RETURNS AND VOLATILITY OF LOW-GRADE BONDS 1977-1988

by

Marshall E. Blume
Donald B. Keim
Sandeep A. Patel

38-89

RODNEY L. WHITE CENTER FOR FINANCIAL RESEARCH
The Wharton School
University of Pennsylvania
Philadelphia, PA 19104-6367

Returns and Volatility of Low-Grade Bonds 1977-1988

Marshall E. Blume
Donald B. Keim
Sandeep A. Patel

The Wharton School
University of Pennsylvania
Philadelphia, PA 19104

October 1989
Revised: December 1989
Comments welcome

This paper represents a consolidation of two earlier papers: "Realized Returns and Defaults on Lower-Grade Bonds" by Blume and Keim; and "The Components of Lower-Grade Bond Price Variability" by Blume, Keim and Patel. The earlier papers benefitted from presentations at the Berkeley Program in Finance, the Garn Institute Symposium, and the NYU Conference on the High Yield Debt Market. We thank George Pennacchi, Mark Weinstein and participants in seminars at Harvard and Wharton for helpful comments, and Neelu Agrawal, Suzanne Barrett and Todd Rosentover for excellent research assistance. Remaining errors are our responsibility.

Abstract

This paper examines the return characteristics of low-grade bonds using dealer bid prices. The volatility of an index of these bonds is less than the volatility of indexes of higher-grade bonds such as long-term Treasury bonds. This reduced volatility is due in large part to the shorter duration of low-grade bonds. We also present evidence that low-grade bonds are a hybrid security with features of both stocks and bonds. A detailed analysis of the returns realized by all low-grade bonds issued in 1977 and 1978 indicates that any relation between bond age and probability of default does not induce a bias in the results based on our index of lower-grade bonds. Moreover, we present evidence that at least part of the observed tendency for the probability of default to increase with age is due to cyclical factors.

The market for low-grade, or "junk", bonds as we know it today is a recent phenomenon. Prior to 1977, virtually all publicly-traded bonds at the time of issue carried an investment grade rating, which for Standard and Poor's is BBB or above and for Moody's is Baa or above. Of course, some of these bonds became "fallen angels" as their credit quality deteriorated, and some did default. Beginning in 1977, investment banking firms began to issue bonds with credit quality below investment grade. The growth in the market has been dramatic: According to Drexel Burnham Lambert, new issues of low-grade bonds have increased from $1.1 billion in 1977 to $37.1 billion in 1988. Drexel estimates that at the end of 1988 the outstanding market value of low-grade bonds was $183 billion, representing roughly one quarter of the total corporate debt market. Also, less than a quarter of the outstanding value of low-grade bonds represents "fallen angels".

Considerable research exists on the changes in bond quality ratings and the incidence of default.[1] During periods when new issues of corporate bonds almost always carried an investment grade rating, this emphasis on changes in credit quality and default was natural. After all, investors buy investment grade bonds on the presumption that they entail minimal credit risk--defaults are the exception. Although studies of credit changes and defaults are also of interest to buyers of low-grade bonds, these investors are more fundamentally concerned with the effect of credit changes and defaults on the returns that these bonds realize.

A major hinderance to the analysis of the returns of low-grade bonds is the difficulty of obtaining reliable prices to use in calculating realized returns.[2] As an example, a price from the Bank and Quotation Record, a source used in some prior studies,[3] may be a transaction price, an average of bid and ask prices, or either a bid or an ask price. The returns computed from this source involve combinations of any four of these possible prices. Statistically, the use of this

---

[1]Hickman (1958) and Atkinson (1967) are examples of some early work that has been followed by numerous other papers.

[2]Cf., Nunn, Hill, and Schneeweis (1986) for a discussion of the potential problems in using published price to measure bond returns.

[3]E.g., Weinstein (1983) as well as Chang and Pinnegar (1986).

mixture of prices results in an upward bias in the calculated returns,[4] and the bias increases as the bid-ask spread widens. In an attempt to mitigate these potential biases, Blume and Keim (1987) assembled an extensive data base of dealer bid prices supplied by traders at Drexel Burnham Lambert and at Salomon Brothers.

In the first section of this paper, we use the Blume and Keim (1987) data base, updated through 1988, to estimate summary statistics of the distribution of historical returns for low-grade bonds. For purposes of comparison, this section also includes summary statistics for other types of assets. Since the market for low-grade bonds has experienced rapid growth, a greater proportion of the market consists of recently issued bonds than is typical for more mature markets. If the probability of default increases or return characteristics change with the age of a bond,[5] overall sample statistics from our data base may be misleading. An analysis of the realized returns of all low-grade bonds issued in 1977 and 1978 explores this possibility.

In the second section of the paper we analyze the covariability of low-grade bond returns with returns on other assets. Some have described low-grade bonds as hybrid securities: They have all the appearances of a fixed-income obligation, but without an equity cushion. An examination of the separate influences of unexpected changes in interest rates, equity returns, and seasonal effects on low-grade bond returns supports this conjecture.

I. Historical Returns

The calculation and analysis of the summary statistics in this section uses many data sources, but the most important source is a data base of low-grade prices covering the years 1982 to 1988. These prices are month-end bid prices from Drexel Burnham Lambert and Salomon

[4]Cf., Blume and Stambaugh (1983).

[5]Altman (1989) and Asquith, Mullins and Wolff (1989).

Brothers.[6] The specific bonds included in our analysis meet the following criteria: (1) face value at time of issue of greater than $25 million, (2) non-convertible, and (3) at least ten years to maturity at the date for which a return is calculated. As of December 1988, the average maturity of our sample is 14.7 years.[7]

To provide a longer perspective, we have also collected month-end prices for the 1977-81 period for all bonds rated below BBB listed in the S&P Bond Guide satisfying the same three conditions as the 1982-88 sample. These data may not be as reliable as the Drexel and Salomon data,[8] but have the virtue of extending our sample back to 1977. Despite the potential errors with the earlier data, the inferences from both sets of data are similar.

From 1977 through 1988, low-grade bonds had a compounded annual rate of return of 10.3 percent (Table 1 and Figure 1). Over the same period, long-term Treasury bonds and long-term high-grade corporate bonds realized annual returns of 8.6 percent and 9.1 percent respectively. Also, over the same period, the S&P Composite Index of 500 Stocks (S&P 500) and an index of small stocks realized annual returns of 13.3 percent and 19.8 percent respectively.

---

[6]Blume and Keim (1987) describe the construction of this data base, which at the time covered the years 1982 to 1986. In that article, they find that there are sometimes significant differences in the prices of individual bonds from Drexel Burnham Lambert and Salomon Brothers, but the differences between the prices tend to offset each other in an index. Thus, the index is more reliable than the prices of individual bonds.

Until recently, Drexel and Salomon stopped reporting the month-end bid prices in the month before a bond defaulted, something that could only be done with hindsight. Moreover, they sometimes retroactively dropped a bond for other reasons. To avoid this hindsight bias, we augment the Drexel and Salomon data with total returns derived from prices in the S&P Bond Guide for the two months following the deletion of a bond from either the Drexel or Salomon sample unless it were called or exchanged. Subsequent to our 1987 study, Salomon and now Drexel have adopted similar procedures to avoid hindsight bias, and following these changes, we have stopped augmenting their bond prices.

[7]A recent trend towards shorter maturities for newly-issued low-grade bonds has resulted in a shorter average maturity for the entire low-grade bond market in comparison to our average maturity of 14.7 years.

[8]A price from the S&P Bond Guide represents the closing price on the New York Bond Exchange, or if not available, the average bid price from one or more market makers, or if neither is available, a "matrix" price. As a consequence, monthly returns calculated from this source may be upward biased. To examine the extent of this bias, Blume and Keim (1987) collected prices from the S&P Bond Guide for the same bonds in the primary sample for this study, but only for the period 1982-1986. The correlation between the indexes constructed from these two data sources is 0.92. For this reason, the text reports some results going back to 1977.

Table 1

Summary Statistics of Returns for Various Asset Categories[1]

	Annual	Monthly		Adj. Standard Dev.[2]		Autocorrelation		
	Geometric Mean	Mean Return	St. Dev.	1st Order	1st&2nd Order	ρ_1	ρ_2	ρ_3
A. 1/1977 - 12/1988								
L.T. Government Bonds	8.6	0.76	3.85	4.06	4.03	0.06	-0.01	-0.14
L.T. Hi-Grade Corp. Bonds	9.1	0.79	3.56	3.99	3.96	0.14	-0.01	-0.01
Low-Grade Bonds	10.3	0.93	2.74	3.16	3.04	0.18	-0.06	-0.13
S&P 500	13.3	1.16	4.63	4.80	4.45	0.04	-0.09	-0.09
Small Stocks	19.8	1.68	5.97	6.59	6.22	0.12	-0.08	-0.13
B. 1/1982 - 12/1988								
L.T. Government Bonds	16.1	1.31	3.54	3.67	3.86	0.04	0.07	-0.07
L.T. Hi-Grade Corp. Bonds	17.2	1.38	3.12	3.47	3.68	0.13	0.09	-0.03
Low-Grade Bonds	16.6	1.31	2.21	2.70	2.85	0.27	0.10	0.05
S&P 500	17.2	1.46	4.92	5.14	5.02	0.05	-0.03	-0.11
Small Stocks	13.8	1.24	5.46	6.38	6.34	0.20	-0.01	-0.07
C. 1/1982 - 6/1985								
L.T. Government Bonds	19.7	1.57	3.47	3.69	4.20	0.07	0.20	-0.16
L.T. Hi-Grade Corp. Bonds	22.1	1.74	3.61	4.02	4.38	0.13	0.14	-0.07
Low-Grade Bonds	21.4	1.66	2.50	3.17	3.40	0.33	0.15	0.11
S&P 500	19.4	1.56	4.08	4.00	4.59	-0.02	0.18	-0.12
Small Stocks	20.0	1.64	4.69	5.56	6.18	0.22	0.20	0.04
D. 7/1985 - 12/1988								
L.T. Government Bonds	12.6	1.05	3.62	3.62	3.59	0.00	-0.01	0.00
L.T. Hi-Grade Corp. Bonds	12.5	1.02	2.53	2.71	2.82	0.08	0.06	-0.03
Low-Grade Bonds	11.9	0.96	1.85	2.01	2.00	0.10	-0.01	-0.14
S&P 500	15.1	1.35	5.69	6.19	5.59	0.10	-0.13	-0.11
Small Stocks	8.0	0.85	6.17	7.12	6.51	0.18	-0.13	-0.14

[1]The monthly low-grade bond returns which form the basis for this table represent an equally weighted index of a large number of such bonds. From 1982 through 1988, the prices used in calculating the

individual returns are bid prices from Drexel Burnham Lambert and Salomon Brothers. Prior to 1982, the prices come from the S&P Bond Guide and may not always be bid prices. The sources for all the other indexes are publications of Ibbotson-Sinquefield.

