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BRADFORD CORNELL and KEVIN GREEN*

ABSTRACT

This study extends the literature on the pricing of low-grade bonds by examining the performance of low-grade bond funds. The findings reveal that over the long run low-grade bond fund returns are approximately equal to the returns provided by an index of high-grade bonds. The relative risks of high and low-grade bonds are more difficult to assess. Because of their shorter durations, low-grade bonds are less sensitive to movements in interest rates than high-grade bonds. On the other hand, low-grade bonds are much more sensitive to changes in stock prices than high-grade bonds. When adjusted for risk using a simple two-factor model, the returns on low-grade bond funds are not statistically different from the returns on high-grade bonds.

ONE OF THE ARGUMENTS used by Drexel Burnham Lambert to promote the sale of low-grade or "junk" bonds is that the risk adjusted returns are greater than those for more highly rated bonds.[1] Though Drexel's hypothesis is of keen interest to both academics and practitioners, definitive tests have proved difficult to conduct because junk bonds are traded over-the-counter by a limited number of market makers so that reliable transaction data are rarely available. The problem is particularly acute in the years prior to the rapid expansion of the original issue low-grade market in the early 1980's.

Given the data limitations, one approach that has been used by Altman [1989] and Goodman [1989] to examine the Drexel hypothesis is to estimate expected returns indirectly by reducing promised returns to reflect the expected future defaults and calls. Altman [1987], Altman and Nammacher [1985], and Weinstein [1987] all report annual default rates for low-grade bonds in the range of 1% to 3% per year. Assuming that expected future default rates are in line with these figures, and not adjusting for other sources of risk, the 3% to 5% yield spreads between junk bonds and investment grade bonds appear to support Drexel's hypothesis. However, recent research by Asquith, Mullins and Wolff [1989], henceforth AMW, and Altman [1989] calls this conclusion into question. Both Altman and AMW find that

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[1]See Drexel Burnham Lambert [1985].

the default rate on new issue low-grade bonds rises significantly as the bonds age. Because the junk bond market has been growing rapidly, AMW argue that the impact of this aging effect has been overlooked by scholars who have focused on the ratio of defaults to bonds outstanding.[2]

Of course, a higher default rate does not necessarily imply lower expected returns. In an efficient market, bond prices should reflect both the time path of expected defaults and the anticipated cash flow to bond holders if default occurs. As Altman [1989] and Goodman [1989] note, the Drexel hypothesis could hold, even with high default rates, if the cash flows provided by the defaulting securities are sufficient. Altman and Goodman examine this possibility using data on the payouts of defaulting securities to calculate the internal rates of return on "buy and hold" portfolios of junk bonds. Altman [1989] reports that based on the defaults and calls in his sample, low-grade bonds earned significant premiums over Treasuries and high-grade bonds during the period from 1977 to 1988. As AMW note, however, both Altman [1989] and Goodman [1989] assume that all bonds that do not default (or are not subject to any other mortality event) sell at par. AMW shows that this assumption leads to overstatement of the returns actually earned by investors.

An alternative approach is to construct a time series of actual returns on low-grade bonds. In light of the data limitations, there are two basic procedures that can be used to estimate the return on a diversified portfolio of low-grade bonds. The first, which is employed by Blume and Keim [1987] and Blume, Keim and Patel [1991], is to rely on dealer worksheets. The main problem with using this approach, aside from the difficulty of verifying the accuracy of the data, is that dealers choose the sample of bonds to include in their quote sheets. Because the dealers tend to drop bonds that are on the verge of default from the sample, a selection bias problem is introduced.[3] To mitigate the selection bias that arises when bonds are dropped from the quote sheets, Blume and Keim [1987] and Blume, Keim and Patel [1991] supplement the dealer data with prices from the *S&P Bond Guide* for the 2 months following deletion of a bond.

Using this procedure Blume, Keim and Patel, calculate monthly returns on an equally weighted portfolio of the low-grade bonds included in indices constructed by Salomon and Drexel. They find that the average return on this portfolio exceeded the average return on a portfolio of high-grade bonds by 0.17% per month during the period from 1977 to 1988. Furthermore, they report that the standard deviation of returns for the low-grade bonds portfolio

[2]Blume and Keim [1987] argue that AMW overstate the importance of the aging effect by failing to take account of the impact of changes in economic activity on the rate of bond defaults. However, Blume and Keim recognize that the growth of the market will distort measured default rates.

[3]Selection bias is also introduced because the dealers choose which bonds to include in the sample at the start. However, this bias is not likely to be significant in an efficient market because it is not based on ex-post investment performance.

was no greater than the standard deviations for portfolios of high-grade bonds and government bonds.

A second approach, and the one that is used here, is to make use of low-grade mutual fund data. To be defined as a "low-grade" mutual fund by Lipper Analytical Services during a given month, a fund must have at least two-thirds of its portfolio invested in corporate bonds rated BAA or lower by Moody's or BBB or lower by Standard & Poor's throughout the month. Shares of open-end, low-grade mutual funds trade on the basis of the fund's net asset value, or NAV. Lipper Analytical Services records NAV's for publicly traded funds and uses the data, in conjunction with data on payouts to investors, to calculate monthly returns. The empirical results presented here are based on the Lipper monthly return data which was made available by the Investment Company Institute.

One advantage of using the mutual fund data is that it eliminates the selection bias problem. Returns are based on the actual portfolios held by the funds. Unfortunately, the funds do not hold exclusively low-grade bonds, and the precise composition of their portfolios is unknown, so some measurement error is introduced. Using the fund data also eliminates the need to collect individual bond prices by shifting that responsibility to the funds. Because Section 22 of the Investment Company Act of 1940 requires that mutual funds stand ready to redeem their shares at NAV, funds have an incentive to calculate NAV accurately. If the reported NAV is less than the true value of the portfolio, sophisticated investors can exploit the fund by buying at bargain prices. If the NAV exceeds the true value of the portfolio, sophisticated investors will quickly sell their shares at the inflated prices leading to a possible run and perhaps leaving the fund insolvent.

In using mutual fund data, this paper implicitly makes the efficient market assumption that fund managers cannot systematically find undervalued bonds.[4] For mutual funds as a group this seems like a reasonable assumption. Even if some funds earn superior returns, it is hard to imagine that mutual funds as a class routinely outperform the market. This is particularly true in light of the fact that mutual funds account for approximately 25% of the holdings of low-grade bonds at the end of 1989.

