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CHARACTERISTICS, COVARIANCES, AND AVERAGE RETURNS: 1929-1997

James Davis, Eugene F. Fama, and Kenneth R. French*

Abstract

The value premium in U.S. stocks returns is robust. The positive relation between average return and book-to-market equity (BE/ME) is as strong for 1929-63 as for the subsequent period studied in previous papers. Like others, we also find a size premium in stock returns. Small stocks have higher average returns than big stocks. The size premium is, however, weaker and less reliable than the value premium. The relations between average return and firm characteristics (size and BE/ME) are better explained by a three-factor risk model than by the behavioral hypothesis that investor overreaction causes characteristics to be compensated irrespective of risk loadings.

* School of Business, Kansas State University (Davis), Graduate School of Business, University of Chicago (Fama) and Yale School of Management /Massachusetts Institute of Technology (French). Support for data collection from Dimensional Fund Advisors and the comments of Kent Daniel and Sheridan Titman are gratefully acknowledged.

Smaller U.S. stocks have higher average returns than larger stocks (Banz (1983)). Firms with high ratios of the book value of common equity to the market value of common equity have higher average returns than firms with low book-to-market ratios (Rosenberg, Reid, and Lanstein (1985)). Because these patterns in average returns are not explained by the capital asset pricing model (CAPM) of Sharpe (1964) and Lintner (1965), they are typically called anomalies.

There are three common explanations for the size and book-to-market (BE/ME) anomalies. One says they are the result of chance and unlikely to be observed out-of-sample (Black (1993), MacKinlay (1995)). The size effect, however, seems to exist during the entire post-1925 period covered by the CRSP files of U.S. stock returns (Banz (1983), Fama and French (1992)). There is also a size effect in international returns (Chan, Hamao, and Lakonishok (1991), Heston, Rouwenhorst, and Wessels (1995)). Davis (1994) shows that the relation between average return and BE/ME observed in recent U.S. returns extends back to 1941. Chan, Hamao, and Lakonishok (1991), Capaul, Rowley, and Sharpe (1993), and Fama and French (1997) report strong relations between average return and BE/ME in markets outside the U.S. These results argue against the sample-specific explanation for the size and BE/ME anomalies.

The second story for the size and BE/ME anomalies is that they are not anomalies at all. The higher average returns on small stocks and high BE/ME stocks are compensation for risk in a multifactor version of Merton's (1973) intertemporal capital asset pricing model (ICAPM) or Ross's (1976) arbitrage pricing theory (APT). Consistent with this view, Fama and French (1993) document covariation in returns related to size and BE/ME, beyond the covariation explained by the market return. Fama and French (1995) show that there are size and BE/ME factors in fundamentals (earnings and sales) like the corresponding common factors in returns. The acid test of a multifactor model is whether it explains differences in average returns. Fama and French (1993, 1996) propose a three-factor model that uses the market portfolio and mimicking portfolios for factors related to size and BE/ME to describe returns. They find that the model captures the average returns on U.S. portfolios formed on size, BE/ME, and other variables known to cause problems for the CAPM (earnings/price, cashflow/price, past sales growth, and long-term past return). Fama and

French (1997) show that an international version of their multifactor model seems to describe average returns on portfolios formed on scaled price variables in 13 major markets.

The third explanation for the size and BE/ME anomalies says they are due to investor overreaction to firm performance. Small stocks and high BE/ME stocks tend to be firms that are weak on fundamentals like earnings and sales, while large stocks and low BE/ME stocks tend to have strong fundamentals. Investors overreact to performance and assign irrationally low values to weak firms and irrationally high values to strong firms. When the overreaction is corrected, weak firms have high stock returns and strong firms have low returns. Proponents of this view include DeBondt and Thaler (1987) Lakonishok, Shleifer, and Vishny (1994), Haugen (1995), and Daniel and Titman (1997).

Daniel and Titman (1997) argue that past research cannot distinguish the risk model from the overreaction model. The reason is that overreaction is associated with covariation in returns. For example, industries move through periods of distress and growth. When portfolios are formed to capture risk factors related to relative distress, they may pick up return covariation within industries that is always present but for the moment happens to be associated with growth or distress. If so, common price corrections can be misinterpreted as compensation for risk. In this view, there are common factors in returns related to growth or distress, but the premiums for these factors are irrational. Because both models are consistent with compensated relative distress factors, one cannot distinguish the risk story from the overreaction story in tests that focus on common factors.

Daniel and Titman (1997) suggest a clever way to break this logjam. If characteristics (growth and distress) drive overreaction, there should be firms that have characteristics that do not match their risk loadings. For example, there should be some strong firms in distressed industries. In the overreaction model, these firms have low returns because they are strong. But they can have high loadings on distress risk factors if the factors are in part due to covariation of returns within industries. Thus, the returns on these firms will be too low, given their risk loadings. Conversely, there are distressed firms in strong industries. Because they are distressed, they have high returns, but in terms of risk loadings they look like strong firms. If overreaction drives prices, their returns will be too high given their risk loadings.

In short, in the Daniel-Titman version of the overreaction hypothesis, relative distress drives stock returns, and size and BE/ME are proxies for relative distress. Large size and/or low BE/ME (the characteristics of strong firms) produce low stock returns, irrespective of risk loadings. Similarly, small stocks and/or high BE/ME stocks (distressed firms) have high returns, regardless of risk loadings. In contrast, the risk story says that expected returns compensate risk loadings, irrespective of characteristics. It is clear, then, that the empirical key to distinguishing the risk model from the overreaction model is to find variation in the size and BE/ME characteristics unrelated to risk loadings and variation in risk loadings unrelated to size and BE/ME.

To identify independent variation in characteristics and risk loadings, Daniel and Titman (1997) form portfolios by sorting stocks on characteristics (size and BE/ME) and risk loadings. We take a similar approach, but we use a longer time period. Daniel and Titman study returns from 7/73 to 12/93, 20.5 years. To provide a long historical perspective, we extend the tests back to July 1929. This allows us to produce out-of-sample evidence on two important questions. (i) Is the relation between BE/ME and average return robust over the 68-year 7/29-6/97 period? (ii) Are the size and BE/ME patterns in average returns better explained by investor overreaction or rational compensation for risk?

Our results are easy to summarize. First, the BE/ME premium in average returns is robust. The premium for 7/29-6/63 is similar to the premium for the subsequent period used in previous studies. Second, a risk story for the size and BE/ME premiums works well for the 68-year sample period and for subperiods that split the data in July 1963, the start date of the earlier Fama-French papers. In fact, the risk model works better out-of-sample (before 1963). There is no evidence that average returns vary with size and BE/ME in a way that cannot be explained by risk loadings. And there is no convincing evidence that variation in risk loadings is uncompensated when it is unrelated to size and BE/ME.

Our conclusions differ from those of Daniel and Titman (1997). Their tests seem to produce more evidence for the overreaction model's prediction that variation in risk loadings does not show up in average returns unless it is associated with the size and BE/ME characteristics. Our evidence suggests that their results are special to their time period. In out-of-sample tests, and in tests on an overall time period more than three times longer than theirs, the risk model outperforms the overreaction model, and their evidence in favor of the overreaction model largely disappears.

I. Summary Statistics for the Premiums

Using Moody's Industrial Manuals, we collect book common equity (BE) from 1925 to 1996 for all NYSE industrial firms that do not have BE data on Compustat. To keep the task manageable, we do not collect BE for financial firms and utilities. To expand the sample of firms, beginning in 1953 we merge the hand-collected data for NYSE industrials with the Compustat data for NYSE, AMEX, and NASDAQ industrials and non-industrials. Limiting the tests to NYSE industrials, however, produces results similar to those for the expanded sample.

Like Daniel and Titman (1997), our rational asset pricing alternative to the overreaction hypothesis is that expected returns conform to the three-factor model in Fama and French (1993),

$$E(R_i) - R_f = b_i[E(R_M) - R_f] + s_iE(SMB) + h_iE(HML). \qquad (1)$$

In this equation, R_i is the return on asset i, R_f is the riskfree interest rate, and R_M is the return on a proxy for the value-weight market portfolio. SMB is the difference between the returns on a portfolio of small stocks and a portfolio of big stocks, constructed to be neutral with respect to BE/ME. Specifically, in June of each year we use independent sorts to allocate NYSE, AMEX, and NASDAQ stocks to two size groups and three BE/ME groups. Big stocks (B) are above the median market equity of NYSE firms and small stocks (S) are below. Similarly, low BE/ME stocks (L) are below the 30^{th} percentile of firms on the NYSE, medium BE/ME stocks (M) are in the middle 40 percent, and high BE/ME stocks (H) are in the top 30 percent. We form six value-weight portfolios, S/L, S/M, S/H, B/L, B/M, and B/H, as the intersections of the size and BE/ME groups. For example, S/L is the value-weight return on the portfolio of stocks that are both below the NYSE median in size and in the bottom 30 percent of BE/ME. SMB is the difference between the equal-weight averages of the returns on the three small stock portfolios and the returns on the three big stock portfolios,

$$SMB = (S/L + S/M + S/H)/3 - (B/L + B/M + B/H)/3. \quad (2)$$

Similarly, HML is the difference between the return on a portfolio of high BE/ME stocks and the return on a portfolio of low BE/ME stocks, constructed to be neutral with respect to size;

$$HML = (S/H + B/H)/2 - (S/L + B/L)/2. \quad (3)$$

The correlation between SMB and HML for the 7/29-6/97 sample period is only 0.13. Thus, SMB indeed seems to provide a measure of the size premium that is relatively free of BE/ME effects, and HML is a measure of the BE/ME premium relatively free of size effects.