[2]The adjustment process first annualizes the estimated monthly standard deviations, taking into account the autocorrelation, and then reexpresses these annualized standard deviations in monthly units by dividing by $\sqrt{12}$. The annualized standard deviation that adjusts for the first order serial correlation is the estimated monthly standard deviation times $\sqrt{12 + 22\rho_1}$, where ρ_1 is the first order autocorrelation. The adjustment for the first and second order autocorrelation is similar except that the estimated monthly standard deviation is multiplied by $\sqrt{12 + 22\rho_1 + 20\rho_2}$, where ρ_2 is the second order autocorrelation.

MAJOR MARKET INDEXES

DECEMBER 1977 THRU DECEMBER 1988

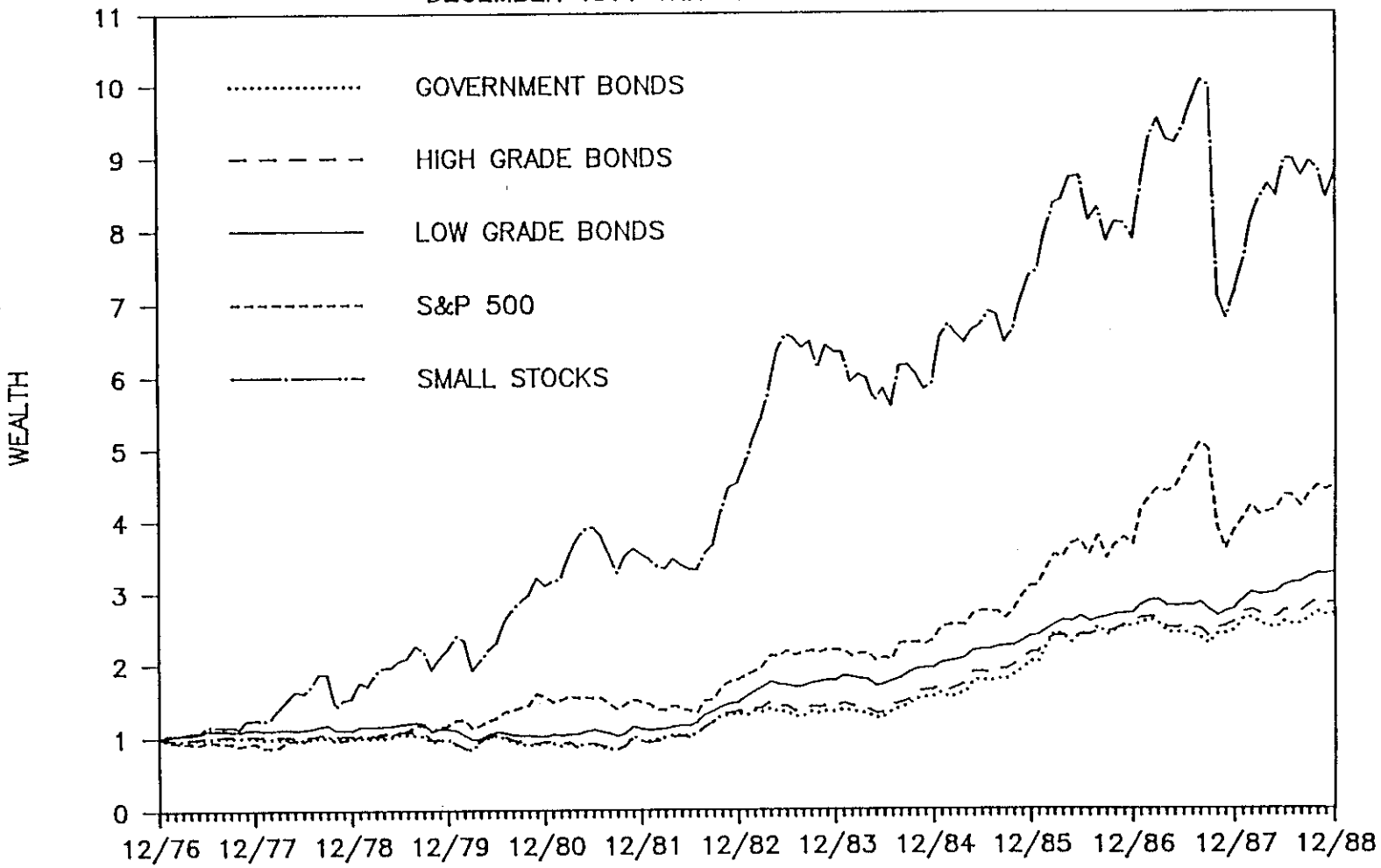


FIGURE 1

The index of small stocks, provided by Ibbotson Associates, is a value-weighted portfolio of stocks in the smallest quintile of NYSE common stocks.

From 1982 through 1988, the period for which we have Drexel and Salomon dealer bid prices, the realized annual return for the low-grade bond index is 16.6 percent: greater than that for Treasury bonds and small stocks, but less than that for high-grade corporate bonds and the S&P 500. In either half of the 1982-88 period, the realized returns on low-grade bonds are never the greatest nor the least. In both halves, the returns on low-grade bonds exceed those of small stocks. The average monthly returns lead to the same conclusions.[9]

A. The Relative Volatility of Low- and High-Grade Bonds

In each of the four periods reported in Table 1, the estimated standard deviation of the monthly low-grade bond returns is less than that for any of the other four categories of assets. One explanation for this possibly unexpected result is a statistical one related to "stale" prices among the individual bond prices in the index. To illustrate, assume that the prices of all low-grade bonds fall, but that dealers mark down only half of the prices the first month and the remaining the following month. Changes in an index of such prices will spread themselves over a series of months, inducing positive autocorrelation in the calculated returns for the index and a downward bias in the estimated standard deviations.[10]

The first order autocorrelations for all of the monthly indexes of the five different types of assets are positive with the exception of that for the S&P 500 in the 1982-85 period. The first

---

[9]Since the low-grade bond prices for 1982-1988 are bid prices, there should be no bid-ask bias in the equally-weighted index of low-grade bonds reported in the text. In the logic of Blume and Stambaugh (1983), an index representing the return from holding a single bond of each issue virtually eliminates the bid-ask bias. The estimate of the returns on this latter index is the ratio of the sum of the bond prices at the end of one month to the sum of the bond prices for the same bonds at the end of the prior month, all adjusted for accrued income and coupon payments. The average monthly return on this alternative index for 1982-1988 is 1.33 percent, and the annual geometric mean is 16.8 percent. These estimates compare respectively to those presented in Table 1 of 1.31 percent and 16.6 percent.

[10]Fisher (1966) is perhaps the first to analyze the effect of stale prices on the autocorrelation of returns in an index.

order autocorrelations are generally the greatest for the low-grade bonds and the small stocks. The second order autocorrelations are sometimes positive and sometimes negative.

To account for the possibility of stale prices, we adjust the estimated standard deviations of monthly returns for the observed autocorrelation.[11] Adjustment for first order autocorrelation or both first and second order autocorrelation does not affect the inferences drawn above--the adjusted standard deviation for low-grade bonds is still less than that of the other four types of assets (Table 1). Stale prices do not explain the apparently lesser volatility of low-grade bonds.

The return on a low-grade bond is a function of general interest rate changes, other factors common to low-grade bonds, and factors unique to a specific bond. In an equally weighted portfolio of a large number of bonds, diversification virtually eliminates bond-specific risk. We can, therefore, safely ignore unique risk.

The indexes of long-term Treasury and long-term high-grade corporate bonds measure the returns on long-term bonds, specifically with 20 years to maturity. In contrast, the average time to maturity for the low-grade bond index is slightly less than 15 years at the end of 1988. Other things equal, this difference in average maturities will result in a lower volatility for low-grade bonds relative to longer term bonds since the former will have a lower duration.[12]

However, even if the average time to maturity were the same for the low-grade bond and the government index, there are valid reasons for the volatility of a low-grade bond index to be less than that of a government index. The sensitivity of the returns of low-grade bonds to changes in the general level of interest rates, as measured by duration, is likely to be less than that of governments with the same maturity. There are three reasons:

---

[11]The adjustment process first annualizes the estimated monthly standard deviations, taking into account the autocorrelation, and then reexpresses these annualized standard deviations in monthly units by dividing by $\sqrt{12}$. The annualized standard deviation that adjusts for the first order serial correlation is the estimated monthly standard deviation times $\sqrt{12 + 22\rho}$, where ρ_1 is the first order autocorrelation. The adjustment for the first and second order autocorrelation is similar except that the estimated monthly standard deviation is multiplied by $\sqrt{12 + 22\rho_1 + 20\rho_2}$, where ρ_2 is the second order autocorrelation.