The accuracy of NAV's reported by mutual fund managers, and the accuracy of the portfolio returns calculated by Blume, Keim and Patel, depend on the underlying prices on which they are based. According to a recent article by John Liscio [1989], this data is suspect for two reason,[5] First, Liscio claims that, "because most of the issues can go for months without trading, there is

[4]In a 1989 seminar at UCLA, Michael Milken, who played a central role in the development of the low-grade bond market, stated that one of the reasons he became interested in low-grade bonds was that they offered insightful analysts unique opportunities to make superior returns. Milken noted that an analyst who discovers an undervalued stock will not reap a reward until the market realizes the stock is undervalued. Because bonds offer fixed returns over a known horizon, an analyst who discovers an undervalued bond will earn superior returns even if the market never realizes that the bond is underpriced.

[5]See Liscio in *Barron's* [1989].

no compelling reason for dealers to set realistic prices." Second, because quotes from dealers are difficult to obtain, many mutual funds rely on matrix price data provided by pricing services. The matrix systems typically price bonds which do not trade by using prices for more actively traded bonds of similar coupon and maturity. As a result, quotes for thinly traded bonds are not properly updated to reflect firm specific information until the bond trades.

If Liscio's claims have a basis in fact, then the nonsynchronous trading problem originally analyzed by Scholes and Williams [1977] applies to low-grade bonds. One difficulty in applying the Scholes-Williams model to low-grade bonds is that Scholes and Williams assume that each security trades every period (though not necessarily at the same time within the period). It is possible, however, that some low-grade bonds go for several periods without trading (or without their prices being adjusted). This more general problem has been analyzed by Cohen et al. [1986], among others. Cohen et. al., show that while nontrading of the type suggested by Lipsco does not bias estimates of the mean return or the standard deviation, it does bias estimates of Beta and also produces spurious autocorrelation in returns for large portfolios.[6] For this reason it is necessary to adjust estimates of systematic risk to take account of the nontrading problem.[7]

The remainder of our paper is organized as follows. The next section describes the Lipper mutual fund data and presents summary statistics. It is found that the mean return on the portfolio of low-grade mutual funds exceeds the mean return on a high-grade corporate bond index and the mean return on a Treasury bond index for the full sample period from 1960–1989. In the more recent years (from 1977) the returns on all three classes of bonds are nearly equal because greater weight is given to 1989 which was a disastrous year for low-grade bonds. While the systematic risk of low-grade bonds exceeds that of high-grade bonds as expected, the standard deviation of returns for the low-grade bond portfolio is less than that for high-grade bonds or Treasury bonds. This somewhat counterintuitive result for the standard deviation is explored in the second section by decomposing the risk of holding bonds into risk associated with movements in interest rates and risk associated with movements in the stock market. It is found that while low-grade bonds are sensitive to both changes in interest rates and changes in stock prices, high-grade bonds respond only to change in interest rats. Because investors typically buy one fund, not a portfolio of funds, the third section

[6]There is one circumstance under which the average return would be upward biased in a small sample. If the market deteriorated sharply at the end of the sample period, and if nontrading prevented the deterioration from being reflected in bond prices, the average return would be misleading. This means that the results reported here would be misleading if there was a sharp drop in the low-grade bond markets in the first few months of 1990. Examination of the *Wall Street Journal* provides no evidence of a such drop.

[7]Nunn, et al. [1986] present evidence showing the measures of systematic risk for bond portfolios are sensitive to the data source used to calculate returns because of the nontrading problem. however, they do not apply the Scholes-Williams approach to attempt to solve the problem.

investigates the behavior of returns across funds. The conclusions are summarized in the final section.

I. Data and Summary Statistics

The Lipper data set consists of monthly returns, net of management fees, transactions costs, and operating expenses, for all publicly traded low-grade bond funds during the period from January 1960 to December 1989.[8] Not surprisingly the number of funds grew dramatically over the sample period. Throughout the 1960's, when the new issue low-grade market was virtually nonexistent, there were never more than five low-grade bond funds, all of which invested in original issue high-grade bonds whose ratings had declined (fallen angels). Things changed dramatically in the 1970's. First, the development of the new issue low-grade market greatly increased the supply of bonds. Second, rising interest rates and several severe economic shocks sharply increased the number of fallen angels. As a result, by the end of 1979 there were 25 publicly traded low-grade bond funds. By 1989, as a result of the continued explosion in the new issue low-grade market, there were more than 90 low-grade bond funds.

Because the goal of this paper is to examine the performance of low-grade bonds as a group, rather than to compare competing mutual funds, an equally weighted portfolio, called the "fund of funds" is constructed by averaging the returns on the funds available each month.[9] To take account of the dramatic growth of the market, the sample is divided into two subperiods: 1960–1976 and 1977–1989. The dividing line is selected so that the beginning of the second subperiod coincides with the beginning of the sample period in Blume and Keim [1987], Blume, Keim and Patel [1991] and Asquith, Mullins and Wolff [1989].

Summary statistics for the returns on low-grade funds and the returns on competing investments are presented in Table I. The competing investments include indexes of returns on 1-month Treasury bills, long-term Treasury bonds, investment-grade corporate bonds, and common stocks (the S&P 500).[10] It is important to note that the returns on the competing investments are gross, while the returns on the "fund of funds" are net of management fees and trading costs. Unfortunately, the Lipper data does not contain information on these fees and costs. However, the *1988 Business Week Mutual Fund Survey* provides rough estimates of these expenses. *Business Week* reports that in 1988 total costs ran from about 0.5% of total assets to 2.0% of total assets for low-grade bond funds with a mean of about 1%. To approximate the

[8]Because open-end funds are required by law to calculate and report net asset values on a daily basis, there is no reporting lag with the Lipper data. The monthly returns are based on the change in net asset value from the end of one month to the end of next month.

[9]The unweighted average is computed because data on the market value of the funds are not available.

[10]All data other than that for the bond funds was provided by Dimensional Fund Advisers. The long-term Treasury bond and high-grade corporate bond series are those constructed by Ibbotson & Associates.

Table I

Summary Statistics for Returns on Low-grade Bond Funds

The data are monthly returns over the sample period shown. The Treasury bill, Treasury bond, and high-grade corporate bond data are the Ibbotson and Sinquefield indices which were provided by Dimensional Fund Advisers. The low-grade bond returns, provided by the Investment Company Institute, are the average net returns on all low-grade open-end bond funds. To be classified as a low-grade bond fund, a fund must have a least two-thirds of its portfolio invested in corporate bonds rated BAA or lower by Moody's or BBB or lower by Standard & Poor's. Beta is estimated by regressing the returns for each asset class on the returns for the S&P 500 index over the sample period shown.