Table 1 shows summary statistics for R_M-R_f, SMB, and HML for 7/29-6/97 and for two subperiods that break in 7/63, the start date in Fama and French (1992, 1993, 1995, 1996). We split the sample at this date to test whether the later period is unusual. The two subperiods are also equal in length, 34 years. Although we have R_M-R_f, SMB, and HML back to 7/26, the results in Table 1 start in 7/29. This is for consistency with the regression tests below, which use the first three years to form portfolios on pre-formation estimates of the SMB and HML slopes in (1).

The average value of the market premium, R_M-R_f, for the full 7/26-6/97 period is 0.67 percent per month (t = 3.33). The market premium for 7/29-6/63 is 0.82 percent per month, versus 0.52 percent for 7/63-6/97. Both are about 2.4 standard errors from zero.

The size effect in Table 1 is puny. The average SMB return for 7/29-6/97 is 0.20 percent per month (t = 1.76). The weak size effect observed here is in part due to the fact that the six components of SMB are value-weight portfolios. More important is the fact that SMB is largely neutral with respect to relative distress (BE/ME). By way of contrast, the average difference between the returns on value-weight portfolios of stocks below and above the NYSE median for 7/29-6/97 is 0.33 percent per month (t = 2.44). This simple size premium is 65 percent larger than the average SMB return because small stocks tend to be relatively more distressed (they have higher BE/ME) than big stocks, and a size premium that is not neutral with respect to BE/ME is affected by the BE/ME premium in average returns.

The average HML return for 7/29-6/63, 0.50 percent per month (t = 2.81) is a bit larger than the return for 7/63-6/97, 0.42 percent per month (t = 3.34). Almost all studies of the book-to-market effect use sample periods that start after June 1963. (Davis (1994), who uses a more limited sample that extends back to 1941, is an exception.) The returns for 7/29-6/63 confirm that the premium of value stock returns over growth stock returns observed in earlier work is not special to the post-1963 period.

Table 1 also shows that the value (BE/ME) premium is not an arbitrage opportunity. The t-statistics for the average HML return are similar to those for the excess market return, R_M-R_f, so the Sharpe ratios (mean/standard deviation) are similar for the two portfolios. The question of more interest, however, is whether the value premium is compensation for risk or the result of investor overreaction.

Finally, Loughran (1997) argues that there is not much of a value premium in the average returns on large stocks for 1963-95. Though nontrivial in magnitude, Table 1 confirms that the value premium for large stocks (the average B/H-B/L return) for 7/63-6/97, 0.29 percent per month, is lower than the value premium for small stocks (the average S/H-S/L return), 0.55 percent per month. For the earlier 7/29-6/97 period, however, large stocks produce a bigger value premium than small stocks, 0.59 versus 0.42 percent per month. In the returns for the overall 7/29-6/97 period, the value premium for large stocks, 0.45 percent, is quite similar to that for small stocks, 0.48 percent.

II. Overreaction Versus Risk: The Approach

Our main interest is testing the overreaction and risk models for the relations between average return and characteristics (size and BE/ME). The overreaction model predicts that characteristics produce variation in expected returns, irrespective of risk loadings. The risk model says that only risk loadings affect expected returns. The specific prediction of the three factor risk model (1) is that the intercept, a_i, in the regression,

$$R_i - R_f = a_i + b_i(R_M - R_f) + s_iSMB + h_iHML + \varepsilon_i, \quad (4)$$

is zero for all assets. In contrast, the overreaction model says that non-zero a_i are to be expected when stocks have characteristics that do not line up with their risk loadings.

The trick to distinguishing between the overreaction and risk models is to isolate independent variation in risk loadings and characteristics. To this end, Daniel and Titman (1997) first allocate stocks to nine portfolios, formed as the intersections of independent sorts of firms into three size and three BE/ME groups. Each of these nine portfolios is subdivided equally into five portfolios based on pre-formation values of one of the three risk loadings, b_i, s_i, or h_i, in (4). The result is three sets of 45 portfolios, with each set constructed to produce variation in one of the risk loadings in (4) that is independent of the size and BE/ME characteristics of the portfolios.

Our approach is a bit different, but in the same spirit. Daniel and Titman report that prior to 1973, some of their portfolios contain few stocks. As a result, they limit their tests to 7/73-12/93. To avoid this problem, we do one less sort in forming portfolios. Specifically, we sort stocks into three groups on size or BE/ME. When we sort on size, we also sort stocks into three groups based on their five-year (three-year minimum) pre-formation loading, s_i, on SMB in (4). The nine size/SMB-slope portfolios produced by the double sorts can isolate variation in loadings on the size factor, SMB, that is independent of the size characteristic. Similarly, to isolate variation in loadings on the BE/ME factor, HML, independent of the BE/ME characteristic, we double sort firms into nine portfolios based on BE/ME and pre-formation loading, h_i, on HML in (4).

We shall find that size and BE/ME are highly correlated with loadings on SMB and HML. In this situation, the sorting order can affect the results (Berk (1997)). Conditional sorts (stocks are allocated equally to portfolios in sequential sorts) produce a wide spread in the first-pass sorting variable but can produce small spreads in the second-pass variable. With correlation between a risk loading and the corresponding characteristic, portfolios formed as the intersections of independent sorts on a characteristic (size or BE/ME) and the corresponding risk loading (s_i or h_i) are more likely to produce large spreads in both. Independent sorts are also better for simultaneously producing variation in a risk loading (s_i or h_i)

unrelated to the corresponding characteristic (size or BE/ME) and variation in the characteristic unrelated to the loading. A possible shortcoming of independent sorts is that firms are allocated unevenly to portfolios, so the number of firms in a portfolio can be small. Because we examine intersections of only two sorts, this is not a problem in our tests. We have, however, replicated the tests using conditional sorts (on a characteristic, then the corresponding risk loading, or vice versa). The results support the same conclusions as the independent sorts.

Finally, Daniel and Titman construct special SMB and HML factors to estimate pre-formation risk loadings. When portfolios are formed on pre-formation risk loadings in June each year, the weights of securities in the pre-formation factors are fixed at their June values. That is, security weights do not evolve with market value. The advantage of this approach is that it is likely to produce a wider spread in post-formation risk loadings (and thus more precise asset pricing tests) if the covariance matrix of security returns is relatively constant. To be consistent with Daniel and Titman, we use fixed-weight factors to estimate pre-formation risk loadings, and standard Fama-French (1993) variable-weight versions of SMB and HML to estimate the three-factor model on post-formation returns. We can report, however, that using standard variable-weight factors to estimate pre-formation risk loadings has little effect on the results.

We test the risk and overreaction models in two steps. To set the stage, we first estimate (4) for portfolios formed on size and BE/ME. A criticism of these results is that they are likely to make the three-factor model (1) look good since the explanatory portfolios SMB and HML in (1) and (4) are also formed on size and BE/ME. These tests are nevertheless a useful benchmark. In particular, we find that other sorts, better tuned to distinguishing the risk model from the overreaction model, produce returns more consistent with the risk model than sorts on size and BE/ME. Moreover, one of our goals is to test the three-factor model outside the post-1963 period for which it was developed. Sorts on size and BE/ME tell us whether the shortcomings of the model observed in the post-6/63 period also show up in an earlier period.

The second step, the main event, is tests of the three-factor model on portfolios designed to produce independent variation in characteristics and risk loadings. These are the tests that in principle allow us to distinguish the risk model from the overreaction model.

III. Sorts on Size and BE/ME

Table 2 shows estimates of (4) for post-formation returns on nine portfolios formed in June each year as the intersections of independent sorts of stocks into three size groups and three BE/ME groups. The overall time period for the regressions is 7/29-6/97. We start in 7/29 to be consistent with later tables, where we sort on pre-formation risk loadings and lose three years (7/26-6/29) forming the first set of portfolios.

The t-statistics for the regression coefficients in Table 2 use White's (1980) heteroskedasticity consistent standard errors applied to ordinary least squares (OLS) coefficients. Without showing the details, we can report that the heteroskedasticity adjustment moves the t-statistics for the regression slopes toward zero, especially in the 7/29-6/63 period. The t-statistics for the regression intercepts are, however, never affected much by the heteroskedasticity adjustment. Apparently, the fact that OLS and White standard errors are the same for a sample mean carries over roughly intact to regression intercepts.

Table 2 shows that sorting on characteristics produces strong orderings on the corresponding risk loadings. The post-formation loadings on SMB in Table 2 decrease monotonically with increasing size, and the spread in SMB slopes from small to big stock portfolios is about 1.3. Post-formation HML loadings increase with BE/ME, and the spread between the HML slopes for high and low BE/ME portfolios is around 0.8. The strong correlations between characteristics and risk loadings will limit our ability to produce variation in characteristics independent of risk loadings, and this will limit the power of later tests that attempt to distinguish the overreaction model from the risk model.