[12]There are many possible mathematical definitions of duration, each making slightly different assumptions about the way in which interest rates move. The text will use the term loosely. To prove rigorously the statements in the text, one would need to postulate a specific bond pricing model and a stochastic process for interest rates.

First, the coupons on low-grade bonds are greater than those on governments. If the current prices and the time to maturity of two bonds are the same, the one with the greater coupon will have a lesser duration.

Second, low-grade bonds are callable.[13] Intuitively, a callable bond is a mixture of two bonds--a callable and a non-callable bond. The "effective" duration of such a bond is somewhere between that of the two bonds. For most purposes, investors view governments as non-callable.

Third, the credit quality of the issuer of a low-grade bond may improve. In this case, the issuer may decide to call and refinance at a lower interest rate even if there has been no change in the overall level of interest rates. The possibility of improved credit increases the likelihood of a call.

In addition to unexpected changes in the general level of interest rates, factors common to all low-grade bonds induce additional volatility. The spread between the yields on low-grade and long-term government bonds is a measure of these additional factors. Since the standard deviations of returns for the low-grade bond index are less than those for the government bond index, the reduction in volatility due to lower duration exceeds the increase in volatility stemming from unexpected changes in spreads.

To separate the volatility of low-grade bonds that is due to unexpected changes in interest rates from that due to unexpected changes in spreads, we construct an equivalent "default-free bond" for each low-grade bond and form portfolios of these equivalent bonds. Such an equivalent portfolio controls for call and maturity differences, and, therefore, differences in duration. Hence, any differences in volatility between our low-grade index and the default-free equivalent portfolio can be attributed to volatility stemming from unexpected changes in spreads.

There are two steps in the construction of an equivalent "default-free" bond. First, we identify a portfolio of government bonds that matches the promised cash flows from the coupons and principal repayment for each low-grade bond at the time it first enters the sample.[14] Then,

---

[13]At the end of 1988, the average time to first call for our low-grade bond sample is 3.50, resulting in an average duration measured to first call of 1.99 years.

[14]We use a backward iterative algorithm to match the cash flows of the low-grade bond with the cash flows of a portfolio of government bonds. First, identify a government bond that matures at the same time as the low-grade bond. Second, find the number of government bonds to buy in order to match the cash flow at maturity of the low-grade bond. Third, reduce all the previous payments on the low-grade bond by the coupon payments on the government bond. We repeat these three steps, but with the "maturity" redefined as the date of the last uncovered cash flow, until we identify a portfolio of the government bonds that mimics the cash-flows of the low-grade bond. In the first step, if we cannot identify a government bond that matures at the

we estimate the value of the call provision of the low-grade bond[15] and subtract this estimate from the price determined in the first step. The returns from this adjusted series of prices mimic an equivalent callable default-free bond. Averaging these returns over all bonds in a specific month provides a monthly index.

The standard deviation of this index of equivalent default-free callable bonds is 1.93 percent. As reported above, the standard deviation of the low-grade bond index over the same period is 2.21 percent. The standard deviation of an index of default-free bonds with the same maturity and coupon characteristics as our sample of low-grade bonds, but before adjustment for call features, is 3.05 percent (Figure 2). Thus, the call features of low-grade bonds are important in reducing their volatility. That the volatility of the low-grade bond index still exceeds the volatility of a comparable default-free bond reflects the additional volatility attributable to unexpected changes in yield spreads.

The earlier finding that the standard deviation of the low-grade bond index is less than that of the long-term government index is misleading. If one compares the two types of assets with explicit control for the differences in coupon levels and call features, the volatility of the low-grade bond index is greater than a comparable default-free index. The additional volatility of low-grade bonds due to changes in spreads is not sufficient to make these bonds more volatile than long-term governments.

B. Aging Bias

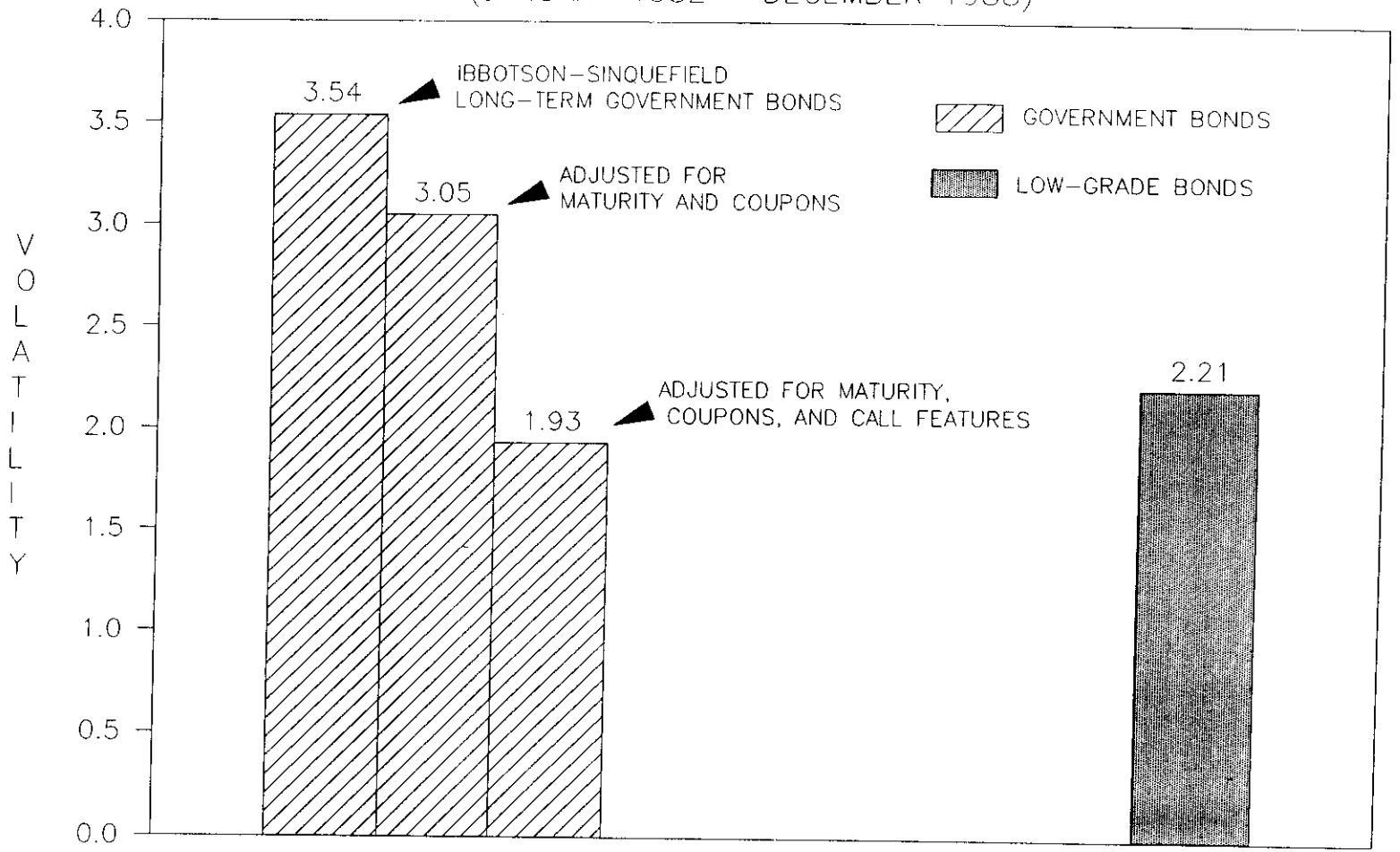
The empirical work of Altman (1989) and Asquith, Mullins, and Wolff (1989) suggests that the probability of default increases with the age of a bond. If so, the expected returns and

---

same time as the low-grade bond, we identify a government bond that matures before the low-grade bond. We then assume that the payments on the government bond are reinvested at the coupon rate on the government bond.

[15]The Black-Scholes formula is used to estimate the value of the call provision on a bond. This estimate values the call provision up to the end of the call protection period only, and thus implicitly assigns a zero value to the call after the call protection period. Explicitly valuing this additional call protection would only lead to a further reduction in the volatility of the comparable default-free bonds. The riskfree rate used in this calculation is the six-month Treasury Rate provided by Salomon Brothers.

FIGURE 2
RELATIVE VOLATILITY OF PORTFOLIOS OF LOW-GRADE AND GOVERNMENT BONDS
(JANUARY 1982 – DECEMBER 1988)



volatility of a low-grade bond may change with the age of a bond. If investors had not properly anticipated the probability of default when the bonds were originally issued, the realized returns on older bonds may be less than on newly issued bonds. In the growing market for low-grade bonds, newer bonds have a greater weight in the index than would occur in a mature market. This greater weight on new bonds may mask possibly lower returns on older bonds. One way to examine this possibility is to compare the returns of a sample of "old" bonds to the returns on a portfolio diversified across age groups. We therefore analyze the sample of the "oldest" low-grade bonds--those issued in 1977 and 1978.

B.1. The Returns for the 1977-78 Low-grade Bond Cohort

In 1977, investment bankers underwrote 26 publicly-traded low-grade bonds with a face value of slightly more than $900 million, and in 1978, they underwrote 52 publicly traded low-grade bonds with a face value of almost $1.5 billion.[16] Appendix tables 1A and 1B list and describe each of these bonds.