SAMPLE 1960:1 TO 1989:12	Mean	St. Dev.	Beta	First order Autocorrelation
One-month Treasury bills	0.51%	0.24%	−0.003	0.947
Long-term Treasury bonds	0.56%	2.92%	0.20	0.033
High-grade bonds	0.59%	2.70%	0.22	0.134
Low-grade bond funds	0.65%	2.47%	0.42	0.206
S&P 500 index	0.91%	4.32%	1.00	0.040
SAMPLE 1960:1 TO 1976:12	**Mean**	**St. Dev.**	**Beta**	**First order Autocorrelation**
One-month Treasury bills	0.38%	0.14%	−0.01	0.909
Long-term Treasury bonds	0.37%	2.06%	0.11	−0.056
High-grade bonds	0.41%	1.92%	0.19	0.082
Low-grade bond funds	0.55%	2.61%	0.54	0.210
S&P 500 index	0.66%	4.12%	1.00	0.047
SAMPLE 1977:1 TO 1989:12	**Mean**	**St. Dev.**	**Beta**	**First order Autocorrelation**
One-month Treasury bills	0.69%	0.23%	−0.005	0.910
Long-term Treasury bonds	0.81%	3.76%	0.28	0.060
High-grade bonds	0.83%	3.46%	0.25	0.147
Low-grade bond funds	0.77%	2.27%	0.29	0.192
S&P 500 index	1.25%	4.56%	1.00	0.024
SAMPLE 1989:1 TO 1989:12	**Mean**			
One-month Treasury bills	0.67%			
Long-term Treasury bonds	1.28%			
High-grade bonds	1.42%			
Low-grade bond funds	−0.14%			
S&P 500 index	2.36%			

gross return, therefore, about 0.08% per month (1% per year) should be added to the mean monthly return reported in Table I. In addition, the fact that funds hold cash reserves reduces the reported return on low-grade bonds during periods when the yield on low-grade bonds exceeds that on money market securities as was true during a majority of the sample period.

Table I shows that over the full sample the mean monthly return for low-grade bonds, 0.65% without adding back fees and costs, is greater than the mean return for high-grade corporate bonds of 0.59% and for Treasury bonds of 0.56%. However, during the second subperiod from 1977 to 1989 the

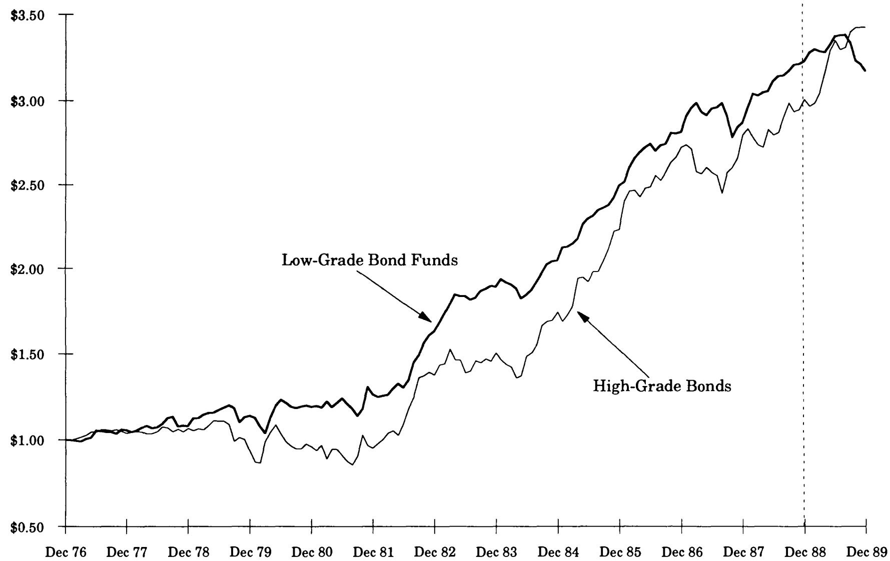

Figure 1. Low-grade bond funds versus high-grade bonds: Path of wealth per dollar invested. The path of wealth is based on monthly returns over the period from December 1976 to December 1989. The low-grade bond returns, provided by the Investment Company Institute, are the average net returns on all low-grade open-end bond funds. To be classified as a low-grade bond fund, a fund must have at least two-thirds of its portfolio invested in corporate bonds rated BAA or lower by Moody's or BBB or lower by Standard & Poor's. The high-grade bond returns are for the Ibbotson and Sinquefield long-term corporate index.

mean return on low grade bonds (0.77%) is slightly less than mean return on either high-grade bonds (0.83%) or Treasury bonds (0.81%). The result of the second subperiod differs from that reported by Blume, Keim and Patel [1991] because of the inclusion of 1989. The relative mean returns for 1989, reported at the bottom of Table I, are markedly different than for any other year in the sample. During 1989 the annualized mean returns on low-grade bonds were approximately -1.7% compared to 15.4% for Treasury bonds and 17.1% for high-grade bonds. If the second samples period is cut off at the end of 1988, the mean return on low-grade bonds exceeds the mean returns on Treasury bonds and high-grade bonds by five basis points per month which is similar to the difference reported by Blume, Keim and Patel [1991].

The impact of 1989 is clearly illustrated in Figure I which shows the cumulative value of a dollar invested in both high-grade bonds and low-grade bonds beginning at the end of 1976. The figure shows that the cumulative value of the investment in low-grade bonds exceeds that for high-grade bonds throughout the period from 1977 to 1988. Then in 1989 the value of the high-grade bond investment increases sharply, while the value of the low-grade bond investment falls.

Though providing an explanation for the sharp drop in low-grade bond prices relative to high-grade bond prices is beyond the scope of this paper, it is worth noting that beginning in late 1988 the low-grade bond market was subject to a series of negative shocks. There were several highly publicized defaults, the Federal Government amended the Federal Deposit Insurance Act to require that savings and loans divest all their holdings of low-grade bonds by July 1, 1994, and insurance regulators began to consider similar sanctions after several insurance companies which were among the largest holders of low-grade bonds experienced financial difficulty. Perhaps the greatest shock, though, was the collapse of Drexel. Drexel was the largest underwriter of low-grade bonds and, more importantly, was by far the most active market maker. Thus Drexel's withdrawal from the market was associated with a sharp drop in liquidity. As Amihud and Mendelson [1986] demonstrate, a decline in liquidity will cause a drop in prices.

During the full period from 1960 to 1989, and during the period from 1977 to 1989, the standard deviation of returns on low-grade bonds is less than the standard deviation of returns for either corporate bonds or Treasury bonds.[11] During the prior period from 1960 to 1976, however, low-grade bond returns were more variable than either high-grade bond returns or Treasury bond returns. This finding is not attributable to 1989, because the results are similar when the sample is ended in 1988.