Tests of the three-factor model (1) center on the intercepts in (4), which, if the model holds, should be indistinguishable from zero. In the Table 2 post-formation regressions for the overall 7/29-6/97 period, the F-test of Gibbons, Ross, and Shanken (1989) (table 7, below) comes close to rejecting the zero-intercepts hypothesis (p-value = 0.066). The rejection is driven by the returns in the second half of the sample, where the p-value for the GRS test is 0.003. During the 7/63-6/97 subperiod, three of the nine intercepts are more than two standard errors from zero. The S/L portfolio (small growth stocks) and the B/H portfolio (big value stocks) have average returns that are too low given their risk loadings, while the average return on the B/L portfolio (big growth stocks) is too high. To some extent, the t-statistics for these intercepts are large not because the differences between the average returns and the predictions of the three-factor model are large, but rather because the regressions absorb so much return variance. All the regression R^2 for the 7/63-6/97 period are at least 0.92, and two of the three intercepts that are different from zero on a statistical basis are only 0.11 and -0.11 percent per month.

Are the portfolios that seem to be mispriced by the three-factor model in the 7/63-6/97 period mispriced in the preceding 7/29-6/63 period? In fact, the returns in the earlier period are more consistent with the three-factor model. The p-value for the GRS test is 0.577, and only one portfolio produces an intercept much different from zero. But the aberrant portfolio is S/L, which is also the biggest embarrassment for the model in the later period. Moreover, the S/L intercepts for the two periods, -0.34 and -0.27 percent per month, are similar. The pricing of small growth stocks thus presents problems for the three-factor model throughout the 7/29-6/97 period.

Table 2 unmasks the three-factor model for what it is, a model, and so necessarily false. As in Fama and French (1993), the model does not even fully capture the size and BE/ME patterns in average returns it was designed to explain. Nevertheless, the evidence presented next says that that the three-factor risk model is a more accurate description of average returns than the behavioral overreaction model.

IV. BE/ME Versus HML Risk Loading

Table 3 shows estimates of the three-factor regression (4) for the post-formation returns on nine portfolios formed as the intersections of independent sorts of stocks into three groups on book-to-market equity (BE/ME) and three groups on five-year pre-formation HML slopes, h_i. The first letter for each portfolio is its BE/ME group (L, M, or H). The second letter is its h_i group (Lh, Mh, or Hh). For example, H/Hh is the portfolio of stocks that have high BE/ME and high HML slopes.

Table 3 also shows regressions for two "arbitrage" portfolios, Hh-Lh and H-L. Hh-Lh is the difference between the returns on high h_i and low h_i portfolios matched on BE/ME,

$$\text{Hh-Lh} = [(\text{L/Hh} - \text{L/Lh}) + (\text{M/Hh} - \text{M/Lh}) + (\text{H/Hh} - \text{H/Lh})]/3. \quad (5)$$

We subtract the returns on low h_i portfolios from the returns on high h_i portfolios with similar BE/ME to isolate differences in post-formation HML slope that are unrelated to BE/ME. Table 3 confirms that within a BE/ME group, BE/ME does not vary much with pre-formation HML slope, so Hh-Lh is indeed neutral with respect to BE/ME. Moreover, the post-formation HML slopes for Hh-Lh are 0.35 or larger, and all are more than five standard errors from zero. Thus, Hh-Lh provides a test of the overreaction model's prediction that an HML slope that is not related to BE/ME does not affect average return.

The second arbitrage portfolio, H-L, is meant to test the overreaction model's converse prediction that differences in BE/ME unrelated to HML slopes do affect average return. To produce a spread in BE/ME while controlling for sensitivity to HML, H-L focuses on the differences between the returns on high and low BE/ME portfolios with similar pre-formation HML slopes,

$$\begin{aligned}\text{H-L} &= [(\text{H/Lh} - \text{L/Lh}) + (\text{H/Mh} - \text{L/Mh}) + (\text{H/Hh} - \text{L/Hh})]/3 \\ &= (\text{H/Lh} + \text{H/Mh} + \text{H/Hh})/3 - (\text{L/Lh} + \text{L/Mh} + \text{L/Hh})/3. \quad (6)\end{aligned}$$

Although H-L controls for pre-formation HML slopes, the post-formation HML slopes for H-L in Table 3 are about 0.75, more than ten standard errors above the target of zero. Since the sorts on BE/ME and pre-formation HML slope are independent, the message is that BE/ME has information about post-formation HML slopes beyond that in pre-formation HML slopes. This is not surprising. Five-year pre-formation HML slopes are noisy estimates of true slopes, and Table 2 documents a strong correlation between BE/ME and post-formation HML slopes.

Despite H-L's large post-formation HML slopes, the control for pre-formation HML slopes in H-L does allow a test of the overreaction model's prediction that spreads in the BE/ME characteristic unrelated to HML slopes affect average returns. To see this, consider an alternative H^*-L^* that is just the difference between the value-weight returns on high and low BE/ME stocks. Equivalently, H^*-L^* value-weights the three high BE/ME and the three low BE/ME components of H-L, while H-L weights them equally. Since average BE/ME is roughly constant across the three high BE/ME portfolios (H/Lh, H/Mh, and H/Hh) and across the three low BE/ME portfolios (L/Lh, L/Mh, and L/Hh), H^*-L^* and H-L produce similar BE/ME spreads. But, without showing the details, we can report that the post-formation HML slopes for H^*-L^* are around 1.05, about 40 percent larger than the slopes for H-L, which are around 0.75. We can infer that more of the BE/ME spread for H-L is unrelated to its post-formation HML slope than is the case for H^*-L^*.

Why does H-L have a lower HML slope than H^*-L^*? Book-to-market equity is highly correlated with HML slope, so the H/Hh (high BE/ME, high HML slope) portfolio has about three times as many stocks as the H/Lh portfolio. Similarly, the L/Lh portfolio has about three times as many stocks as the L/Hh portfolio. In equal-weighting the six components of H-L, we are in effect tilting H toward the relatively small sample of high BE/ME stocks that have low HML slopes, while L is tilted toward the relatively small sample of low BE/ME stocks with high HML slopes. In contrast, H^*-L^* weights the six component portfolios by their market values.

If BE/ME and post-formation HML slope are not perfectly correlated, even the univariate BE/ME sort in H^*-L^* produces some spread in BE/ME unrelated to its post-formation HML slope. But H-L produces more. Thus, despite its large post-formation HML slopes, H-L provides a better test of the overreaction model's prediction that variation in BE/ME unrelated to HML slope affects average return.

Daniel and Titman (1997) estimate the three-factor regression (4) for 7/73-12/93 on a portfolio like Hh-Lh. Their intercept, -0.18 percent per month (t = -2.30), is consistent with the overreaction model's prediction that an HML slope unrelated to BE/ME does not affect average return.[1] When we estimate (4)

[1] The intercept reported in Daniel and Titman (1997) is -0.354. Daniel and Titman define the return on their arbitrage portfolio as the sum of the returns on two high h_i portfolios minus the sum of the returns on two low h_i portfolios. We divide their intercepts and slopes by two to make them comparable to the results for our arbitrage portfolios, which have only one dollar invested in the long and short portfolios. The t-statistics are not affected by the way the portfolios are standardized.

using our version of Hh-Lh for the same 7/73-12/93 time period, our intercept, -0.17 (Table 3), is close to theirs. But the 7/73-12/93 period is an exception. Our Hh-Lh regressions for other periods do not support the Daniel-Titman conclusion that expected returns are determined by the BE/ME characteristic rather than HML risk loading. The intercept in our Hh-Lh regression for 7/63-6/97, a 34-year period that includes their 20.5-year sample, is -0.06 (t = -0.51). This failure to reject the three-factor model is not caused by a failure to produce a large HML slope unrelated to BE/ME. The post-formation HML slope in the Hh-Lh regression for 7/63-6/97, 0.47, is larger than Daniel and Titman's slope for 7/73-12/93, 0.36. The results for the full 68-year period, from 7/29 to 6/97, provide the most powerful test of the risk model against the overreaction model. The intercept in our estimate of (4) on Hh-Lh for the 7/29-6/97 period, -0.06 (t = -0.62), is again quite consistent with the risk model's prediction that HML risk loading determines expected return regardless of BE/ME. In short, the Daniel-Titman evidence in favor of the overreaction model seems to be limited to the rather brief 7/73-12/93 time period

The estimates of (4) for H-L add to the evidence against the overreaction model. Since the spread of BE/ME for H-L is more extreme than its HML risk loading, the overreaction model predicts positive intercepts for H-L in (4). The intercept for 7/29-6/63, 0.12 (t = 1.26), is positive, but the intercept for 7/63-6/97 is negative, -0.11 (t = -1.41), and about the same magnitude. As a result, the intercept for the 68-year 7/29-6/97 period, -0.01 (t = -0.20) is almost perfectly in line with the risk model's prediction that HML risk loading, not the BE/ME characteristic, determines expected returns.