For the purposes of calculating a realized return, we collected a final price for each of these bonds. This final price is one of the following: (1) if the bond defaults, the first month-end price following the date of default; (2) if there is an exchange, the first month-end price following the announcement of the exchange, but if this price is not available, an estimate of the value of the securities received in the exchange; (3) the actual call price; or (4) the price at the end of 1988. Appendix Tables 2A and 2B contain these final prices and the source of the information. Of the 78 bonds issued during 1977-78, 15 defaulted, 22 were called, and 14 were exchanged during the 1977-88 period, 3 matured before 1988, and 24 were still outstanding at the end of 1988.[17]

As long as the prices in Appendix Tables 2A and 2B are unbiased, the returns calculated with these prices can be viewed as the returns on a buy-and-hold policy. We point out, though,

---

[16]These bonds were identified from the calendar of new offerings in the S&P Bond Guide and the new rating section of Moody's Bond Record.

[17]For one of these 24 bonds, we were unable to obtain bond prices after December 1987. As a result, we treated the bond as if it were called at the last available price.

that with the exception of call prices, all of the prices are quoted prices. The thin trading that characterizes the low-grade market raises questions about the interpretation of quoted prices. In a thinly traded market, any large transaction might affect the quoted price. To determine the sensitivity of the following results to this interaction between trading and prices, we alternatively reduce the final prices of defaulted bonds as reported in Appendix Tables 2A and 2B by 10 percent, 50 percent, and 100 percent.[18]

The published or "promised" yield on a newly issued bond is the yield to maturity at the time of issue.[19] Appendix Tables 3A and 3B list these yields for each bond issued in 1977 and 1978. To summarize the promised yields of the individual bonds, we compute the yield for the entire portfolio of bonds. Calculating this summary measure involves two steps: (1) sum within each month the cash flows of all the bonds outstanding, weighting the cash flows by the size of issue, and (2) calculate the yield, or internal rate of return of this aggregate time series. Table 2 reports this summary measure of promised yield separately for the low-grade bonds issued in 1977 and 1978 and for both years combined. The promised yield on all low-grade bonds issued in both 1977 and 1978 was 11.12 percent.

The realized return on an investment in a portfolio of bonds to the end of 1988 hinges on: (1) the actual calls, exchanges and redemptions, the value of the bond at default or at the end of 1988, if still outstanding; and (2) the rate at which the coupons and other cash flows can be reinvested. Using the final prices reported in Appendix Tables 2A and 2B, we have computed the realized returns for the 1977 and 1978 cohort of low-grade bonds. These calculations assume that the monthly cash flows from a single bond or the aggregate cash flows from a portfolio of bonds are reinvested in one of three indexes. Thus, there is an initial cash outflow in the case of a

---

[18]Hradsky and Long (1989) have analyzed the price pattern of bonds prior and after default, adjusted for general price movements in the low-grade universe. Their results show that, on average, the price falls very dramatically before the month of default, continues to fall but more slowly for the next six months or so, and then over the next 18 months increases to a level above the price at default. Thus, the price at default may be a good measure of the price of a bond for a buy-and-hold policy.

[19]Promised yields will exceed the coupon rate if the bond is issued at a discount. The yields calculated in this study follow the conventional method for determining stated yield--six-month effective yields multiplied by 2 to obtain an annual nominal yield.

Table 2

Promised and Actual Returns on All Low-Grade Bonds Issued in 1977 and 1978

Cohort	Reduction in Defaulted Price	Promised Yield	Return to December 1988 with Coupons & Repayments Reinvested at:				
			Low-Grade Bonds	High-Grade Corporates	Long Term Governments	Promised Yield	Promised Yield Less 2%
1977	None	10.71%	10.70%	10.78%	10.56%	9.62%	8.70%
1978	None	11.40	10.50	10.52	10.27	9.56	8.66
Both Years	None	11.12	10.58	10.63	10.39	9.59	8.68
1977	10%	10.71%	10.65%	10.73%	10.52%	9.60%	8.68%
1978	10	11.40	10.43	10.46	10.20	9.50	8.60
Both Years	10	11.12	10.53	10.57	10.34	9.55	8.64
1977	50%	10.71%	10.59%	10.67%	10.46%	9.52%	8.60%
1978	50	11.40	10.17	10.19	9.93	9.24	8.34
Both Years	50	11.12	10.35	10.39	10.16	9.37	8.46
1977	100%	10.71%	10.51%	10.59%	10.37%	9.43%	8.50%
1978	100	11.40	9.83	9.84	9.58	8.91	8.01
Both Years	100	11.12	10.12	10.16	9.92	9.14	8.23

Source: Appendix Tables 1A, 1B, 2A, 2B, 3A and 3B provide the basic data used in calculating these numbers. The text describes the procedure used to aggregate the individual bond returns to obtain the overall returns shown in this table.

single bond and a series of cash outflows in the case of a portfolio of bonds and a final value as of December 31, 1988. The internal rate of return of these cash flows is the estimated return.

If the cash flows are reinvested in the Blume-Keim low-grade bond index, the total return, for the combined sample of bonds issued in 1977 and 1978 and using the final default price reported in Appendix Tables 2A and 2B, is 10.58 percent (Table 2).[20] If reinvested in high-grade corporate bonds, the return is 10.63 percent. If reinvested in long-term Treasury bonds, the return is 10.39 percent. In the extreme case in which the final values of all defaulted bonds are zero, the corresponding returns are 10.12 percent for the low-grade bond index, 10.16 percent for the high-grade corporate index, and 9.92 percent for the long-term Treasury bonds. These returns are very close to those reported for the overall sample, suggesting that the overall returns are not subject to any significant age bias.

Between the late seventies and the eighties, there was a general increase in the coupons on high-grade bonds, allowing investors to reinvest their coupons and principal repayments at greater rates than they might have anticipated in 1977 or 1978. Thus, one might argue that the returns realized by the 1977-78 cohort overstate the returns that investors may have thought possible at the time. Two additional series of returns provide an analysis of this possibility. The first assumes that the reinvestment rate for coupons and principal repayments is the promised yield, and the second assumes more conservatively that the reinvestment rate is the promised yield less two percent to reflect possible defaults. The returns for both years combined range from 8.23 percent to 9.59 depending upon the assumed discount for defaulted bonds and the reinvestment rate (Table 2).

For purposes of comparison, the (promised) yield on intermediate Treasury bonds issued during the 1977-78 period averaged 7.60 percent. The yield on the composite AAA corporate

---

[20]For an individual bond, this return is computed by comparing the final lump-sum proceeds, which result from monthly compounding of the reinvested cash flows at the lower-grade index rate of return, to the initial investment at the issue price; that is, a normal price relative. The aggregate return is computed by first summing all cash flows within each month and reinvesting them at the lower-grade rate of return, compounded monthly to arrive at a lump-sum final amount. The internal rate of return computed using this final cash flow and the series of (negative) initial investments made in each bond during 1977 and 1978 provides an estimate of the return.

index averaged 8.43 percent. Since the high coupons and callability features of low-grade bonds shorten the duration of low-grade bonds, the yield of intermediate-term Treasury bonds of 7.60 percent is probably the more appropriate benchmark to use in evaluating the returns of the low-grade bonds issued in 1977 and 1978.

That the return on an index of low-grade bonds does not vary much with the final value attributed to defaulted bonds is not that surprising. Even if a bond defaults and then has no value, the realized return will still be positive if the coupons are large enough and the bond pays the promised coupon a sufficient number of times before default. For example, in Table 3 we show that the annual realized return of a bond that pays coupons for eight years and then becomes valueless is -1.0 percent if the coupon is 12 percent, 2.7 percent if the coupon is 14 percent, and 6.2 percent if the coupon is 16 percent.

B.2. The Relation Between Default Rates and Bond Age

The empirical work of both Altman (1989) and Asquith, Mullins and Wolff (1989) indicates that default rates increase with the age of a low-grade bond. However, a further analysis of the data that Asquith et al have collected shows that a significant portion of the higher default rates that they attribute to the age of a bond might better be attributed to general economic conditions than to age itself. There are more defaults in some years than others--regardless of age.

A rearrangement of the default rates shown in Table 3 of Asquith et al illustrates this phenomenon. Specifically, in our Table 4 we rearray their default rates by calendar years (rows) and age of bond (columns). At the bottom of each "age" column in the top panel of Table 4 is the average default rate for that age category. Consistent with prior findings, these average default rates are positively and significantly correlated with the age of the bond ($t = 4.58$).[21]

---

[21]We test the null hypothesis that the rank correlation between bond age and default rate is equal to zero. To do this, we first determine the age of the bonds and the ranking of default rates for each year within each cohort. For example, in the 1977 cohort there are twelve age categories--one year old (i.e.,1977) through twelve years old (1988)--and twelve rankings for the magnitude of default rate in each year--one for the lowest default rate (0.0%) and twelve for the highest (19.27%). We pool these values for each of the ten cohorts examined by Asquith et al, resulting in a sample of 75 observations. The computed Spearman rank correlation is 0.49 and the Fisher z-transform provides the test statistic.