The relative decline in the standard deviation of low-grade bond returns appears to be associated with an increase in the variability of interest rates. Table I shows that during the period from 1977 to 1989, the standard deviation of Treasury bond returns is almost 90% *higher* than it was in the earlier subperiod. The relation between the relative variability of low-grade bond returns and the variability of interest rates is investigated further below.

Even if low-grade bond returns have a higher mean and a lower standard deviation than high-grade bond returns, low-grade bonds may not be underpriced if the systematic risk is greater. Unfortunately, there is not a consensus on how systematic risk should be measured. In the standard CAPM, only market risk is considered, but, in more detailed asset pricing models such as the APT and the consumption based CAPM, risk factors related to other economic variables are also included.[12] Initial estimates of the market risk reported in Table I reveal that the Beta of low-grade bonds, calculated using ordinary least squares, is larger than the Beta of high-grade bonds in all the sample periods.[13,14] This suggests that the slightly greater average returns on low-grade bonds could possibly be attributable to a risk premium.

[11]Cash holdings by funds will also tend to reduce the reported standard deviation.

[12]See, for example, Chen, Roll and Ross [1986].

[13]As Rogalski and Shyam-Sunder [1990] note there is a problem interpreting the Betas of low-grade bonds because of the attached put option. This put option makes the Beta of the debt nonstationary even if the Beta of the firm is constant. However, the problem is likely to be less pronounced for large portfolios such as low-grade bond funds. In the case of funds, though, active management may also tend to produce nonstationary Betas.

[14]Kaplan and Stein [1989] calculate Betas for low-grade debt by computing the change in the equity Beta that occurs as a result of leverage recapitalizations and find higher values on the order of 0.42 to 0.65 depending on the assumptions employed. Unfortunately, their approach limits them to a sample of 12 companies.

Table II

Statistical Tests Comparing High-grade and Low-grade bonds: Monthly Returns

The "net" difference is calculated by subtracting the monthly return on the Ibbotson and Sinquefield high-grade bond index from the average return on low-grade bond funds. The low-grade bond returns, provided by the Investment Company Institute, are the average net returns on all low-grade open-end bond funds. To be classified as a low-grade bond fund, a fund must have at least two-thirds of its portfolio invested in corporate bonds rated BAA or lower by Moody's or BBB or lower by Standard & Poor's. The gross difference is computed by adding the *Business Week* estimate of transaction costs and management fees, which is about 0.08% per month, to the monthly return on the low-grade bond funds.

SAMPLE PERIOD 1960:1 TO 1989:12	Difference of Means	*t*-statistic	Ratio of St. Devs.	*F*-statistic	Beta diff	*F*-statistic
Low-grade-High grade (net)	0.055%	0.28	0.915	1.19[a]	0.20	12.6[b]
Low-grade-High grade (gross)	0.135%	0.69				

SAMPLE PERIOD 1960:1 TO 1976:12	Difference of Means	*t*-statistic	Ratio of St. Devs.	*F*-statistic	Beta diff	*F*-statistic
Low-grade-High grade (net)	0.145%	0.64	1.358	1.85[b]	0.35	40.1[b]
Low-grade-High grade (gross)	0.226%	0.99				

SAMPLE PERIOD 1977:1 TO 1989:12	Difference of Means	*t*-statistic	Ratio of St. Devs.	*F*-statistic	Beta diff	*F*-statistic
Low-grade-High grade (net)	−0.063%	0.19	0.658	2.31[b]	0.04	0.21
Low-grade-High grade (gross)	0.017%	0.05				

[a]Denotes significance at the 0.10 level.
[b]Denotes significance at the 0.05 level.

Table II presents the results of statistical tests designed to determine whether the differences between the means, standard deviations and Betas reported in Table I are significant. The table reveals that the hypothesis that expected returns on high-grade and low-grade bonds are equal cannot be rejected, even when the return on the fund of funds is grossed up by adding back 0.08% per month to take account of transaction costs. The tests for equality of the standard deviations produce stronger results. For the full sample an *F*-test indicates the standard deviation of return is significantly less (at the 5% level) for low-grade bonds than for high-grade bonds. This finding, however, is not robust with respect to the division of the sample period. During the period from 1960 to 1976 the standard deviation of returns for low-grade bonds is significantly greater (at the 5% level) than the standard deviation of returns for high-grade bonds, while during the period from 1977 to 1989 the standard deviation of returns for low-grade bonds is significantly less (also at the 5% level). The Beta estimates are also sensitive to the choice of sample period. For the full period, the Beta of low-grade bonds is significantly higher than that for high-grade bonds, but this result is

Table III

Autocorrelation Functions for Monthly Bond Returns

The autocorrelations for low-grade bond returns and high-grade bond returns are calculated for the indicated sample periods. The low-grade bond returns, provided by the Investment Company Institute, are the average net returns on all low-grade open-end bond funds. To be classified as a low-grade bond fund, a fund must have at least two-thirds of its portfolio invested in corporate bonds rated BAA or lower by Moody's or BBB or lower by Standard & Poor's. The high grade bond returns are from the Ibbotson and Sinquefield high-grade long-term corporate index.

Lag	1	2	3	4	5	6	7	8	9	10	11	12	Std. Err
SAMPLE 1960:1 TO 1989:12													
Low-grade bonds													
Correlation	0.205[a]	−.035	−.016	.070	.150	.007	−.100	−.098	.055	.017	.076	.040	.054
High-grade bonds													
Correlation	0.140[a]	−.023	−.076	−.021	.079	.072	−.081	.021	.085	.013	.179	.001	.054
SAMPLE 1960:1 TO 1976:12													
Low-grade bonds													
Correlation	0.210[a]	.005	.051	.117	.072	−.028	−.091	−.109	.048	−0.39	.078	.051	.070
High-grade bonds													
Correlation	.083	−.023	−.036	.050	.037	.015	−.133	−.023	.123	−0.153[a]	.125	.070	.070
SAMPLE 1977:1 TO 1989:12													
Low-grade bonds													
Correlation	0.197[a]	−.105	−.132	−.019	.277	.051	−.126	−.071	.053	.112	.069	.019	.083
High-grade bonds													
Correlation	.152	−.026	−.102	−.059	.089	.084	−.069	.025	.057	.074	.194	−.032	.083

[a]Denotes significance at the 0.05 level.

due to the behavior of returns in the 1960 to 1976 period. In the more recent period, the Betas are essentially equal.[15]

The OLS estimates of Beta should be interpreted with caution because the autocorrelations reported in Table I indicate that nontrading is a problem in the case of low-grade bonds and may be a problem for high-grade bonds. Unlike the returns on stock and Treasury bonds, the returns on the the "fund of funds" exhibit noticeable autocorrelation.[16] More complete autocorrelation functions are presented in Table III. While the results in Table III are consistent with the view that prices of low-grade bonds respond with a lag, the lag is apparently on the order of 1 month because there is no clear evidence of significant autocorrelation beyond that point.[17]

To take account of the lagged movements in bonds prices, adjusted Betas are calculated using the procedure described by Dimson [1979].[18] This procedure calls for including leads and lags of the return on the market in the regression equation and summing the coefficients of the market returns.