There is a caveat. The tests in Table 3 are consistent with the three-factor risk model's prediction that HML risk loading determines expected return, and they provide no consistent support for the overreaction model's prediction that expected return is better explained by the BE/ME characteristic. But the power of the tests is not overwhelming. For example, the overreaction model predicts that the HML slopes for Hh-Lh will cause the three-factor risk model to over-predict the average return on Hh-Lh by its HML slope times the HML average return. For the 7/29-6/97 period the intercept predicted by the overreaction model is -0.18. An intercept this size would be about -1.97 standard errors from zero. Thus the overreaction model is in principle distinguishable from the risk model, but only marginally.

The power culprit in Table 3 is the strong correlation between BE/ME and post-formation HML slope, which weakens tests of the overreaction model's prediction that expected returns are explained by BE/ME, not HML risk loading. The post-formation HML slope for Hh-Lh for 7/29-6/97 is 0.38. For perspective, a univariate sort of stocks into three value-weight portfolios based on pre-formation HML slope produces a spread in post-formation HML slopes of 0.84. This slope is more than twice that for Hh-Lh, which also controls for BE/ME. This is strong testimony that the correlation between BE/ME and post-formation HML slopes limits the range of independent variation in BE/ME and HML slopes, and so limits the power of tests meant to distinguish the overreaction model from the risk model.

V. Robustness

Our estimate of the three-factor regression (4) for Hh-Lh for the 7/73-12/93 period used by Daniel and Titman (1997) produces an intercept, -0.17, close to theirs, -0.18. But their intercept is more precise (t = -2.30) than ours (t = -0.99). Their approach gives more weight to small stocks, and it is possible that this increases precision. We sort firms into nine value-weight portfolios based on BE/ME and pre-formation HML slope, h_i. As defined in (5), Hh-Lh is then the difference between the returns on high and low h_i portfolios matched on BE/ME. Because we do not control for size and the six components of Hh-Lh are value-weight portfolios, the (value-weight) average size of the stocks in the portfolios (Table 3) is typically above the 0.7 fractile of ME for NYSE firms. In short, our version of Hh-Lh (like the market itself) is weighted toward large firms.

In contrast, the Daniel-Titman version of Hh-Lh controls for size and BE/ME. They sort stocks into nine portfolios on size and BE/ME. They subdivide each of these nine portfolios into five value-weight portfolios based on pre-formation h_i. Their Hh-Lh is the difference between the sum of the returns on the two high h_i portfolios of a size-BE/ME group minus the sum of the returns on the two low h_i portfolios of the same size-BE/ME group, averaged across the nine size-BE/ME groups. Equal-weighting across the nine size-BE/ME groups tilts their version of Hh-Lh more toward small firms.

Table 4 shows estimates of the three-factor regression (4) on a version of Hh-Lh similar to theirs. Like them, we place stocks into nine groups based on independent sorts on size and BE/ME. Unlike them, we subdivide each of the nine groups into three portfolios (rather than five) based on pre-formation HML slopes. The advantage of fewer third-pass sorts on h_i is that the resulting 27 portfolios always contain some stocks, so the tests need not be limited to their 7/73-12/93 period. This is important given the evidence above that their results are sensitive to time period. Forming three (rather than five) h_i portfolios for each size-BE/ME group should be innocuous since Daniel and Titman calculate their version of Hh-Lh as the difference between the sum of the returns on the two high h_i portfolios and the sum of the returns on the two low h_i portfolios in each size-BE/ME group. Our version of Hh-Lh simply takes the difference between the returns on the high h_i and the low h_i portfolio of each size-BE/ME group, and then averages these differences over the nine groups.

The estimate of (4) on our new Hh-Lh portfolio for 7/73-12/93 (the Daniel-Titman period) produces an intercept, -0.17, close to theirs, -0.18. But the t-statistic for our intercept, -1.63, is still less extreme than theirs, -2.30. This is surprising, given that our new approach is so similar to theirs. Moreover, the post-formation HML slope produced by our new version of Hh-Lh, 0.45, is larger than theirs, 0.36. Thus, our version of Hh-Lh produces a bigger post-formation HML slope independent of the BE/ME characteristic, so in principle our test should be more powerful than theirs. Apparently even the remaining small differences in approaches have a non-trivial effect on inferences.

More important, Table 4 confirms the evidence in Table 3 that any support for the overreaction model is special to the rather short 7/73-12/93 period. Merely extending the tests to 7/63-6/97 causes the intercept in the three-factor regression for Hh-Lh to drop to -0.06 ($t = -0.80$). Most convincing, the Hh-Lh regression for the 68-year 7/29-6/97 period produces an intercept, -0.01 ($t = -0.11$), that could hardly be more consistent with the three-factor risk model's prediction that HML risk loadings affect expected returns even when they are unrelated to the BE/ME characteristic.

Table 5 presents a more detailed comparison of the predictions of the risk model and the overreaction model for the Hh-Lh regressions in Table 4. As always, the risk model predicts the intercept is zero. Since the Hh-Lh portfolio controls for BE/ME, the overreaction model's competing prediction is that the intercept equals the negative of the HML slope times the average HML premium.

The results in Table 5 say that, in principle, the tests have power to distinguish the risk model from the overreaction model. In three of four time periods, the intercepts predicted by the overreaction model are more than two standard errors from zero. Thus, if the estimated intercepts matched the predictions of the overreaction model, we would be able to reject the risk model in favor of the overreaction model. In fact, consistent with the risk model, in all four time periods the intercepts in the Hh-Lh regression are within two standard errors of zero. In the three longest periods, the intercepts are less than one standard error from zero.

The 68-year 7/29-6/97 period produces the most precise (lowest standard error) intercept. The estimated intercept, -0.007, is -0.11 standard errors from zero, and it is –2.20 standard errors from the -0.150 value predicted by the overreaction model. Thus, the most precise Hh-Lh regression rejects the overreaction model in favor of the risk model.

VI. Size versus SMB Risk Loading

Our tests to explain the size effect are like the tests of the book-to-market equity effect in Table 3. We start by constructing nine portfolios as the intersections of independent sorts of stocks into three groups on size and three groups on five-year (three-year minimum) pre-formation SMB slope, s_i. Each portfolio is identified by its size group (S, M, or B) and its s_i group (Ls, Ms, or Hs). For example, S/Hs is the portfolio of stocks that are in the smallest size group and the highest s_i group.

Table 6 shows estimates of the three-factor regression (4) on post-formation returns for the nine size/SMB-slope portfolios and for two arbitrage portfolios, Hs-Ls and S-B. Hs-Ls focuses on the differences between the returns on high and low s_i portfolios matched on size,

$$\text{Hs-Ls} = [(\text{S/Hs} - \text{S/Ls}) + (\text{M/Hs} - \text{M/Ls}) + (\text{B/Hs} - \text{B/Ls})]/3. \quad (7)$$

The over-reaction model says that expected return depends on size, while the risk model says expected return depends on sensitivity to SMB. Hs-Ls is meant to test these hypotheses by isolating differences in post-formation SMB slopes that are unrelated to size. Table 6 confirms that within a size group, size does not vary much with pre-formation SMB slope, so Hs-Ls is indeed neutral with respect to size. Hs-Ls does, however, produce non-trivial post-formation SMB slopes, from 0.36 (t=2.96) to 0.69 (t=17.64). Thus, Hs-Ls will provide a test of the overreaction model's prediction that an SMB slope unrelated to size does not affect average return.

The second arbitrage portfolio, S-B, is designed to test the overreaction model's converse prediction that differences in size unrelated to SMB slope do affect average return. To produce a spread in size that controls for SMB slope, S-B focuses on the differences between the returns on small and big stock portfolios matched on pre-formation SMB slopes,

$$\text{S-B} = [(\text{S/Ls} - \text{B/Ls}) + (\text{S/Ms} - \text{B/Ms}) + (\text{S/Hs} - \text{B/Hs})]/3. \quad (8)$$

Table 6 shows, however, that S-B does not eliminate differences between the post-formation SMB slopes of the small and big portfolios. The post-formation SMB slopes for S-B are near 1.0 and more than ten standard errors from the target of zero. As with H-L above, the strong correlation between size and post-formation SMB slope (Table 2), and noisy five-year estimates of pre-formation SMB slopes, combine to limit our ability to isolate differences in size unrelated to differences in SMB slope.

Controlling for pre-formation SMB slope does, however, produce spread in size that is unrelated to the SMB slope for S-B. Again, a univariate sort on size provides a benchmark. Define S^*-B^* as the difference between the value-weight return on all small stocks (below the 33rd NYSE percentile) and the value-weight return on all big stocks (above the 67th NYSE percentile). Equivalently, S^*-B^* value-weights the components of S and B while S-B weights them equally. If size and post-formation SMB slope are not perfectly correlated, the univariate size sort in S^*-B^* produces some spread in size that is unrelated to the post-formation SMB slope for S^*-B^*. But S-L produces more. To see this, note that since average size is roughly constant across the three small-stock portfolios (S/Ls, S/Ms, and S/Hs) and across the three big stock portfolios (B/Ls, B/Ms, and B/Hs), S^*-B^* and S-B have similar size spreads. But the post-formation SMB slopes for S^*-B^*, around 1.3, are about 30 percent larger than the slopes for S-B. We can infer that controlling for pre-formation SMB slope causes more of the size spread for S-B to be unrelated to its post-formation SMB slope than is the case for S^*-B^*. Thus, despite its large post-formation SMB slope, S-B in principle provides a test of the overreaction model's prediction that variation in size unrelated to SMB slope affects average return.