Table 3

Realized Yield on a Bond Issued at Par as a Function of Years to Default and Coupon Level, Assuming No Residual Value After Default

	Default Immediately Following Year						
Coupon	2	4	6	8	10	12	14
8	-72.0%	-36.2%	-18.7%	-9.4%	-4.0%	-0.6%	1.6%
10	-67.8	-30.8	-13.7	-5.0	0.0	3.0	5.0
12	-63.8	-25.9	-9.2	-1.0	3.6	6.4	8.2
14	-60.0	-21.4	-5.1	2.7	7.0	9.5	11.1
16	-56.3	-17.1	-1.2	6.2	10.2	12.5	13.8

Source: Authors' calculations

Table 4

"Aged Defaults (%) for Low-Grade Bonds Grouped by Year of Default

A.		Age of Bond 1	2	3	4	5	6	7	8	9	10	11	12	Mean
(1977)	1	0.00												0.00
	2	0.00	0.00											0.00
	3	0.00	8.32	0.00										2.77
	4	0.00	0.00	0.00	0.00									0.00
Year	5	0.00	0.57	5.54	1.39	0.00								1.50
of	6	1.00	6.05	2.45	1.11	0.00	0.00							1.77
Default	7	0.00	2.41	0.00	0.00	2.38	7.91	0.00						1.81
	8	2.29	0.00	1.61	8.06	0.00	6.73	4.85	7.71					3.91
	9	0.00	1.99	6.08	11.49	6.85	13.90	1.98	3.12	3.63				5.45
	10	2.73	0.80	2.03	7.83	0.00	0.00	6.30	0.00	5.55	19.27			4.45
	11		3.84	2.28	3.06	4.80	9.44	0.00	1.88	5.78	1.39	3.30		3.58
(1988)	12			1.57	0.45	0.00	0.50	0.00	0.00	2.45	1.19	1.73	0.00	0.79
Mean		0.60	2.40	2.16	3.71	1.75	5.50	2.19	2.54	4.35	7.28	2.52	0.00	

B.[1]

(1977)	1	0.00												
	2	0.00	0.00											
	3	-2.77	5.55	-2.77										
	4	0.00	0.00	0.00	0.00									
Year	5	-1.50	-0.93	4.04	-0.11	-1.50								
of	6	-0.77	4.28	0.68	-0.66	-1.77	-1.77							
Default	7	-1.81	0.60	-1.81	-1.81	0.57	6.10	-1.81						
	8	-1.62	-3.91	-2.30	4.15	-3.91	2.82	0.94	3.80					
	9	-5.45	-3.46	0.63	6.04	1.40	8.45	-3.47	-2.33	-1.82				
	10	-1.72	-3.65	-2.42	3.38	-4.45	-4.45	1.85	-4.45	1.10	14.82			
	11		0.26	-1.30	-0.52	1.22	5.86	-3.58	-1.70	2.20	-2.19	-0.28		
(1988)	12			0.78	-0.34	-0.79	-0.29	-0.79	-0.79	1.66	0.40	0.94	-0.79	
Mean		-1.56	-0.13	-0.45	1.13	-1.15	2.39	-1.14	-1.09	0.79	4.34	0.33	-0.79	

[1]Default rates are adjusted for the mean default rate in the year in which they occurred.

Source: Rearrangement of Table 3 of Asquith et al.

Analysis of the rearranged data shows that in several years, most notably 1985 and 1987, the default rates were uniformly high across all age groups. In contrast, in 1988 the default rates were uniformly low across all age groups. This finding is not very surprising since general economic conditions contribute to the likelihood of default.

The bottom panel of Table 4 reports a default measure that adjusts for this time dependency, defined as the raw default rate less the mean default rate for the year in which the bonds defaulted. The averages of these mean-adjusted default rates, reported at the bottom of each column, are still positively

related to the age of the bond, but the relation is no longer significant at the usual levels ($t = 1.91$).[22]

II. Covariability of Low-Grade Bond Returns

Low-grade bonds exhibit some of the characteristics of high-grade bonds and some of the characteristics of equities. From 1977 through 1988, the correlation between low-grade bonds and long-term Treasury bonds is 0.72 (Table 5). In contrast, the correlation between Treasury bonds and high-grade bonds is 0.95. The correlation between low-grade bonds and small stocks is 0.51. In contrast, the correlation between Treasury bonds and small stocks is 0.20. The correlations over the various subperiods shown in Table 5 point to similar conclusions.

To analyze further the relation between low-grade bond returns and other types of assets, we estimated a series of regressions using the monthly return on the low-grade bond index as the dependent variable. The independent variables include returns from various combinations of the long-term government bond index, the long-term high-grade corporate index, and the small stock index.[23] We also included two dummy variables to reflect temporal or seasonal patterns in the low-grade bond returns. The first is a variable that has a value of one for January observations

---

[22]The details of this test are the same as those described in footnote 8, except that the default rankings are now based on the mean-adjusted default rates. The resulting rank correlation is 0.22.

[23]We also estimated regressions using the S&P 500 index in place of the small stock index. The results are very similar.

Table 5

Correlations of Returns of Various Asset Categories
Various Dates

	L.T. Corp.	Low-Grade Corp.	S&P 500	Small Stocks
A. 1/1977 - 12/1988				
L.T. Government Bonds	0.95	0.72	0.35	0.20
L.T. Hi-Grade Corp. Bonds		0.77	0.33	0.19
Low-Grade Bonds			0.50	0.51
S&P 500				0.82
B. 1/1982 - 12/1988				
L.T. Government Bonds	0.92	0.63	0.33	0.17
L.T. Hi-Grade Corp. Bonds		0.72	0.32	0.17
Low-Grade Bonds			0.55	0.52
S&P 500				0.87
C. 1/1982 - 6/1985				
L.T. Government Bonds	0.96	0.70	0.46	0.24
L.T. Hi-Grade Corp. Bonds		0.77	0.46	0.26
Low-Grade Bonds			0.61	0.48
S&P 500				0.83
D. 7/1985 - 12/1988				
L.T. Government Bonds	0.92	0.56	0.25	0.11
L.T. Hi-Grade Corp. Bonds		0.61	0.21	0.08
Low-Grade Bonds			0.56	0.58
S&P 500				0.90

Source: See Table 1

and zero otherwise. This variable reflects the mounting evidence that the process generating returns may be different in January from other months. For example, Keim and Stambaugh (1986) find a significant January seasonal in the risk premiums of low-grade bonds as well as smaller stocks.[24] The second dummy variable has a value of one for October 1987 and zero otherwise. October 1987 was a month of considerable turbulence, and the normal relations between the different markets may have temporarily changed.

The regressions for both the 1977-1988 and the 1982-1988 period lead to similar conclusions (Table 6) and will be discussed together.[25] The return on the long-term Treasury bonds is a purer measure of interest rate risk than the return on long-term high-grade corporate bonds. Both the government returns and the small stock returns, whether included together or separately, are significant. Replacing the government returns with the high-grade corporate returns leads to greater R-squareds, suggesting that there is a component to the variation in low-grade returns in addition to the pure interest and equity effects. These results support the conjecture that low-grade bonds can be viewed as a hybrid security incorporating some of the features of bonds and equities.

The coefficient on the January dummy is consistent with a January seasonal of one to two percent. In the regressions that include only bond returns and the dummy variables, the coefficient is positive for both periods, but only significant for the 1977-1988 period. Replacing the bond returns by the stock returns reduces the size of the coefficient to less than one percent. In the 1977-1988 period, the coefficient is no longer significant at the usual levels. However, in the regressions including both bond returns and stock returns, the coefficient on the January dummy variable is significant in the overall period. This behavior of coefficients suggests that

---

[24]In addition to this relation in January, Keim and Stambaugh (1986) find that the premium of low-grade over high-grade bonds and the premium of small over large stocks are correlated for all months over the 1928 to 1977 period. We confirm this for the 1977-88 period with a correlation of 0.45. This is further evidence that equity price movements, and in particular price movements of small stocks, may play a role in the determination of low-grade bond prices and the variability.

[25]The same regressions for each half of the 1982-1988 period lead to similar conclusions as the overall period and thus are not shown to conserve space.

Table 6

Regressions of Low-Grade Bond Returns on Bond and Stock Market Returns and Dummy Variables[1]

	Intercept	Oct. 1987 Dummy	January Dummy	Govt.Bond Total Return	Corp. Bond Total Return	Small Stocks Total Return	R^2
A. 1977-1988	0.39 (2.54)	-6.02 (-16.52)	1.91 (2.81)	0.465 (7.79)			0.52
	0.30 (2.23)	-5.80 (-17.93)	1.97 (3.35)		0.544 (8.46)		0.61
	0.35 (1.85)	3.86 (3.43)	0.81 (1.27)			0.238 (6.55)	0.28
	0.19 (1.34)	-1.03 (-1.08)	1.39 (2.40)	0.398 (6.93)		0.150 (5.58)	0.61
	0.11 (0.89)	-0.93 (-1.04)	1.46 (2.95)		0.480 (7.88)	0.149 (5.85)	0.70
B. 1982-1988	0.71 (3.91)	-6.07 (-18.17)	1.47 (1.52)	0.420 (6.93)			0.51
	0.51 (3.36)	-5.98 (-22.98)	1.52 (1.90)		0.538 (9.61)		0.64
	0.89 (4.05)	3.48 (2.12)	0.90 (1.20)			0.243 (4.52)	0.27
	0.59 (3.34)	-1.44 (-1.03)	1.06 (1.25)	0.362 (6.01)		0.142 (3.31)	0.57
	0.42 (2.78)	-1.85 (-1.60)	1.14 (1.64)		0.481 (9.12)	0.128 (3.51)	0.69

[1]Numbers in parentheses are t-values calculated with heteroscedastic consistent standard errors.

Source: See Table 1

there is some interaction among the bond returns, the stock returns, and the month of January that these regressions do not fully capture--a possible subject for future research.

The coefficient on the dummy variable for October 1987 is negative and significant at usual levels in the regressions that exclude the small stock returns. However, this coefficient is positive and significant in the regressions that only include the equity returns. This pattern in the values of the coefficients on this dummy variable are consistent with an interpretation of low-grade bonds as hybrid securities. In October 1987, the return on the low-grade bond index is less than predicted by their normal relation of these bonds to governments and high-quality corporates but greater than that predicted by their normal relation to small stocks. In the regressions that include both bond returns and stock returns, the coefficient on the dummy variable is no longer significant.

III. Conclusion

This paper finds that a diversified portfolio of low-grade bonds with more than 10 years to maturity exhibits less volatility than indexes of long-term Treasury bonds, long-term high-yield corporate bonds, S&P 500 stocks, and small stocks. This perhaps unexpected result is attributable in large part to the lower sensitivity of low-grade bonds to unexpected changes in interest rates. A comparison of the volatility of low-grade bonds to the volatility of equivalent government bonds, equivalent in terms of coupons and call features, shows that low-grade bonds have the greater volatility.