Comparing Table IV with Table I reveals that the adjusted Betas are higher for both high-grade and low-grade bonds, with the increase being noticeably larger for low-grade bonds. For the full sample period the Beta for high-grade bonds rises from 0.22 to 0.25, while the Beta for low-grade bonds rises from 0.42 to 0.52.

II. Risk, Duration, and the Pricing of Low-grade Bond Funds

There are two widely discussed issues regarding the risk/return tradeoff provided by low-grade bonds. First, as Blume, Keim and Patel [1991] find and as the results reported here confirm, the standard deviation of low-grade bond returns is frequently less than the standard deviation of high-grade bond returns. Blume, Keim and Patel attribute this to the fact that low-grade bonds typically have shorter duration. The effective duration of low-grade bonds is lower than that for high-grade bonds and Treasury bonds because the coupons are higher and because low-grade bonds are often called earlier. Early calls occur more often for low-grade bonds because they generally have weaker call protection than their higher grade counterparts and because the credit quality of low-grade bonds is more likely to rise.

Second, many fund managers assert that low-grade bond returns are more sensitive to changes in economic activity than to changes in interest rates. For example, Neal Litvack of Fidelty fund stated that, "Interest rates are a

[15]The Beta estimates in the 1977 to 1989 period are similar to those reported by Blume, Keim and Patel for the same period.

[16]The returns on Treasury bills are highly autocorrelated because the holding period equals the maturity of the security. There is no evidence of nontrading for Treasury bills.

[17]Though the autocorrelation for the low-grade bond portfolio is also significant at a lag of 4 months, this appears to be due to random chance rather than the slow adjustment of prices, because the autocorrelations at lags 2 and 3 are small.

[18]See Fowler and Rorke [1983] for a detailed discussion of the Dimson estimation procedure.

Table IV

Regressions of Low-grade Bond Returns on Treasury Bond Returns and Stock Market Returns

$$\textbf{Bond return} = \beta_0 + \beta_1^*\mathrm{TB}(1) + \beta_2^*\mathrm{TB}(0) + \beta_3^*\mathrm{TB}(-1) + \beta_4^*\mathrm{SP500}(1) + \beta_5^*\mathrm{SP500}(0) + \beta_6^*\mathrm{SP500}(-1)$$

The low-grade bond returns, provided by the Investment Company Institute, are the average net returns on all low-grade open-end bond funds. To be classified as a low-grade bond fund, a fund must have at least two-thirds of its portfolio invested in corporate bonds rated BAA or lower by Moody's or BBB or lower by Standard & Poor's. The high-grade bond returns are from the Ibbotson and Sinquefield high-grade long-term corporate index.

Panel A: Low-grade Bonds

	β_0	β_1	β_2	β_3	β_4	β_5	β_6	Coeff sum	Adj R^2	DW	SEE
1960:1 to 1989:12											
(1) Coefficient	0.337	−0.056	0.432	0.188				0.564	0.315	1.67	2.05
t-statistic	2.96	−1.51	11.66	5.09							
(2) Coefficient	0.173				0.061	0.42	0.038	0.519	0.556	1.72	1.65
t-statistic	1.86				3.03	20.71	1.87				
(3) Coefficient	0.051	−0.009	0.278	0.1	0.034	0.355	0.037		0.664	1.78	1.44
t-statistic	0.62	−0.32	10.08	3.63	1.85	18.95	1.99				
1960:1 to 1976:12											
(4) Coefficient	0.309	−0.078	0.463	0.305				0.690	0.174	1.69	2.38
t-statistic	1.76	−0.96	5.67	3.73							
(5) Coefficient	0.1				0.042	0.546	0.085	0.673	0.764	1.70	1.27
t-statistic	1.08				1.92	24.96	3.89				
(6) Coefficient	0.036	0.001	0.225	0.027	0.021	0.518	0.092		0.790	1.80	1.20
t-statistic	0.40	0.03	5.16	0.61	0.96	23.63	4.36				
1977:1 to 1989:12											
(7) Coefficient	0.35	−0.047	0.425	0.146				0.524	0.565	1.67	1.50
t-statistic	2.72	−1.48	13.17	4.53							
(8) Coefficient	0.339				0.078	0.287	−0.013	0.352	0.350	1.71	1.83
t-statistic	2.06				2.38	8.86	−0.39				
(9) Coefficient	0.176	−0.04	0.342	0.131	0.044	0.177	−0.023		0.679	1.69	1.29
t-statistic	1.49	−1.34	11.45	4.31	1.76	7.19	−0.9				

secondary factor. The primary variable that will impact junk bonds is the performance of the economy."[19]

To evaluate these conjectures further and to assess the risk of low-grade bonds in greater detail, three sets of regressions are estimated for both low-grade and high-grade bonds. As shown in equations (1) and (3), corporate bond returns are regressed on Treasury bond (TB) returns, stock market returns (SP500), and then a combination of the two. In each case a lead and

[19] *Wall Street Journal*, June 6, 1989.

Table IV—*Continued*

Panel B: High-grade bonds

	β_0	β_1	β_2	β_3	β_4	β_5	β_6	Coeff sum	Adj R^2	DW	SEE
1960:1 to 1989:12											
(1) Coefficient	0.05	0.036	0.829	0.097				0.962	0.826	2.25	1.13
t-statistic	0.80	1.77	40.55	4.74							
(2) Coefficient	0.362				0.095	0.22	−0.07	0.245	0.154	1.78	2.49
t-statistic	2.58				3.09	7.18	−2.29				
(3) Coefficient	0.032	0.033	0.798	0.098	0.015	0.055	−0.031		0.834	2.24	1.10
t-statistic	0.50	1.56	37.64	4.65	1.05	3.80	−2.17				
1960:1 to 1976:12											
(4) Coefficient	0.071	0.004	0.741	0.177				0.922	0.640	2.27	1.16
t-statistic	0.83	0.09	18.67	4.45							
(5) Coefficient	0.2.62				0.064	0.193	−0.049	0.208	0.187	1.76	1.74
t-statistic	2.07				2.15	6.45	−1.65				
(6) Coefficient	0.470	0.014	0.687	0.144	0.003	0.101	−0.032		0.681	2.24	1.09
t-statistic	0.58	0.35	17.39	3.62	0.18	5.07	−1.68				
1977:1 to 1989:12											
(7) Coefficient	0.036	0.043	0.867	0.062				0.972	0.908	2.26	1.05
t-statistic	0.40	1.88	38.35	2.76							
(8) Coefficient	0.493				0.121	0.244	−0.094	0.271	0.133	1.79	3.23
t-statistic	1.71				2.11	4.29	−1.65				
(9) Coefficient	0.032	0.016	0.860	0.061	0.051	−0.003	−0.023		0.911	2.31	1.03
t-statistic	0.34	0.67	35.88	2.53	2.54	−0.32	−1.16				

lag term is included to take account of the potential impact of nontrading.