Unfortunately, the arbitrage portfolio results in Table 6 suggest that it may be impossible to determine whether the premium in the returns on small stocks is determined by size or loading on SMB. There are two problems. First, because of the correlation between size and SMB slope (Table 2), it is hard to create a large spread in SMB slopes unrelated to differences in size. This problem is analogous to the difficulty we have identifying independent variation in BE/ME and HML slopes in Tables 3 and 4. The second and more serious problem is the puny average SMB return, about 0.20 percent per month (Table 1). Together, these two problems imply that the three-factor risk model's predictions about how SMB slopes affect average return are not much different from those of the overreaction model.

For example, the Hs-Ls regression for the overall 7/29-6/97 period should be our best shot at testing the overreaction model's prediction that variation in SMB slope unrelated to size does not affect average return. The intercept for Hs-Ls in Table 6, -0.08, is only -1.18 standard errors from zero, so the risk model seems to work well. But the overreaction model also works well. It predicts that the intercept in the Hs-Ls regression is -0.10 (the negative of the SMB slope for Hs-Ls, 0.49, times the SMB average return, 0.20), which is close to the observed intercept, -0.08. Similarly, the Hs-Ls intercepts for 7/29-6/63 and 7/63-6/97 are within one standard error of the values predicted by both the risk model and the overreaction model. Ironically, the intercept furthest from the value predicted by the overreaction model is the estimate for Daniel and Titman's 7/73-12/93 period. This intercept, -0.03 (t = -0.24), is close to the zero value predicted by the risk model, but it is more than 1.5 standard errors from the -0.22 predicted by the overreaction model.

Though statistically flimsy, the negative signs of the intercepts in (4) for Hs-Ls are in line with the overreaction model's prediction that an SMB slope unrelated to size does not affect average return. In contrast, the estimates of (4) for S-B typically contradict the model's converse prediction that variation in size unrelated to SMB slope does affect average return. Since the size spread for S-B is more extreme than its SMB slope, the overreaction model predicts that S-B should produce positive intercepts in (4). But the intercepts for the overall period and the two later subperiods are negative and within 1.5 standard errors of zero. The intercept for the first subperiod, 0.01, is only 0.16 standard errors above zero.

In short, the Hs-Ls and S-B returns are consistent with the three-factor risk model, and they offer no reason to abandon rationality in favor of the behavioral overreaction model. But the correlation between size and SMB risk loading combines with a rather weak size effect to prevent us from cleanly testing the overreaction model's prediction that size, not SMB risk loading, determines average return.

VII. Sorts on Market Slopes

There is one issue on which our results agree entirely with Daniel and Titman (1997). Table 7 shows estimates of the three-factor regression (4) for three portfolios (Lb, Mb, and Hb) formed on five-year pre-formation market slopes, b_i, in (4). The spreads in the post-formation market slopes, from 0.29 to 0.50, are rather narrow. But the post-formation market slopes do reproduce the ordering of the pre-formation slopes, so pre-formation slopes are informative about post-formation slopes.

The spreads in average return from the low b_i portfolio (Lb) to the high b_i (Hb) portfolio in Table 7 are tiny, ten basis points per month or less. As a result, the intercepts in the estimates of (4) are positive for Lb and negative for Hb. The difference between the high b_i and low b_i returns, Hb-Lb, produces intercepts for the overall 6/29-6/97 period, -0.26, and for the earlier 6/29 to 6/63 subperiod, -0.36, that are

-2.75 and -2.44 standard errors from zero. Although the Hb-Lb intercept for the later 7/63-6/97 subperiod is closer to zero, -0.13 (t = -1.07), overall the results suggest that the average value of R_M-R_f overstates the expected premium for differences in loadings on the market return.

These results are like those observed in tests of the Sharpe (1964) - Lintner (1965) CAPM, which typically find that the relation between average return and univariate market β is too flat (Black, Jensen, and Scholes (1972), Fama and MacBeth (1973), Fama and French (1992)). And the standard explanations can be invoked. (i) Perhaps the multifactor version of Merton's (1973) ICAPM that does not include a riskfree security (Fama (1996)), and is analogous to the Black (1972) version of the CAPM, is more relevant than the riskfree rate version. (ii) The problem may be one of implementation. For example, we use a market portfolio that includes only common stocks. (iii) The three-factor model is just a model, and this may be one of its shortcomings.

VIII. Summary and Conclusions

The value premium in average stock returns is robust. Measured by HML (which is neutral with respect to size effects), the value premium for 7/29-6/63 is 0.50 percent per month (t = 2.81). This is a bit larger than the premium for 7/63-6/97, 0.42 percent per month (t = 3.34), observed in earlier work. The size effect in average returns is smaller. Measured by SMB (which is neutral with respect to value effects), the size premium for the overall 7/29-6/97 period is 0.20 percent per month (t = 1.76).

The three-factor risk model (1) explains the value premium better than a popular competitor, the overreaction model of Daniel and Titman (1997), Lakonishok, Shleifer, and Vishny (1994), and others. Contradicting the overreaction model, our H-L portfolio produces no evidence that average return varies with the BE/ME characteristic in a way that cannot be explained by HML risk loading. Specifically, the intercepts in the three-factor regression (4) for H-L tend to be negative, rather than positive (the prediction of the overreaction model), but always close to zero. Similarly, our Hh-Lh returns produce no convincing evidence against the three-factor risk model's prediction that HML risk loading determines expected returns, irrespective of the BE/ME characteristic. The intercepts in the three-factor regressions for Hh-Lh tend to be negative, which is consistent with the overreaction model. But except for the rather short 7/73-12/93 period studied by Daniel and Titman, the intercepts in the Hh-Lh regressions are economically and statistically close to zero. The most precise Hh-Lh regression, that for the overall 7/29-6/97 period in Table 4, cleanly rejects the overreaction model in favor of the risk model.

In contrast, our attempts to use the size effect to test the predictions of the overreaction model are inconclusive. The main problem is the weak size premium in average returns. In essence, there is not much size effect for the risk and overreaction models to quarrel about.

On a more general note, it is interesting that the three-factor model (1) does better in the 7/29-6/63 period than in the subsequent 7/63-6/97 period for which it was designed. Table 8 summarizes the intercepts in the three-factor regression (4) for the different sorting rules we have tried (Tables 2 to 7). The GRS statistics for 7/29-6/63 are typically near the median of the distribution relevant when the three-factor model holds. Nevertheless, Table 8 does say that when portfolios are formed from independent sorts of stocks on size and BE/ME (Table 2), the three-factor model is rejected by the GRS test for 6/63-7/97, and the model is on the margin of rejection for the overall 7/29-6/97 period. These results suffice to show that the three-factor model is just a model and thus an incomplete description of expected returns. What the remaining tests say is that the model's shortcomings are just not those predicted by the overreaction model.

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Table 1 - Summary statistics for monthly percent three-factor explanatory returns

R_f is the one-month Treasury bill rate (from Ibbotson Associates). R_M is the value-weight return on all NYSE, AMEX, and NASDAQ the stocks with book equity data for the previous calendar year. SMB and HML are constructed as follows. At the end of June of each year t (1926 to 1996), stocks are allocated to two groups (small or big; S or B) based on whether their June size (market capitalization, ME, defined as stock price times shares outstanding) is below or above the median for all NYSE stocks on CRSP. Stocks are allocated in an independent sort to three book-to-market equity (BE/ME) groups (low, medium, or high; L, M, or H) based on the breakpoints for the bottom 30%, middle 40% and top 30% of the values of BE/ME for the NYSE stocks in our sample. BE is the book value of stockholders' equity, plus balance sheet deferred taxes and investment tax credit (if available), minus the book value of preferred stock. Depending on availability, we use the redemption, liquidation, or par value (in that order) to estimate the book value of preferred stock. Stockholders' equity is the value reported by Moody's or Compustat, if it is available. If not, we measure stockholders' equity as the book value of common equity plus the par value of preferred stock, or the book value of assets minus total liabilities (in that order). The BE/ME ratio used to form portfolios in June of year t is book common equity for the fiscal year ending in calendar year t-1, divided by market equity at the end of December of t-1. Six portfolios (S/L, S/M, S/H, B/L, B/M, B/H) are formed as the intersections of the two size and the three BE/ME groups. Value-weight monthly returns on the portfolios are calculated from July of year t to June of t+1. SMB is the difference, each month, between the average of the returns on the three small-stock portfolios (S/L, S/M, and S/H) and the average of the returns on the three big stock portfolios (B/L, B/M, and B/H). HML is the difference between the average of the returns on the two high BE/ME portfolios (S/H and B/H) and the average of the returns on the two low BE/ME portfolios (S/L and B/L). The sample of stocks includes all NYSE industrials that have BE data either in Moody's Industrial Manuals or on Compustat for fiscal years ending in the 1925 to 1996 period. After 6/54, the sample for year t also includes all NYSE, AMEX, and NASDAQ firms with BE data on Compustat for the fiscal year ending in the preceding calendar year. To be included in the portfolios formed in June of year t (here and in all following tables), firms must also have Compustat or CRSP data on ME for December of year t-1 and June of year t. We do not use negative BE firms when calculating the breakpoints for BE/ME or when forming the size-BE/ME portfolios. Also, only firms with ordinary common equity (as classified by CRSP) are included in the tests. This means that ADR's, REIT's, and units of beneficial interest are excluded.