Previous work suggests that the probability of default of a low-grade bond increases with the age of the bond. Even if true, a detailed analysis of the returns realized by all low-grade bonds issued in 1977 and 1978 finds that such an increased probability of default does not induce any significant bias in the empirical results of this paper. Moreover, this paper presents evidence that at least part of the observed tendency for the probability of default to increase with the age of a bond is due to cyclical conditions in the credit market that affect all bonds regardless of their age. Thus, the relation of default to the age of a bond is weaker than previous studies suggest.

Finally, the paper finds support for the conjecture that low-grade bonds are hybrid securities with some of the properties of bonds and some of the properties of equities. Any model the returns of these bonds should include both bond and equity factors.

References

Altman, E. I., 1989, Measuring corporate bond mortality and performance, Journal of Finance 44, pp. 909-922.

Asquith, P., D. W. Mullins, Jr., and E. D. Wolff, 1989, Original issue high yield bonds: aging analysis of defaults, exchanges and calls, Journal of Finance 44, pp. 923-952.

Atkinson, T. R., 1967, Trends in Corporate Bond Quality (National Bureau of Economic Research, New York).

Blume, M. E. and D. B. Keim, 1987, Lower-grade bonds: their risks and returns, Financial Analysts Journal, July-August, pp. 26-33.

Blume, M. E. and R. F. Stambaugh, 1983, Biases in computed returns: an application to the size effect, Journal of Financial Economics 12, pp. 387-404.

Chang, E. and M. Pinnegar, 1986, Return seasonality and tax-loss selling in the market for long-term government and corporate bonds, Journal of Financial Economics 17, pp. 391-416.

Fisher, L., 1966, Some new stock market indices, Journal of Business 29, pp. 191-225.

Hickman, W. B., 1958, Corporate Bond Quality and Investor Experience (Princeton University Press, Princeton, N. J. and the National Bureau of Economic Research, New York).

Hradsky, G. T. and R. D. Long, 1989, High yield default losses and the return performance of bankrupt debt, Financial Analysts Journal, July-August, pp. 38-49.

Keim, D. B. and R. F. Stambaugh, 1986, Predicting returns in the stock and bond markets, Journal of Financial Economics 17, pp. 357-390.

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, pp. 197-208.

Weinstein, M. I., 1983, Bond systematic risk and the option pricing model, The Journal of Finance 38, pp. 1415-1429.

Appendix Table 1A
Description of Junk Bonds Issued in 1977

Issuer of Bond	Maturity Date	Type	Coupon	Int. Pay.	First Refund Date	Amt. Issued (in mil)	Initial Price
Action Industries, Inc.	1992	Sr Sub Deb	11@	mar/Sep 15	9/15/83	12	100
APL Corp.	1997	Sub Deb	10.75	feb/Aug 1	8/1/87	35	100
Buttes Gas & Oil Co.	1997	Sub Deb	10.25	feb/Aug 15	8/15/87	70	93.23*
Caesars World	1997	Sr SF Deb	11.25	jun/Dec 1	12/1/87	25	92.30*
Cascade Nat. Gas Corp.	1992	Sr Sub Deb	10.5	jun/Dec 1	12/1/78	10	100
Chrysler Financial	1987	Sub Notes	9.375	mar/Sep 1	9/1/82	75	99.84
City Investing	1997	SF Deb	9.125	mar/Sep 1	9/1/87	100	89.09*
Comdisco, Inc.	1993	Sub Deb	11.5	jun/Dec 1	12/1/83	15	100
Emerson Radio Corp.	1992	Sr SF Deb	11	apr/Oct 15	10/5/82	7.5	96.42*
Gulf Res. & Chem. Corp.	1997	Sub Deb	10.875	apr/Oct 15	10/15/87	50	100
Lear Petroleum	1992	Deb	11.5	jun/Dec 1	11/30/83	13	100
Loral Corp.	1997	Sub SF Deb	10.75	mar/Sep 15	9/15/87	20	100
LTV Corp.	1997	Deb	9.25	Feb/aug 1	2/1/82	75	83.90*
Michigan General	1992	Sr SF Deb	10.875	jan/Jul 15	1/15/81	27.5	100
Pan. Amer. World Airw.	1994	Eq Ctfs A	11.5	May/nov 1	11/15/78	26.5	100
Pan. Amer. World Airw.	1994	Eq Ctfs B	11.5	May/nov 1	11/15/78	26.5	100
Polychrome Corp.	1997	SF Deb	10.5	may/Nov 1	11/1/87	20	100
Smith's Transfer	1987	Sub Deb	8.75	may/Nov 1	None	10	99.25
Tannetics	1992	Sr SF Deb	10.5	jun/Dec 1	12/1/83	12.5	100
Texas Int'l Co.	1997	Sub Deb	11.5	Apr/oct 1	4/1/87	30	100
UV Ind.	1987	Sr Sub Deb	9.25	Apr/oct 15	None	25	100
U.S. Home	1987	Notes	10	feb/Aug 15	None	50	100
Western Co. of N. A.	1997	Sub Deb	10.875	mar/Sep 15	9/14/87	35	96.75#
Western Pacific RR	2002	Mtge B	9.125	Jun/dec 15	6/15/83	20	99.5
World Airways	1993	Sec Eq Ctfs	10	jun/Dec 15	12/15/78	65	100
Zapata Corp.	1997	Sub Deb	10.25	Mar/sep 15	3/15/87	75	91.75*

Month of maturity is capitalized

@ 11.25% as of 5/15/82

* Issued as part of unit
Values from Capital Changes Reporter

Unit offering; price from Moody's
Bond Guide 10/77 at first listing

Appendix Table 1B
Description of Junk Bonds Issued in 1978

Issuer of Bond	Maturity Date	Type	Coupon	Int. Pay	First Refund Date	Amt. Issued (in mil.)	Issue Price
Anglo Co.	1998	Sub Deb	11.875	jan/Jul 15	7/15/88	17.5	99.75
Arrow Electronics	1998	Sub Deb	12	Jun/dec 1	6/1/88	17	99*
A-T-O, Inc.	1998	Sub Deb	10.375	Apr/oct 1	4/1/88	20	100
Bangor Punta	1998	Sub Deb	11.25	apr/Oct 1	10/1/89	40	100
Bangor Punta	1998	Sub Deb	11.5	jan/Jul 1	7/1/89	50	100
Budget Capital	1998	Sr Sub SF Deb	11.875	Jun/dec 1	6/1/88	25	99
California Life	1998	SF Deb	11	Mar/sep 15	3/14/88	20	100
CCI Corp.	1998	Sub Deb	12.75	jun/Dec 15	12/15/88	25	99.625
Champion Parts Reb.	1993	Sub Deb	13.25	jun/Dec 1	12/1/83	15	99
Charter Co.	1998	Sub Deb	10.625	mar/Sep 1	9/1/88	50	100
Charter Medical	1993	SF Deb	11	Feb/aug 1	2/1/84	12	100
Columbia Gen'l	1993	Sr Sub Deb	11.25	May/nov 1	5/1/79	6	100
Crown Industries	1993	Sub Deb	12	Sep 1 #	9/1/81	6	100
Crystal Oil	1990	Sub Deb	12.625	Jun/dec 15	6/15/81 ^	30	100
Documation	1998	Sub Deb	11.5	May/nov 1	5/1/88	15	100
Early Calif. Ind.	1993	SF Deb	12.5	jun/Dec 1	12/1/84	20	93.5*
Essex Chemical	1998	Sub Deb	11.375	mar/Sep 1	9/1/88	25	100
Filmways, Inc.	1998	Sub SF Deb	11	jan/Jul 1	7/1/88	35	100
Foothill Group	1998	Sub SF Deb	12.5	apr/Oct 15	10/15/88	10	100
Global Marine	1998	Sr Sub Deb	12.375	feb/Aug 1	8/1/88	25	99.75
Inforex, Inc.	1998	Sub Deb	10.625	May/nov 1	5/1/88	20	100
Itel Corp.	1998	Sub Deb	9.625	Apr/oct 15	4/15/88	100	100
Kay Corp.	1998	Sub SF Deb	13.5	jun/Dec 1	12/1/88	10	100
Kenai Corp.	1998	Sub SF Dev	10.5	feb/Aug 15	8/15/88	27.5	88.625*
Mecenco	1998	Sub Deb	11	Apr/oct 1	10/1/88	10	95.94*
Midland Glass	1998	SF Deb	10.75	Feb/aug 15	2/15/88	25	100
Moran Bros.	1998	Sub Deb	11.5	May/nov 1	5/1/88	15	99
Norin Corp.	1998	Sub SF Deb	11	Dec 31 #	1/31/83	26	100
Oak Industries	1998	Sub Deb	11.875	May/nov 15	5/15/88	30	100
Petro-Lewis Corp.	1998	Sub Deb	12.25	feb/Aug 1	8/1/88	35	95.5*
Petro-Lewis Corp.	1997	Sub Deb	11	jun/Dec 31	1/1/88	25	93.95*
Pneumo Corp.	1993	Sub SF Deb	9.625	feb/Aug 1	8/1/88	25	87.825*
Ramada Inns	1993	Sub Deb	10	mar/Sep 1	9/1/83	100	89
Realty Refund Trust	1998	Sub SF Deb	12	May/nov 15	5/15/88	15	100
Risdon Manufacturing	1998	Sub Deb	11.75	apr/Oct 1	10/1/88	20	99.5
Savin Corp.	1998	Sub Deb	11.375	apr/Oct 1	10/1/88	60	99.5
Sea Containers	1998	Sub Deb	10.25	mar/Sep 1	9/1/88	40	100
Sun Chemical	1996	Sub Deb	11.5	jun/Dec 1	12/1/88	40	100
Sys. Eng. Labs	1993	Sub Deb	12.5	Jun/dec 1	6/1/86	12	96.75
Telemed Corp.	1993	Sub Deb	12.25	jan/Jul 15	7/15/85	15	100
Telex	1996	Sr Sub Deb	11.75	feb/Aug 15	8/15/88	35	100
Texas Int'l Airlines	1998	Sub Deb	10.875	Apr/oct 15	4/15/88	18	94.5*
Texas Int'l Co.	1997	Sub Deb	11.5	Apr/oct 1	4/1/87	20	100
Tipperary Corp.	1998	Sub Deb	11.5	mar/Sep 15	9/15/88	35	90*
Transcontinental Oil	1998	Sub Deb	12.875	Jun/dec 15	6/15/83	30	96
20th Century-Fox Film	1998	Sub Deb	10.25	Apr/oct 1	4/1/85	50	99.25
Tyler Corp.	1998	Sub Deb	10.5	Jun/dec 1	6/1/88	30	100
UNC Resources	1998	Sub Deb	12	jun/Dec 1	12/1/88	35	100
Wainoco Oil	1998	Sub Deb	10.75	apr/Oct 1	10/1/88	30	100
Western Co. of N. A.	1998	Sub Deb	10.7	Apr/oct 1	4/1/88	30	100
Wetterau Finance	1993	Sub Notes	9	Sep 1 @	9/1/83	6	100
World Airways	1994	Eq Tr Ctfs	11.25	Apr/oct 15	4/15/79	67.9	100

