35.5	0.17	0.32	1.18
4	57.2	0.16	0.30	1.08
5	93.1	0.16	0.27	1.00
6	153.4	0.16	0.28	1.03
7	262.4	0.16	0.25	0.88
8	461.7	0.13	0.23	0.80
9	913.0	0.13	0.21	0.68
10A	1750.4	0.12	0.19	0.62
10B	7832.2	0.11	0.17	0.50

Table IV—*Continued*

Portfolio	Size	Return		Beta
		Avg.	Std. Dvn.	
Panel C. CRSP – COMPUSTAT				
1A	3.3	0.14	0.44	1.42
1B	7.0	0.12	0.40	1.32
2	13.0	0.14	0.35	1.23
3	22.4	0.17	0.31	1.12
4	34.6	0.14	0.25	0.89
5	50.6	0.13	0.24	0.88
6	76.1	0.12	0.26	0.94
7	119.2	0.14	0.25	0.91
8	205.2	0.13	0.22	0.81
9	406.8	0.12	0.21	0.75
10A	807.8	0.13	0.21	0.69
10B	3606.1	0.12	0.18	0.53

the highest return; nearly 30 percent per year, with a standard deviation in excess of 50 percent and a beta of 1.47. Since there is little cross-sectional variation in beta for Portfolios 1A through 10B, the Jensen alpha abnormal return estimates are also closely related to the B/M ratio.

B. Exploring Selection Biases

In this section we first discuss how COMPUSTAT has included firms on its tapes over the years. This discussion suggests potential sample selection or survivorship biases in COMPUSTAT data.[13] To further explore these biases, we report results of separately analyzing the samples of firms on the CRSP tape, on COMPUSTAT, and on CRSP but not on COMPUSTAT (the CRSP – COMPUSTAT sample). If the COMPUSTAT sample exhibits a survivorship bias, we expect the CRSP – COMPUSTAT sample to include a preponderance of failing stocks. This provides indirect evidence consistent with an upward bias in the average returns for the high B/M portfolios. Finally, we present some indirect evidence that the positive relation between B/M and returns is period specific.

[13] Banz and Breen (1986) explore selection biases in COMPUSTAT data in examining the anomalous performance of extreme earnings-yield portfolios. In a different context, Chari, Jagannathan, and Ofer (1988) control for survivorship by restricting the sample of firms in their study to only those firms that were on a COMPUSTAT tape dated prior to their analysis period. Several recent studies have followed up on our arguments and obtained results consistent with survivorship bias. Breen and Korajczyk (1993) conclude that more than half of the B/M effect documented in FF is due to survivorship bias. La Porta (1993) finds that the B/M effect is weakened after partially controlling for survivorship bias. While the remaining effect is significant, we doubt that all bias has been eliminated. A recent study by Davis (1994) that is free of survivorship bias finds a statistically significant B/M effect over the period 1940 to 1963. The estimated effect and t-statistic are only about half that obtained by FF, however.

B.1. COMPUSTAT Selection Procedures

There are at least two aspects of COMPUSTAT selection procedures that appear to impart a survivorship bias in COMPUSTAT data. First, based on our conversations with COMPUSTAT officials, it appears that prior to 1978 COMPUSTAT routinely included *historical* financial statement information for as many years as available going back to 1946 on firms added to their database in a given year. In 1978 COMPUSTAT launched a major database expansion project from about 2700 NYSE-AMEX and high-profile NASDAQ companies to about 6000 companies. Five years of annual data, i.e., data going back to 1973, were added for most of these firms. Consider a firm in 1973, with substantial assets but relatively poor earnings prospects, considerable uncertainty, and correspondingly low market value. Suppose this high B/M firm performed poorly over the next five years, with earnings even lower than expected and negative stock returns. If this company was not on COMPUSTAT to begin with, it might not be added to the database in 1978, either because of delisting or failure to meet minimum asset or market value requirements. On the other hand, if this high B/M company performed unexpectedly well over the next five years, it could very well be included in 1978.[14] The high ex post returns over this period and the high initial B/M ratio could give the appearance of a positive relation between B/M and *expected* returns even when no such relation existed.

Second, even in recent years, COMPUSTAT's procedures for inclusion of financial data on firms favor surviving firms. This is important because we would expect that the survivorship-bias story just told (i.e., the first reason) is more relevant in the early start-up years of COMPUSTAT. Yet, FF report significant B/M results in both the 1963 to 1976 and 1977 to 1990 subperiods. An additional source of survivorship bias may help explain this finding.

Alford, Jones, and Zmijewski (1994) report that firms experiencing unfavorable economic conditions have a high propensity to delay the filing of their financial statements to the Securities and Exchange Commission (SEC) and the stock exchanges. Eventually some of these firms' stocks are delisted from the exchanges because of failure to comply with disclosure requirements, thin trading activity, or financial distress. Financial statement information for these firms during the distress period is less likely to be obtainable and included in the COMPUSTAT database. Indeed, of the 6433 CRSP firm-year observations on firms that were on COMPUSTAT for some earlier period but were removed from COMPUSTAT or do not have book value data on COMPUSTAT, 2009 (i.e., 31 percent of 6433) were subsequently delisted from the stock exchanges because of financial distress, exchange-forced delistings, and SEC-forced delistings. The 31 percent financial-distress frequency in this sample is more than ten times as much as that for a typical firm on CRSP. The median market capitalization of the 2009 firms, at the beginning of the

[14] Banz and Breen's (1986, p. 792) assessment of COMPUSTAT's selection procedures is similar: "For example, among all firms that begin public trading in a year, only the successful ones will be added to the current COMPUSTAT at some time in the future."

year in which they are delisted for financial-distress reasons, is only $12 million.