	R_M-R_f	SMB	HML	S/L	S/M	S/H	B/L	B/M	B/H
				7/29-6/97: 816 Months					
Mean	0.67	0.20	0.46	0.74	0.99	1.22	0.58	0.73	1.03
Std	5.75	3.26	3.12	7.91	7.48	8.43	5.66	6.21	7.41
t(Mn)	3.33	1.76	4.23	2.66	3.78	4.12	2.95	3.35	3.96
				7/29-6/63: 408 Months					
Mean	0.82	0.19	0.50	0.98	1.12	1.40	0.71	0.92	1.30
Std	6.89	3.65	3.62	9.03	9.10	10.64	6.51	7.74	9.52
t(Mn)	2.40	1.05	2.81	2.20	2.48	2.66	2.21	2.39	2.76
				7/63-6/97: 408 Months					
Mean	0.52	0.21	0.42	0.49	0.86	1.04	0.46	0.54	0.75
Std	4.32	2.82	2.54	6.62	5.39	5.40	4.67	4.14	4.40
t(Mn)	2.44	1.52	3.34	1.50	3.21	3.87	1.97	2.63	3.46
				7/73-12/93: 246 Months					
Mean	0.51	0.33	0.50	0.63	1.00	1.15	0.36	0.60	0.83
Std	4.79	2.75	2.74	6.91	5.66	5.71	5.24	4.56	4.70
t(Mn)	1.67	1.86	2.84	1.42	2.76	3.14	1.07	2.05	2.78

Table 2 – Three-factor regressions for portfolios formed from independent sorts on size and BE/ME

$$R_i - R_f = a_i + b_i(R_M - R_f) + s_iSMB + h_iHML + \varepsilon_i$$

At the end of June of each year t (1929 to 1996), we allocate the NYSE, AMEX, and NASDAQ stocks in our sample to three size groups (small, medium, or big; S, M, or B) based on their June market capitalization, ME. The breakpoints are the 33rd and 67th ME percentiles for NYSE firms. We allocate stocks in an independent sort to three book-to-market equity (BE/ME) groups (low, medium, or high; L, M, or H) based on BE/ME for December of the preceding year. The breakpoints are the 33rd and 67th percentiles of BE/ME for NYSE firms with positive BE. We form nine portfolios (S/L, S/M, S/H, M/L, M/M, M/H, B/L, B/M, B/H) as the intersections of the three size and the three BE/ME groups. The returns explained by the regressions, R_i, are the value-weight returns on the portfolios from July of year t to June of t+1. The t-statistics, t(), for the regression coefficients (here and in all following tables) use the heteroskedasticity consistent standard errors of White (1980). Here and in all following tables: (i) BE/ME is the aggregate of BE for the firms in a portfolio divided by the aggregate of ME; (ii) Size is the value-weight average of the NYSE size percentiles for the firms in a portfolio; (iii) BE/ME and Size are averages of the annual values for the time periods shown; (iv) Ex Ret is the average monthly post-formation return in excess of R_f; (v) the regression R^2 are adjusted for degrees of freedom.

	BE/ME	Size	Ex Ret	a	b	s	h	t(a)	t(b)	t(s)	t(h)	R^2
						7/29-6/97						
S/L	0.54	21.97	0.72	-0.38	1.05	1.61	0.15	-3.79	28.37	8.15	1.69	0.89
S/M	1.11	21.70	1.07	-0.01	0.99	1.15	0.40	-0.16	65.43	22.02	14.84	0.97
S/H	2.81	18.62	1.25	-0.03	1.02	1.13	0.77	-0.61	66.19	44.04	27.16	0.98
M/L	0.53	54.90	0.71	-0.05	1.03	0.63	-0.13	-1.06	57.80	20.65	-5.40	0.96
M/M	1.07	54.11	0.94	-0.01	1.03	0.51	0.33	-0.24	34.87	20.86	10.11	0.97
M/H	2.18	52.25	1.13	-0.03	1.07	0.54	0.72	-0.72	52.35	9.92	12.55	0.97
B/L	0.43	94.51	0.58	0.02	1.02	-0.10	-0.23	0.95	145.85	-6.65	-13.32	0.99
B/M	1.03	91.90	0.72	-0.09	1.01	-0.13	0.34	-1.90	60.19	-4.43	13.52	0.95
B/H	1.87	89.39	1.00	-0.08	1.06	-0.06	0.83	-1.35	52.13	-0.79	20.84	0.93
						7/29-6/63						
S/L	0.67	24.25	0.95	-0.34	0.98	1.81	0.28	-1.86	19.86	6.78	2.13	0.88
S/M	1.34	23.98	1.25	0.01	0.97	1.21	0.43	0.07	40.48	17.53	9.48	0.96
S/H	3.91	20.44	1.47	-0.01	1.01	1.17	0.83	-0.08	43.82	34.93	18.42	0.98
M/L	0.64	55.66	0.86	-0.05	0.98	0.60	0.00	-0.76	41.26	13.39	-0.07	0.97
M/M	1.27	54.47	1.11	0.00	1.05	0.50	0.31	-0.02	27.78	14.42	8.26	0.97
M/H	2.82	51.85	1.30	-0.06	1.06	0.52	0.78	-0.88	51.98	6.06	8.88	0.97
B/L	0.47	94.97	0.72	-0.01	1.02	-0.08	-0.20	-0.25	125.23	-4.71	-7.88	0.99
B/M	1.21	92.07	0.89	-0.10	1.01	-0.11	0.37	-1.30	43.23	-2.56	10.01	0.96
B/H	2.32	89.18	1.29	-0.01	1.03	-0.11	0.96	-0.13	34.23	-0.92	17.82	0.94
						7/63-6/97						
S/L	0.42	19.70	0.48	-0.27	1.05	1.25	-0.14	-4.08	59.98	39.32	-4.35	0.96
S/M	0.87	19.41	0.89	0.03	0.97	1.04	0.31	0.65	73.53	55.57	14.07	0.98
S/H	1.72	16.80	1.03	0.02	0.99	1.05	0.63	0.59	68.74	58.92	23.73	0.98
M/L	0.42	54.14	0.56	-0.03	1.07	0.64	-0.25	-0.58	68.40	27.91	-9.37	0.96
M/M	0.87	53.75	0.76	0.00	0.99	0.53	0.31	0.02	61.44	24.00	12.05	0.95
M/H	1.54	52.65	0.96	0.04	1.04	0.57	0.63	0.79	79.83	32.26	28.23	0.96
B/L	0.38	94.06	0.45	0.11	0.99	-0.14	-0.33	3.09	95.46	-8.98	-17.34	0.98
B/M	0.86	91.74	0.54	-0.05	0.99	-0.18	0.26	-0.78	55.29	-6.41	8.28	0.92
B/H	1.42	89.60	0.72	-0.11	1.04	0.00	0.68	-2.22	70.26	0.06	28.48	0.95

Table 3 - Regressions for portfolios formed from independent sorts on BE/ME and HML slope

$$R_i - R_f = a_i + b_i(R_M - R_f) + s_iSMB + h_iHML + \varepsilon_i$$

At the end of June of each year t (1929 to 1996), we allocate equal numbers of stocks to three groups (low, medium, or high; Lh, Mh, or Hh) based on their HML slope, h_i, for the preceding five-year (three year minimum) period. In an independent sort, we allocate stocks to three book-to-market equity (BE/ME) groups (low, medium, or high; L, M, or H) based on BE/ME for December of the preceding year. The breakpoints are the 33rd and 67th percentiles of BE/ME for NYSE firms with positive BE. L/Lh, L/Mh, L/Hh, M/Lh, M/Mh, M/Hh, H/Lh, H/Mh, and H/Hh are the intersections of the three size and the three h groups. The regressions explain R_i, the value-weight returns on the portfolios from July of year t to June of t+1. Hh-Lh is [(L/Hh-L/Lh) + (M/Hh-M/Lh) + (H/Hh-H/Lh)]/3. H-L is [(H/Lh-L/Lh) + (H/Mh-L/Mh) + (H/Hh-L/Hh)]/3.