$$\text{Bond return} = \beta_0 + \beta_1^*\text{TB}(1) + \beta_2^*\text{TB}(0) + \beta_3^*\text{TB}(-1) \tag{1}$$

$$\text{Bond return} = \beta_0 + \beta_1^*\text{SP500}(1) + \beta_2^*\text{SP500}(0) + \beta_3^*\text{SP500}(-1) \tag{2}$$

$$\begin{aligned}\text{Bond return} = \beta_0 &+ \beta_1^*\text{TB}(1) + \beta_2^*\text{TB}(0) + \beta_3^*\text{TB}(-1) + \beta_4^*\text{SP500}(1) \\ &+ \beta_5^*\text{SP500}(0) + \beta_6^*\text{SP500}(-1)\end{aligned} \tag{3}$$

Equation (1) measures the sensitivity of the bond returns to changes in the long-term risk-free rate. If the standard deviation of low-grade bond returns is less than that of high-grade bond returns because the duration is shorter, then the estimated coefficients should be smaller in the low-grade bond regression. The findings reported in Table IV, Panels A and B, are consistent with this interpretation. The sum of the coefficients for the Treasury bond variables is less for the low-grade bonds in all of the sample periods. In addition, the R^2 for the high-grade bond regression is 0.83 for the full sample, while the R^2 for the low-grade regression is only 0.32. As a result, the standard error of the regression is less for the high-grade bonds, even in the second subperiod when the unconditional standard deviation of returns for high-grade bonds is significantly greater than that for low-grade bonds. Once the impact of changes in interest rates has been removed, the remaining variance is considerably greater for low-grade bonds.

Initial support for the view that low-grade bonds are more sensitive to changes in economic activity is provided by the extended market model regressions given by equation (2) and reported in lines 2, 5, and 8 of Table IV, panels A and B. As reported earlier, the Dimson Betas, which equal the sum of the coefficients, are significantly greater for low-grade bonds. In addition, Table IV also reveals that the R^2 is much higher for the low-grade regression (0.56) than the high-grade regression (0.15). These findings hold for both subperiods as well.

The regressions which include both Treasury bond returns and market returns as explanatory variables, given by lines 3, 6 and 9 of Table IV, panels A and B, provide further insight into the performance of low-grade bonds. Looking first at the results for high-grade bonds reported in Panel B, it is clear that high-grade bond returns respond primarily to changes in interest rates. Though the market return variables as a group are significant, adding them to the regression for the entire period increases the adjusted R^2 only from 0.826 to 0.834. By comparison the R^2 falls to 0.154 in line 2 if the Treasury bond returns are dropped as explanatory variables. Finally, the coefficient on the contemporaneous market return β_5 is 0.055 compared to a coefficient of 0.798 for the contemporaneous return on Treasury bonds.

In contrast, Panel A shows that movements in stock prices explain a larger fraction of the variance of low-grade bond returns than do movements in interest rates. Adding the market return increases the regression R^2 from 0.315 in line 1 to 0.664 in line 3, whereas adding the interest rate variable only increases the R^2 from 0.556 in line 2 to 0.664 in line 3. Because the sum of the coefficients for both explanatory variables are approximately equal, the greater explanatory power of the market return reflects its greater variability. Further examination of Panel A reveals that the results are sample sensitive. Whereas almost all the explanatory power is provided by the market return in the period 1960 to 1976, during the period 1977 to 1989 Treasury bond returns provide more explanatory power. Part of this shift is due to the fact that the standard deviation of Treasury bond returns nearly doubled in the second subperiod as shown in Table I, but that is not the whole story. For some unexplained reason, the correlation of low-grade bond returns with Treasury bond returns rose while the correlation of low-grade bond returns with stock returns fell.[20]

[20]One possible explanation which was suggested to us is that the rise in the correlation is due to an increase in the duration of low-grade bonds which made them more sensitive to interest rates and more comparable to Treasury bonds. Although Blume, Keim and Patel [1991] report that there has been a trend toward shorter maturities in the entire new-issue, low-grade market, the explanation may still be true in part. During the early period most of the low-grade bonds were fallen angels which had been in circulation a while. Thus the duration at issue estimates calculated by Blume, Keim and Patel overstate the duration of the outstanding bonds in the early period.

The regressions reported in Table IV also explain the behavior of the standard deviation of low-grade bond returns. Because low-grade bonds are less sensitive to movements in interest rates but more sensitive to movements in stock prices, the relative standard deviation of returns for low-grade bond returns depends on the variability of stock returns compared to Treasury bond returns. During periods such as 1977–1989, when the variability of interest rates is large relative to the variability of stock returns, the standard deviation of high-grade bond returns is larger while the reverse is true during periods such as 1960–1976 when the relative variability of interest rates is less.[21]

It is possible that Treasury bond returns and stock market returns fail to account for the full impact of economic activity on low-grade bond returns. To test this hypothesis, macroeconomic variables including changes in industrial production, inflation and the price of oil were added to equation (3) along with a dummy variable which equals one during periods defined as "recessions" by the NBER.[22] One problem with using these macroeconomic variables is identifying the unexpected component. Rather than attempting to model expectations, leads and lags up to 3 months were included for all of the variables except the recession dummy. The results (not reported) show that none of the macroeconomic variables, when added to the regression as additional right-hand variables, significantly increase the explanatory power of equation (3).

Even though the macrovariables do not add explanatory power, it is possible that the sensitivity of bond returns to interest rates and market conditions depends on economic conditions. This suggests a return generating model of the form

$$\text{Bond return} = \beta_0 + \beta_1^*(1 + x)^*\text{SP500} + \beta_2^*(1 + x)^*\text{TB} + \beta_2^* x, \qquad (4)$$

where x represents the macro-variable.[23] Estimating equation (4), the most significant results are obtained with x equal to a recession dummy variable. The findings, reported in Table V, show that high-grade bond returns are more sensitive to market movements during recessions, while low-grade bond returns are more sensitive to movement in interest rates during recessions. Furthermore, there is some evidence that low-grade bonds perform more poorly in recessions.