Some of the firms that delay filing of financial statements due to financial distress subsequently improve their performance. They then file their previously delayed financial statements and COMPUSTAT incorporates data on these firms. Thus, COMPUSTAT's selection procedures may induce an upward bias in the average return on COMPUSTAT firms, particularly the high B/M firms, even in the later period.[15]

B.2. CRSP, COMPUSTAT, and CRSP – COMPUSTAT Samples: Descriptive Results

Ideally, we would like to examine the relation between B/M and average returns separately for firms on and not on COMPUSTAT. Since accounting data for the latter firms are not readily available, this is not feasible. We can provide some indirect evidence on the potential impact of the selection bias, however, by analyzing returns for the CRSP, COMPUSTAT, and CRSP – COMPUSTAT samples. Over the 1963 to 1989 period, there are 63,581 NYSE-AMEX firm-year observations on CRSP. Of these, 46,021 appear on COMPUSTAT, leaving 17,568 in the CRSP – COMPUSTAT sample.[16] The COMPUSTAT sample is assembled by combining data on the COMPUSTAT Expanded Annual Industrial and Full Coverage file and the COMPUSTAT Research Annual Industrial file. The former contains historical data on firms that are currently traded on the NYSE, AMEX, or NASDAQ over the counter (OTC) exchanges. The COMPUSTAT Research tape contains historical data on firms until they either were delisted or did not survive due to bankruptcies or corporate control transactions. The number of NYSE-AMEX firms on COMPUSTAT is low in the initial few years since 1963, but it increases rapidly from 1967. The number increases from 352 in 1963 to between 1900 and 2200 from 1971 to 1989. As expected, the number of NYSE-AMEX firms in the CRSP – COMPUSTAT sample declines, from 1694 in 1963 to between 500 and 300 from 1971 to 1989.

Consistent with the survivorship bias (or COMPUSTAT selection bias) stories, we find that the average annual return on the COMPUSTAT sample, 15.8 percent, exceeds that on the CRSP – COMPUSTAT sample, 13.9 percent, by 1.9 percent. The t-statistic, 1.45, for the difference is significant at the 10 percent level using a one-sided test. The difference in average returns

[15] Although we provide no direct evidence, the low B/M stocks' poor performance might be related to merger-and-takeover activity. While B/M data on failed takeover targets are available on COMPUSTAT, the database does not always include financial data on the successfully acquired firms for the most recent year. The failed targets experience abnormal price declines when the takeover bids fail (e.g., Bradley, Desai, and Kim (1983)). Since the B/M ratio of takeover targets is low due to the price run-up that they initially experience, the tendency to include failed targets on COMPUSTAT, but not the successful ones, downward biases the low B/M stocks' performance.

[16] Book value of equity data is not available on COMPUSTAT prior to 1963, even though data on earnings and a few other selected variables are available since 1946.

is about the same over two subperiods: 1.75 percent over 1963 to 1975 and 2.04 percent over 1976 to 1989. It cannot be explained by differences in beta, which are small. The higher average return for COMPUSTAT firms is particularly interesting considering that the average annual market capitalization of equity of the COMPUSTAT sample, $657 million, is about twice that of the CRSP – COMPUSTAT sample, $317 million. Absent a survivorship bias in the COMPUSTAT sample, one expects the smaller sized CRSP – COMPUSTAT firms to earn larger raw returns, on average, than the COMPUSTAT sample firms.

The survivorship bias story predicts that distressed firms on COMPUSTAT with low market value (and high volatility) will have higher subsequent returns than similar-sized firms that are on CRSP but not on COMPUSTAT. Table IV presents market values, means and standard deviations of return, and market betas for 12 portfolios formed on size rankings of individual securities. The rankings are done separately for the entire CRSP universe as well as the COMPUSTAT and CRSP – COMPUSTAT subsets. Portfolios 1A and 1B represent the smallest 5 percent and next smallest 5 percent market-capitalization stocks. Similarly, Portfolios 10B and 10A represent the largest 5 percent and next largest 5 percent stocks. Since we do not isolate the distressed firms from other more healthy firms of a given size, the return differences observed between the COMPUSTAT and CRSP – COMPUSTAT samples probably understate any survivorship bias that may be present. We expect the proportion of distressed firms to be higher within extremely small firm portfolios, however, and thus there should be both more signal (bias) and less noise (dilution by healthy firms) in this case.

Although the measures of risk are quite similar, average returns for the smallest COMPUSTAT size portfolios are indeed much higher than the corresponding CRSP – COMPUSTAT portfolio returns. This is true despite the fact that the smallest COMPUSTAT firms are somewhat larger in market value than the corresponding CRSP – COMPUSTAT portfolio. For example, average returns on portfolios 1A and 1B are 23 and 22 percent, respectively, for firms on COMPUSTAT, as compared to 14 and 12 percent, respectively, for the corresponding CRSP – COMPUSTAT portfolios. The average returns on Portfolios 1A and 1B for firms on COMPUSTAT are reliably greater than those on the corresponding CRSP – COMPUSTAT portfolios. Differences in returns for the larger size portfolios are less dramatic, but still nontrivial. For example, average annual return on the COMPUSTAT firm-size deciles 4 to 7 is 16 percent, whereas CRSP – COMPUSTAT deciles 4 to 8, which consist of marginally smaller size firms, earn 12 to 14 percent annual return. There is thus a 2 to 4 percent difference in average annual returns between these low-to-medium-capitalization stocks of the COMPUSTAT and CRSP – COMPUSTAT samples. The potential for a survivorship bias affecting COMPUSTAT stocks therefore does not appear limited to the extremely small firms. Overall, results in Table IV are consistent with a selection bias or survivorship bias affecting average returns on the COMPUSTAT high B/M stocks.