Month of maturity is capitalized

Int. paid monthly @ Int. paid quarterly

^ Moody's Industrials puts date as 6/15/81,
but this date matches actual refunding, as in S&P.

* Issued as part of unit. Values from Capital Changes Reporter.

Appendix Table 2A
Last Prices for Junk Bonds Issued in 1977

Issuer of Bond	Maturity Date	Last Price *Month End	Moody's	S&P	Disposition of Bond Explanation	Source
Action Industries, Inc.	1992	Dec 88	92	88	Outstanding as of 12/88	S&P Bond Guide, 1/89
APL Corp.	1997	Dec 88	44.25	44.25	Outstanding as of 12/88	S&P Bond Guide, 1/89
Buttes Gas & Oil Co.	1997	Aug 85		25.375	Defaulted on 8/15/85 payment	S&P Bond Guide, 9/85
Caesars World	1997	Jul 83	89.5	89.5	Exchange offer expires 8/17/83	Capital Changes Reporter
Cascade Nat. Gas Corp.	1992				Called 12/1/88 at 101.62	S&P Bond Guide, 12/88
Chrysler Financial	1987				Matured September 1, 1987	Maturity date of bond
City Investing	1997				Called 9/1/85 at 105.28	S&P Bond Guide, 9/85
Comdisco, Inc.	1993	Dec 88	93	93	Outstanding as of 12/88	S&P Bond Guide, 1/89
Emerson Radio Corp.	1992				Called 9/26/86 at 100	S&P Called Bond Record
Gulf Res. & Chem. Corp.	1997	Dec 88	91.5	90	Outstanding as of 12/88	S&P Bond Guide, 1/89
Lear Petroleum	1992				Called 12/1/88 at 100	S&P Bond Guide, 12/88
Loral Corp.	1997	Dec 88	100.5	100	Outstanding as of 12/88	S&P Bond Guide, 1/89
LTV Corp.	1997	Apr 86	76	76	Exchange offer of 4/20/86	First Boston
Michigan General	1992	Dec 81	66.25	66.5	Exchange offer first noted	S&P Bond Guide, 1/82
Pan. Amer. World Airw.	1994				Called 12/20/88 at 100	S&P Bond Guide, 12/88
Pan. Amer. World Airw.	1994	Dec 88		100	Outstanding as of 12/88	S&P Bond Guide, 1/89
Polychrome Corp.	1997				Called on 7/11/88 at 102.042	S&P Called Bond Record
Smith's Transfer	1987				Matured November 1, 1987	Maturity date of bond
Tannetics	1992	Nov 83	92.125	92.25	Prop called	S&P Bond Guide, 12/83
Texas Int'l Co.	1997	Jun 85	48.5	49.5	Exchange offer of 6/6/85	First Boston
UV Ind.	1987				Matured April 15, 1987	Maturity date of bond
U.S. Home	1987	Sep 85	93.125	93.125	Exchange offer of 9/5/85	First Boston
Western Co. of N. A.	1997	Sep 85	57	57	Exchange offer of 9/10/85	First Boston
Western Pacific RR	2002				Called on 3/2/87 at 105.39	S&P Called Bond Record
World Airways	1993	May 84	71.125	71.125	Exchange offer first noted	S&P Bond Guide, 6/84
Zapata Corp.	1997	Sep 86		29.125	Defaulted on 9/15/86 payment	S&P Bond Guide, 10/86

* Month end prices taken from next month's S&P Bond Guide and Moody's Bond Record: Month end May 86 figures taken from June 86 issue of S&P and Moody's

Appendix Table 28
Last Prices for Junk Bonds Issued in 1978

Issuer of Bond	Maturity Date	Last Price Month End*	Moody's	S&P	Disposition of Bond Explanation	Source
Anglo Co.	1998	Nov 83		71	First rated as defaulted	S&P Bond Guide, 12/83
Arrow Electronics	1998	Dec 88		89	Outstanding as of 12/88	S&P Bond Guide, 1/89
A-T-O, Inc.	1998	Dec 88	92	92	Outstanding as of 12/88	S&P Bond Guide, 1/89
Bangor Punta	1998				Called on 3/18/87 at 105.25	S&P Called Bond Record
Bangor Punta	1998				Called on 3/18/87 at 105.367	S&P Called Bond Record
Budget Capital	1998	Sep 88	14.5	14.5	First rated as defaulted	S&P Bond Guide, 10/88
California Life	1998	Apr 82	30	25	First rated as defaulted	S&P Bond Guide, 5/82
CCI Corp.	1998	Dec 88	86		Outstanding as of 12/88	Moody's Bond Record, 1/89
Champion Parts Reb.	1993	Dec 88	92.5		Outstanding as of 12/88	Moody's Bond Record, 1/89
Charter Co.	1998	Apr 84	35.75	36.5	First rated as defaulted	S&P Bond Guide, 5/84
Charter Medical	1993				Called on 4/10/87 at 101.1	S&P Called Bond Record
Columbia Gen'l	1993				Outstanding as of 1/1/89 at 97	National Bond Summary
Crown Industries	1993				Called on 12/14/86 at 104.5	S&P Called Bond Record
Crystal Oil	1990	Apr 86		12	First rated as defaulted	S&P Bond Guide, 5/86
Documation	1998	Oct 84	65	65	First rated as defaulted	S&P Bond Guide, 11/84
Early Calif. Ind.	1993	Dec 88		50	Outstanding as of 12/88	S&P Bond Guide, 1/89
Essex Chemical	1998				Called on 6/1/87 at 102.275	S&P Called Bond Record
Filmways, Inc.	1998	Dec 88	87.75	86.5	Outstanding as of 12/88	S&P Bond Guide, 1/89
Foothill Group	1998	Dec 88	99	98	Outstanding as of 12/88	S&P Bond Guide, 1/89
Global Marine	1998	Aug 85	35	35	First rated as defaulted	S&P Bond Guide, 9/85
Inforex, Inc.	1998	Oct 79		31	First rated as defaulted	S&P Bond Guide, 11/87
Itel Corp.	1998	Mar 80	20.125	20.125	Last price before rated in default	by S&P Bond Guide, 8/80
Kay Corp.	1998	Dec 88	94	94	Outstanding as of 12/88	S&P Bond Guide, 1/89
Kenai Corp.	1998	Oct 84	46	45	First rated as defaulted	S&P Bond Guide, 11/84
Medenco	1998	Dec 88	99.5	99.5	Outstanding as of 12/88	S&P Bond Guide, 1/89
Midland Glass	1998	Dec 87	68.75		Last available price in either	Moody's or S&P
Moran Bros.	1998	Jan 87		44	First rated as defaulted	S&P Bond Guide, 2/87
Norin Corp.	1998				Called on 1/1/88 at 101.5	S&P Bond Guide, 1/88
Oak Industries	1998	Feb 85	57	57	Exchange offer of 2/7/85	First Boston
Petro-Lewis Corp.	1998	Nov 85	66.625	66.625	Exchange offer of 11/6/85	First Boston
Petro-Lewis Corp.	1997	Nov 85	61.25	61.25	Exchange offer of 11/6/85	First Boston
Pneumo Corp.	1993	Dec 88	96	92.625	Outstanding as of 12/88	S&P Bond Guide, 1/89
Ramada Inns	1993	Dec 88	89.5	89.5	Outstanding as of 12/88	S&P Bond Guide, 1/89
Realty Refund Trust	1998				Called on 10/16/86 at 101	S&P Bond Guide, 9/86
Risdon Manufacturing	1998				Called on 10/1/86 at 107.48	S&P Called Bond Record
Savin Corp.	1998	Feb 86	49	49	First rated as defaulted	S&P Bond Guide, 3/86
Sea Containers	1998	Dec 88		85.5	Outstanding as of 12/88	S&P Bond Guide, 1/89
Sun Chemical	1996				Called 12/1/88 at 100	S&P Bond Guide, 12/88
Sys. Eng. Labs	1993				Called on 3/3/86 at 100.375	S&P Called Bond Record
Telemed Corp.	1993				Called on 7/15/86 at 102.45	S&P Called Bond Record
Telex	1996				Called on 3/23/87 at 102.35	S&P Called Bond Record
Texas Int'l Airlines	1998	Sep 83	47.5	47.5	Defaulted on 10/15/83 payment	S&P Bond Guide, 10/83
Texas Int'l Co.	1997	Jun 85	48.5	49	Exchange offer of 6/6/85	First Boston
Tipperary Corp.	1998	Mar 85	30	30	Exchange offer of 3/31/85	First Boston
Transcontinental Oil	1998	Nov 83	54	54	Exchange offer first noted	S&P Bond Guide, 12/83
20th Century-Fox Film	1998	Dec 88	86.75	86.5	Outstanding as of 12/88	S&P Bond Guide, 1/89
Tyler Corp.	1998	Dec 88	88	88	Outstanding as of 12/88	S&P Bond Guide, 1/89
UNC Resources	1998				Called on 7/14/86 at 103.6	S&P Called Bond Record
Wainoco Oil	1998	Dec 88	87	88	Outstanding as of 12/88	S&P Bond Guide, 1/89
Western Co. of N. A.	1998	Sep 85	61.375	57	Exchange offer of 9/10/85	First Boston
Wetterau Finance	1993				Outstanding as of 1/1/89 at 94.75	National Bond Summary
World Airways	1994				Called on 5/1/87 at 101.125	S&P Bond Guide, 5/87