The finding that high-grade bonds are more sensitive to movements in the market during recessions is in line with intuition. Presumably, high-grade bonds are not affected by market movements in good times because they trade as essentially risk-free securities. In bad times, on the other hand, the

[21] During the period from 1960 to 1976 the ratio of the standard deviation of stock returns to the standard deviation of Treasury bond returns was 2.01. During the period from 1977 to 1989 it fell to 1.21.

[22] In a related study, Wyss, Probyn, and de Angelis [1989] use the DRI econometric model to forecast the returns on low-grade bonds in future recessions.

[23] In some cases x is a dummy variable such as one during recessions and zero otherwise; in other cases it is an ordinal variable such as the level of oil prices.

Table V

Regressions Which Allow Macroeconomic Variables to Affect Betas

Bond return = $\beta_0 + \beta_1^*\text{TB} + \beta_2^*\text{TB*Recess} + \beta_3^*\text{SP500} + \beta_4^*\text{SP500*Recess} + \beta_5^*\text{Recess}$

The low-grade bond returns, provided by the Investment Company Institute, are the average net returns on all low-grade open-end bond funds. To be classified as a low-grade bond fund, a fund must have at least two-thirds of its portfolio invested in corporate bonds rated BAA or lower by Moody's or BBB or lower by Standard & Poor's. The high-grade bond returns are from the Ibbotson and Sinquefield high-grade long-term corporate index. The Treasury bond returns TB are from the Ibbotson and Sinquefield long-term government bond index. SP is the return on the S&P 500 and recess is a dummy variable which equals 1 during recessions as defined by the NBER and 0 otherwise. The *t*-statistics are below the coefficients.

			Low-grade bonds				
1960:1 to 1989:12	β_0	β_1	β_2	β_3	β_4	β_5	Adj R^3
Coefficient	0.249	0.181	0.268	0.349	0.038	−0.431	0.664
t-statistic	2.88	5.33	4.71	15.92	0.96	−2.11	
1977:1 to 1989:12							
Coefficient	0.273	0.220	0.319	0.186	0.034	−0.062	0.698
t-statistic	2.40	6.06	5.33	7.12	0.58	−0.212	
			High-grade bonds				
1960:1 to 1989:12							
Coefficient	0.106	0.773	0.080	0.034	0.079	−0.018	0.827
t-statistic	1.57	29.11	1.79	1.99	2.52	−0.11	
1977:1 to 1989:12							
Coefficient	0.113	0.818	0.135	−0.002	0.006	0.109	0.906
t-statistic	1.17	26.61	2.67	−0.09	0.12	0.44	

possibility of downgrading makes high-grade bonds more sensitive to economic conditions. It is worth noting, however, that this effect disappears during the subperiod from 1977 to 1989. During this subperiod, the results indicate that high-grade bonds are more sensitive to interest rates during a recession.

The finding that low-grade bonds are more sensitive to interest rates during recessions is more difficult to understand. One possibility is that as the probability of default rises, bond prices react more strongly to economic conditions. However, this explanation implies that low-grade bond prices should become more sensitive to both interest rates and the market, but only the former is observed. Finally, the finding that low-grade bonds perform more poorly in recession does not hold for the subperiod from 1977–1989. This is somewhat ironic because the hypothesis arose after the explosion of the new issue low-grade market after 1977.

Overall, the regression results show that low-grade bonds are less sensitive to movements in long-term interest rates but more sensitive to changes in stock prices than high-grade bonds. To evaluate the Drexel hypothesis in this context it is necessary to estimate the price of interest rate risk and market risk. More specifically, in a cross-sectional model of the form,

$$R_i = \gamma_0 + \gamma_1^* \beta_{i,m} + \gamma_2^* \beta_{i,\mathrm{TB}} \tag{5}$$

estimates of γ_1 and γ_2 are required.[24] (In equation (5) $\beta_{i,m}$ and $\beta_{i,\mathrm{TB}}$ are the market Beta and the interest rate Beta for security i.)

The Fama-MacBeth [1973] approach is used to estimate γ_1 and γ_2. Beginning in July of 1978, when a sufficient number of funds became available, the following procedure is employed. First, 5 years of data prior to July 1978 are used to estimate $\beta_{i,m}$ and $\beta_{i,\mathrm{TB}}$ for all available low-grade bond funds, the index of high-grade bonds, and a portfolio of small capitalization common stocks.[25] The high-grade bond index and the small stock portfolio are included to improve the power of the estimation procedure by increasing the spread of the estimated β's. Second, the cross-sectional regression given by equation (5) is estimated for July 1978 using the β's from the previous step. The sample is then moved forward to August 1978, and the entire procedure is repeated. Proceeding in this fashion produces 138 cross-sectional estimates of the parameters γ_1 and γ_2. The average of these 138 estimates is 0.61% per month for γ_1 and 0.20% per month for γ_2.

Application of equation (5) also requires estimates $\beta_{i,m}$ and $\beta_{i,\mathrm{TB}}$. Using the sum of the coefficients for the S&P500 variable and the Treasury bond variables from the 1977–1989 regressions (lines 7 and 8 in Table IV), $\beta_{i,m}$ and $\beta_{i,\mathrm{TB}}$ are 0.352 and 0.524 for low-grade bonds, and 0.271 and 0.972 for high-grade bonds.[26] Substituting these estimates, and the estimates of the prices of risk γ_1 and γ_2 into equation (5) produces ex ante risk premiums of 0.32% per month for low-grade bond funds and 0.36% per month for high-grade bonds. These compare with ex post risk premiums (over 1-month Treasury bills) of 0.08% low-grade bond funds and 0.14% for high-grade bonds.[27]

III. The Cross-Sectional Behavior of Low-grade Bond Fund Returns

Some critics have argued that investors face unique risk when choosing a low-grade fund because the wide dispersion in performance greatly exceeds that for high-grade funds. To test this hypothesis the cross-sectional standard deviation of returns was calculated each month for both the low-grade bond

[24] Equation (4) is based on the assumption that low-grade bonds can be accurately priced in the context of a two-factor model. This is not necessarily the case. However, attempting to include low-grade bonds in a full scale factor model of the type developed by Chen, Roll, and Ross [1986] is beyond the scope of this paper.

[25] The small stock portfolio consists of all stocks which are in the last size quintile of the New York Stock exchange. The data were provided by Dimensional Fund Advisers.

[26] The more recent period is chosen because the Fama-MacBeth procedure was employed during this period.