It is conceivable that the lower average return on the CRSP − COMPUSTAT sample is due to COMPUSTAT systematically excluding certain kinds of securities that are included by CRSP. We therefore repeated the analysis in this section, excluding all securities other than "Ordinary Common Shares." The excluded securities are Certificates, American Depository Receipts (ADRs), Share Beneficial Interests (SBIs), Voting Trust Shares, Capital Shares, and Units that include Depository units, Units of Beneficial Interests, Units of Limited Partnership Interest, and Depository Receipts, etc. These results are very similar to those reported in the article and are available upon request. For example, the small capitalization stocks in the CRSP − COMPUSTAT sample continue to earn about 10 percent less on average than those in the COMPUSTAT sample.

B.3. B/M and Size Factor Results

This section examines whether the differences in small-firm returns noted above are explained by systematic differences in the B/M ratios for small firms on and off of COMPUSTAT. Although we cannot test this directly due to lack of B/M data for the CRSP − COMPUSTAT sample, we consider an indirect test. Fama and French (1993) show that the cross-sectional explanatory power of B/M equity and size is also captured by multiple regression coefficients on B/M and size "factors." We construct similar factors and include these along with the market index in three-factor (annual) excess-return time-series regressions for the size portfolios.

To construct size and B/M equity factors, we independently rank all the COMPUSTAT stocks into five size portfolios and five B/M portfolios each year. Since we do not have B/M data on the CRSP − COMPUSTAT sample, we cannot use the CRSP sample to construct the size and B/M factors. We exclude the negative B/M equity stocks in forming the quintile portfolios. The size factor is the difference, each year, between the simple average return on the five portfolios within the smallest market-capitalization quintile (i.e., the smallest firm quintile that is split into five portfolios on the basis of low to high B/M) minus the simple average return on the five portfolios within the largest market-capitalization quintile.[17] The B/M factor is constructed similarly as the difference between the average return on the five portfolios within the highest B/M quintile minus the average return on the five portfolios within the lowest B/M quintile. As in Fama and French (1993), the B/M and size factors are only weakly correlated (correlation −0.20). The size factor has a correlation coefficient of 0.69 with the equally-weighted market, whereas the B/M factor has a correlation of −0.26 with the market.

Results for excess return time-series regressions of 12 size-portfolio returns on the equally weighted market and the size and B/M equity factors are reported in Table V. The intercepts for the COMPUSTAT size portfolios are

[17] Since stocks are ranked *independently* on size and B/M, the five B/M portfolios within the smallest market capitalization quintile are unbalanced. Hence, the average of the returns on these five portfolios within the smallest size quintile would be different from the equally weighted return on the smallest size quintile portfolio.

Table V

Results for Excess-Return Time-series Regressions of 12 Size-portfolio Returns on the Equally-weighted Market and the Size and Book-to-Market-Equity Factors: 1963 to 1989

Estimated coefficients from the following excess-return time-series regressions using annual-return data from 1963 to 1989, associated t-statistics below the parameter estimates, and adjusted R^2s are reported for the CRSP, COMPUSTAT, and CRSP − COMPUSTAT samples:

$$R_{pt} = \alpha_0 + \beta_1 R_{mt} + \beta_2 R_{B/Mt} + \beta_3 R_{Sizet} + \varepsilon_{pt}$$

where R_{pt} is the equally-weighted excess return on size portfolio p calculated from July of year t to June of year $t+1$ where size is measured as of June-end of year t and returns are in excess of the T-bill rate; R_{mt} is the annual excess return on the equally weighted market portfolio; $R_{B/Mt}$ is the return on the book-to-market equity (B/M) factor; R_{Sizet} is the return on the size factor; α_0, β_1, β_2, and β_3 are regression parameters; and ε_{pt} is the regression error. The CRSP, COMPUSTAT, and CRSP − COMPUSTAT samples consist of 63,581 firm-year observations on CRSP, 46,021 on COMPUSTAT, and 17,568 that appear on CRSP but not COMPUSTAT from 1963 to 1989. Portfolios are formed on size rankings of individual securities done separately in respective samples each year. Portfolios 1A and 1B represent the smallest 5 percent and next smallest 5 percent market-capitalization stocks. Similarly, Portfolios 10B and 10A represent the largest 5 percent and next largest 5 percent stocks. Portfolios are equally weighted.

The size and B/M equity factors are constructed by independently ranking all the COMPUSTAT stocks into five size portfolios and five B/M portfolios each year. The negative B/M stocks are excluded in forming the quintile portfolios. The size factor is the difference, each year, between the simple average return on the five portfolios within the smallest market-capitalization quintile (i.e., the smallest firm quintile that is split into five portfolios on the basis of low to high B/M) minus the simple average return on the five portfolios within the largest market-capitalization quintile. The B/M factor is constructed similarly as the difference between the average return on the five portfolios within the highest B/M quintile minus the average return on the five portfolios within the lowest B/M quintile.

Table V—*Continued*

Portfolio	α_0 t-statistic	β_1 t-statistic	β_2 t-statistic	β_3 t-statistic	Adj. R^2
		Panel A. CRSP			
1A	−0.025	1.00	0.54	0.82	95.8
	−1.14	10.59	3.44	8.93	
1B	−0.009	1.00	0.20	0.55	98.2
	−0.73	18.66	2.26	10.56	
2	−0.019	1.03	0.15	0.32	98.7
	−2.00	26.01	2.28	8.16	
3	−0.005	1.03	0.04	0.21	98.0
	−0.48	22.00	0.45	4.64	
4	−0.004	0.99	0.09	0.14	98.4
	−0.43	26.22	1.41	3.71	
5	−0.001	0.99	−0.10	0.02	99.0
	−0.01	35.99	−2.12	0.79	
6	0.005	1.07	−0.05	−0.08	98.6
	0.61	31.87	−0.86	−2.37	
7	0.018	1.04	−0.11	−0.18	97.4
	1.79	24.69	−1.56	−4.47	
8	0.006	1.00	−0.13	−0.26	98.7
	0.88	37.10	−2.94	−9.73	
9	0.012	0.99	−0.15	−0.39	97.5
	1.51	28.57	−2.53	−11.54	
10A	−0.002	0.93	−0.06	−0.43	96.6
	−0.23	25.50	−1.03	−12.01	
10B	0.005	0.80	−0.15	−0.46	84.8
	0.31	11.52	−1.29	−6.74	