	BE/ME	Size	Ex Ret	a	b	s	h	t(a)	t(b)	t(s)	t(h)	R^2
						7/29-6/97						
L/Lh	0.39	91.72	0.56	0.02	1.06	-0.06	-0.33	0.53	90.25	-2.43	-11.13	0.97
L/Mh	0.51	89.15	0.65	0.04	0.96	-0.05	-0.08	0.77	54.25	-1.49	-2.45	0.92
L/Hh	0.54	78.01	0.79	-0.11	1.10	0.31	0.20	-1.15	30.26	3.88	3.78	0.86
M/Lh	0.99	79.11	0.73	-0.08	1.07	0.15	0.13	-1.03	30.15	1.94	2.56	0.88
M/Mh	1.05	85.40	0.71	-0.11	0.98	-0.04	0.37	-1.88	48.06	-1.21	13.12	0.92
M/Hh	1.08	80.64	0.87	-0.04	1.01	0.10	0.46	-0.48	39.65	1.66	11.34	0.90
H/Lh	2.00	54.36	1.21	0.05	1.11	0.71	0.57	0.52	27.70	9.03	9.12	0.88
H/Mh	1.95	71.00	1.00	-0.11	1.07	0.25	0.72	-1.20	30.87	2.63	9.18	0.89
H/Hh	2.14	76.15	1.11	-0.03	1.05	0.20	0.86	-0.54	46.82	2.38	22.09	0.94
Hh-Lh			0.09	-0.06	-0.02	-0.06	0.38	-0.62	-0.75	-0.96	7.32	0.17
H-L			0.44	-0.01	0.04	0.32	0.79	-0.20	1.71	9.00	17.58	0.74
						7/29-6/63						
L/Lh	0.44	93.97	0.72	0.00	1.05	-0.04	-0.27	0.05	89.92	-1.48	-6.63	0.98
L/Mh	0.57	91.43	0.74	0.01	0.94	-0.10	-0.05	0.17	41.91	-2.51	-1.26	0.93
L/Hh	0.60	81.52	0.76	-0.33	1.12	0.31	0.22	-2.22	21.08	2.40	2.64	0.87
M/Lh	1.16	79.17	0.90	-0.08	1.06	0.15	0.16	-0.67	22.63	1.24	2.45	0.90
M/Mh	1.24	85.90	0.82	-0.19	0.97	0.00	0.40	-1.93	34.54	-0.10	10.34	0.94
M/Hh	1.27	81.70	1.12	0.05	1.00	0.07	0.47	0.39	27.77	0.76	7.88	0.91
H/Lh	2.59	49.48	1.47	0.10	1.07	0.81	0.67	0.69	21.49	7.56	8.06	0.91
H/Mh	2.48	66.99	1.24	-0.08	1.04	0.27	0.83	-0.52	23.75	1.75	7.28	0.89
H/Hh	2.74	75.09	1.35	0.02	1.03	0.19	0.90	0.21	31.81	1.40	18.68	0.95
Hh-Lh			0.05	-0.10	-0.01	-0.12	0.35	-0.75	-0.22	-1.11	5.18	0.15
H-L			0.62	0.12	0.01	0.37	0.83	1.26	0.36	7.89	11.85	0.78
						7/63-6/97						
L/Lh	0.34	89.47	0.40	0.12	0.99	-0.10	-0.51	2.54	69.69	-4.66	-19.54	0.96
L/Mh	0.46	86.88	0.55	0.00	1.04	0.02	0.01	-0.01	43.22	0.70	0.37	0.92
L/Hh	0.47	74.51	0.82	0.19	1.01	0.33	0.08	1.61	29.10	6.38	1.26	0.82
M/Lh	0.82	79.05	0.55	-0.07	1.07	0.14	0.09	-0.67	37.23	2.91	1.58	0.83
M/Mh	0.86	84.91	0.60	0.01	0.95	-0.10	0.26	0.19	44.92	-3.24	7.64	0.88
M/Hh	0.89	79.58	0.62	-0.15	1.03	0.14	0.48	-1.70	38.72	3.14	9.49	0.87
H/Lh	1.41	59.23	0.94	0.10	1.10	0.53	0.38	0.68	19.93	8.59	5.98	0.80
H/Mh	1.41	75.01	0.75	-0.05	1.03	0.18	0.52	-0.57	32.76	5.46	10.57	0.89
H/Hh	1.53	77.20	0.87	-0.08	1.06	0.21	0.82	-1.17	54.94	7.07	23.61	0.92
Hh-Lh			0.14	-0.06	-0.02	0.03	0.47	-0.51	-0.42	0.60	6.93	0.22
H-L			0.26	-0.11	0.05	0.22	0.71	-1.41	1.71	6.56	18.41	0.62
						7/73-12/93						
Hh-Lh			0.10	-0.17	-0.01	0.10	0.50	-0.99	-0.21	1.17	5.41	0.22
H-L			0.37	-0.05	0.04	0.12	0.71	-0.41	1.28	2.43	13.41	0.61

Table 4 – Regressions for Hh-Lh portfolios formed from sorts on size, BE/ME, and HML slopes

$$Hh\text{-}Lh = a + b(R_M - R_f) + sSMB + hHML + \varepsilon$$

At the end of June of each year t (1929 to 1996), we allocate stocks to three size groups (small, medium, or big; S, M, or B) based on their June market capitalization, ME. The breakpoints are the 33rd and 67th ME percentiles for NYSE firms. We allocate stocks in an independent sort to three book-to-market equity (BE/ME) groups (low, medium, or high; L, M, or H) based on BE/ME for December of the preceding year. The breakpoints are the 33rd and 67th percentiles of BE/ME for NYSE firms with positive BE. We form nine portfolios (S/L, S/M, S/H, M/L, M/M, M/H, B/L, B/M, B/H) as the intersections of the three size and the three BE/ME groups. These nine portfolios are each subdivided into three portfolios (Lh, Mh, or Hh) based on five-year (three year minimum) pre-formation HML slopes. Value-weight returns on the portfolios are calculated for July of year t to June of t+1. Hh-Lh is [(S/L/Hh-S/L/Lh) + (M/L/Hh-M/L/Lh) + (B/L/Hh-B/L/Lh) + (S/M/Hh-S/M/Lh) + (M/M/Hh-M/M/Lh) + (B/M/Hh-B/M/Lh) + (S/H/Hh-S/H/Lh) + (M/H/Hh-M/H/Lh) + (B/H/Hh-B/H/Lh)]/9.

Period	Ex Ret	a	b	s	h	t(a)	t(b)	t(s)	t(h)	R^2
7/29-6/97	0.14	-0.01	-0.03	0.06	0.32	-0.11	-0.97	1.42	4.60	0.22
7/29-6/63	0.15	0.01	-0.02	0.10	0.26	0.11	-0.63	1.45	2.46	0.17
7/63-6/97	0.12	-0.06	0.01	0.01	0.42	-0.80	0.32	0.38	10.48	0.36
7/73-12/93	0.08	-0.17	0.02	0.07	0.45	-1.63	0.62	1.41	8.20	0.38

Table 5 – Comparison of the estimated intercepts, a, for the Hh-Lh regressions in Table 4 and the intercepts, P(a), predicted by the overreaction model

Mn(HML) is the average HML return for the time period; h(Hh-Lh) is the HML slope for the Hh-Lh regression in Table 4; s(a) is the standard error of the estimated intercept from the regression, a. The intercept P(a) predicted by the overreaction model is the negative of Mn(HML)*h(Hh-Lh).

Period	Mn(HML)	h(Hh-Lh)	s(a)	a	P(a)	a/s(a)	P(a)/s(a)	[P(a)–a]/s(a)
7/29-6/97	0.462	0.324	0.065	-0.007	-0.150	-0.11	-2.30	-2.20
7/29-6/63	0.504	0.265	0.104	0.012	-0.134	0.12	-1.28	-1.40
7/63-6/97	0.420	0.418	0.074	-0.059	-0.176	-0.80	-2.37	-1.58
7/73-12/93	0.497	0.451	0.107	-0.174	-0.224	-1.63	-2.09	-0.47

Table 6 - Regressions for portfolios formed from independent sorts on size and SMB slope

$$R_i - R_f = a_i + b_i(R_M - R_f) + s_iSMB + h_iHML + \varepsilon_i$$

In June of each year t (1929 to 1996), we allocate equal numbers of stocks to three groups (low, medium, or high; Ls, Ms, or Hs) based on their SMB slope, s_i, for the preceding five-year (three year minimum) period. In an independent sort, we allocate stocks to three size groups (small, medium, or big; S, M, or B) based on their June market capitalization, ME. The breakpoints are the 33rd and 67th ME percentiles for NYSE firms. S/Ls, S/Ms, S/Hs, M/Ls, M/Ms, M/Hs, B/Ls, B/Ms, and B/Hs are the intersections of the three size and the three s_i groups. The regressions explain R_i, the value-weight returns on the portfolios from July of year t to June of t+1. Hs-Ls is [(S/Hs-S/Ls) + (M/Hs-M/Ls) + (B/Hs-B/Ls)]/3. S-B is [(S/Ls-B/Ls) + (S/Ms-B/Ms) + (S/Hs-B/Hs)]/3.