[27] The low-grade premium is 0.16% per month adding back the average costs and fees.

funds and the high-grade bond funds in the Lipper universe.[28] Cross-sectional standard deviations are computed only for the period from 1977 to 1989 because prior to that time the sample of low-grade funds was so small (between 3 and 9). The results show that while the cross-sectional standard deviation for low-grade bond funds (0.96%) is greater than that for high-grade funds (0.70%), it is still less than 1%.

A related concern is that the dispersion in performance is magnified during recessions when higher rates of default make bond selection skills more important. This concern, however, is not supported by the data. A time series regression of the difference between the cross-sectional standard deviation for low-grade funds and high-grade funds on variables including stock market returns, the change in industrial production (with three leads and lags), and the NBER recession dummy uncovered no evidence of a relation between the dispersion of performance and the level of economic activity.

IV. Summary and Conclusions

This study extends the literature on the pricing of low-grade bonds by examining the performance of low-grade bond funds. Using mutual fund data transfers the problem of collecting prices from the researcher to the fund. Though funds have a clear incentive to collect accurate data when calculating net asset value, they still have to rely, in part, on dealer price estimates and matrix pricing systems. The results reported here indicate that such reliance leads to a lagged reaction of net asset values to movements in the market. Though the existence of such a lag does not bias estimates of the mean return, it does bias estimates of systematic risk. Consequently, the risk measures are adjusted to take into account the lag.

The basic findings are consistent with both prior research and with intuition. On the risk-return menu, low-grade bonds fall somewhere between high-grade bonds and common stock. During the full sample period from 1960 to 1989 the mean return on low-grade bonds was six basis points per month greater than that of high-grade bonds but lower than that of common stocks. However, during the second subperiod from 1977 to 1989 the mean return on low-grade bonds was six basis points less that that on high-grade bonds. This finding for the second subperiod is due to the sharp decline in the relative prices of low-grade bonds in 1989.

It is more difficult to assess risk, because risk measurement requires choosing an asset pricing model. If standard deviation is chosen as the measure of risk for each category of assets, then the surprising result emerges that during the sample period from 1977 to 1989 low-grade bonds were less risky than both high-grade bonds and Treasury bonds. Further investigation revealed that two factors are responsible for this surprising

[28] Data for the monthly mean return and for the cross-sectional standard deviation for all high-grade funds in the Lipper Universe were also provided by Jacob Dryer of the Investment Company Institute.

finding. First, low-grade bonds typically have higher coupons and are called earlier, so that their duration is lower. Second, during the period from 1977 to 1989 the standard deviation of changes in the long-term interest rate was large relative to the standard deviation of stock returns.

When measures of systematic risk are used, low-grade bonds are seen to be riskier than high-grade bonds. Over the full sample period the Dimson Beta for low-grade bonds is 0.52 compared to a Dimson Beta of 0.25 for high-grade bonds. Perhaps the best measure of risk is provided by the two-factor model which takes account of the sensitivity of bond prices to movements in both interest rates and stock prices. Whereas low-grade bonds are less sensitive to changes in interest rates, they are much more sensitive to movements in stock prices. Taking account of both factors, a rough estimate of the risk premium is consistent with the hypothesis that low-grade bonds are fairly priced relative to high-grade bonds.

REFERENCES

Altman, E. I., 1987, The anatomy of the high-yield bond market, *Financial Analysts Journal* 12-25.

——, 1989, Measuring corporate bond mortality and performance, *Journal of Finance* 44, 903-922.

—— and S. A. Nammacher, 1985, The default rate experience on high-yield corporate debt, *Financial Analysts Journal* 25-41.

Amihud, Y. and M. Mendelson, 1986, Asset pricing and the bid-ask spread, *Journal of Financial Economics* 17, 223-249.

Asquith, P., D. W. Mullins, and E. D. Wolff, 1989, Original issue high yield bonds: Aging analyses of defaults, exchanges, and calls, *Journal of Finance* 44, 923-952.

Blume, M. E. and d. B. Keim, 1987, Lower-grade bonds: Their risks and returns, *Financial Analysts Journal* 26-33.

——, D. B. Keim, and S. Patel, 1991, Returns and the volatility of low-grade bonds, *Journal of Finance* 46, 49-74.

Chen, N., R. Roll, and S. Ross, 1986, Economic forces and the stock market, *Journal of Business* 59, 383-404.

Cohen, K. J., G. A. Hawawini, S. F. Maier, R. A. Schwartz, and D. K. Whitcomb, 1986, *The Microstructure of Securities Markets* (Prentice Hall, Englewood Cliffs, NJ).

Dimson, E., 1979, Risk measurement when shares are subject to infrequent trading, *Journal of Financial Economics* 7, 197-226.

Drexel Burnham Lambert, 1985, *The Case for High Yield Securities* (same, New York).

Fama, E. F. and J. D. MacBeth, 1973, Risk, return, and equilibrium: Empirical tests, *Journal of Political Economy* 81, 608-636.

Fowler, D. J. and C. H. Rorke, 1983, Risk measurement when shares are subject to infrequent trading: Comment, *Journal of Financial Economics* 12, 279-284.

Fridson, M. S., F. Wahl, and S. B. Jones, 1988, *The Anatomy of the High Yield Debt Market: 1987* (Morgan Stanley Credit Research, New York).

General Accounting Office, 1988, *Financial Markets: Issuers, Purchasers, and Purposes of High, Yield, Non-Investment Grade Bonds* (same, Washington, D.C.).

Goodman, L. S., 1989, *High-Yield Default Rates: Is There Cause for Concern?* (Goldman, Sachs & Co., Fixed Income Research, New York).

Kaplan, S. N. and J. C. Stein, 1989, How risky is debt in highly leveraged transaction: Evidence from public recapitalizations, Unpublished working paper, Graduate School of Business, University of Chicago.

Liscio, J., 1989, Inflated junk: The pricing scandal in the high-yield bond market, *Barron's* May 22, p. 15.

Nunn, K. P., J. Hill, and T. Schneeweis, 1986, Corporate bond price data sources and return/risk measurement, *Journal of Financial and Quantitative Analysis* 21, 197–209.

Rogalski, R. and L. Shyam-Sunder, 1990, An analysis of the equity component of low-grade bond returns, Unpublished working paper, The Amos Tuck School of Business Administration, Dartmouth College.

Scholes, M. and J. Williams, 1977, Estimating betas from nonsynchronous data, *Journal of Financial Economics* 5, 309–327.

Weinstein, M. I., 1987, A curmudgeon's view of junk bonds, *Journal of Portfolio Management* 13, 76–80.

Wyss, D., C. Probyn, and R. de Angelis, 1989, The impact of recession on high-yield bonds, DRI working paper, DRI, Washington, D.C.