Table V—*Continued*

Portfolio	α_0 t-statistic	β_1 t-statistic	β_2 t-statistic	β_3 t-statistic	Adj. R^2
		Panel B. COMPUSTAT			
1A	−0.015	1.06	0.64	0.65	95.1
	−0.66	11.02	3.99	6.94	
1B	0.015	1.04	0.13	0.53	98.4
	1.21	20.14	1.50	10.53	
2	−0.018	1.03	0.24	0.31	97.6
	−1.39	19.25	1.91	2.71	
3	−0.020	1.09	0.16	0.14	97.4
	−1.62	20.74	1.81	2.78	
4	−0.022	1.15	0.17	−0.08	94.0
	−1.22	15.37	1.35	−1.05	
5	−0.004	1.07	0.04	−0.10	96.4
	−0.29	20.21	0.46	−1.85	
6	0.002	1.14	−0.02	−0.16	95.7
	0.16	18.93	−0.24	−2.76	
7	0.005	1.08	0.03	−0.28	97.6
	0.58	27.70	0.49	−7.43	
8	−0.006	1.05	−0.08	−0.37	96.0
	−0.52	22.02	−1.01	−7.94	
9	−0.002	1.10	−0.02	−0.48	97.0
	−0.20	27.28	−0.37	−13.19	
10A	−0.003	0.94	−0.02	−0.46	94.7
	−0.23	20.54	−0.23	−10.25	
10B	0.006	0.80	−0.15	−0.45	80.3
	0.31	9.89	−0.09	−5.74	

Table V—*Continued*

Portfolio	α_0 t-statistic	β_1 t-statistic	β_2 t-statistic	β_3 t-statistic	Adj. R^2
Panel C. CRSP – COMPUSTAT					
1A	−0.068	0.89	0.22	0.80	85.4
	−1.65	5.15	0.74	4.70	
1B	−0.071	0.82	0.11	0.73	88.9
	−2.18	5.96	0.48	5.46	
2	−0.043	1.00	0.08	0.35	90.4
	−1.64	8.92	0.43	3.19	
3	0.014	0.96	−0.20	0.20	93.2
	0.70	11.46	−1.42	2.42	
4	−0.003	0.84	0.02	0.08	87.6
	−0.16	9.12	0.11	0.92	
5	−0.008	0.76	−0.04	0.17	92.3
	−0.47	10.78	−0.30	2.43	
6	−0.015	0.89	−0.20	0.04	91.2
	−0.82	11.15	−1.48	0.45	
7	0.007	0.96	−0.27	−0.12	96.1
	0.63	18.87	−3.16	−2.33	
8	0.001	0.92	−0.19	−0.19	94.2
	0.04	16.50	−2.07	−3.55	
9	0.008	0.88	−0.25	−0.23	91.8
	0.53	13.91	−2.35	−3.70	
10A	0.013	0.95	−0.21	−0.40	94.4
	1.12	18.78	−2.52	−8.04	
10B	0.015	0.82	−0.19	−0.45	90.2
	1.12	14.55	−2.04	−8.21	

small and not significantly different from zero, consistent with the hypothesis that the size and B/M factors capture the relevant components of systematic risk as in Fama and French (1993). The extremely small firms have a nontrivial coefficient on the B/M factor as well as the size factor in the CRSP and COMPUSTAT samples (Panels A and B). Apart from this, the B/M factor betas are small and generally statistically insignificant. This remains true even when the size factor is excluded (results available on request).

Results for the small firm portfolios of the CRSP − COMPUSTAT sample are still at odds with those for the CRSP and COMPUSTAT samples. Intercepts for the CRSP − COMPUSTAT small-firm Portfolios 1A and 1B are about −7 percent. The intercept for Portfolio 1B is reliably negative at the 5 percent level, whereas intercepts for Portfolios 1A and 2 are marginally significantly below zero. These portfolios have very small and statistically insignificant coefficients on the B/M equity factor. Thus, whether because of a selection bias or some alternative explanation, the COMPUSTAT size and B/M equity factors are not able to account for the low returns on the CRSP − COMPUSTAT small-firm portfolios.

Overall, the results of this subsection are supportive of the COMPUSTAT selection-bias stories. Although we do not find evidence of a bias for relatively large distressed firms, this is not surprising given the "dilution" effect of healthy firms referred to earlier; in other words, the power of the test is likely to be low in this case.

C. Period-Specific Results

We now consider another aspect of the B/M puzzle. We analyze the COMPUSTAT B/M portfolios' returns over the 12-month *preranking* period ending on June 30. The results in Table III indicate that the low B/M Portfolios 1A and 1B earn average returns of 29 and 28 percent, respectively, over this one-year period. More generally, prior one-year returns monotonically decline with B/M, with Portfolio 10B averaging only a 7.3 percent return.

The above-average stock-price performance over the preranking period accords low (high) B/M stocks the "winner-stock" ("loser-stock") status from the stock-market overreaction literature revived by DeBondt and Thaler (1985, 1987). This is interesting because it provides the basis for an "educated guess" as to whether the positive relation between average returns and book-to-market is a period-specific phenomenon or indicative of a more general relation. Ball, Kothari, and Shanken (1995) examine the performance of 50 winner and loser stock portfolios over two periods. Like the low B/M stocks, winners *underperform* the losers in the post-1957 period, but the reverse is true in the pre-1958 period.