* Month end prices taken from next month's S&P Bond Guide and Moody's Bond Record: Month end May 86 figures taken from June 86 issue of S&P and Moody's

Appendix Table 3A
Promised and Actual Performance on Individual Junk Bonds
Issued in 1977

Bond	Issue Date	Redemption Date	Promised Yield	Return to December 1988 with coupons and repayments reinvested at: Junk Yield	High-Grade Corporates Yield	T-Bonds Yield
Action Ind.	Sep 77	Dec 88	10.89%	11.36%	11.42%	11.22%
APL Corp.	Jul 77	Dec 88	10.75%	9.85%	9.87%	9.65%
Buttes Gas & Oil	Aug 77	Aug 85	11.10%	8.23%	8.36%	8.14%
Caesars World	Dec 77	Jul 83	12.29%	12.39%	12.72%	12.53%
Cascade Nat. Gas	Dec 77	Dec 88	10.50%	11.31%	11.24%	11.08%
Chrysler Fin'l	Aug 77	Sep 87	9.40%	10.58%	10.67%	10.47%
City Investing	Aug 77	Sep 85	10.43%	12.08%	12.22%	12.12%
Comdisco	Dec 77	Dec 88	11.37%	11.76%	11.69%	11.50%
Emerson Radio	Oct 77	Sep 86	11.38%	11.83%	11.63%	11.29%
Gulf Res. & Chem.	Oct 77	Dec 88	10.77%	11.26%	11.27%	11.07%
Lear Petroleum	Dec 77	Dec 88	11.50%	12.02%	11.95%	11.78%
Loral Corp.	Sep 77	Dec 88	10.75%	11.49%	11.55%	11.36%
LTV Corp.	Feb 77	Apr 86	11.30%	11.07%	10.97%	10.61%
Michigan General	Aug 77	Dec 81	11.00%	10.93%	11.06%	10.55%
Pan Am Ser. A	Apr 77	Dec 88	11.50%	11.87%	11.81%	11.64%
Pan Am Ser. B	Apr 77	Dec 88	11.50%	11.87%	11.81%	11.62%
Polychrome	Oct 77	Jul 88	10.50%	11.38%	11.33%	11.15%
Smith's Transfer	Nov 77	Nov 87	8.86%	10.69%	10.43%	10.17%
Tannetics	Dec 77	Nov 83	10.50%	11.34%	11.69%	11.52%
Texas Int'l Co.	Apr 77	Jun 85	11.50%	9.65%	9.73%	9.52%
U.S. Home	Aug 77	Sep 85	10.00%	10.93%	11.10%	10.99%
UV Ind.	Apr 77	Apr 87	9.25%	9.16%	9.13%	8.89%
Western Co. of N.A.	Dec 77	Sep 85	11.29%	9.75%	9.92%	9.77%
Western Pacific RR	Jun 77	Mar 87	9.18%	10.46%	10.27%	9.99%
World Airways	Aug 77	May 84	10.21%	10.52%	10.95%	10.77%
Zapata Corp.	Mar 77	Sep 86	11.30%	9.06%	9.06%	8.78%

Appendix Table 38
Promised and Actual Performance on Individual Junk Bonds
Issued in 1978

Bond	Issue Date	Redemption Date	Promised Yield	Return to December 1988 with coupons and repayments reinvested at: Junk Yield	High-Grade Corporates Yield	T-Bonds Yield
Anglo Co.	Jul 78	Nov 83	11.91%	10.56%	10.92%	10.70%
Arrow Electronics	Jun 78	Dec 88	12.13%	12.24%	12.18%	11.98%
A-T-O, Inc.	Mar 78	Dec 88	10.28%	11.09%	11.16%	10.96%
Bangor Punta, 11.5	Jun 78	Mar 87	11.38%	11.98%	11.79%	11.45%
Bangor Punta, 11.25	Oct 78	Mar 87	11.25%	12.02%	11.94%	11.59%
Budget Capital	Jul 78	Sep 88	12.14%	9.57%	9.49%	9.23%
California Life	Mar 78	Apr 82	11.00%	6.22%	6.18%	5.69%
CCI Corp.	Dec 78	Dec 88	12.80%	12.58%	12.56%	12.33%
Champion Parts Reb.	Dec 78	Dec 88	13.41%	13.18%	13.15%	12.93%
Charter Co.	Sep 78	Apr 84	10.63%	7.41%	7.90%	7.61%
Charter Medical	Feb 78	Apr 87	11.00%	11.56%	11.49%	11.20%
Columbia General	Apr 78	Dec 88	11.12%	11.86%	11.84%	11.64%
Crown Industries	Sep 78	Dec 86	12.30%	12.64%	12.38%	12.05%
Crystal Oil	Jun 78	Apr 86	12.63%	8.17%	8.14%	7.81%
Documation	May 78	Oct 84	11.50%	10.39%	10.55%	10.36%
Early California Ind.	Dec 78	Dec 88	13.52%	11.95%	11.92%	11.67%
Essex Chemical	Aug 78	May 87	11.26%	12.03%	12.09%	11.78%
Filmways, Inc.	Jul 78	Dec 88	11.00%	11.46%	11.42%	11.19%
Foothill Group	Oct 78	Dec 88	12.50%	12.81%	12.85%	12.63%
Global Marine	Jul 78	Aug 85	12.27%	9.07%	9.25%	9.02%
Inforex, Inc.	May 78	Oct 79	10.63%	1.98%	1.82%	1.58%
Itel Corp.	Apr 78	Mar 80	9.62%	0.70%	0.68%	0.36%
Kay Corp.	Dec 78	Dec 88	13.50%	13.28%	13.24%	13.03%
Kenai Corp.	Aug 78	Oct 84	12.01%	9.38%	9.65%	9.42%
Medenco	Jun 78	Dec 88	11.77%	12.42%	12.49%	12.28%
Midland Glass	Feb 78	Dec 87	10.75%	10.62%	10.49%	10.26%
Moran Bros.	May 78	Jan 87	11.63%	9.95%	9.80%	9.49%
Norin Corp.	Aug 78	Jan 88	10.81%	11.85%	11.67%	11.43%
Oak Industries	May 78	Feb 85	11.88%	10.42%	10.70%	10.54%
Petro-Lewis, 11	Jan 78	Nov 85	11.79%	10.81%	10.74%	10.56%
Petro-Lewis, 12.25	Jul 78	Nov 85	12.74%	11.50%	11.57%	11.39%
Pneumo Corp.	Aug 78	Dec 88	11.33%	12.06%	12.12%	11.93%
Ramada Inns	Sep 78	Dec 88	11.56%	12.10%	12.22%	11.95%
Realty Refund Trust	May 78	Oct 86	12.00%	12.26%	12.12%	11.86%
Risdon Mfg.	Oct 78	Oct 86	11.82%	12.57%	12.48%	12.12%
Savin Corp.	Oct 78	Feb 86	11.44%	9.53%	9.51%	9.21%
Sea Containers	Sep 78	Dec 88	10.25%	10.88%	11.00%	10.79%
Sun Chemical	Nov 78	Dec 88	11.38%	12.12%	12.09%	11.91%
Sys. Engineering Labs	May 78	Mar 86	12.84%	12.75%	12.47%	12.19%
Telemed	Aug 78	Jul 86	12.40%	12.51%	12.38%	11.95%
Telex	Aug 78	Mar 87	11.75%	12.08%	12.04%	11.73%
Texas Int'l Airlines	Apr 78	Sep 83	11.59%	9.01%	9.22%	8.97%
Texas Int'l Co.	Jul 78	Jun 85	11.38%	10.07%	10.23%	10.02%
Tipperary Corp.	Sep 78	Mar 85	12.91%	9.12%	9.43%	9.18%
Transcontinental Oil	Jun 78	Nov 83	12.85%	10.39%	10.62%	10.38%
20th-Century Fox	Apr 78	Dec 88	10.34%	11.00%	11.07%	10.87%
Tyler Corp.	Jun 78	Dec 88	10.50%	11.13%	11.07%	10.88%
UNC Resources	Dec 78	Jul 86	12.00%	12.36%	12.23%	11.78%
Wainoco Oil	Sep 78	Dec 88	10.75%	11.38%	11.46%	11.24%
Western Co. of N.A.	Mar 78	Sep 85	10.60%	9.84%	10.03%	9.87%
Wetterau Finance	Sep 78	Dec 88	9.10%	10.38%	10.41%	10.22%
World Airways	May 78	Apr 87	11.38%	11.98%	11.95%	11.64%