	BE/ME	Size	Ex Ret	a	b	s	h	t(a)	t(b)	t(s)	t(h)	R^2
						7/29-6/97						
S/Ls	1.81	21.99	0.88	-0.12	0.90	0.97	0.45	-1.55	38.15	7.94	7.68	0.90
S/Ms	1.76	21.67	1.06	-0.02	0.96	1.06	0.47	-0.29	44.28	17.38	11.12	0.95
S/Hs	1.89	18.54	1.10	-0.16	1.14	1.37	0.47	-2.86	62.90	31.98	14.87	0.97
M/Ls	1.14	55.98	0.87	0.03	0.95	0.41	0.26	0.61	59.28	17.71	10.89	0.95
M/Ms	1.13	53.61	0.93	0.01	1.06	0.54	0.22	0.20	48.92	18.56	7.72	0.97
M/Hs	1.20	50.83	0.92	-0.15	1.21	0.88	0.19	-2.42	57.75	17.87	4.63	0.95
B/Ls	0.69	94.71	0.62	-0.02	1.00	-0.16	-0.01	-1.05	199.17	-12.49	-0.85	0.99
B/Ms	0.77	87.98	0.78	0.05	1.06	0.14	-0.02	0.84	56.80	3.52	-0.63	0.94
B/Hs	0.78	79.96	0.83	-0.05	1.20	0.45	-0.03	-0.42	39.01	5.34	-0.48	0.82
Hs-Ls			0.16	-0.08	0.23	0.49	-0.03	-1.18	11.86	5.29	-0.55	0.54
S-B			0.27	-0.09	-0.08	0.99	0.48	-1.47	-4.99	12.83	13.09	0.79
						7/29-6/63						
S/Ls	2.58	23.40	1.05	-0.13	0.88	1.07	0.49	-0.87	24.21	6.15	5.44	0.89
S/Ms	2.44	23.70	1.29	0.04	0.91	1.09	0.59	0.42	28.29	12.34	9.05	0.95
S/Hs	2.75	21.01	1.42	-0.06	1.09	1.33	0.66	-0.70	45.11	20.57	20.76	0.98
M/Ls	1.42	56.43	1.05	0.06	0.94	0.43	0.29	0.72	40.23	13.37	7.81	0.96
M/Ms	1.42	54.36	1.07	-0.02	1.02	0.48	0.32	-0.29	36.08	14.73	9.39	0.97
M/Hs	1.60	51.65	1.18	-0.09	1.15	0.77	0.37	-1.18	47.79	14.92	9.15	0.97
B/Ls	0.72	95.47	0.76	-0.02	1.01	-0.14	-0.04	-0.97	139.00	-9.86	-3.97	0.99
B/Ms	0.82	89.97	0.97	0.09	1.00	0.11	0.08	1.14	41.15	1.79	2.00	0.95
B/Hs	0.88	80.53	0.81	-0.24	1.15	0.34	0.07	-1.53	28.32	3.38	0.94	0.88
Hs-Ls			0.18	-0.10	0.19	0.36	0.12	-0.95	7.08	2.96	2.01	0.51
S-B			0.41	0.01	-0.10	1.06	0.54	0.14	-4.26	10.26	11.19	0.84
						7/63-6/97						
S/Ls	1.04	20.57	0.72	-0.05	0.90	0.78	0.31	-0.83	51.04	33.34	10.88	0.95
S/Ms	1.09	19.63	0.82	-0.03	0.99	0.98	0.32	-0.77	70.17	47.07	12.23	0.98
S/Hs	1.02	16.08	0.78	-0.17	1.10	1.39	0.21	-2.80	59.58	48.75	6.37	0.97
M/Ls	0.85	55.53	0.69	0.02	0.95	0.39	0.22	0.39	57.04	16.96	7.89	0.94
M/Ms	0.85	52.87	0.79	0.03	1.07	0.63	0.16	0.57	85.59	30.60	6.74	0.97
M/Hs	0.80	50.01	0.66	-0.19	1.20	1.03	0.01	-2.02	40.73	24.70	0.29	0.93
B/Ls	0.66	93.95	0.47	0.01	0.98	-0.20	-0.01	0.60	245.34	-32.27	-0.78	0.99
B/Ms	0.71	85.98	0.58	-0.02	1.13	0.15	-0.06	-0.24	52.70	5.04	-1.47	0.92
B/Hs	0.67	79.39	0.85	0.07	1.25	0.61	-0.02	0.40	23.09	7.74	-0.21	0.73
Hs-Ls			0.14	-0.09	0.24	0.69	-0.11	-0.94	8.11	17.64	-2.21	0.64
S-B			0.14	-0.11	-0.12	0.86	0.31	-1.31	-5.21	23.31	6.53	0.68
						7/73-12/93						
Hs-Ls			0.24	-0.04	0.22	0.66	-0.11	-0.28	6.07	12.40	-1.80	0.59
S-B			0.21	-0.16	-0.12	0.89	0.27	-1.47	-4.19	18.15	4.51	0.68

Table 7 – Regressions for portfolios formed from a simple sort on market slope

$$R_i - R_f = a_i + b_i(R_M - R_f) + s_i SMB + h_i HML + \varepsilon_i$$

At the end of June of each year t (1929 to 1996), we allocate equal numbers of stocks to three portfolios (Lb, Mb, or Hb) based on their three-factor R_M-R_f slope, b_i, for the preceding five-year (three year minimum) period. The regressions explain R_i, the value-weight returns on the portfolios from July of year t to June of t+1.

	BE/ME	Size	Ex Ret	a	b	s	h	t(a)	t(b)	t(s)	t(h)	R^2
						7/29-6/97						
Lb	0.79	85.15	0.63	0.11	0.79	-0.03	-0.01	2.11	41.49	-0.92	-0.26	0.90
Mb	0.73	90.08	0.67	0.03	0.99	-0.09	-0.01	1.16	146.24	-7.40	-0.90	0.98
Hb	0.80	84.20	0.71	-0.15	1.22	0.09	0.06	-2.92	71.46	3.78	1.95	0.96
Hb-Lb			0.08	-0.26	0.43	0.12	0.07	-2.75	12.42	2.41	1.14	0.49
						7/29-6/63						
Lb	0.85	86.42	0.78	0.15	0.77	0.03	0.00	1.86	31.70	0.78	0.02	0.91
Mb	0.80	92.23	0.82	0.03	0.99	-0.09	0.00	0.67	92.14	-5.07	-0.22	0.98
Hb	0.86	86.41	0.84	-0.21	1.26	0.06	0.00	-2.57	58.20	1.96	0.09	0.97
Hb-Lb			0.06	-0.36	0.50	0.04	0.00	-2.44	11.51	0.55	0.04	0.57
						7/63-6/97						
Lb	0.73	83.88	0.48	0.06	0.85	-0.12	0.01	0.89	39.46	-4.55	0.42	0.88
Mb	0.66	87.92	0.52	0.04	0.99	-0.09	-0.02	1.43	133.55	-7.42	-1.63	0.98
Hb	0.73	82.00	0.58	-0.07	1.13	0.17	0.05	-1.08	64.27	6.25	1.47	0.95
Hb-Lb			0.10	-0.13	0.29	0.29	0.03	-1.07	7.85	5.93	0.60	0.34
						7/73-12/93						
Lb	0.83	82.74	0.57	0.19	0.83	-0.14	-0.02	1.99	31.26	-3.84	-0.44	0.88
Mb	0.76	86.58	0.48	0.02	0.99	-0.09	-0.03	0.57	111.70	-5.43	-1.40	0.99
Hb	0.85	80.72	0.55	-0.11	1.13	0.17	0.06	-1.38	52.78	4.63	1.52	0.95
Hb-Lb			-0.01	-0.30	0.30	0.31	0.08	-1.82	6.50	4.61	1.05	0.34

Table 8 - Summary of the three-factor regression intercepts in Tables 2 to 7

GRS is the F-statistic of Gibbons, Ross, and Shanken (1989). The GRS p-value, p(GRS), is the probability of a larger value of GRS if the true values of intercepts in a given set of regressions are all equal to zero. Mn a, Mn |a|, and MN a^2 are the mean, mean absolute, and mean squared values of the intercepts in a set of regressions. MN R^2 is the average of the regression R^2 (adjusted for degrees of freedom) for a set of regressions.

Sort	Table	GRS	p(GRS)	Mn a	Mn |a|	Mn a^2	Mn R^2
		7/29 - 6/97					
Independent ME & BE/ME	2	1.79	0.066	-0.073	0.078	0.0185	0.956
Independent BE/ME & h_i	3	0.94	0.485	-0.040	0.066	0.0055	0.769
Independent ME & BE/ME, Conditional h_i	4	1.32	0.132	-0.075	0.107	0.0233	0.856
Independent ME & s_i	6	2.01	0.036	-0.048	0.067	0.0078	0.832
b_i	7	2.85	0.037	-0.004	0.098	0.0120	0.832
		7/29 - 6/63					
Independent ME & BE/ME	2	0.84	0.577	-0.064	0.066	0.0149	0.958
Independent BE/ME & h_i	3	1.04	0.411	-0.054	0.096	0.0190	0.787
Independent ME & BE/ME, Conditional h_i	4	0.86	0.668	-0.058	0.102	0.0213	0.856
Independent ME & s_i	6	0.80	0.613	-0.041	0.082	0.0109	0.849
b_i	7	2.18	0.090	-0.011	0.128	0.0220	0.859
		7/63 - 6/97					
Independent ME & BE/ME	2	2.88	0.003	-0.030	0.073	0.0116	0.960
Independent BE/ME & h_i	3	2.53	0.008	0.008	0.085	0.0104	0.731
Independent ME & BE/ME, Conditional h_i	4	1.77	0.011	-0.035	0.104	0.0192	0.878
Independent ME & s_i	6	1.55	0.128	-0.036	0.066	0.0084	0.822
b_i	7	1.84	0.140	0.011	0.055	0.0032	0.785