While Ball, Kothari, and Shanken (1995) examine winner stocks' performance over a five-year period, as is often done in the stock-market overreaction literature, more relevant to this study is the winner stocks' performance in the first postranking year. Using their method, we estimate winner stocks' one-year postranking abnormal returns over the pre-1963 and post-1962 subperiods. Over the pre-1963 period, winner stocks earn 3.6 percent average annual abnormal return (Jensen alpha), whereas they earn −4.2 percent abnormal return over the post-1962 period. On the other hand, the losers outperform the market by 2.3 percent in the post-1962 period, but underperform by 3.3 percent in the pre-1963 period. Thus, a positive relation between returns and B/M, even after adjusting for the survivorship biases discussed above, may be period-specific as well. Given the difficulty of satisfactorily quantifying the statistical impact of data snooping over the more recent period, definitive conclusions about B/M as a predictor of the expected rate of return beyond beta are not feasible.

D. B/M and Average Returns: S&P Data

We now turn to an alternative data set—B/M ratios obtained from the *S&P Analyst's Handbook* for industries represented in the S&P 500 and monthly share prices for these industries reported in the *S&P Stock Price Guide*. This data set has the advantage of permitting us to examine the relation between B/M and stock returns back to 1947. The *S&P Analyst's Handbook* reports selected accounting data on a per share basis that corresponds to S&P's industry stock price indexes. S&P selects stocks to be included in each industry on the basis of "their industry representation and adequacy of their market activity" (*S&P Analyst's Handbook*, 1989, in the Description of Methodology section). The number of industries and their composition thus changes over time, but the year-to-year changes in a given industry are generally not dramatic. The share-price index and the per share accounting data are adjusted for stock splits and the index itself is value weighted. The accounting data are reported for calendar years, although data for the individual firms included in an industry are on a fiscal year basis. S&P places accounting data in the calendar year in which the most months of a company's fiscal year fall. COMPUSTAT follows the same procedure, which is hardly surprising because S&P sells the COMPUSTAT tapes.

For consistency with FF, we calculate B/M ratios by taking the ratio of the (industry) book-value per share at the end of the previous calendar year to the share-price index for the month of June of the next year. S&P's definition of book value is: "Total of common stock, capital surplus, and retained earnings less treasury stock, intangibles, and the difference between the carrying value and liquidating value of preferred stock." Annual July-to-June returns are calculated using the monthly share-price indexes and adding the (annual cash) dividend per share as reported in the *S&P Analyst's Handbook*. We obtain similar results using December-end returns.

Since firms that do not survive or become less attractive on S&P's criteria are excluded from the S&P industry indexes, the S&P industry data suffers from a survivorship bias. Insofar as the composition of the industry indices changes from the year in which we obtain B/M ratios to the following year in which we compute returns, there could be a bias against finding a B/M effect.[18] Although we can not rule out this possibility, it seems at least equally plausible that there is actually a bias in favor of the B/M effect. High B/M industries that consist of one or more poorly performing stocks are more likely to lose some firms that do not survive. Since these failing stocks are not included in the industry index in the future, the return on the industry may be biased upward. The degree of bias is probably small, however, because the S&P industry portfolios are value weighted and include the (primarily) large market-capitalization S&P 500 stocks that fail relatively infrequently.

Each year from 1947 to 1987, we form 10 B/M portfolios as with the COMPUSTAT data, except that the portfolios are now equally-weighted combinations of industries rather than individual firms. The number of industries in a given year ranges from 45 to 75. Unlike the COMPUSTAT data, none of the industries has a negative book value, so there is no separate negative B/M portfolio. Summary data are provided in Table VI and Figure 1 for the entire period, 1947 to 1988, as well as two subperiods split at 1963.

As expected, working with industry data reduces the range of B/M relative to that in Table III using the COMPUSTAT data. The B/M ratio ranges from 0.27 for Portfolio 1 to 1.65 for Portfolio 10. The spread is still considerable, however, and corresponds roughly to the range for Portfolios 1B through 10A based on the COMPUSTAT data. Absence of an S&P-based B/M portfolio that corresponds to Portfolio 10B using the COMPUSTAT data should not, however, be a serious deficiency. The return on the COMPUSTAT Portfolio 10B, 23 percent, is only slightly higher than that of Portfolio 10A, 22 percent, in Table III (and it is actually *lower* in the FF sample), despite Portfolio 10B's much higher B/M ratio relative to Portfolio 10A. Thus, the S&P industry data retains most of the range over which average return has been observed to be positively related to B/M in the COMPUSTAT data.

Looking at the entire-period results in Panel A of Table VI, we see that, apart from the lowest B/M portfolio 1, average returns remain essentially flat as B/M increases. While the lowest return of 13 percent is indeed earned by Portfolio 1, average returns for Portfolios 2 through 10 range only between 15 and 18 percent per annum and are not monotonically related to the B/M ratios. From Panel B, it is apparent that the low return on Portfolio 1 is due to the pre-1963 data. Moreover, the highest return over this fairly short subperiod is achieved by the low B/M Portfolio 2. Most surprising is the fact that average return is flat for the post-1962 period as well, in sharp contrast to the monotonic relation in Table III and in FF using the COMPUSTAT data. In this subperiod, Portfolio 1's average return is 15 percent compared to 16 percent for Portfolio 10. Other portfolios earn between 13 and 18 percent per year. Figure 1 vividly conveys these patterns.

Another perspective is provided in Table VII, via cross-sectional regressions of average return on the natural logarithm of B/M equity. Regression

[18] It is encouraging to note that a significant relation between annual returns and the following year's earnings growth is observed both in time series and cross-section for the S&P industry indices. See Collins *et al.* (1994).

results using the S&P data for the entire, pre-1963, and post-1962 periods, are given in Panel A of Table VII. The results using the industry portfolios are virtually identical to those based on 10 B/M portfolios. The pre-1963 coefficients on B/M are about 1.6 standard errors above zero, although the relation appears in Figure 1 to be nonlinear and driven entirely by the lowest B/M portfolio. The t-statistics are only slightly above one for the entire period. The t-statistic on B/M for the post-1962 period using the industry-level data is only 0.15, and it is 0.31 using 10 B/M portfolios.

Panel B presents COMPUSTAT cross-sectional regression results for the 1963 to 1989 period. To facilitate comparison with the S&P industry data analysis, results are first presented for COMPUSTAT industry portfolios and then for ten B/M-portfolios formed by ranking industries on their average B/M. Results using both equally and value-weighted portfolios are reported. We use the 3-digit Standard Industrial Classification (SIC) code for industry portfolios.

As seen from Panel B of Table VII, in each case there is a reliably positive relation between B/M and average return, the lowest t-statistic being 2.63. Most of the increase in statistical significance comes from the estimated coefficients, as the standard errors (not shown) are only slightly smaller than those obtained using the S&P data. Similar strong results are still obtained with the COMPUSTAT data even if we leave firms with negative B/M equity in the industry portfolios, as is the case with the S&P data. Finally, we report results using 10 equally and value-weighted portfolios formed each year by ranking all the available COMPUSTAT firms on their B/M ratios (i.e., without regard to their industry membership). Once again, the evidence indicates a strong positive relation between average return and B/M ratios that is robust to equally and value-weighted portfolio formation.[19] In summary, the evidence in Table VII suggests that the startling differences between our S&P results and the earlier findings of FF are not attributable to value weighting or to our ranking at the industry, rather than individual security, level.[20]

The finding of a significant B/M effect for the value-weighted COMPUSTAT portfolios, but not the S&P portfolios, is puzzling in that it is not likely due to the survivorship biases discussed earlier. To explore this further, we redo the cross-sectional analysis restricted to the 500 largest market-capitali-

[19] Even stronger evidence is obtained using individual securities or 20 book-to-market portfolios based on individual security book-to-market-rankings. These results are available upon request.

[20] Since expected return is known to be negatively related to firm size, flat returns for the S&P B/M-portfolios might conceivably be the result of offsetting effects due to a strong positive association between B/M and size. This seems unlikely, though, given the strong negative relation between size and B/M for COMPUSTAT data in Table III. Unfortunately, information on market capitalization is not available for the S&P portfolios to provide direct evidence on the relation between B/M and size for the S&P data. However, when we regress the S&P portfolios on the market index and a size factor (returns on the smallest firm-size quintile minus returns on the largest firm-size quintile) there is no systematic pattern to the coefficients on size. Therefore, it is unlikely that the flat returns are driven by a size effect.

Table VI

Returns on Book-to-market Equity Portfolios Using the S&P Industry Data

Book-to-market equity (B/M) ratios are calculated using S&P industry book values per share and industry price indexes. Book values are from the *Standard and Poor Analyst's Handbook* and price indexes are from *Standard and Poor's Stock Price Guide*. Each year from 1947 to 1987 industries are ranked on their B/M ratios and 10 portfolios are formed. The average and standard deviation of the B/M ratios over the 1946 to 1986 period for each portfolio is reported. An equally-weighted annual return on the industries in each B/M portfolio is calculated from July of year t to June of year $t+1$ where B/M is for year $t-1$. The average return, standard deviation, minimum, and maximum return for each portfolio over the period 1947 to 1987 are reported. The same procedures are repeated for the 1947 to 1962 and 1963 to 1987 subperiods.

	B/M		Return			
Portfolio	Average	Std. Dvn.	Average	Std. Deviation	Minimum	Maximum
			Panel A. 1947 to 1987			
1	0.27	0.10	0.13	0.26	−0.27	1.11
2	0.38	0.13	0.27	0.24	−0.32	0.60
3	0.48	0.14	0.15	0.24	−0.32	0.60
4	0.57	0.16	0.16	0.27	−0.27	1.06
5	0.65	0.17	0.15	0.20	−0.24	0.72
6	0.75	0.19	0.17	0.22	−0.19	0.77
7	0.87	0.20	0.15	0.20	−0.30	0.68
8	1.01	0.25	0.15	0.22	−0.33	0.74
9	1.19	0.30	0.17	0.21	−0.18	0.68
10	1.65	0.35	0.18	0.22	−0.16	0.98

Table VI—*Continued*

Portfolio	B/M		Return			
	Average	Std. Dvn.	Average	Std. Deviation	Minimum	Maximum
Panel B. Pre-1963						
1	0.33	0.09	0.11	0.19	−0.27	0.38
2	0.47	0.12	0.22	0.20	−0.15	0.60
3	0.57	0.13	0.17	0.19	−0.19	0.64
4	0.66	0.15	0.16	0.20	−0.14	0.56
5	0.73	0.16	0.17	0.17	−0.16	0.44
6	0.81	0.18	0.15	0.20	−0.19	0.56
7	0.92	0.20	0.16	0.16	−0.12	0.44
8	1.10	0.25	0.16	0.22	−0.29	0.55
9	1.34	0.33	0.20	0.24	−0.18	0.50
10	1.77	0.35	0.21	0.20	−0.14	0.53
Panel C. Post-1962						
1	0.22	0.09	0.15	0.30	−0.26	1.11
2	0.32	0.10	0.13	0.26	−0.32	0.58
3	0.41	0.11	0.13	0.28	−0.33	0.82
4	0.50	0.13	0.16	0.32	−0.27	1.06
5	0.60	0.16	0.14	0.23	−0.24	0.72
6	0.72	0.19	0.18	0.24	−0.16	0.77
7	0.83	0.20	0.14	0.22	−0.30	0.68
8	0.94	0.22	0.15	0.24	−0.33	0.74
9	1.09	0.25	0.16	0.20	−0.18	0.68
10	1.58	0.33	0.16	0.24	−0.16	0.98

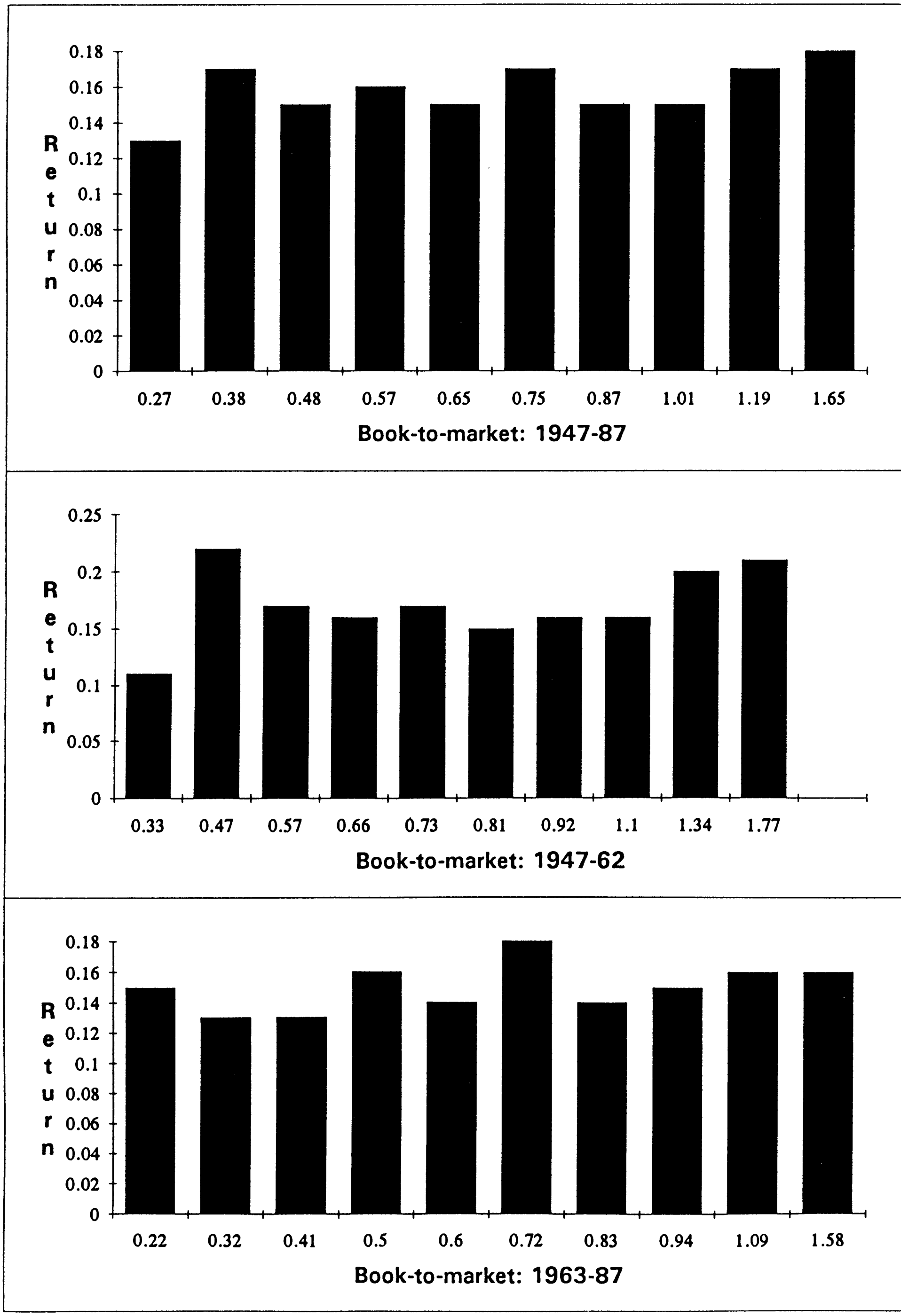

Figure 1. Average annual returns on portfolios sorted by book-to-market ratios. Data are from 1947 to 1987 on S&P industry portfolios.

Table VII
Cross-sectional Regressions of Average Return on the Natural Logarithm of the Book-to-market Equity

Time-series averages of estimated coefficients from the following annual cross-sectional regressions, associated t-statistics in parentheses, and adjusted R^2s are reported:

$$R_{pt} = \gamma_{0t} + \gamma_{1t} B/M_{pt-1} + \varepsilon_{pt}$$

where R_{pt} is the return on the industry or book-to-market equity (B/M) portfolio p, calculated from July of year t to June of year $t + 1$, B/M_{pt-1} is the natural logarithm of the average B/M of the industries in portfolio p (or simply industry p's B/M ratio) at the end of calendar year $t - 1$; γ_{0t} and γ_{1t} are regression parameters; and ε_{pt} is the regression error. Average return and B/M ratios for the portfolios are calculated using S&P industry book values of equity per share, dividends per share, and industry price indexes. Book values are from the *Standard and Poor Analyst's Handbook* and price indexes are from *Standard and Poor's Stock Price Guide*. For the analysis using 10 B/M portfolios, each year from 1947 to 1987 industries are ranked on their B/M ratios, and 10 portfolios are formed.

Portfolio	Period	γ_0 (%)	t-Statistic	γ_1 (%)	t-Statistic	Adj. R^2 (%)
Panel A. S&P data						
Industry	Entire	16.3	5.40	1.41	1.02	4.0
Industry	Pre-1963	17.9	4.40	2.99	1.59	2.4
Industry	Post-1962	15.2	3.64	0.29	0.15	5.1
10 portfolios	Entire	16.4	5.38	1.59	1.17	11.6
10 portfolios	Pre-1963	17.9	4.06	2.99	1.61	7.1
10 portfolios	Post-1962	15.3	3.62	0.59	0.31	14.7
Panel B. COMPUSTAT data						
Industry, equally-weighted	Post-1962	16.5	2.73	5.18	2.96	1.3
10 portfolios, from equally-weighted industry portfolios	Post-1962	16.5	2.72	5.35	2.86	9.4
Industry, value-weighted	Post-1962	16.9	2.85	5.07	2.63	1.2
10 portfolios, from value-weighted industry portfolios	Post-1962	17.0	2.85	5.39	2.64	12.0
10 equally-weighted portfolios from firm-level data	Post-1962	17.1	3.42	5.29	3.85	46.9
10 value-weighted portfolios from firm-level data	Post-1962	14.8	2.21	5.23	4.26	28.7

zation COMPUSTAT stocks each year. We expect considerable overlap between these stocks and those included in S&P industry portfolios. Comparison of the S&P 500 stocks and the 500 largest market-capitalization stocks in one year (1988) reveals a 69 percent overlap. We find that S&P includes many midsize stocks in constructing the industry portfolios. This is perhaps because S&P attempts to include only those firms in the industry portfolios that have a relatively high fraction of their business activity in one industry. Also, foreign stocks are excluded, but some of those are included by COMPUSTAT and CRSP.

We form 10 B/M portfolios using 3-digit SIC codes of the 500 largest market capitalization stocks. These portfolios are value weighted. The average returns on these portfolios are not monotonically related to B/M. The average coefficient on B/M from annual cross-sectional regressions is 2.55, with a *t*-statistic of 1.38. This is only about half as large as the average coefficient reported in Panel B of Table VII (comparable standard error) and, although statistically insignificant, it is larger than that using the S&P industry data. Precision is improved by using firm-level data in the cross-sectional regressions. The average estimated slope coefficient is 3.12 with a *t*-statistic of 1.96. The coefficient is approximately 40 percent smaller than that using all COMPUSTAT stocks. Although we cannot fully explain the difference between the results using the S&P and COMPUSTAT data, the substantial reduction in the B/M coefficient is consistent with the survivorship bias stories discussed earlier.

III. Conclusions and Implications for Research

We have presented evidence that average returns do indeed reflect substantial compensation for beta risk, provided that betas are measured at the annual interval. Of course, this does not mean that beta alone accounts for all the cross-sectional variation in expected returns, as implied by the capital asset pricing model. While doubt has been cast on the explanatory power of B/M equity, we do see evidence of a size effect. Although a more complete examination of the pantheon of past anomalies is beyond the scope of this article, such an analysis may well suggest other expected return deviations, even with annual betas. Whether these deviations reflect the imperfect nature of our proxies for the market portfolio, the limitations of unconditional time-series estimates of beta or more fundamental inadequacies of the asset pricing theory are issues that are difficult to sort out.[21] In this regard, the analytical framework developed recently by Kandel and Stambaugh (1987) and Shanken (1987, 1992) provides a useful perspective that has yet to be fully exploited. In the meantime, we find it comforting to know that a simple measure of nondiversifiable risk does help account for the actual differences in average returns over the past sixty years or so.

[21] Of course, conversely, evidence consistent with efficiency of the proxy certainly does not guarantee that the true market portfolio is efficient (see Roll (1977)).

While this article has employed full-period annual betas in addressing the question of whether there is compensation for beta risk, the important issue of how best to estimate an ex ante beta in a given empirical application needs to be considered. Given the observed sensitivity of asset pricing empirical results to the return interval employed, a deeper understanding of the source of these differences is clearly called for and may prove relevant to other research questions as well. Two of the current prime suspects are trading frictions and associated risk estimation issues on the one hand, and more theoretical concerns involving investment horizon on the other.

Our analysis of the explanatory power of B/M, in particular the related investigation of selection biases associated with the COMPUSTAT tapes, has implications for other research. Fairfield and Harris (1993), Ou and Penman (1989a, 1989b) and Lev and Thiagarajan (1993) have reported abnormal returns to a trading strategy that exploits information in financial statements (i.e., fundamental analysis). Since these studies rely on the COMPUSTAT samples to document abnormal returns and market inefficiency, selection biases in the COMPUSTAT data are likely to have a bearing on their findings as well (also see Holthausen and Larcker (1992) on this issue).

The finance and accounting literature has extensively documented the tendency of stock prices to drift upwards following extreme earnings increases and drift downwards following extreme earnings declines (see Jones and Litzenberger (1970) for an early example and Bernard and Thomas (1989) for a recent example). The evidence on B/M equity and sample-selection biases in the COMPUSTAT data could be relevant for this "postearnings-announcement drift" anomaly. Firms reporting extreme earnings increases (decreases) are more likely to be high (low) B/M stocks and studies documenting the drift have relied on COMPUSTAT data. Our evidence suggests that a small portion of the drift may be attributable to the COMPUSTAT survivorship bias.

Finally, we emphasize that the failure of a significant relation between B/M and return to emerge from the S&P industry portfolios, insofar as it is not driven by low power, poses a serious challenge to the B/M "empirical asset pricing model." This is true regardless of the extent of the COMPUSTAT selection bias. A useful pricing model must be trusted to work under a wide variety of conditions and not just for a limited set of portfolios.

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